SOLID *Embedded Engine*

Programmer Guide

Version 3.0

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Welcome

SOLID Embedded Engine™ provides the local data storage needs required for today's complex distributed systems.

SOLID *Embedded Engine* provides support for real-time operating systems such as VxWorks and ChorusOS, and for preferred platforms such as Windows 98/NT, Linux, Solaris, HP-UX and other UNIX platforms. It also provides the features you would expect to find in any industrial-strength database server—multithread architecture, stored procedures, optimistic row level transaction management, but delivered with the special needs of today's applications.

About this Guide

The SOLID **Programmer Guide** contains information about using the different Application Programming Interfaces of SOLID *Embedded Engine*.

SOLID *SQL API* is the native call level interface of SOLID DBMS. SOLID *SQL API* is based on the SQL Access Group's CLI specification, a standard dynamic call level interface. The SQL syntax used in SOLID *Embedded Engine* is based on the ANSI X3H2-1989 level 2 standard including important ANSI X3H2-1992 (SQL2) extensions. Developers also have the option of accessing SQL *SQL API* through ODBC API in the Windows (NT/98/95) environments. ODBC provides a single interface for SQL queries to access a variety of relational and non-relational databases.

Even though this manual is written from the viewpoint of ODBC application developers, most of the information applies also to development of applications that access SOLID *SQL API* directly.

In addition to SOLID *SQL API*, the other APIs, SOLID *Light Client* and SOLID *JDBC Driver*, are available for application development purposes. SOLID Light Client is a lightweight version of the SOLID *SQL API* that is meant for environments where the footprint of the client application is critical. The SOLID *JDBC Driver* is a SOLID implementation of the JDBC 1.2 standard.

Organization

This manual contains the following chapters:

- *Chapter 1, Introduction to SOLID APIs* provides an overview of the application programming interfaces available for accessing SOLID *Embedded Engine*.
- *Chapter 2, Using SOLID SQL API and ODBC API* covers how to develop applications using SOLID *SQL API* and ODBC API.
- *Chapter 3, Calling Stored Procedures, Events, and Sequences* explains advanced features for developing applications using SOLID *Embedded Engine.*
- *Chapter 4, Using Unicode in SOLID Embedded Engine* describes how to implement the UNICODE standard, providing the capability to encode characters used in the major languages of the world.
- *Chapter 5, Function Reference* provides an alphabetic reference to the ODBC API and SQL API functions.
- *Chapter 6, Using SOLID Light Client* describes how to use SOLID Light Client, and API especially designed for implementing embedded solutions with limited memory resources.
- *Chapter 7, Using the JDBC Driver* describes how to use the SOLID JDBC Driver, a 100% Pure Java™ implementation of the Java Database Connectivity (JDBC™) standard.

Appendixes

The *Appendixes* give you detailed information about error messages, data types, and SOLID SQL functionality, etc.

Glossary

The *Glossary of Terms* explains some of the terminology used in SOLID documentation.

Audience

This manual assumes a working knowledge of the C programming language, general DBMS knowledge, and a familiarity with SQL.

Conventions

Product Name

In version 3.0, SOLID *Server* or SOLID Web Engine is now known as SOLID *Embedded Engine.* This guide may still make reference to SOLID *Server.* Throughout this guide, "SOLID *Server"* and "SOLID *Embedded Engine"* are used synonymously.

Typographic

This manual uses the following typographic conventions.

Format	Used for
WIN.INI	Uppercase letters indicate filenames, SQL statements, macro names, and terms used at the operating-system command level.
`RETCODE SQLFetch(hdbc)`	This font is used for sample command lines and program code.
argument	Italicized words indicate information that the user or the application must provide, or word emphasis.
SQLTransact	Bold type indicates that syntax must be typed exactly as shown, including function names.
[ ]	Brackets indicate optional items; if in bold text, brackets must be included in the syntax.
|	A vertical bar separates two mutually exclusive choices in a syntax line.
{}	Braces delimit a set of mutually exclusive choices in a syntax line; if in bold text, braces must be included in the syntax.
...	An ellipsis indicates that arguments can be repeated several times.
. . .	A column of three dots indicates continuation of previous lines of code.

Other Solid Documentation

SOLID *Embedded Engine* documentation is distributed as printed material or in an electronic format (PDF, HTML, or Windows Help files).

SOLID Online Services on our Web server offer the latest product and technical information free of charge. The service is located at:

`http://www.solidtech.com/`

Electronic Documentation

- **Read Me** contains installation instructions and additional information about the specific product version. This `readme.txt` file is typically copied onto your system when you install the software.
- **Release Notes** contains additional information about the specific product version. This `relnotes.txt` file is typically copied onto your system when you install the software.
- **SOLID *SynchroNet* Guide** describes administrative procedures for SOLID *SynchroNet*. It also provides information about SOLID SQL functionality.
- **SOLID Administrator Guide** describes administrative procedures for SOLID *Embedded Engine*, including tools and utilities, and also reference information.

Where to Find Additional Information

- For more information about SQL, the following standards are available:
- Database Language — SQL with Integrity Enhancement, ANSI, 1989 ANSI X3.135-1989.
- X/Open and SQL Access Group SQL CAE specification (1992).
- Database Language — SQL: ANSI X3H2 and ISO/IEC JTC1/SC21/WG3 9075:1992 (SQL-92).
- In addition to standards and vendor-specific SQL guides, there are many books that describe SQL, including:
- Date, C. J.: *A Guide to the SQL Standard* (Addison-Wesley, 1989).
- Emerson, Sandra L., Darnovsky, Marcy, and Bowman, Judith S.: *The Practical SQL Handbook* (Addison-Wesley, 1989).
- Groff, James R. and Weinberg, Paul N.: *Using SQL* (Osborne McGraw-Hill, 1990).

- Gruber, Martin: *Understanding SQL* (Sybex, 1990).
- Hursch, Jack L. and Carolyn J.: *SQL, The Structured Query Language* (TAB Books, 1988).
- Melton, Jim and Simon, Alan R.: *Understanding the new SQL: a complete guide* (Morgan Kaufmann, 1993).
- Pascal, Fabian: *SQL and Relational Basics* (M & T Books, 1990).
- Trimble, J. Harvey, Jr. and Chappell, David: *A Visual Introduction to SQL* (Wiley, 1989).
- Van der Lans, Rick F.: *Introduction to SQL* (Addison-Wesley, 1988).
- Vang, Soren: *SQL and Relational Databases* (Microtrend Books, 1990).
- Viescas, John: *Quick Reference Guide to SQL* (Microsoft Corp., 1989).

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5 Function Reference

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1

Introduction to SOLID APIs

This chapter provides an overview of the application programming interfaces available to you for accessing SOLID *Embedded Engine*. These APIs include:

- SOLID *SQL API* (Application Programming Interface)
- SOLID *Light Client*
- SOLID *JDBC Driver*

SOLID *SQL API*

SOLID *SQL API* (Application Programming Interface) is the native call level interface (CLI) of SOLID *Embedded Engine*. It is a DLL for Windows and a library for other environments. SOLID *SQL API* is compliant with ANSI X3H2 SQL CLI and ODBC CLI.

SOLID *SQL API* has functions that support a rich set of database access operations sufficient to creating robust database applications, including:

- Allocating and deallocating handles
- Getting and setting attributes
- Opening and closing database connections
- Accessing descriptors
- Executing SQL statements
- Accessing schema metadata
- Controlling transactions
- Accessing diagnostic information

A database application calls these functions for all interactions with a database. SOLID *SQL API* enables applications to establish multiple database connections simultaneously and to process multiple statements simultaneously.

A native 32 bit SOLID *ODBC Driver* is available for maximum power and functionality. Using SOLID *SQL API*, users can also access ODBC Driver Manager supported functions.

The driver maintains a transaction for each active database connection. Depending on the applications request, the driver can automatically commit each SQL statement or wait for an explicit commit or rollback request. When the driver performs a commit or rollback operation, the driver resets all statement requests associated with the connection. The Driver Manager manages the work of allowing an application to switch connections while transactions are in progress on the current connection.

The ODBC interface is available in Windows 95/98, and Windows NT clients. You can download the SOLID *ODBC Driver Package* as a part of the SDK from the SOLID Web site.

SOLID *SQL API*

An application using either the SOLID *SQL API* directly performs the following tasks.

1. The application allocates memory for an environment handle (*henv*) and a connection handle (*hdbc*); both are required to establish a database connection.

   An application may request multiple connections for one or more data sources. Each connection is considered a separate transaction space.

2. The **SQLConnect** call establishes the database connection, specifying the server name, user id, and password.

3. The application then allocates memory for a statement handle and calls either **SQLExecDirect**, which both prepares and executes an SQL statement, or **SQLPrepare** and **SQLExecute**, which allows statements to be executed multiple times.

4. If the statement was a SELECT statement, the resulting columns need to be bound to variables in the application. This is done by using **SQLBindCol**. The rows can be then fetched using repeatedly **SQLFetch**.

5. If the statement was a UPDATE, DELETE or INSERT, the application needs to check if the execution succeeded and call **SQLTransact** to commit the transaction.

6. Finally the application closes the connection.

Read *Chapter 2, "Using SOLID SQL API and ODBC API"* for more information on using these APIs.

SOLID *Light Client*

SOLID *Light Client* allows you to develop small-footprint applications using C (or any tool that conforms to the C function call conversion). It is a 21-function subset of the ODBC API, providing full SQL capabilities for application developers accessing SOLID E*mbedded Engine* databases. It provides functions for controlling database connections, executing SQL statements, retrieving result sets, committing transactions, and other SOLID *Embedded Engine* functionality. Read *Chapter 6, "Using SOLID Light Client"* for more details.

SOLID *JDBC Driver*

SOLID *JDBC Driver* allows you to develop your application with a Java tool that accesses the database using JDBC. The JDBC API, JavaSoft's core API for JDK 1.1, defines Java classes to represent database connections, SQL statements, result sets, database metadata, etc. It allows you to issue SQL statements and process the results. JDBC is the primary API for database access in Java. Read *Chapter 7, "Using the SOLID JDBC Driver"* for more details.

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Using SOLID *SQL API* and *ODBC API*

This chapter describes how to develop applications using SOLID *SQL API* and *ODBC API*. Although this chapter is written from the viewpoint of ODBC application developers, most of the information applies also to development of applications that access SOLID *SQL API* directly. Topic covered in this chapter include:

- Guidelines for calling functions
- Basic application steps
- Connecting to a data source
- Executing SQL statements
- Retrieving status and error information
- Terminating transactions and connections
- Constructing an application

Guidelines for calling Functions

This section describes the general characteristics of ODBC functions, determining driver conformance levels, the role of the Driver Manager, ODBC function arguments, and the values ODBC functions return.

General Information

Each SOLID *SQL API* and ODBC function name starts with the prefix "SQL." Each function accepts one or more arguments. Arguments are defined as input (to the driver) or output (from the the driver).

C programs that call ODBC functions must include the SQL.H, SQLEXT.H, and WINDOWS.H header files. These files define Windows and ODBC constants and types and provide function prototypes for all ODBC functions.

C programs that call SOLID *SQL API* functions must include the CLI0CORE.H, CLI0DEFS.H, CLI0ENV.H and CLI01EXT1.H header files. These files define constants and types and provide function prototypes for all SOLID *SQL API* functions.

Determining Conformance Levels

Driver Conformance

ODBC defines conformance levels for drivers in two areas: the *ODBC API* and the ODBC SQL grammar (which includes the ODBC SQL data types). These levels establish standard sets of functionality. By inquiring the conformance levels supported by a driver, an application can easily determine if the driver provides the necessary functionality.

NOTE: The following sections refer to **SQLGetInfo** and **SQLGetTypeInfo**, which are part of the Level 1 API conformance level. Although it is strongly recommended that drivers support this conformance level, drivers are not required to do so. If these functions are not supported, an application developer must consult the driver documentation to determine its conformance levels.

API Conformance Levels

ODBC functions are divided into core functions, which are defined in the X/Open and SQL Access Group Call Level Interface specification, and two levels of extension functions, with which ODBC extends this specification. To determine the function conformance level of a driver, an application calls **SQLGetInfo** with the SQL_ODBC_SAG_CLI_CONFORMANCE and SQL_ODBC_API_CONFORMANCE flags. Note that a driver can support one or more extension functions but not conform to ODBC extension Level 1 or 2. To determine if a driver supports a particular function, an application calls **SQLGetFunctions**. Note that **SQLGetFunctions** is implemented by the Driver Manager and can be called for any driver, regardless of its level.

SQL Conformance Levels

The ODBC SQL grammar, which includes SQL data types, is divided into a minimum grammar, a core grammar, which corresponds to the X/Open and SQL Access Group SQL CAE specification (1992), and an extended grammar, which provides common extensions to SQL. To determine the SQL conformance level of a driver, an application calls **SQLGetInfo** with the SQL_ODBC_SQL_CONFORMANCE flag. To determine whether a driver supports a specific SQL extension, an application calls **SQLGetInfo** with a flag for that extension. See *Appendix C, "SQL Grammar"* for more information. To determine whether a driver supports a specific SQL data type, an application calls **SQLGetTypeInfo**.

Using the Driver Manager

The Driver Manager is a DLL that provides access to ODBC drivers. An application typically links with the Driver Manager import library (ODBC.LIB) to gain access to the Driver Manager.

Applications accessing SOLID *SQL API* directly bypass the Driver Manager and cannot therefore use ODBC functions that are implemented in the Driver Manager.

Whenever an application calls an ODBC function, the Driver Manager performs one of the following actions:

- For **SQLDataSources** and **SQLDrivers**, the Driver Manager processes the call. It does not pass the call to the driver.
- For **SQLGetFunctions**, the Driver Manager passes the call to the driver associated with the connection. If the driver does not support **SQLGetFunctions**, the Driver Manager processes the call.
- For **SQLAllocEnv**, **SQLAllocConnect**, **SQLSetConnectOption**, **SQLFreeConnect**, and **SQLFreeEnv**, the Driver Manager processes the call. The Driver Manager calls **SQLAllocEnv**, **SQLAllocConnect**, and **SQLSetConnectOption** in the driver when the application calls a function to connect to the data source (**SQLConnect**, or **SQLDriverConnect**) . The Driver Manager calls **SQLFreeConnect** and **SQLFreeEnv** in the driver when the application calls **SQLDisconnect**.
- For **SQLConnect**, **SQLDriverConnect**, and **SQLError**, the Driver Manager performs initial processing then passes the call to the driver associated with the connection.
- For any other ODBC function, the Driver Manager passes the call to the driver associated with the connection.

If requested, the Driver Manager records each called function in a trace file. The name of each function is recorded, along with the values of the input arguments and the names of the output arguments (as listed in the function definitions).

Calling ODBC Functions

The following paragraphs describe general characteristics of ODBC functions.

Buffers

An application passes data to a driver in an input buffer. The driver returns data to an application in an output buffer. The application must allocate memory for both input and output buffers. (If the application will use the buffer to retrieve string data, the buffer must contain space for the null termination byte.)

Note that some functions accept pointers to buffers that are later used by other functions. The application must ensure that these pointers remain valid until all applicable functions have used them. For example, the argument *rgbValue* in **SQLBindCol** points to an output buffer in which **SQLFetch** returns the data for a column.

CAUTION: ODBC does not require drivers to correctly manage buffers that cross segment boundaries in Windows 3.1. The Driver Manager supports the use of such buffers, since it passes buffer addresses to drivers and does not operate on buffer contents. If a driver supports buffers that cross segment boundaries, the documentation for the driver should clearly state this.

For maximum interoperability, applications that use buffers that cross segment boundaries should pass them in pieces to ODBC functions. None of these pieces can cross a segment boundary. For example, suppose a data source contains 100 kilobytes of bitmap data. A Windows 3.1 application can safely allocate 100K of memory (beginning at a segment boundary) and retrieve the data in two pieces (64K and 36K), each of which begins on a segment boundary.

Input Buffers

An application passes the address and length of an input buffer to a driver. The length of the buffer must be one of the following values:

- A length greater than or equal to zero. This is the actual length of the data in the input buffer. For character data, a length of zero indicates that the data is an empty (zero length) string. Note that this is different from a null pointer. If the application specifies the length of character data, the character data does not need to be null-terminated.
- SQL_NTS. This specifies that a character data value is null-terminated.
- SQL_NULL_DATA. This tells the driver to ignore the value in the input buffer and use a NULL data value instead. It is only valid when the input buffer is used to provide the value of a parameter in an SQL statement.

The operation of ODBC functions on character data containing embedded null characters is undefined, and is not recommended for maximum interoperability.

Unless it is specifically prohibited in a function description, the address of an input buffer may be a null pointer. When the address of an input buffer is a null pointer, the value of the corresponding buffer length argument is ignored.

See *"Converting Data from C to SQL Data Types" on page D-33* for more information on converting buffers.

Output Buffers

An application passes the following arguments to a driver, so that it can return data in an output buffer:

- The address of the buffer in which the driver returns the data (the output buffer). Unless it is specifically prohibited in a function description, the address of an output buffer can be a null pointer. In this case, the driver does not return anything in the buffer and, in the absence of other errors, returns SQL_SUCCESS.
- If necessary, the driver converts data before returning it. The driver always null-terminates character data before returning it.
- The length of the buffer. This is ignored by the driver if the returned data has a fixed length in C, such as an integer, real number, or date structure.
- The address of a variable in which the driver returns the length of the data (the length buffer). The returned length of the data is SQL_NULL_DATA if the data is a NULL value in a result set. Otherwise, it is the number of bytes of data available to return. If the driver converts the data, it is the number of bytes after the conversion. For character data, it does not include the null termination byte added by the driver.

If the output buffer is too small, the driver attempts to truncate the data. If the truncation does not cause a loss of significant data, the driver returns the truncated data in the output buffer, returns the length of the available data (as opposed to the length of the truncated data) in the length buffer, and returns SQL_SUCCESS_WITH_INFO. If the truncation causes a loss of significant data, the driver leaves the output and length buffers untouched and returns SQL_ERROR. The application calls **SQLError** to retrieve information about the truncation or the error.

See *"Converting Data from SQL to C Data Types" on page D-19* for more information about output buffers.

Environment, Connection, and Statement Handles

When so requested by an application, the Driver Manager and each driver allocate storage for information about the ODBC environment, each connection, and each SQL statement. The handles to these storage areas are returned to the application. The application then uses one or more of them in each call to an ODBC function.

The ODBC interface defines three types of handles:

- The **environment handle** identifies memory storage for global information, including the valid connection handles and the current active connection handle. ODBC defines the environment handle as a variable of type HENV. An application uses a single environment handle; it must request this handle prior to connecting to a data source.

- **Connection handles** identify memory storage for information about a particular connection. ODBC defines connection handles as variables of type HDBC. An application must request a connection handle prior to connecting to a data source. Each connection handle is associated with the environment handle. The environment handle can, however, have multiple connection handles associated with it.
- **Statement handles** identify memory storage for information about an SQL statement. ODBC defines statement handles as variables of type HSTMT. An application must request a statement handle prior to submitting SQL requests. Each statement handle is associated with exactly one connection handle. Each connection handle can, however, have multiple statement handles associated with it.

For more information about requesting a connection handle, read *"Connecting to a Data Source"* in this chapter. For more information about requesting a statement handle, read *"Executing SQL Statements"* in this chapter.

Using Data Types

Data stored on a data source has an SQL data type, which may be specific to that data source. A driver maps data source–specific SQL data types to ODBC SQL data types, which are defined in the ODBC SQL grammar, and driver-specific SQL data types. (A driver returns these mappings through **SQLGetTypeInfo**. It also uses the ODBC SQL data types to describe the data types of columns and parameters in **SQLColAttributes**, **SQLDescribeCol**, and **SQLDescribeParam**.)

Each SQL data type corresponds to an ODBC C data type. By default, the driver assumes that the C data type of a storage location corresponds to the SQL data type of the column or parameter to which the location is bound. If the C data type of a storage location is not the *default* C data type, the application can specify the correct C data type with the *fCType* argument in **SQLBindCol**, **SQLGetData**, or **SQLBindParameter**. Before returning data from the data source, the driver converts it to the specified C data type. Before sending data to the data source, the driver converts it from the specified C data type.

See *Appendix D, "Data Types"* for more informaton about data types. The C data types are defined in SQL.H and SQLEXT.H.

NOTE: The C data types of SOLID *SQL API* are defined in CLI0DEFS.H.

Function Return Codes

When an application calls a function, the driver executes the function and returns a predefined code. These return codes indicate success, warning, or failure status. The return codes are:

SQL_SUCCESS

SQL_SUCCESS_WITH_INFO

SQL_NO_DATA_FOUND

SQL_ERROR

SQL_INVALID_HANDLE

SQL_STILL_EXECUTING

SQL_NEED_DATA

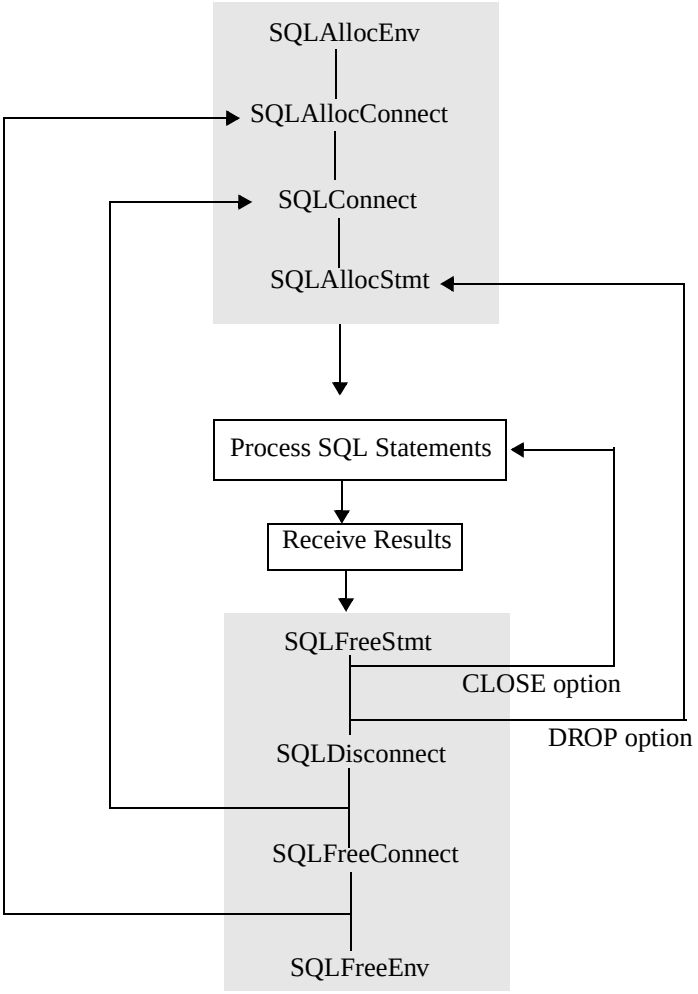
If the function returns SQL_SUCCESS_WITH_INFO or SQL_ERROR, the application can call **SQLError** to retrieve additional information about the error. Read "*Retrieving Error Messages"* for a complete description of return codes and error handling.

Basic Application Steps

To interact with a data source, a simple application:

1. Connects to the data source. It specifies the data source name and any additional information needed to complete the connection.
2. Processes one or more SQL statements.
   - The application places the SQL text string in a buffer. If the statement includes parameter markers, it sets the parameter values.
   - If the statement returns a result set, the application assigns a cursor name for the statement or allows the driver to do so.
   - The application submits the statement for prepared or immediate execution.
   - If the statement creates a result set, the application can inquire about the attributes of the result set, such as the number of columns and the name and type of a specific column. It assigns storage for each column in the result set and fetches the results.
   - If the statement causes an error, the application retrieves error information from the driver and takes appropriate action.
3. Ends each transaction by committing it or rolling it back.
4. Terminates the connection when it has finished interacting with the data source.

The following diagram lists the ODBC function calls than an application makes to connect to the data source, process SQL statements, and disconnect from the data source. Depending on its needs, an application may call other ODBC functions.


SQLAllocEnv
SQLAllocConnect
SQLConnect
SQLAllocStmt
Process SQL Statements
Receive Results
SQLFreeStmt
CLOSE option
DROP option
SQLDisconnect
SQLFreeConnect
SQLFreeEnv

Connecting to a Data Source

This section briefly introduces data sources. It then describes how to establish a connection to a data source.

About Data Sources

A data source consists of the data a user wants to access, its associated DBMS, the platform on which the DBMS resides, and the network (if any) used to access that platform. Each data source requires that a driver provide certain information in order to connect to it. At the core level, this is defined to be the name of the data source, a user ID, and a password. ODBC extensions allow drivers to specify additional information such as a network address or additional passwords.

NOTE: If the used data source name can be interpreted as a valid SOLID *Embedded Engine* (server) network name, the client first connects using the information given in the data source name. A valid network name consists of a *communication protocol*, and optional *host computer name* and a *server name*. See **SOLID Administrator Guide** for more information about listen names.

If the data source name is not a valid SOLID *Embedded Engine* (server) listen name, the information needed to locate a server in the network is read from the ODBC.INI file or registry.

The connection information for each data source is stored in the ODBC.INI file or registry, which is created during installation and maintained with an administration program. A section in this file lists the available data sources. Additional sections describe each data source in detail, specifying the driver name, a description, and any additional information the driver needs in order to connect to the data source.

NOTE: Applications that directly access the SOLID *SQL API* must connect to the server using a valid listen name. If the data source name is not a valid SOLID *Embedded Engine* (server) listen name, all SOLID client applications search for a valid listen name from:

1) the SOLID.INI file
2) the ODBC.INI or registry

See **SOLID Administrator Guide** for more information about the use of data source names.

Initializing the API Environment

Before an application can use any other ODBC function, it must initialize the ODBC interface and associate an environment handle with the environment. To initialize the interface and allocate an environment handle, an application:

1. Declares a variable of the type HENV. For example, the application could use the declaration:

```
HENV henv1;
```

2. Calls **SQLAllocEnv** and passes it the address of the variable. The driver initializes the ODBC environment, allocates memory to store information about the environment, and returns the environment handle in the variable.

These steps should be performed only once by an application; **SQLAllocEnv** supports one or more connections to data sources.

Allocating a Connection Handle

Before an application can connect to a driver, it must allocate a handle for the connection. To allocate a connection handle, an application:

1. Declares a variable of the type HDBC. For example, the application could use the declaration:

```
HDBC hdbc1;
```

2. Calls **SQLAllocConnect** and passes it the address of the variable. The driver allocates memory to store information about the connection and returns the connection handle in the variable.

Connecting to a Data Source

Next, the application specifies a specific driver and data source. It passes the following information to the driver in a call to **SQLConnect**:

- **Data source name** The name of the data source being requested by the application.
- **User ID** The login ID or account name for access to the data source if appropriate (optional).
- **Authentication string (password)** A character string associated with the user ID that allows access to the data source (optional).

When an application calls **SQLConnect**, the Driver Manager uses the data source name to read the name of the driver DLL from the appropriate section of the ODBC.INI file or registry. It then loads the driver DLL and passes the **SQLConnect** arguments to it. If the driver needs additional information to connect to the data source, it reads this information from the same section of the ODBC.INI file.

If the application specifies a data source name that is not in the ODBC.INI file or registry, or if the application does not specify a data source name, the Driver Manager searches for the default data source specification. If it finds the default data source, it loads the default driver

DLL and passes the application-specified data source name to it. If there is no default data source, the Driver Manager returns an error.

NOTE: When an application uses SOLID *SQL API* directly and calls **SQLConnect** and does not specify a SOLID *Embedded Engine* network name, it is read from the parameter Connect in the [Com] section of the SOLID.INI file. The SOLID.INI file must reside in the current working directory of the application or in path specified by the SOLIDDIR environment variable.

ODBC Extensions for Connections

ODBC extends the X/Open and SQL Access Group Call Level Interface to provide additional functions related to connections, drivers, and data sources. The remainder of this chapter describes these functions. To determine if a driver supports a specific function, an application calls **SQLGetFunctions**.

Connecting to a Data Source With SQLDriverConnect

SQLDriverConnect supports:

- Data sources that require more connection information than the three arguments in **SQLConnect**.
- Dialog boxes to prompt the user for all connection information.
- Data sources that are not defined in the ODBC.INI file or registry.

SQLDriverConnect uses a connection string to specify the information needed to connect to a driver and data source.

A connection string contains the following information:

- Data source name or driver description
- Zero or more user IDs
- Zero or more passwords
- Zero or more data source-specific parameter values

The connection string is a more flexible interface than the data source name, user ID, and password used by **SQLConnect**. The application can use the connection string for multiple levels of login authorization or to convey other data source-specific connection information.

An application calls **SQLDriverConnect** in one of three ways:

- Specifies a connection string that contains a data source name. The Driver Manager retrieves the full path of the driver DLL associated with the data source from the

ODBC.INI file or registry. To retrieve a list of data source names, an application calls **SQLDataSources**.

- Specifies a connection string that contains a driver description. The Driver Manager retrieves the full path of the driver DLL. To retrieve a list of driver descriptions, an application calls **SQLDrivers**.
- Specifies a connection string that does not contain a data source name or a driver description. The Driver Manager displays a dialog box from which the user selects a data source name. The Driver Manager then retrieves the full path of the driver DLL associated with the data source.

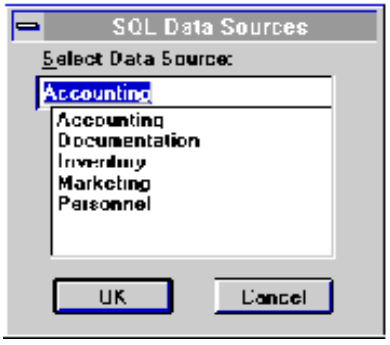
The Driver Manager then loads the driver DLL and passes the **SQLDriverConnect** arguments to it.

The application may pass all the connection information the driver needs. It may also request that the driver always prompt the user for connection information or only prompt the user for information it needs. Finally, if a data source is specified, the driver may read connection information from the appropriate section of the ODBC.INI file or registry.

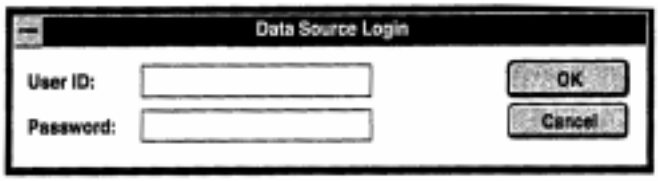
After the driver connects to the data source, it returns the connection information to the application. The application may store this information for future use.

If the application specifies a data source name that is not in the ODBC.INI file or registry, the Driver Manager searches for the default data source specification. If it finds the default data source, it loads the default driver DLL and passes the application-specified data source name to it. If there is no default data source, the Driver Manager returns an error.

The Driver Manager displays the following dialog box if the application calls **SQLDriverConnect** and requests that the user be prompted for information.



On request from the application, the driver displays a dialog box similar to the following to retrieve login information.



Translating Data

An application and a data source can store data in different formats. For example, the application might use a different character set than the data source. ODBC provides a mechanism by which a driver can translate all data (data values, SQL statements, table names, row counts, and so on) that passes between the driver and the data source.

The driver translates data by calling functions in a translation DLL. A default translation DLL can be specified for the data source in the ODBC.INI file or registry; the application can override this by calling **SQLSetConnectOption**. When the driver connects to the data source, it loads the translation DLL (if one has been specified). After the driver has connected to the data source, the application may specify a new translation DLL by calling **SQLSetConnectOption**.

Translation functions may support several different types of translation. For example, a function that translates data from one character set to another might support a variety of character sets. To specify a particular type of translation, an application can pass an option flag to the translation functions with **SQLSetConnectOption**.

Additional Extension Functions

ODBC also provides the following functions related to connections, drivers, and data sources. See *Chapter 5, "Function Reference"* for more information about these functions .

Function	Description
SQLDataSources	Retrieves a list of available data sources. The Driver Manager retrieves this information from the ODBC.INI file or registry. An application can present this information to a user or automatically select a data source.

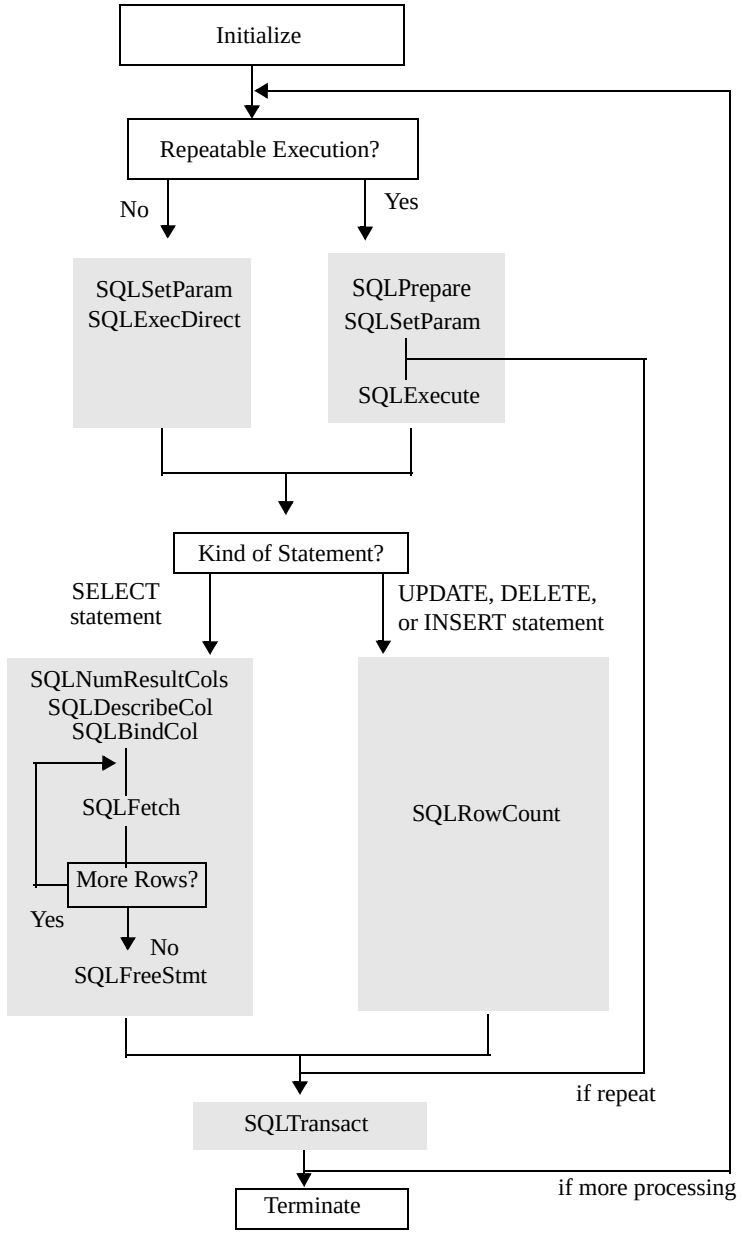
SQLDrivers	Retrieves a list of installed drivers and their attributes. The Driver Manager retrieves this information from the ODBCINST.INI file or registry. An application can present this information to a user or automatically select a driver.
SQLGetFunctions	Retrieves functions supported by a driver. This function allows an application to determine at run time whether a particular function is supported by a driver.
SQLGetInfo	Retrieves general information about a driver and data source, including filenames, versions, conformance levels, and capabilities.
SQLGetTypeInfo	Retrieves the SQL data types supported by a driver and data source.
SQLSetConnectOption SQLGetConnectOption	These functions set or retrieve connection options, such as the data source access mode, automatic transaction commitment, timeout values, function tracing, data translation options, and transaction isolation.

Executing SQL Statements

An application can submit any SQL statement supported by a data source. ODBC defines a standard syntax for SQL statements. For maximum interoperability, an application should only submit SQL statements that use this syntax; the driver will translate these statements to the syntax used by the data source. If an application submits an SQL statement that does not use the ODBC syntax, the driver passes it directly to the data source.

Note For **CREATE TABLE** and **ALTER TABLE** statements, applications should use the data type name returned by **SQLGetTypeInfo** in the TYPE_NAME column, rather than the data type name defined in the SQL grammar.

The following diagram shows a simple sequence of ODBC function calls to execute SQL statements. Note that statements can be executed a single time with **SQLExecDirect** or prepared with **SQLPrepare** and executed multiple times with **SQLExecute**. Note also that an application calls **SQLTransact** to commit or roll back a transaction.


Initialize
Repeatable Execution?
No
Yes
SQLSetParam
SQLExecDirect
SQLPrepare
SQLSetParam
SQLExecute
Kind of Statement?
SELECT
statement
UPDATE, DELETE,
or INSERT statement
SQLNumResultCols
SQLDescribeCol
SQLBindCol
SQLFetch
More Rows?
Yes
No
SQLFreeStmt
SQLRowCount
if repeat
SQLTransact
if more processing
Terminate

Allocating a Statement Handle

Before an application can submit an SQL statement, it must allocate a statement handle for the statement. To allocate a statement handle, an application:

1. Declares a variable of type HSTMT. For example, the application could use the declaration:

```
HSTMT hstmt1;
```

2. Calls **SQLAllocStmt** and passes it the address of the variable and the connected *hdbc* with which to associate the statement. The driver allocates memory to store information about the statement, associates the statement handle with the *hdbc*, and returns the statement handle in the variable.

Executing an SQL Statement

An application can submit an SQL statement for execution in two ways:

- Prepared Call SQLPrepare and then call SQLExecute.
- Direct Call SQLExecDirect.

These options are similar, though not identical to, the prepared and immediate options in embedded SQL. See *Appendix E, "Comparison Between Embedded SQL and ODBC"* for a comparison of the ODBC functons and embedded SQL.

Prepared Execution

An application should prepare a statement before executing it if either of the following is true:

- The application will execute the statement more than once, possibly with intermediate changes to parameter values.
- The application needs information about the result set prior to execution.

A prepared statement executes faster than an unprepared statement because the data source compiles the statement, produces an access plan, and returns an access plan identifier to the driver. The data source minimizes processing time as it does not have to produce an access plan each time it executes the statement. Network traffic is minimized because the driver sends the access plan identifier to the data source instead of the entire statement.

IMPORTANT1: Committing or rolling back a transaction, either by calling **SQLTransact** or by using the SQL_AUTOCOMMIT connection option, can cause the data source to delete the access plans for all *hstmts* on an *hdbc*. For more information, see the SQL_CURSOR_COMMIT_BEHAVIOR and SQL_CURSOR_ROLLBACK_BEHAVIOR information types in **SQLGetInfo**.

IMPORTANT2: Committing also read-only transactions is required in SOLID *Embedded Engine*. The first SQL statement that is executed after the last commit (including a SELECT statement) starts a new transaction. If this transaction is not committed, it stays alive until the client disconnects or the transaction is timed out. These “accidentally created” long-running transactions can cause significant performance problems in SOLID *Embedded Engine*. AUTOCOMMIT mode does not solve ths issue because SELECTs in AUTOCOMMIT mode are committed in the beginning of the next executed statement.

To prepare and execute an SQL statement, an application:

1. Calls **SQLPrepare** to prepare the statement.
2. Sets the values of any statement parameters. For more information, read “*Setting Parameter Values”* in this chapter.
3. Retrieves information about the result set, if necessary. For more information, read “*Determining the Characteristics of a Result Set”* in this chapter.
4. Calls **SQLExecute** to execute the statement.
5. Repeats steps 2 through 4 as necessary.

Direct Execution

An application should execute a statement directly if both of the following are true:

- The application will execute the statement only once.
- The application does not need information about the result set prior to execution.

To execute an SQL statement directly, an application:

1. Sets the values of any statement parameters. For more information, see “Setting Parameter Values” later in this chapter.
2. Calls **SQLExecDirect** to execute the statement.

Setting Parameter Values

An SQL statement can contain parameter markers that indicate values that the driver retrieves from the application at execution time. For example, an application might use the following statement to insert a row of data into the EMPLOYEE table:

```
INSERT INTO EMPLOYEE (NAME, AGE, HIREDATE)
    VALUES (?, ?, ?)
```

An application uses parameter markers instead of literal values if:

- It needs to execute the same prepared statement several times with different parameter values.

- The parameter values are not known when the statement is prepared.
- The parameter values need to be converted from one data type to another.

To set a parameter value, an application performs the following steps in any order:

- Calls **SQLBindParameter** to bind a storage location to a parameter marker and specify the data types of the storage location and the column associated with the parameter, as well as the precision and scale of the parameter.
- Places the parameter's value in the storage location.

These steps can be performed before or after a statement is prepared, but must be performed before a statement is executed.

Parameter values must be placed in storage locations in the C data types specified in **SQLBindParameter**. For example:

Parameter Value	SQL Data Type	C Data Type	Stored Value
ABC	SQL_CHAR	SQL_C_CHAR	ABC\0 [a]
10	SQL_INTEGER	SQL_C_SLONG	10
10	SQL_INTEGER	SQL_C_CHAR	10\0 [a]
1 P.M.	SQL_TIME	SQL_C_TIME	13,0,0 [b]
1 P.M.	SQL_TIME	SQL_C_CHAR	{t '13:00:00'}\0[a,c]

a "\0" represents a null-termination byte; the null termination byte is required only if the parameter length is SQL_NTS.

b The numbers in this list are the numbers stored in the fields of the TIME_STRUCT structure.

c The string uses the ODBC date escape clause. For more information, see "Date, Time, and Timestamp Data" later in this chapter.

Storage locations remain bound to parameter markers until the application calls **SQLFreeStmt** with the SQL_RESET_PARAMS option or the SQL_DROP option. An application can bind a different storage area to a parameter marker at any time by calling **SQLBindParameter**. An application can also change the value in a storage location at any time. When a statement is executed, the driver uses the current values in the most recently defined storage locations.

Performing Transactions

In *auto-commit* mode, every SQL statement is a complete transaction, which is automatically committed. In *manual-commit* mode, a transaction consists of one or more statements. In manual-commit mode, when an application submits an SQL statement and no transaction is open, the driver implicitly begins a transaction. The transaction remains open until the application commits or rolls back the transaction with **SQLTransact**.

If a driver supports the SQL_AUTOCOMMIT connection option, the default transaction mode is auto-commit; otherwise, it is manual-commit. An application calls **SQLSetConnectOption** to switch between manual-commit and auto-commit mode. Note that if an application switches from manual-commit to auto-commit mode, the driver commits any open transactions on the connection.

Applications should call **SQLTransact**, rather than submitting a **COMMIT** or **ROLLBACK** statement, to commit or roll back a transaction. The result of a **COMMIT** or **ROLLBACK** statement depends on the driver and its associated data source.

IMPORTANT: Committing or rolling back a transaction, either by calling **SQLTransact** or by using the SQL_AUTOCOMMIT connection option, can cause the data source to close the cursors and delete the access plans for all *hstmts* on an *hdbc*. For more information, see the SQL_CURSOR_COMMIT_BEHAVIOR and SQL_CURSOR_ROLLBACK_BEHAVIOR information types in **SQLGetInfo**.

ODBC Extensions for SQL Statements

ODBC extends the X/Open and SQL Access Group Call Level Interface to provide additional functions related to SQL statements. ODBC also extends the X/Open and SQL Access Group SQL CAE specification (1992) to provide common extensions to SQL. The remainder of this chapter describes these functions and SQL extensions.

To determine if a driver supports a specific function, an application calls **SQLGetFunctions**. To determine if a driver supports a specific ODBC extension to SQL, such as outer joins or procedure invocation, an application calls **SQLGetInfo**.

Retrieving Information About the Data Source's Catalog

The following functions, known as catalog functions, return information about a data source's catalog:

- **SQLTables** returns the names of tables stored in a data source.
- **SQLColumns** returns the names of columns in one or more tables.
- **SQLPrimaryKeys** returns the names of columns that comprise the primary key of a single table.

- **SQLSpecialColumns** returns information about the optimal set of columns that uniquely identify a row in a single table or the columns in that table that are automatically updated when any value in the row is updated by a transaction.
- **SQLStatistics** returns statistics about a single table and the indexes associated with that table.

Each function returns the information as a result set. An application retrieves these results by calling **SQLBindCol** and **SQLFetch**.

Sending Parameter Data at Execution Time

To send parameter data at statement execution time, such as for parameters of the SQL_LONGVARCHAR or SQL_LONGVARBINARY types, an application uses the following three functions:

- SQLBindParameter
- SQLParamData
- SQLPutData

To indicate that it plans to send parameter data at statement execution time, an application calls **SQLBindParameter** and sets the *pcbValue* buffer for the parameter to the result of the SQL_LEN_DATA_AT_EXEC(*length*) macro. If the *fSqlType* argument is SQL_LONGVARBINARY or SQL_LONGVARCHAR and the driver returns "Y" for the SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo**, *length* is the total number of bytes of data to be sent for the parameter; otherwise, it is ignored.

The application sets the *rgbValue* argument to a value that, at run time, can be used to retrieve the data. For example, *rgbValue* might point to a storage location that will contain the data at statement execution time or to a file that contains the data. The driver returns the value to the application at statement execution time.

When the driver processes a call to **SQLExecute** or **SQLExecDirect** and the statement being executed includes a data-at-execution parameter, the driver returns SQL_NEED_DATA. To send the parameter data, the application:

1. Calls **SQLParamData**, which returns *rgbValue* (as set with **SQLBindParameter**) for the first data-at-execution parameter.
2. Calls **SQLPutData** one or more times to send data for the parameter. (More than one call will be needed if the data value is larger than the buffer; multiple calls are allowed only if the C data type is character or binary and the SQL data type is character, binary, or data source–specific.)

3. Calls **SQLParamData** again to indicate that all data has been sent for the parameter. If there is another data-at-execution parameter, the driver returns *rgbValue* for that parameter and SQL_NEED_DATA for the function return code. Otherwise, it returns SQL_SUCCESS for the function return code.
4. Repeats steps 2 and 3 for the remaining data-at-execution parameters.

   For additional information, see the description of "*SQLBindParameter (ODBC 2.0, Level 1)"* in *Chapter 5, "Function Reference."*

Executing Functions Asynchronously

By default, a driver executes ODBC functions synchronously; the driver does not return control to an application until a function call completes. If a driver supports asynchronous execution, however, an application can request asynchronous execution for the functions listed below. (All of these functions either submit requests to a data source or retrieve data. These operations may require extensive processing.)

SQLColAttributes	SQLGetTypeInfo	SQLSpecialColumns
SQLColumns	SQLNumParams	SQLStatistics
SQLDescribeCol	SQLNumResultCols	SQLTables
SQLDescribeParam	SQLParamData	
SQLExecDirect	SQLPrepare	
SQLExecute	SQLPrimaryKeys	
SQLExtendedFetch	SQLPrimaryKeys	
SQLFetch	SQLPutData	
SQLGetData	SQLSetPos	

Asynchronous execution is performed on a statement-by-statement basis. To execute a statement asynchronously, an application:

1. Calls **SQLSetStmtOption** with the SQL_ASYNC_ENABLE option to enable asynchronous execution for an *hstmt*. (To enable asynchronous execution for all *hstmts* associated with an *hdbc*, an application calls **SQLSetConnectOption** with the SQL_ASYNC_ENABLE option.)
2. Calls one of the functions listed earlier in this section and passes it the *hstmt*. The driver begins asynchronous execution of the function and returns SQL_STILL_EXECUTING.

   NOTE: If the application calls a function that cannot be executed asynchronously, the driver executes the function synchronously.

3. Performs other operations while the function is executing asynchronously. The application can call any function with a different *hstmt* or an *hdbc* not associated with the original *hstmt*. With the original *hstmt* and the *hdbc* associated with that *hstmt*, the application can only call the original function, **SQLAllocStmt**, **SQLCancel**, or **SQLGetFunctions**.

4. Calls the asynchronously executing function to check if it has finished. While the arguments must be valid, the driver ignores all of them except the *hstmt* argument. For example, suppose an application called **SQLExecDirect** to execute a **SELECT** statement asynchronously. When the application calls **SQLExecDirect** again, the return value indicates the status of the **SELECT** statement, even if the *szSqlStr* argument contains an **INSERT** statement.

   If the function is still executing, the driver returns SQL_STILL_EXECUTING and the application must repeat steps 3 and 4. If the function has finished, the driver returns a different code, such as SQL_SUCCESS or SQL_ERROR. For information about canceling a function executing asynchronously, see *"Terminating Statement Processing"* this chapter.

5. Repeats steps 2 through 4 as needed.

To disable asynchronous execution for an *hstmt*, an application calls **SQLSetStmtOption** with the SQL_ASYNC_ENABLE option. To disable asynchronous execution for all *hstmts* associated with an *hdbc*, an application calls **SQLSetConnectOption** with the SQL_ASYNC_ENABLE option.

NOTE: ODBC drivers for SOLID *Embedded Engine* do not support asynchronous execution.

Using ODBC Extensions to SQL

ODBC defines the following extensions to SQL, which are common to most DBMS's:

- Date, time, and timestamp data
- Scalar functions such as numeric, string, and data type conversion functions
- **LIKE** predicate escape characters
- Outer joins
- Procedures

The syntax defined by ODBC for these extensions uses the escape clause provided by the X/Open and SQL Access Group SQL CAE specification (1992) to cover vendor-specific extensions to SQL. Its format is:

```
--(*vendor(vendor-name), product(product-name)
```

```
        extension *)--
```

For the ODBC extensions to SQL, *product-name* is always “ODBC”, since the product defining them is ODBC. *Vendor-name* is always “Microsoft”, since ODBC is a Microsoft product. ODBC also defines a shorthand syntax for these extensions:

{*extension***}**

Most DBMS’s provide the same extensions to SQL as does ODBC. Because of this, an application may be able to submit an SQL statement using one of these extensions in either of two ways:

- Use the syntax defined by ODBC. An application that uses the ODBC syntax will be interoperable among DBMS’s.
- Use the syntax defined by the DBMS. An application that uses DBMS-specific syntax will not be interoperable among DBMS’s.

Due to the difficulty in implementing some ODBC extensions to SQL, such as outer joins, a driver might only implement those ODBC extensions that are supported by its associated DBMS. To determine whether the driver and data source support all the ODBC extensions to SQL, an application calls **SQLGetInfo** with the SQL_ODBC_SQL_CONFORMANCE flag. For information about how an application determines whether a specific extension is supported, see the section that describes the extension.

NOTE: Many DBMS’s provide extensions to SQL other than those defined by ODBC. To use one of these extensions, an application uses the DBMS-specific syntax. The application will not be interoperable among DBMS’s.

Date, Time, and Timestamp Data

The escape clauses ODBC uses for date, time, and timestamp data are:

```
--(*vendor(Microsoft),product(ODBC) d 'value' *)--
--(*vendor(Microsoft),product(ODBC) t 'value' *)--
--(*vendor(Microsoft),product(ODBC) ts 'value' *)--
```

where **d** indicates *value* is a date in the “yyyy-mm-dd” format, **t** indicates *value* is a time in the “hh:mm:ss” format, and **ts** indicates *value* is a timestamp in the “yyyy-mm-dd hh:mm:ss[.f...]” format. The shorthand syntax for date, time, and timestamp data is:

```
{d 'value'}
{t 'value'}
{ts 'value'}
```

For example, each of the following statements updates the birthday of John Smith in the EMPLOYEE table. The first statement uses the escape clause syntax. The second statement

uses the shorthand syntax. The third statement uses the native syntax for a DATE column in DEC's Rdb and is not interoperable among DBMS's.

```
UPDATE EMPLOYEE

   SET BIRTHDAY=--(*vendor(Microsoft),product(ODBC)
       d '1967-01-15' *)--
   WHERE NAME='Smith, John'

UPDATE EMPLOYEE SET BIRTHDAY={d '1967-01-15'}
   WHERE NAME='Smith, John'

UPDATE EMPLOYEE SET BIRTHDAY='15-Jan-1967'
   WHERE NAME='Smith, John'
```

The ODBC escape clauses for date, time, and timestamp literals can be used in parameters with a C data type of SQL_C_CHAR. For example, the following statement uses a parameter to update the birthday of John Smith in the EMPLOYEE table:

```
UPDATE EMPLOYEE SET BIRTHDAY=? WHERE NAME='Smith, John'
```

A storage location of type SQL_C_CHAR bound to the parameter might contain any of the following values. The first value uses the escape clause syntax. The second value uses the shorthand syntax. The third value uses the native syntax for a DATE column in DEC's Rdb and is not interoperable among DBMS's.

```
"--(*vendor(Microsoft),product(ODBC)
   d '1967-01-15' *)--"

"{d '1967-01-15'}"

"'15-Jan-1967'"
```

An application can also send date, time, or timestamp values as parameters using the C structures defined by the C data types SQL_C_DATE, SQL_C_TIME, and SQL_C_TIMESTAMP.

To determine if a data source supports date, time, or timestamp data, an application calls **SQLGetTypeInfo**. If a driver supports date, time, or timestamp data, it must also support the escape clauses for date, time, or timestamp literals.

Scalar Functions

Scalar functions–such as string length, absolute value, or current date–can be used on columns of a result set and on columns that restrict rows of a result set. The escape clause ODBC uses for scalar functions is:

```
--(*vendor(Microsoft),product(ODBC)
```

fn *scalar-function* ***)--**

where *scalar-function* is one of the functions listed in Appendix F, "Scalar Functions." The shorthand syntax for scalar functions is:

{fn *scalar-function***}**

For example, each of the following statements creates the same result set of uppercase employee names. The first statement uses the escape clause syntax. The second statement uses the shorthand syntax. The third statement uses the native syntax for SOLID *Embedded Engine* and is not interoperable among DBMS's.

```
SELECT --(*vendor(Microsoft),product(ODBC)
   fn UCASE(NAME) *)-- FROM EMPLOYEE
SELECT {fn UCASE(NAME)} FROM EMPLOYEE
SELECT UCASE(NAME) FROM EMPLOYEE
```

An application can mix scalar functions that use native syntax and scalar functions that use ODBC syntax. For example, the following statement creates a result set of last names of employees in the EMPLOYEE table. (Names in the EMPLOYEE table are stored as a last name, a comma, and a first name.) The statement uses the ODBC scalar function **SUBSTRING** and the SQL Server scalar function **CHARINDEX** and will only execute correctly on SQL Server.

```
SELECT {fn SUBSTRING(NAME, 1, CHARINDEX(',', NAME) – 1)}
    FROM EMPLOYEE
```

To determine which scalar functions are supported by a data source, an application calls **SQLGetInfo** with the SQL_NUMERIC_FUNCTIONS, SQL_STRING_FUNCTIONS, SQL_SYSTEM_FUNCTIONS, and SQL_TIMEDATE_FUNCTIONS flags.

Data Type Conversion Function

ODBC defines a special scalar function, **CONVERT**, that requests that the data source convert data from one SQL data type to another SQL data type. The escape clause ODBC uses for the **CONVERT** function is:

--(*vendor(Microsoft),product(ODBC)
fn CONVERT(*value_exp***, *** data_type***) *)--**

where *value_exp* is a column name, the result of another scalar function, or a literal value, and *data_type* is a keyword that matches the **#define** name used by an ODBC SQL data type (as defined in *Appendix D, "Data Types"*). The shorthand syntax for the **CONVERT** function is:

{fn CONVERT(*value_exp***, *** data_type***)}**

For example, the following statement creates a result set of the names and ages of all employees in their twenties. It uses the **CONVERT** function to convert each employee's age from type SQL_SMALLINT to type SQL_CHAR. Each resulting character string is compared to the pattern "2%" to determine if the employee's age is in the twenties.

```
SELECT NAME, AGE FROM EMPLOYEE WHERE
{fn CONVERT(AGE,SQL_CHAR)} LIKE '2%'
```

To determine if the **CONVERT** function is supported by a data source, an application calls **SQLGetInfo** with the SQL_CONVERT_FUNCTIONS flag. See *Appendix F, "Scalar Functions"* for more information about the **CONVERT** function.

LIKE Predicate Escape Characters

In a **LIKE** predicate, the percent character (%) matches zero or more of any character and the underscore character (_) matches any one character. The percent and underscore characters can be used as literals in a **LIKE** predicate by preceding them with an escape character. The escape clause ODBC uses to define the **LIKE** predicate escape character is:

```
--(*vendor(Microsoft),product(ODBC)
    escape 'escape-character' *)--
```

where *escape-character* is any character supported by the data source. The shorthand syntax for the **LIKE** predicate escape character is:

```
{escape 'escape-character'}
```

For example, each of the following statements creates the same result set of department names that start with the characters "%AAA". The first statement uses the escape clause syntax. The second statement uses the shorthand syntax. The third statement uses the native syntax for Ingres and is not interoperable among DBMS's. Note that the second percent character in each **LIKE** predicate is a wild-card character that matches zero or more of any character.

```
SELECT NAME FROM DEPT WHERE NAME LIKE '\%AAA%'
   --(*vendor(Microsoft),product(ODBC) escape '\'*)--

SELECT NAME FROM DEPT WHERE NAME LIKE '\%AAA%'
   {escape '\'}

SELECT NAME FROM DEPT WHERE NAME LIKE '\%AAA%'
    ESCAPE '\'
```

To determine whether **LIKE** predicate escape characters are supported by a data source, an application calls **SQLGetInfo** with the SQL_LIKE_ESCAPE_CLAUSE information type.

Outer Joins

ODBC supports the ANSI SQL-92 left outer join syntax. The escape clause ODBC uses for outer joins is:

```
--(*vendor(Microsoft),product(ODBC) oj outer-join *)--
```

where *outer-join* is:

```
table-reference LEFT OUTER JOIN {table-reference |
      outer-join} ON search-condition
```

table-reference specifies a table name, and *search-condition* specifies the join condition between the *table-references*. The shorthand syntax for outer joins is:

```
{oj outer-join}
```

An outer join request must appear after the **FROM** keyword and before the **WHERE** clause (if one exists). See*Appendix C, "SQL Grammar"* for complete syntax information.

For example, each of the following statements creates the same result set of the names and departments of employees working on project 544. The first statement uses the escape clause syntax. The second statement uses the shorthand syntax. The third statement uses the native syntax for Oracle and is not interoperable among DBMS's.

```
SELECT EMPLOYEE.NAME, DEPT.DEPTNAME FROM
   --(*vendor(Microsoft),product(ODBC) oj EMPLOYEE
       LEFT OUTER JOIN DEPT ON
       EMPLOYEE.DEPTID=DEPT.DEPTID*)--
    WHERE EMPLOYEE.PROJID=544

SELECT EMPLOYEE.NAME, DEPT.DEPTNAME FROM
   {oj EMPLOYEE LEFT OUTER JOIN DEPT ON
       EMPLOYEE.DEPTID=DEPT.DEPTID}
    WHERE EMPLOYEE.PROJID=544

SELECT EMPLOYEE.NAME, DEPT.DEPTNAME FROM EMPLOYEE, DEPT
    WHERE (EMPLOYEE.PROJID-544) AND
        (EMPLOYEE.DEPTID = DEPT.DEPTID (+))
```

To determine the level of outer joins a data source supports, an application calls **SQLGetInfo** with the SQL_OUTER_JOINS flag. Data sources can support two-table outer joins, partially support multi-table outer joins, fully support multi-table outer joins, or not support outer joins.

Procedures

An application can call a procedure in place of an SQL statement. The escape clause ODBC uses for calling a procedure is:

```
--(*vendor(Microsoft),product(ODBC)
     [?=] call procedure-name
          [([parameter][,[parameter]]...)] *)--
```

where *procedure-name* specifies the name of a procedure stored on the data source and *parameter* specifies a procedure parameter. A procedure can have zero or more parameters and can return a value. The shorthand syntax for procedure invocation is:

```
{[?=]call procedure-name
     [([parameter][,[parameter]]...)]}
```

For output parameters, *parameter* must be a parameter marker. For input and input/output parameters, *parameter* can be a literal, a parameter marker, or not specified. If *parameter* is a literal or is not specified for an input/output parameter, the driver discards the output value. If *parameter* is not specified for an input or input/output parameter, the procedure uses the default value of the parameter as the input value; the procedure also uses the default value if *parameter* is a parameter marker and the *pcbValue* argument in **SQLBindParameter** is SQL_DEFAULT_PARAM. If a procedure call includes parameter markers (including the "?=" parameter marker for the return value), the application must bind each marker by calling **SQLBindParameter** prior to calling the procedure.

NOTE: For some data sources, *parameter* cannot be a literal value. For all data sources, it can be a parameter marker. For maximum interoperability, applications should always use a parameter marker for *parameter*.

If an application specifies a return value parameter for a procedure that does not return a value, the driver sets the *pcbValue* buffer specified in **SQLBindParameter** for the parameter to SQL_NULL_DATA. If the application omits the return value parameter for a procedure returns a value, the driver ignores the value returned by the procedure.

If a procedure returns a result set, the application retrieves the data in the result set in the same manner as it retrieves data from any other result set.

For example, each of the following statements uses the procedure EMPS_IN_PROJ to create the same result set of names of employees working on a project. The first statement uses the escape clause syntax. The second statement uses the shorthand syntax.

```
--(*vendor(Microsoft),product(ODBC)
   call EMPS_IN_PROJ(?)*)--

{call EMPS_IN_PROJ(?)}
```

To determine if a data source supports procedures, an application calls **SQLGetInfo** with the SQL_PROCEDURES information type.

Additional Extension Functions

ODBC also provides the following functions related to SQL statements. See *Chapter 5, "Function Reference"* for more information about these functions.

Function	Description
SQLDescribeParam	Retrieves information about prepared parameters.
SQLNumParams	Retrieves the number of parameters in an SQL statement.
SQLSetStmtOption SQLSetConnectOption SQLGetStmtOption	These functions set or retrieve statement options, such as asynchronous processing, orientation for binding rowsets, maximum amount of variable length data to return, maximum number of result set rows to return, and query timeout value. Note that **SQLSetConnectOption** sets options for all statements in a connection.

Retrieving Results

A **SELECT** statement is used to retrieve data that meets a given set of specifications. For example, **SELECT * FROM EMPLOYEE WHERE EMPNAME = "Jones"** is used to retrieve all columns of all rows in EMPLOYEE where the employee's name is Jones. ODBC extension functions also can retrieve data. For example, **SQLColumns** retrieves data about columns in the data source. These sets of data, called result sets, can contain zero or more rows.

Note that other SQL statements, such as **GRANT** or **REVOKE**, do not return result sets. For these statements, the return code from **SQLExecute** or **SQLExecDirect** is usually the only source of information as to whether the statement was successful. (For **INSERT**, **UPDATE**, and **DELETE** statements, an application can call **SQLRowCount** to return the number of affected rows.)

The steps an application takes to process a result set depends on what is known about it.

- **Known result set** The application knows the exact form of the SQL statement, and therefore the result set, at compile time. For example, the query **SELECT EMPNO**, **EMPNAME FROM EMPLOYEE** returns two specific columns.
- **Unknown result set** The application does not know the exact form of the SQL statement, and therefore the result set, at compile time. For example, the ad hoc query **SELECT * FROM EMPLOYEE** returns all currently defined columns in the EMPLOYEE table. The application may not be able to predict the format of these results prior to execution.

Assigning Storage for Results (Binding)

An application can assign storage for results before or after it executes an SQL statement. If an application prepares or executes the SQL statement first, it can inquire about the result set before it assigns storage for results. For example, if the result set is unknown, the application must retrieve the number of columns before it can assign storage for them.

To associate storage for a column of data, an application calls **SQLBindCol** and passes it the following information:

- The data type to which the data is to be converted. For more information, see *"Converting Data from SQL to C Data Types" on page D-19*.
- The address of an output buffer for the data. The application must allocate this buffer and it must be large enough to hold the data in the form to which it is converted.
- The length of the output buffer. This value is ignored if the returned data has a fixed width in C, such as an integer, real number, or date structure.
- The address of a storage buffer in which to return the number of bytes of available data.

Determining the Characteristics of a Result Set

To determine the characteristics of a result set, an application can:

- Call **SQLNumResultCols** to determine how many columns a request returned.
- Call **SQLColAttributes** or **SQLDescribeCol** to describe a column in the result set.

If the result set is unknown, an application can use the information returned by these functions to bind the columns in the result set. An application can call these functions at any time after a statement is prepared or executed. Note that, although **SQLRowCount** can sometimes return the number of rows in a result set, it is not guaranteed to do so. Few data sources support this functionality and interoperable applications should not rely on it.

NOTE: For optimal performance, an application should call **SQLColAttributes**, **SQLDescribeCol**, and **SQLNumResultCols** after a statement is executed. In data sources that emulate statement preparation, these functions sometimes execute more slowly before a statement is executed because the information returned by them is not readily available until after the statement is executed.

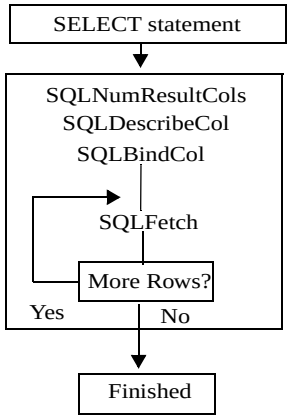
Fetching Result Data

To retrieve a row of data from the result set, an application:

1. Calls **SQLBindCol** to bind the columns of the result set to storage locations if it has not already done so.

2. Calls **SQLFetch** to move to the next row in the result set and retrieve data for all bound columns.

The following diagram shows the operations an application uses to retrieve data from the result set:



Using Cursors

To keep track of its position in the result set, a driver maintains a cursor. The cursor is so named because it indicates the current position in the result set, just as the cursor on a CRT screen indicates current position.

Each time an application calls **SQLFetch**, the driver moves the cursor to the next row and returns that row. The cursor supported by the core ODBC functions only scrolls forward, one row at a time. (To reretrieve a row of data that it has already retrieved from the result set, the application must close the cursor by calling **SQLFreeStmt** with the SQL_CLOSE option, reexecute the **SELECT** statement, and fetch rows with **SQLFetch** until the target row is retrieved.)

IMPORTANT: Committing or rolling back a transaction, either by calling **SQLTransact** or by using the SQL_AUTOCOMMIT connection option, can cause the data source to close the cursors for all *hstmts* on an *hdbc*. For more information, see the SQL_CURSOR_COMMIT_BEHAVIOR and SQL_CURSOR_ROLLBACK_BEHAVIOR information types in **SQLGetInfo**.

ODBC Extensions for Results

ODBC extends the X/Open and SQL Access Group Call Level Interface to provide additional functions related to retrieving results. The remainder of this chapter describes these

functions. To determine if a driver supports a specific function, an application calls **SQLGetFunctions**.

Retrieving Data from Unbound Columns

To retrieve data from unbound columns – that is, columns for which storage has not been assigned with **SQLBindCol** – an application uses **SQLGetData**. The application first calls **SQLFetch** or **SQLExtendedFetch** to position the cursor on the next row. It then calls **SQLGetData** to retrieve data from specific unbound columns.

An application may retrieve data from both bound and unbound columns in the same row. It calls **SQLBindCol** to bind as many columns as desired. It calls **SQLFetch** or **SQLExtendedFetch** to position the cursor on the next row of the result set and retrieve all bound columns. It then calls **SQLGetData** to retrieve data from unbound columns.

If the data type of a column is character, binary, or data source–specific and the column contains more data than can be retrieved in a single call, an application may call **SQLGetData** more than once for that column, as long as the data is being transferred to a buffer of type SQL_C_CHAR or SQL_C_BINARY. For example, data of the SQL_LONGVARBINARY and SQL_LONGVARCHAR types may need to be retrieved in several parts.

For maximum interoperability, an application should only call **SQLGetData** for columns to the right of the rightmost bound column and then only in left-to-right order. To determine if a driver can return data with **SQLGetData** for any column (including unbound columns before the last bound column and any bound columns) or in any order, an application calls **SQLGetInfo** with the SQL_GETDATA_EXTENSIONS option.

Assigning Storage for Rowsets (Binding)

In addition to binding individual rows of data, an application can call **SQLBindCol** to assign storage for a *rowset* (one or more rows of data). By default, rowsets are bound in column-wise fashion. They can also be bound in row-wise fashion.

To specify how many rows of data are in a rowset, an application calls **SQLSetStmtOption** with the SQL_ROWSET_SIZE option.

Column-Wise Binding

To assign storage for column-wise bound results, an application performs the following steps for each column to be bound:

1. Allocates an array of data storage buffers. The array has as many elements as there are rows in the rowset.
2. Allocates an array of storage buffers to hold the number of bytes available to return for each data value. The array has as many elements as there are rows in the rowset.

3. Calls **SQLBindCol** and specifies the address of the data array, the size of one element of the data array, the address of the number-of-bytes array, and the type to which the data will be converted. When data is retrieved, the driver will use the array element size to determine where to store successive rows of data in the array.

Row-Wise Binding

To assign storage for row-wise bound results, an application performs the following steps:

1. Declares a structure that can hold a single row of retrieved data and the associated data lengths. (For each column to be bound, the structure contains one field to contain data and one field to contain the number of bytes of data available to return.)
2. Allocates an array of these structures. This array has as many elements as there are rows in the rowset.
3. Calls **SQLBindCol** for each column to be bound. In each call, the application specifies the address of the column's data field in the first array element, the size of the data field, the address of the column's number-of-bytes field in the first array element, and the type to which the data will be converted.
4. Calls **SQLSetStmtOption** with the SQL_BIND_TYPE option and specifies the size of the structure. When the data is retrieved, the driver will use the structure size to determine where to store successive rows of data in the array.

Retrieving Rowset Data

Before it retrieves rowset data, an application calls **SQLSetStmtOption** with the SQL_ROWSET_SIZE option to specify the number of rows in the rowset. It then binds columns in the rowset with **SQLBindCol**. The rowset may be bound in column-wise or row-wise fashion. For more information, read *"Assigning Storage for Rowsets (Binding)"* in the previous section.

To retrieve rowset data, an application calls **SQLExtendedFetch**. SOLID *SQL API* does not support **SQLExtendedFetch**. The functionality is available through ODBC Driver Manager.

For maximum interoperability, an application should not use **SQLGetData** to retrieve data from unbound columns in a block (more than one row) of data that has been retrieved with **SQLExtendedFetch**. To determine if a driver can return data with **SQLGetData** from a block of data, an application calls **SQLGetInfo** with the SQL_GETDATA_EXTENSIONS option.

Using Block and Scrollable Cursors

As originally designed, cursors in SQL only scroll forward through a result set, returning one row at a time. However, interactive applications often require forward and backward scrolling, absolute or relative positioning within the result set, and the ability to retrieve and update blocks of data, or *rowsets*.

To retrieve and update rowset data, ODBC provides a *block* cursor attribute. To allow an application to scroll forwards or backwards through the result set, or move to an absolute or relative position in the result set, ODBC provides a *scrollable* cursor attribute. Cursors may have one or both attributes.

Block Cursors

An application calls **SQLSetStmtOption** with the SQL_ROWSET_SIZE option to specify the rowset size. The application can call **SQLSetStmtOption** to change the rowset size at any time. Each time the application calls **SQLExtendedFetch**, the driver returns the next *rowset size* rows of data. After the data is returned, the cursor points to the first row in the rowset. By default, the rowset size is one.

Scrollable Cursors

Applications have different needs in their ability to sense changes in the tables underlying a result set. For example, when balancing financial data, an accountant needs data that appears static; it is impossible to balance books when the data is continually changing. When selling concert tickets, a clerk needs up-to-the minute, or dynamic, data on which tickets are still available. Various cursor models are designed to meet these needs, each of which requires different sensitivities to changes in the tables underlying the result set.

Static Cursors

At one extreme are *static* cursors, to which the data in the underlying tables appears to be static. The membership, order, and values in the result set used by a static cursor are generally fixed when the cursor is opened. Rows updated, deleted, or inserted by other users (including other cursors in the same application) are not detected by the cursor until it is closed and then reopened; the SQL_STATIC_SENSITIVITY information type returns whether the cursor can detect rows it has updated, deleted, or inserted.

Static cursors are commonly implemented by taking a snapshot of the data or locking the result set. Note that in the former case, the cursor diverges from the underlying tables as other users make changes; in the latter case, other users are prohibited from changing the data.

Dynamic Cursors

At the other extreme are *dynamic* cursors, to which the data appears to be dynamic. The membership, order, and values in the result set used by a dynamic cursor are ever-changing. Rows updated, deleted, or inserted by all users (the cursor, other cursors in the same application, and other applications) are detected by the cursor when data is next fetched. Although ideal for many situations, dynamic cursors are difficult to implement.

Keyset-Driven Cursors

Between static and dynamic cursors are *keyset-driven* cursors, which have some of the attributes of each. Like static cursors, the membership and ordering of the result set of a keyset-driven cursor is generally fixed when the cursor is opened. Like dynamic cursors, most changes to the values in the underlying result set are visible to the cursor when data is next fetched.

When a keyset-driven cursor is opened, the driver saves the keys for the entire result set, thus fixing the membership and order of the result set. As the cursor scrolls through the result set, the driver uses the keys in this *keyset* to retrieve the current data values for each row in the rowset. Because data values are retrieved only when the cursor scrolls to a given row, updates to that row by other users (including other cursors in the same application) after the cursor was opened are visible to the cursor.

If the cursor scrolls to a row of data that has been deleted by other users (including other cursors in the same application), the row appears as a *hole* in the result set, since the key is still in the keyset but the row is no longer in the result set. Updating the key values in a row is considered to be deleting the existing row and inserting a new row; therefore, rows of data for which the key values have been changed also appear as holes. When the driver encounters a hole in the result set, it returns a status code of SQL_ROW_DELETED for the row.

Rows of data inserted into the result set by other users (including other cursors in the same application) after the cursor was opened are not visible to the cursor, since the keys for those rows are not in the keyset.

The SQL_STATIC_SENSITIVITY information type returns whether the cursor can detect rows it has deleted or inserted. Because updating key values in a keyset-driven cursor is considered to be deleting the existing row and inserting a new row, keyset-driven cursors can always detect rows they have updated.

Mixed (Keyset/Dynamic) Cursors

If a result set is large, it may be impractical for the driver to save the keys for the entire result set. Instead, the application can use a *mixed* cursor. In a mixed cursor, the keyset is smaller than the result set, but larger than the rowset.

Within the boundaries of the keyset, a mixed cursor is keyset-driven, that is, the driver uses keys to retrieve the current data values for each row in the rowset. When a mixed cursor scrolls beyond the boundaries of the keyset, it becomes dynamic, that is, the driver simply retrieves the next *rowset size* rows of data. The driver then constructs a new keyset, which contains the new rowset.

For example, assume a result set has 1000 rows and uses a mixed cursor with a keyset size of 100 and a rowset size of 10. When the cursor is opened, the driver (depending on the implementation) saves keys for the first 100 rows and retrieves data for the first 10 rows. If another user deletes row 11 and the cursor then scrolls to row 11, the cursor will detect a hole in the result set; the key for row 11 is in the keyset but the data is no longer in the result set. This is the same behavior as a keyset-driven cursor. However, if another user deletes row 101 and the cursor then scrolls to row 101, the cursor will not detect a hole; the key for the row 101 is not in the keyset. Instead, the cursor will retrieve the data for the row that was originally row 102. This is the same behavior as a dynamic cursor.

Specifying the Cursor Type

To specify the cursor type, an application calls **SQLSetStmtOption** with the SQL_CURSOR_TYPE option. The application can specify a cursor that only scrolls forward, a static cursor, a dynamic cursor, a keyset-driven cursor, or a mixed cursor. If the application specifies a mixed cursor, it also specifies the size of the keyset used by the cursor.

NOTE: To use the ODBC cursor library, an application calls **SQLSetConnectOption** with the SQL_ODBC_CURSORS option before it connects to the data source. The cursor library supports block scrollable cursors. It also supports positioned update and delete statements.

Unless the cursor is a forward-only cursor, an application calls **SQLExtendedFetch** to scroll the cursor backwards, forwards, or to an absolute or relative position in the result set. The application calls **SQLSetPos** to refresh the row currently pointed to by the cursor.

Specifying Cursor Concurrency

Concurrency is the ability of more than one user to use the same data at the same time. A transaction is *serializable* if it is performed in a manner in which it appears as if no other transactions operate on the same data at the same time. For example, assume one transaction doubles data values and another adds 1 to data values. If the transactions are serializable and both attempt to operate on the values 0 and 10 at the same time, the final values will be 1 and 21 or 2 and 22, depending on which transaction is performed first. If the transactions are not serializable, the final values will be 1 and 21, 2 and 22, 1 and 22, or 2 and 21; the sets of values 1 and 22, and 2 and 21, are the result of the transactions acting on each value in a different order.

Serializability is considered necessary to maintain database integrity. For cursors, it is most easily implemented at the expense of concurrency by locking the result set. A compromise between serializability and concurrency is *optimistic concurrency control*. In a cursor using optimistic concurrency control, the driver does not lock rows when it retrieves them. When the application requests an update or delete operation, the driver or data source checks if the row has changed. If the row has not changed, the driver or data source prevents other transactions from changing the row until the operation is complete. If the row has changed, the transaction containing the update or delete operation fails.

To specify the concurrency used by a cursor, an application calls **SQLSetStmtOption** with the SQL_CONCURRENCY option. The application can specify that the cursor is read-only, locks the result set, uses optimistic concurrency control and compares row versions to determine if a row has changed, or uses optimistic concurrency control and compares data values to determine if a row has changed. The application calls **SQLSetPos** to lock the row currently pointed to by the cursor, regardless of the specified cursor concurrency.

Using Bookmarks

A bookmark is a 32-bit value that an application uses to return to a row. The application does not request that the driver places a bookmark on a row; instead, the application requests a bookmark that it can use to return to a row. For example, if a bookmark is a row number, an application requests the row number of a row and stores it. Later, the application passes this row number back to the driver and requests that the driver return to the row.

Before opening the cursor, an application must call **SQLSetStmtOption** with the SQL_USE_BOOKMARKS option to inform the driver it will use bookmarks. After opening the cursor, the application retrieves bookmarks either from column 0 of the result set or by calling **SQLGetStmtOption** with the SQL_GET_BOOKMARK option. To retrieve a bookmark from the result set, the application either binds column 0 and calls **SQLExtendedFetch** or calls **SQLGetData**; in either case, the *fCType* argument must be set to SQL_C_BOOKMARK. To return to the row specified by a bookmark, the application calls **SQLExtendedFetch** with a fetch type of SQL_FETCH_BOOKMARK.

If a bookmark requires more than 32 bits, such as when it is a key value, the driver maps the bookmarks requested by the application to 32-bit binary values. The 32-bit binary values are then returned to the application. Because this mapping may require considerable memory, applications should only bind column 0 of the result set if they will actually use bookmarks for most rows. Otherwise, they should call **SQLGetStmtOption** with the SQL_BOOKMARK statement option or call **SQLGetData** for column 0.

Before an application opens a cursor with which it will use bookmarks, it:

- Calls **SQLSetStmtOption** with the SQL_USE_BOOKMARKS option and a value of SQL_UB_ON.

To retrieve a bookmark for the current row, an application:

- Retrieves the value from column 0 of the rowset. The application can either call **SQLBindCol** to bind column 0 before it calls **SQLExtendedFetch** or call **SQLGetData** to retrieve the data after it calls **SQLExtendedFetch**. In either case, the *fCType* argument must be SQL_C_BOOKMARK.

  NOTE: To determine whether it can call **SQLGetData** for a block (more than one row) of data and whether it can call **SQLGetData** for a column before the last bound column, an application calls **SQLGetInfo** with the SQL_GETDATA_EXTENSIONS information type.

  – Or –

  Calls **SQLSetPos** with the SQL_POSITION option to position the cursor on the row and calls **SQLGetStmtOption** with the SQL_BOOKMARK option to retrieve the bookmark.

To return to the row specified by a bookmark (or a row a certain number of rows from the bookmark), an application:

- Calls **SQLExtendedFetch** with the *irow* argument set to the bookmark and the *fFetchType* argument set to SQL_FETCH_BOOKMARK. The driver returns the rowset starting with the row identified by the bookmark.

Modifying Result Set Data

ODBC provides two ways to modify data in the result set. Positioned update and delete statements are similar to such statements in embedded SQL. Calls to **SQLSetPos** allow an application to update, delete, or add new data without executing SQL statements.

Executing Positioned Update and Delete Statements

An application can update or delete the row in the result set currently pointed to by the cursor. This is known as a positioned update or delete statement. After executing a **SELECT** statement to create a result set, an application calls **SQLFetch** one or more times to position the cursor on the row to be updated or deleted. Alternatively, it fetches the rowset with **SQLExtendedFetch** and positions the cursor on the desired row by calling **SQLSetPos** with the SQL_POSITION option. To update or delete the row, the application then executes an SQL statement with the following syntax on a different *hstmt*:

```
UPDATE table-name
SET Column-identifier = {expression | NULL}
[, column-identifier = {expression | NULL}]...
WHERE CURRENT OF cursor-name
```

DELETE FROM *table-name* **WHERE CURRENT OF** *cursor-name*

Positioned update and delete statements require cursor names. An application can name a cursor with **SQLSetCursorName**. If the application has not named the cursor by the time the driver executes a **SELECT** statement, the driver generates a cursor name. To retrieve the cursor name for an *hstmt*, an application calls **SQLGetCursorName**.

To execute a positioned update or delete statement, an application must follow these guidelines:

- The **SELECT** statement that creates the result set must use a **FOR UPDATE** clause.
- The cursor name used in the **UPDATE** or **DELETE** statement must be the same as the cursor name associated with the **SELECT** statement.
- The application must use different *hstmts* for the **SELECT** statement and the **UPDATE** or **DELETE** statement.
- The *hstmts* for the **SELECT** statement and the **UPDATE** or **DELETE** statement must be on the same connection.

To determine if a data source supports positioned update and delete statements, an application calls **SQLGetInfo** with the SQL_POSITIONED_STATEMENTS option. For an example of code that performs a positioned update in a rowset, see "*SQLSetPos (ODBC 1.0, Level 2)*" in Chapter 5, "Function Reference."

NOTE: In ODBC 1.0, positioned update, positioned delete, and **SELECT FOR UPDATE** statements were part of the core SQL grammar; in ODBC 2.0, they are part of the extended grammar. Applications that use the SQL conformance level to determine whether these statements are supported also need to check the version number of the driver to correctly interpret the information. In particular, applications that use these features with ODBC 1.0 drivers need to explicitly check for these capabilities in ODBC 2.0 drivers.

Modifying Data with SQLSetPos

To add, update, and delete rows of data, an application calls **SQLSetPos** and specifies the operation, the row number, and how to lock the row. Where new rows of data are added to the result set, and whether they are visible to the cursor is data source–defined.

The row number determines both the number of the row in the rowset to update or delete and the index of the row in the rowset buffers from which to retrieve data to add or update. If the row number is 0, the operation affects all of the rows in the rowset.

SQLSetPos retrieves the data to update or add from the rowset buffers. It only updates those columns in a row that have been bound with **SQLBindCol** and do not have a length of

SQL_IGNORE. However, it cannot add a new row of data unless all of the columns in the row are bound, are nullable, or have a default value.

To add a new row of data to the result set, an application:

1. Places the data for each column the *rgbValue* buffers specified with **SQLBindCol**. To avoid overwriting an existing row of data, the application should allocate an extra row of the rowset buffers to use as an add buffer.

2. Places the length of each column in the *pcbValue* buffer specified with **SQLBindCol;** this only needs to be done for columns with an *fCType* of SQL_C_CHAR or SQL_C_BINARY. To use the default value for a column, the application specifies a length of SQL_IGNORE.

   NOTE: To add a new row of data to a result set, one of the following two conditions must be met:

   - All columns in the underlying tables must be bound with **SQLBindCol**.
   - All unbound columns and all bound columns for

     which the specified length is SQL_IGNORE must accept NULL values or have default values.

   To determine if a row in a result set accepts NULL values, an application calls **SQLColAttributes**. To determine if a data source supports non-nullable columns, an application calls **SQLGetInfo** with the SQL_NON_NULLABLE flag.

3. Calls **SQLSetPos** with the *fOption* argument set to SQL_ADD. The *irow* argument determines the row in the rowset buffers from which the data is retrieved. For information about how an application sends data for data-at-execution columns, see "*SQLSetPos (ODBC 1.0, Level 2)"* in Chapter 5, "Function Reference."

   After the row is added, the row the cursor points to is unchanged.

   NOTE: Columns for long data types, such as SQL_LONGVARCHAR and SQL_LONGVARBINARY, are generally not bound. However, if an application uses **SQLSetPos** to send data for these columns, it must bind them with **SQLBindCol**. Unless the driver returns the SQL_GD_BOUND bit for the SQL_GETDATA_EXTENSIONS information type, the application must unbind them before calling **SQLGetData** to retrieve data from them.

To update a row of data, an application:

1. Modifies the data of each column to be updated in the *rgbValue* buffer specified with **SQLBindCol**.

2. Places the length of each column to be updated in the *pcbValue* buffer specified with **SQLBindCol**. This only needs to be done for columns with an *fCType* of SQL_C_CHAR or SQL_C_BINARY.
3. Sets the value of the *pcbValue* buffer for each bound column that is not to be updated to SQL_IGNORE.
4. Calls **SQLSetPos** with the *fOption* argument set to SQL_UPDATE. The *irow* argument specifies the number of the row in the rowset to modify and the index of row in the rowset buffer from which to retrieve the data. The cursor points to this row after it is updated.

For information about how an application sends data for data-at-execution columns, "*SQLSetPos (ODBC 1.0, Level 2)"* in Chapter 5, "Function Reference."

To delete a row of data, an application:

- Calls **SQLSetPos** with the *fOption* argument set to SQL_DELETE. The *irow* argument specifies the number of the row in the rowset to delete. The cursor points to this row after it is deleted.

  NOTE: The application cannot perform any positioned operations, such as executing a positioned update or delete statement or calling **SQLGetData**, on a deleted row.

To determine what operations a data source supports for **SQLSetPos**, an application calls **SQLGetInfo** with the SQL_POS_OPERATIONS flag.

The protocol describes:

- Use of the error text to identify the source of an error.
- Rules to ensure consistent and useful error information.
- Responsibility for setting the ODBC SQLSTATE based on the native error.

Function Return Codes

When an application calls an ODBC function, the driver executes the function and returns a predefined code. These return codes indicate success, warning, or failure status. The following table defines the return codes.

Return Code	Description
SQL_SUCCESS	Function completed successfully; no additional information is available.
SQL_SUCCESS_WITH_INFO	Function completed successfully, possibly with a non-fatal error. The application can call **SQLError** to retrieve additional information.
SQL_NO_DATA_FOUND	All rows from the result set have been fetched.
SQL_ERROR	Function failed. The application can call **SQLError** to retrieve error information.
SQL_INVALID_HANDLE	Function failed due to an invalid environment handle, connection handle, or statement handle. This indicates a programming error. No additional information is available from **SQLError**.
SQL_STILL_EXECUTING	A function that was started asynchronously is still executing.
SQL_NEED_DATA	While processing a statement, the driver determined that the application needs to send parameter data values.

The application is responsible for taking the appropriate action based on the return code.

Retrieving Error Messages

If an ODBC function other than **SQLError** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an application can call **SQLError** to obtain additional information. The application may need to call **SQLError** more than once to retrieve all the error messages from a function, since a function may return more than one error message. When the application calls a different function, the error messages from the previous function are deleted.

Additional error or status information can come from one of two sources:

- Error or status information from an ODBC function, indicating that a programming error was detected.
- Error or status information from the data source, indicating that an error occurred during SQL statement processing.

The information returned by **SQLError** is in the same format as that provided by SQL-STATE in the X/Open and SQL Access Group SQL CAE specification (1992). Note that **SQLError** never returns error information about itself.

ODBC Error Messages

ODBC defines a layered architecture to connect an application to a data source. At its simplest, an ODBC connection requires two components: the Driver Manager and a driver.

A more complex connection might include more components: the Driver Manager, a number of drivers, and a (possibly different) number of DBMS's. The connection might cross computing platforms and operating systems and use a variety of networking protocols.

As the complexity of an ODBC connection increases, so does the importance of providing consistent and complete error messages to the application, its users, and support personnel. Error messages must not only explain the error, but also provide the identity of the component in which it occurred. The identity of the component is particularly important to support personnel when an application uses ODBC components from more than one vendor. Because **SQLError** does not return the identity of the component in which the error occurred, this information must be embedded in the error text.

Error Text Format

Error messages returned by **SQLError** come from two sources: data sources and components in an ODBC connection. Typically, data sources do not directly support ODBC. Consequently, if a component in an ODBC connection receives an error message from a data source, it must identify the data source as the source of the error. It must also identify itself as the component that received the error.

If the source of an error is the component itself, the error message must explain this. Therefore, the error text returned by **SQLError** has two different formats: one for errors that occur in a data source and one for errors that occur in other components in an ODBC connection.

For errors that do not occur in a data source, the error text must use the format:

```
[vendor-identifier][ODBC-component-identifier]

component-supplied-text
```

For errors that occur in a data source, the error text must use the format:

```
[vendor-identifier][ODBC-component-identifier]

[data-source-identifier] data-source-supplied-text
```

The following table shows the meaning of each element.

Element	Meaning
vendor-identifier	Identifies the vendor of the component in which the error occurred or that received the error directly from the data source.
ODBC-component-identifier	Identifies the component in which the error occurred or that received the error directly from the data source.
data-source-identifier	Identifies the data source. For single-tier drivers, this is typically a file format. For multiple-tier drivers, this is the DBMS product.
component-supplied-text	Generated by the ODBC component.
data-source-supplied-text	Generated by the data source.

1 In this case, the driver is acting as both the driver and the data source.

Note that the brackets (**[ ]**) are included in the error text; they do not indicate optional items.

Sample Error Messages

The following are examples of how various components in an ODBC connection might generate the text of error messages and how various drivers might return them to the application with **SQLError**. Note that these examples do not represent actual implementations of the error handling protocol. For more information on how an individual driver has implemented the protocol, see the documentation for that driver.

Single-Tier Driver

A single-tier driver acts both as an ODBC driver and as a data source. It can therefore generate errors both as a component in an ODBC connection and as a data source. Because it also is the component that interfaces with the Driver Manager, it formats and returns arguments for **SQLError**.

For example, if a Microsoft driver for dBASE® could not allocate sufficient memory, it might return the following arguments for **SQLError**:

```
szSQLState = "S1001"
pfNativeError = NULL
szErrorMsg = "[Microsoft][ODBC dBASE Driver]Unable to
        allocate sufficient memory."
pcbErrorMsg = 67
```

Because this error was not related to the data source, the driver only added prefixes to the error text for the vendor ([Microsoft]) and the driver ([ODBC dBASE Driver]).

If the driver could not find the file EMPLOYEE.DBF, it might return the following arguments for **SQLError**:

```
szSQLState = "S0002"
pfNativeError = NULL
szErrorMsg = "[Microsoft][ODBC dBASE Driver][dBASE]
        Invalid file name;file EMPLOYEE.DBF not found."
pcbErrorMsg = 83
```

Because this error was related to the data source, the driver added the file format of the data source ([dBASE]) as a prefix to the error text. Because the driver was also the component that interfaced with the data source, it added prefixes for the vendor ([Microsoft]) and the driver ([ODBC dBASE Driver]).

Multiple-Tier Driver

A multiple-tier driver sends requests to a DBMS and returns information to the application through the Driver Manager. Because it is the component that interfaces with the Driver Manager, it formats and returns arguments for **SQLError**.

For example, if a Microsoft driver for DEC's Rdb using SQL/Services encountered a duplicate cursor name, it might return the following arguments for **SQLError**:

```
szSQLState = "3C000"
pfNativeError = NULL
szErrorMsg = "[Microsoft][ODBC Rdb Driver]
        Duplicate cursor name:EMPLOYEE_CURSOR."
pcbErrorMsg = 67
```

Because the error occurred in the driver, it added prefixes to the error text for the vendor ([Microsoft]) and the driver ([ODBC Rdb Driver]).

If the DBMS could not find the table EMPLOYEE, the driver might format and return the following arguments for **SQLError**:

```
szSQLState = "S0002"
pfNativeError = -1
szErrorMsg = "[Microsoft][ODBC RDB Driver][RDB]
        %SQL-F-RELNOTDEF, Table EMPLOYEE is not defined in schema."
pcbErrorMsg = 92
```

Because the error occurred in the data source, the driver added a prefix for the data source identifier ([Rdb]) to the error text. Because the driver was the component that interfaced with the data source, it added prefixes for its vendor ([Microsoft]) and identifier ([ODBC Rdb Driver]) to the error text.

Gateways

In a gateway architecture, a driver sends requests to a gateway that supports ODBC. The gateway sends the requests to a DBMS. Because it is the component that interfaces with the Driver Manager, the driver formats and returns arguments for **SQLError**.

For example, if DEC based a gateway to Rdb on Microsoft Open Data Services, and Rdb could not find the table EMPLOYEE, the gateway might generate the following error text:

```
"[S0002][-1][DEC][ODS Gateway][SOLID]%SQL-F-RELNOTDEF,
  Table EMPLOYEE is not defined in schema."
```

Because the error occurred in the data source, the gateway added a prefix for the data source identifier ([Rdb]) to the error text. Because the gateway was the component that interfaced with the data source, it added prefixes for its vendor ([DEC]) and identifier ([ODS Gateway]) to the error text. Note that it also added the SQLSTATE value and the Rdb error code to the beginning of the error text. This permitted it to preserve the semantics of its own message structure and still supply the ODBC error information to the driver.

Because the gateway driver is the component that interfaces with the Driver Manager, it would use the preceding error text to format and return the following arguments for **SQLError**:

```
szSQLState = "S0002"
pfNativeError = -1
szErrorMsg = "[DEC][ODS Gateway][RDB]%SQL-F-RELNOTDEF,
        Table EMPLOYEE is not defined in schema."
pcbErrorMsg = 81
```

Driver Manager

The Driver Manager can also generate error messages. For example, if an application passed an invalid argument value to **SQLDataSources**, the Driver Manager might format and return the following arguments for **SQLError**:

```
szSQLState = "S1009"
pfNativeError = NULL
szErrorMsg = "[Microsoft][ODBC DLL]Invalid argument
        value: SQLDataSources."
pcbErrorMsg = 60
```

Because the error occurred in the Driver Manager, it added prefixes to the error text for its vendor ([Microsoft]) and its identifier ([ODBC DLL]).

Processing Error Messages

Applications should provide users with all the error information available through **SQLError**: the ODBC SQLSTATE, the native error code, the error text, and the source of the error. The application may parse the error text to separate the text from the information identifying the source of the error. It is the application's responsibility to take appropriate action based on the error or provide the user with a choice of actions.

The ODBC interface provides functions that terminate statements, transactions, and connections, and free statement (*hstmt*), connection (*hdbc*), and environment (*henv*) handles.

Terminating Transactions and Connections

The ODBC interface provides functions that terminate statements, transactions, and connections, and free statement (*hstmt*), connection (*hdbc*), and environment (*henv*) handles.

Terminating Statement Processing

To free resources associated with a statement handle, an application calls **SQLFreeStmt**. The **SQLFreeStmt** function has four options:

- **SQL_CLOSE** Closes the cursor, if one exists, and discards pending results. The application can use the statement handle again later.
- **SQL_DROP** Closes the cursor if one exists, discards pending results, and frees all resources associated with the statement handle.
- **SQL_UNBIND** Frees all return buffers bound by **SQLBindCol** for the statement handle.
- **SQL_RESET_PARAMS** Frees all parameter buffers requested by **SQLBindParameter** for the statement handle.

To cancel a statement that is executing asynchronously, an application:

- Calls **SQLCancel**. When and if the statement is actually canceled is driver- and data source–dependent.
- Calls the function that was executing the statement asynchronously. If the statement is still executing, the function returns SQL_STILL_EXECUTING; if it was successfully canceled, the function returns SQL_ERROR and SQLSTATE S1008 (Operation canceled); if it completed normal execution, the function returns any valid return code, such as SQL_SUCCESS or SQL_ERROR.

- Calls **SQLError** if the function returned SQL_ERROR. If the driver successfully canceled the function, the SQLSTATE will be S1008 (Operation canceled).

Terminating Transactions

An application calls **SQLTransact** to commit or roll back the current transaction.

Terminating Connections

To terminate a connection to a driver and data source, an application performs the following steps:

1. Calls **SQLDisconnect** to close the connection. The application can then use the handle to reconnect to the same data source or to a different data source.
2. Calls **SQLFreeConnect** to free the connection handle and free all resources associated with the handle.
3. Calls **SQLFreeEnv** to free the environment handle and free all resources associated with the handle.

Constructing an Application

This section provides two examples of C-language source code for applications. For developers, a summary of development, debugging, installation, and administration tools provided by the ODBC SDK 2.0 is included.

Sample Application Code

The following sections contain two examples that are written in the C programming language:

- An example that uses static SQL functions to create a table, add data to it, and select the inserted data.
- An example of interactive, ad-hoc query processing.

These examples can use either ODBC header files or SOLID *SQL API* header files.

Static SQL Example

The following example constructs SQL statements within the application. The example comments include equivalent embedded SQL calls for illustrative purposes.

```
#ifdef SOLIDSQLAPI
#include "CLI0DEFS.H"
```

```
#include "CLI0CORE.H"
#include "CLI0EXT1.H"
#else
#include "SQL.H"
#include "SQLEXT.H"
#endif

#include <string.h>

#ifndef NULL
#define NULL 0
#endif

#define MAX_NAME_LEN 50
#define MAX_STMT_LEN 100

int print_err(HDBC hdbc, HSTMT hstmt);

int example1(server, uid, pwd)
UCHAR * server;
UCHAR * uid;
UCHAR * pwd;
{
HENV   henv;
HDBC   hdbc;
HSTMT  hstmt;

SDWORD  id;
UCHAR   name[MAX_NAME_LEN + 1];
UCHAR   create[MAX_STMT_LEN]
UCHAR   insert[MAX_STMT_LEN]
UCHAR   select[MAX_STMT_LEN]
SDWORD  namelen;

RETCODE rc;
/* EXEC SQL CONNECT TO :server USER :uid USING :pwd; */
/* Allocate an environment handle. */
/* Allocate a connection handle. */
/* Connect to a data source. */
/* Allocate a statement handle. */

SQLAllocEnv(&henv);
SQLAllocConnect(henv, &hdbc);
rc = SQLConnect(hdbc, server, SQL_NTS, uid, SQL_NTS,
      pwd, SQL_NTS);
```

```
if (rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO)
      return(print_err(hdbc, SQL_NULL_HSTMT));
SQLAllocStmt(hdbc, &hstmt);

/* EXEC SQL CREATE TABLE NAMEID       */
/*    (ID integer, NAME varchar(50)); */
/* Execute the SQL statement. */

lstrcpy(create, "CREATE TABLE NAMEID (ID INTEGER, NAME
      VARCHAR(50))");
rc = SQLExecDirect(hstmt, create, SQL_NTS);
if (rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO)
      return(print_err(hdbc, hstmt));

/* EXEC SQL COMMIT WORK;      */
/* Commit the table creation. */

/* Note that the default transaction mode for drivers */
/* that support SQLSetConnectOption is auto-commit    */
/* and SQLTransact has no effect. */

SQLTransact(hdbc, SQL_COMMIT);

/* EXEC SQL INSERT INTO NAMEID VALUES ( :id, :name ); */
/* Show the use of the SQLPrepare/SQLExecute method:  */
/* Prepare the insertion and bind parameters. */
/* Assign parameter values. */
/* Execute the insertion. */
lstrcpy(insert, "INSERT INTO NAMEID VALUES (?, ?)");
if (SQLPrepare(hstmt, insert, SQL_NTS) != SQL_SUCCESS)
      return(print_err(hdbc, hstmt));
SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
      SQL_INTEGER, 0, 0, &id, 0, NULL);
SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR,
      SQL_VARCHAR, MAX_NAME_LEN, 0, name, 0, NULL);
id=500;
lstrcpy(name, "Babbage");
if (SQLExecute(hstmt) != SQL_SUCCESS)
      return(print_err(hdbc, hstmt));

/* EXEC SQL COMMIT WORK; */
/* Commit the insertion. */

SQLTransact(hdbc, SQL_COMMIT);
```

```
/* EXEC SQL DECLARE c1 CURSOR FOR */
/* SELECT ID, NAME FROM NAMEID;   */
/* EXEC SQL OPEN c1; */
/* Show the use of the SQLExecDirect method. */
/* Execute the selection. */
/* Note that the application does not declare a cursor.
*/

lstrcpy(select, "SELECT ID, NAME FROM NAMEID");
if (SQLExecDirect(hstmt, select, SQL_NTS) !=
      SQL_SUCCESS)
      return(print_err(hdbc, hstmt));

/* EXEC SQL FETCH c1 INTO :id, :name; */
/* Bind the columns of the result set */
/* with SQLBindCol.     */
/* Fetch the first row. */

SQLBindCol(hstmt, 1, SQL_C_SLONG, &id, 0, NULL);
SQLBindCol(hstmt, 2, SQL_C_CHAR, name,
  (SDWORD)sizeof(name), &namelen);
SQLFetch(hstmt);

/* EXEC SQL COMMIT WORK;   */
/* Commit the transaction. */

SQLTransact(hdbc, SQL_COMMIT);

/* EXEC SQL CLOSE c1;         */
/* Free the statement handle. */

SQLFreeStmt(hstmt, SQL_DROP);

/* EXEC SQL DISCONNECT;             */
/* Disconnect from the data source. */
/* Free the connection handle.      */
/* Free the environment handle.     */

SQLDisconnect(hdbc);
SQLFreeConnect(hdbc);
SQLFreeEnv(henv);

return(0);
```

```
}
```

Interactive Ad Hoc Query Example

The following example illustrates how an application can determine the nature of the result set prior to retrieving results.

```
#ifdef SOLIDSQLAPI
#include "CLI0DEFS.H"
#include "CLI0CORE.H"
#include "CLI0EXT1.H"
#else
#include "SQL.H"
#include "SQLEXT.H"
#endif
#include <string.h>
#include <stdlib.h>

#define MAXCOLS 100
#define max(a,b) (a>b?a:b)

int    print_err(HDBC hdbc, HSTMT hstmt);
UDWORD display_size(SWORD coltype, UDWORD collen, UCHAR *colname);

example2(server, uid, pwd, sqlstr)
UCHAR * server;
UCHAR * uid;
UCHAR * pwd;
UCHAR * sqlstr;
{
int     i;
HENV    henv;
HDBC    hdbc;
HSTMT   hstmt;
UCHAR   errmsg[256];
UCHAR   colname[32];
SWORD   coltype;
SWORD   colnamelen;
SWORD   nullable;
UDWORD  collen[MAXCOLS];
SWORD   scale;
SDWORD  outlen[MAXCOLS];
UCHAR * data[MAXCOLS];
SWORD   nresultcols;
SDWORD  rowcount;
```

```
RETCODE rc;

/* Allocate environment and connection handles. */
/* Connect to the data source. */
/* Allocate a statement handle. */
SQLAllocEnv(&henv);
SQLAllocConnect(henv, &hdbc);
rc = SQLConnect(hdbc, server, SQL_NTS, uid, SQL_NTS,
      pwd, SQL_NTS);
if (rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO)
      return(print_err(hdbc, SQL_NULL_HSTMT));
SQLAllocStmt(hdbc, &hstmt);

/* Execute the SQL statement. */
if (SQLExecDirect(hstmt, sqlstr, SQL_NTS) !=
      SQL_SUCCESS)
      return(print_err(hdbc, hstmt));

/* See what kind of statement it was.  If there are */
/* no result columns, the statement is not a SELECT */
/* statement.  If the number of affected rows is    */
/* greater than 0, the statement was probably an    */
/* UPDATE, INSERT, or DELETE statement, so print    */
/* the number of affected rows.  If the number of   */
/* affected rows is 0, the statement is probably a  */
/* DDL statement, so print that the operation was   */

/* successful and commit it.                        */

SQLNumResultCols(hstmt, &nresultcols);
if (nresultcols == 0) {
      SQLRowCount(hstmt, &rowcount);
      if (rowcount > 0 ) {
           printf("%ld rows affected.\n", rowcount);
      } else {
           printf("Operation successful.\n");
      }
      SQLTransact(hdbc, SQL_COMMIT);

/* Otherwise, display the column names of the result */
/* set and use the display_size() function to        */
/* compute the length needed by each data type.      */
/* Next, bind the columns and specify all data will  */
/* be converted to char.  Finally, fetch and print   */
/* each row, printing truncation messages as         */
```

```
/* necessary. */

} else {
  for (i = 0; i < nresultcols; i++) {
       SQLDescribeCol(hstmt, i + 1, colname,
            (SWORD)sizeof(colname), &colnamelen,
            &coltype, &collen[i], &scale,
            &nullable);
       collen[i] = display_size(coltype, collen[i],
            colname);
       printf("%*.*s", collen[i], collen[i],
            colname);
       data[i] = (UCHAR *) malloc(collen[i] + 1);
       SQLBindCol(hstmt, i + 1, SQL_C_CHAR,
            data[i], collen[i], &outlen[i]);
}
  while (TRUE) {

rc = SQLFetch(hstmt);
       if (rc == SQL_SUCCESS || rc ==
            SQL_SUCCESS_WITH_INFO) {
            errmsg[0] = '\0';
            for (i = 0; i < nresultcols; i++)
                 if (outlen[i] == SQL_NULL_DATA)
                      {
                      lstrcpy(data[i], "NULL");
                      }
                 else if (outlen[i] >= collen[i])
                      {
                      sprintf(&errmsg[strlen(errmsg)],
                           "%d chars truncated, col %d\n",
                           outlen[i] - collen[i] + 1,
                           colnum);
                      }
                 printf("%*.*s ", collen[i], collen[i],
                      data[i]);
            }
            printf("\n%s", errmsg);
       } else {
            break;
       }
  }
}
/* Free the data buffers. */
for (i = 0; i < nresultcols; i++) {
```

```
      free(data[i]);
}
/* Free the statement handle.       */
SQLFreeStmt(hstmt, SQL_DROP );
/* Disconnect from the data source. */
SQLDisconnect(hdbc);
/* Free the connection handle.      */
SQLFreeConnect(hdbc);
/* Free the environment handle.     */
SQLFreeEnv(henv);

return(0);
}
/*****************************************************/
/* The following function is included for            */
/* completeness,but is not relevant for understanding */
/* the function of ODBC.                             */
/*****************************************************/
#define MAX_NUM_PRECISION 15

/* Define max length of char string representation of */
/* number as: = max(precision) + leading sign + E +   */
/* exp sign + max exp length                          */
/* =  15 + 1 + 1 + 1 + 2                              */
/* =  15 + 5                                          */

#define MAX_NUM_STRING_SIZE (MAX_NUM_PRECISION + 5)
UDWORD  display_size(coltype, collen, colname)
SWORD   coltype;
UDWORD  collen;
UCHAR * colname;
{
switch (coltype) {

      case SQL_CHAR:
      case SQL_VARCHAR:
           return(max(collen, strlen(colname)));

      case SQL_SMALLINT:
           return(max(6, strlen(colname)));

      case SQL_INTEGER:
           return(max(11, strlen(colname)));

      case SQL_DECIMAL:
```

```
        case SQL_NUMERIC:
        case SQL_REAL:
        case SQL_FLOAT:
        case SQL_DOUBLE:
             return(max(MAX_NUM_STRING_SIZE,
                  strlen(colname)));

        /* Note that this function only supports the */
        /* core data types. */
        default:
             printf("Unknown datatype, %d\n", coltype);
             return(0);
        }
}
```

Testing and Debugging an Application

The ODBC SDK provides the following tools for application development:

- ODBC Test, an interactive utility that enables you to perform ad hoc and automated testing on drivers. A sample test DLL (the Quick Test) is included which covers basic areas of ODBC driver conformance.
- ODBC Spy, a debugging tool with which you can capture data source information, emulate drivers, and emulate applications.
- Sample applications, including source code and makefiles.
- A **#define**, ODBCVER, to specify which version of ODBC you want to compile your application with. By default, the SQL.H and SQLEXT.H files include all ODBC 2.0 constants and prototypes. To use only the ODBC 1.0 constants and prototypes, add the following line to your application code before including SQL.H and SQLEXT.H:

  ```
  #define ODBCVER 0x0100
  ```

For additional infomation about the ODBC SDK tools, see the *Microsoft ODBC SDK Guide*.

Installing and Configuring ODBC Software

Users install ODBC software with a driver-specific setup program (built with the Driver Setup Toolkit that is shipped with the ODBC SDK) or an application-specific setup program. They configure the ODBC environment with the ODBC Administrator (also shipped with the ODBC SDK) or an application-specific administration program. Application developers must decide whether to redistribute these programs or write their own setup and administration programs. For more information about the Driver Setup Toolkit and the ODBC Administrator, see the *Microsoft ODBC SDK Guide*.

A setup program written by an application developer uses the installer DLL to retrieve information from the ODBC.INF file, which is created by a driver developer and describes the disks on which the ODBC software is shipped. The setup program also uses the installer DLL to retrieve the target directories for the Driver Manager and the drivers, record information about the installed drivers, and install ODBC software.

Administration programs written by application developers use the installer DLL to retrieve information about the available drivers, to specify default drivers, and to configure data sources.

Application developers who write their own setup and administration programs must ship the installer DLL and the ODBC.INF file.

3

Stored Procedures, Events, and Sequences

SOLID *Embedded Engine* offers a number of features that make it possible to move parts of the application logic into the database. These features include:

- stored procedures
- event alerts
- sequences

Stored Procedures

Stored procedures are simple programs, or procedures, that are executed in SOLID *Embedded Engine*. The user can create procedures that contain several SQL statements or whole transactions, and execute them with single call statement. In addition to SQL statements, 3GL type control structures can be used enabling procedural control. In this way complex, data-bound transactions may be run on the server itself, thus reducing network traffic.

Granting execute rights on a stored procedure automatically invokes the necessary access rights to all database objects used in the procedure. Therefore, administering database access rights may be greatly simplified by allowing access to critical data through procedures.

This section explains in detail how to use the SOLID *Embedded Engine* stored procedures. In the beginning of this section the general concepts of using the procedures are explained. Later sections go more in-depth and describe the actual syntax of different statements in the procedures. The end of this section discusses transaction management, sequences and other advanced stored procedure features.

Basic procedure structure

A stored procedure is a standard SOLID database object that can be manipulated using standard DDL statements CREATE and DROP.

In its simplest form a stored procedure definition looks like:

```
"CREATE PROCEDURE procedure_name
parameter_section
BEGIN
declare_section_local_variables
procedure_body
END";
```

NOTE: As the *SQL Editor* is not able to parse these statements the whole statement has to be enclosed in double quotes.

The following example creates a procedure called TEST:

```
"CREATE PROCEDURE test
BEGIN
END";
```

Procedures can be run by issuing a CALL statement followed by the name of the procedure to be invoked:

```
CALL test;
```

Naming procedures

Procedure names have to be unique within a database schema.

All the standard naming restrictions considering database objects, like using reserved words, identifier lengths etc., apply to stored procedure names. See Appendix F in the **SOLID Administrator Guide** for an overview of reserved words.

Parameter section

A stored procedure communicates with the calling program using parameters. Stored procedures accept two types of parameters:

- Input parameters; given as an input to the procedure can be used inside the procedure.
- Output parameters; returned values from the procedure. Stored procedures may return a result set of several rows with output parameters as the columns.

The types of parameters must be declared. See *Appendix C* in the **SOLID Administrator Guide** for supported data types. The syntax used in parameter declaration is:

```
parameter_name parameter_datatype
```

Input parameters are declared between parentheses directly after the procedure name, output parameters are declared in a special RETURNS section of the procedure definition:

```
"CREATE PROCEDURE procedure_name
[ (input_param1 datatype,
   input_param2 datatype, … >) ]
[ RETURNS
  (output_param1 datatype,
   output_param2 datatype, … >) ]

BEGIN

END";
```

There can be any number of input and output parameters. Input parameters have to be supplied in the same order as they are defined when the procedure is called.

Declaring input parameters in the procedure heading make their values accessible inside the procedure by referring to the parameter name.

The output parameters will appear in the returned result set. The parameters will appear as columns in the result set in the same order as they are defined. A procedure may return one or more rows. Thus, also select statements can be wrapped into database procedures.

The following statement creates a procedure that has two input parameters and two output parameters:

```
"CREATE PROCEDURE PHONEBOOK_SEARCH
     (FIRST_NAME VARCHAR, LAST_NAME VARCHAR)
     RETURNS (PHONE_NR NUMERIC, CITY VARCHAR)
BEGIN
-- procedure_body
END";
```

This procedure should be called using two input parameter of data type VARCHAR. The procedure returns an output table consisting of 2 columns named phone_nr of type NUMERIC and CITY of type VARCHAR.

For example:

```
call phonebook_search ( 'JOHN','DOE');
Result looks like the following (when the procedure body has been programmed)
PHONE_NR      CITY
34335556      NEW YORK
23452266      LOS ANGELES
```

Declare section

Local variables that are used inside the procedure for temporary storage of column and control values are defined in a separate section of the stored procedure directly following the BEGIN keyword.

The syntax of declaring a variable is:

```
DECLARE variable_name datatype;
```

Note that every declare statement should be ended with a semicolon (;).

The variable name is an alphanumeric string that identifies the variable. The data type of the variable can be any valid SQL data type supported. See *Appendix C* in the **SOLID Administrator Guide** for supported data types.

For example:

```
"CREATE PROCEDURE PHONEBOOK_SEARCH
    (FIRST_NAME VARCHAR, LAST_NAME VARCHAR)
    RETURNS (PHONE_NR NUMERIC, CITY VARCHAR)
BEGIN
DECLARE i INTEGER;

DECLARE dat DATE;

END";
```

Note that input and output parameters are treated like local variables within a procedure with the exception that input parameters have a preset value and output parameter values are returned or can be appended to the returned result set.

Procedure body

The procedure body contains the actual stored procedure program based on assignments, expressions, SQL statements and the likes.

Any type of expression including scalar functions can be used in a procedure body. See *Appendix D* in the SOLID Administrator Guide for valid expressions.

Assignments

To assign values to variables either of the following syntax is used:

```
SET variable_name = expression ;
```

or

variable_name := *expression* ;

Example:

```
SET i = i+ 20 ;

i := 100;
```

Variables and constants are initialized every time a procedure is executed. By default, variables are initialized to NULL. Unless a variable has been explicitly initialized, its value is undefined, as the following example shows:

```
BEGIN
DECLARE   total   INTEGER;
...
total := total + 1;  -- assigns a null to total
...
```

Therefore, a variable should never be referenced before it has been assigned a value.

The expression following the assignment operator can be arbitrarily complex, but it must yield a data type that is the same as or convertible to the data type of the variable.

When possible, SOLID procedure language can provide conversion of data types implicitly. This makes it possible to use literals, variables and parameters of one type where another type is expected.

Implicit conversion is not possible if:

- information would be lost in the conversion.
- a string to be converted to an integer contains non-numeric data

Examples:

```
DECLARE integer_var INTEGER;
integer_var := 'NR:123';
```

returns an error.

```
DECLARE string_var CHAR(3);
string_var := 123.45;
```

results in value ‘123’ in variable *string_var*.

```
DECLARE string_var VARCHAR(2);
string_var := 123.45;
```

returns an error.

Expressions

Comparison Operators

Comparison operators compare one expression to another. The result is always TRUE, FALSE, or NULL. Typically, comparisons are used in conditional control statements and allow comparisons of arbitrarily complex expressions. The following table gives the meaning of each operator:

Operator	Meaning
=	is equal to
<>	is not equal to
<	is less than
>	is greater than
<=	is less than or equal to
>=	is greater than or equal to

Note that the != notation cannot be used inside a stored procedure, use the ANSI-SQL compliant <> instead.

Logical Operators

The logical operators can be used to build more complex queries. The logical operators AND, OR, and NOT operate according to the tri-state logic illustrated by the truth tables shown below. AND and OR are binary operators; NOT is a unary operator.

NOT	true	false	null
	false	true	null

AND	true	false	null
true	true	false	null
false	false	false	false

null	null	false	null

OR	true	false	null
true	true	true	true
false	true	false	null
null	true	null	null

As the truth tables show, AND returns the value TRUE only if both its operands are true. On the other hand, OR returns the value TRUE if either of its operands is true. NOT returns the opposite value (logical negation) of its operand. For example, NOT TRUE returns FALSE.

NOT NULL returns NULL because nulls are indeterminate.

When not using parentheses to specify the order of evaluation, operator precedence determines the order.

Note that 'true' and 'false' are not literals accepted by SQL parser but values. Logical expression value can be interpreted as a numeric variable:

false = 0 or NULL
true = 1 or any other numeric value

Example:

```
IF expression = TRUE THEN
```

can be simply written

```
IF expression THEN
```

IS NULL Operator

The IS NULL operator returns the Boolean value TRUE if its operand is null, or FALSE if it is not null. Comparisons involving nulls always yield NULL. To test whether a value is NULL, do not use the expression,

```
IF variable = NULL THEN ...
```

because it never evaluates to TRUE.

Instead, use the following statement:

```
IF variable IS NULL THEN ...
```

Note that when using multiple logical operators in Solid stored procedures the individual logical expressions should be enclosed in parentheses like:

```
( (A >= B ) AND  ( C= 2)  ) OR ( A= 3)
```

Control structures

IF Statement

Often, it is necessary to take alternative actions depending on circumstances. The IF statement executes a sequence of statements conditionally. There are three forms of IF statements: IF-THEN, IF-THEN-ELSE, and IF-THEN-ELSEIF.

IF-THEN

The simplest form of IF statement associates a condition with a statement list enclosed by the keywords THEN and END IF (not ENDIF), as follows:

```
IF condition THEN
        statement_list;
END IF
```

The sequence of statements is executed only if the condition evaluates to TRUE. If the condition evaluates to FALSE or NULL, the IF statement does nothing. In either case, control passes to the next statement. An example follows:

```
IF sales > quota THEN
    SET pay = pay + bonus;
END IF
```

IF-THEN-ELSE

The second form of IF statement adds the keyword ELSE followed by an alternative statement list, as follows:

```
IF condition THEN
   statement_list1;
ELSE
   statement_list2;
END IF
```

The statement list in the ELSE clause is executed only if the condition evaluates to FALSE or NULL. Thus, the ELSE clause ensures that a statement list is executed. In the following example, the first or second assignment statement is executed when the condition is true or false, respectively:

```
IF trans_type = 'CR' THEN
    SET balance = balance + credit;
ELSE
    SET balance = balance - debit;
END IF
```

THEN and ELSE clauses can include IF statements. That is, IF statements can be nested, as the following example shows:

```
IF trans_type = 'CR' THEN
    SET balance = balance + credit ;
ELSE
    IF new_balance >= minimum_balance THEN
        SET balance = balance - debit ;
    ELSE
        SET balance = minimum_balance;
    END IF
END IF
```

IF-THEN-ELSEIF

Occasionally it is necessary to select an action from several mutually exclusive alternatives. The third form of IF statement uses the keyword ELSEIF to introduce additional conditions, as follows:

```
IF condition1 THEN
      statement_list1;
 ELSEIF condition2 THEN
      statement_list2;
 ELSE
      statement_list3;
END IF
```

If the first condition evaluates to FALSE or NULL, the ELSEIF clause tests another condition. An IF statement can have any number of ELSEIF clauses; the final ELSE clause is optional. Conditions are evaluated one by one from top to bottom. If any condition evaluates to TRUE, its associated statement list is executed and the rest of the statements (inside

the IF-THEN-ELSEIF) are skipped. If all conditions evaluate to FALSE or NULL, the sequence in the ELSE clause is executed. Consider the following example:

```
IF sales > 50000 THEN
    bonus := 1500;
ELSEIF sales > 35000 THEN
    bonus := 500;
ELSE
    bonus := 100;
END IF
```

If the value of "sales" is more than 50000, the first and second conditions are true. Nevertheless, "bonus" is assigned the proper value of 1500 since the second condition is never tested. When the first condition evaluates to TRUE, its associated statement is executed and control passes to the next statement following the IF-THEN-ELSEIF.

When possible, use the ELSEIF clause instead of nested IF statements. That way, the code will be easier to read and understand. Compare the following IF statements:

```
     IF condition1 THEN
    statement_list1;
ELSE
  IF condition2 THEN
     statement_list2;
  ELSE
    IF condition3 THEN
       statement_list3;
    END IF
  END IF
END IF
```

```
IF condition1 THEN
   statement_list1;
ELSEIF condition2 THEN
    statement_list2;
ELSEIF condition3 THEN
    statement_list3;
END IF
```

These statements are logically equivalent, but the first statement obscures the flow of logic, whereas the second statement reveals it.

WHILE-LOOP

The WHILE-LOOP statement associates a condition with a sequence of statements enclosed by the keywords LOOP and END LOOP, as follows:

```
WHILE condition LOOP
   statement_list;
END LOOP
```

Before each iteration of the loop, the condition is evaluated. If the condition evaluates to TRUE, the statement list is executed, then control resumes at the top of the loop. If the condition evaluates to FALSE or NULL, the loop is bypassed and control passes to the next statement. An example follows:

```
WHILE total <= 25000 LOOP
    ...
    total := total + salary;
END LOOP
```

The number of iterations depends on the condition and is unknown until the loop completes. Since the condition is tested at the top of the loop, the sequence might execute zero times. In the latter example, if the initial value of "total" is greater than 25000, the condition evaluates to FALSE and the loop is bypassed, altogether

Loops can be nested. When an inner loop is finished control is returned to the next loop. The procedure continues from the next statement after end loop.

Leaving Loops

It may be necessary to force the procedure to leave a loop prematurely. This can be implemented using the LEAVE keyword:

```
WHILE total < 25000 LOOP
        statement_list
        total := total + salary;
        IF exit_condition THEN
          LEAVE;
        END IF
END LOOP
statement_list2
```

Upon successful evaluation of the *exit_condition* the loop is left, and the procedure continues at the *statement list 2*.

NOTE: Although SOLID *Embedded Engine* supports version 2.2 onwards of the ANSI-SQL CASE syntax, the CASE construct cannot be used inside a stored procedure as a control structure.

Handling Nulls

Nulls can cause confusing behaviour. To avoid some common errors, observe the following rules:

- comparisons involving nulls always yield NULL
- applying the logical operator NOT to a null yields NULL
- in conditional control statements, if the condition evaluates to NULL, its associated sequence of statements is not executed

In the example below, you might expect the statement list to execute because "x" and "y" seem unequal. Remember though that nulls are indeterminate. Whether "x" is equal to "y" or not is unknown. Therefore, the IF condition evaluates to NULL and the statement list is bypassed.

```
x := 5;
y := NULL;
...
IF x <> y THEN  -- evaluates to NULL, not TRUE
    statement_list;  -- not executed
END IF
```

In the next example, one might expect the statement list to execute because "a" and "b" seem equal. But, again, this is unknown, so the IF condition evaluates to NULL and the statement list is bypassed.

```
a := NULL;
b := NULL;
...
IF a = b THEN  -- evaluates to NULL, not TRUE
    statement_list;  -- not executed
END IF
```

NOT Operator

Applying the logical operator NOT to a null yields NULL. Thus, the following two statements are not always equivalent:

```
IF  x > y THEN
  high := x;
```

```
IF NOT x > y THEN
    high := y;
```

```
ELSE                                    ELSE
  high := y;                                high := x;
END IF                                  END IF
```

The sequence of statements in the ELSE clause is executed when the IF condition evaluates to FALSE or NULL. If either or both "x" and "y" are NULL, the first IF statement assigns the value of "y" to "high", but the second IF statement assigns the value of "x" to "high". If neither "x" nor y" is NULL, both IF statements assign the corresponding value to "high".

Zero-Length Strings

Zero length strings are treated by SOLID *Embedded Engine* like they are : a string of zero length, instead of a null. NULL values should be specifically assigned as in the following:

```
SET a = NULL;
```

This also means that checking for NULL values will return FALSE when applied to a zero-length string.

Example

Following is an example of a simple procedure that determines whether a person is an adult on the basis of a birthday as input parameter.

Note the usage of {} on scalar functions, and semicolons to end assignments and IF/END IF structures.

```
"CREATE PROCEDURE grown_up
(  birth_date DATE)
RETURNS ( description VARCHAR)
BEGIN
DECLARE temp INTEGER;
-- determine the number of years since the day of birth
temp := {fn TIMESTAMPDIFF(SQL_TSI_YEAR,birth_date,now())};
IF temp >= 18  THEN
--over 18 it's an adult
     description := 'ADULT';
ELSE
-- still a minor
     description := 'MINOR';
END IF
END";
```

Exiting a procedure

A procedure may be exited prematurely by issuing the keyword

```
RETURN;
```

at any location. After this keyword control is directly handed to the program calling the procedure, returning the values bound to the output parameters as indicated in the returns-section of the procedure definition.

Returning data

By default a stored procedure returns one row of data. The row is returned when the complete procedure has been run or has been forced to exit. This row conforms to the declared output parameters in the parameter section of the procedure.

Starting from SOLID *Embedded Engine* 2.2 (formerly SOLID *Server*) it is also possible to return result sets from a procedure using the following syntax:

```
return row;
```

Every RETURN ROW call adds a new row into the returned result set.

Using SQL in a stored procedure

Using SQL statements inside a stored procedure is somewhat different from issuing SQL directly from tools like SOLID *SQL Editor.*

Any SQL statement will have to be executed through an explicit cursor definition. A cursor is a specific allocated part of the server process memory in which track is kept of the statement being processed. Memory space is allocated for holding one row of the underlying statement, together with some status information on the current row (in SELECTS) or the number of rows affected by the statement (in UPDATES, INSERTS and DELETES).

In this way query results are processed one row at a time. The stored procedure logic should take care of the actual handling of the rows, and the positioning of the cursor on the required row(s).

There are five basic steps in handling a cursor:

1. Preparation of the cursor - the definition
2. Executing the cursor - executing the statement
3. Fetching on the cursor (for select procedure calls) - getting the results row by row
4. Closing the cursor after use - still enabling it to re-execute
5. Dropping the cursor from memory - definitely removing it

1. Preparation of a Cursor

A cursor is defined (prepared) using the following syntax:

```
EXEC SQL PREPARE cursor_name SQL_statement;
```

By preparing a cursor, memory space is allocated to accommodate one row of the result set of the statement, the statement is parsed and optimized.

A cursor name given for the statement has to be unique within the connection. When a cursor is prepared SOLID *Embedded Engine* checks that no other cursor of this name is currently open. If there is one, error number 14504 is returned.

Note that statement cursors can be opened also using the ODBC API. Also these cursor names need to be different from the cursors opened from procedures.

Example:

```
EXEC SQL PREPARE sel_tables
      SELECT table_name
      FROM sys_tables
      WHERE table_name like 'SYS%';
```

This statement will prepare the cursor named *sel_tables*, but will not execute the statement that it contains.

Once a procedure has been successfully prepared it can be executed. An execute binds possible input and output variables to it and runs the actual statement.

Syntax of the execute statement is:

```
EXEC SQL EXECUTE cursor_name
     [ INTO  ( var1, var2, … ) ];
```

The optional section INTO binds result data of the statement to variables.

Variables listed in parenthesis after the INTO keyword are used when running a SELECT or CALL statement. The resulting columns of the SELECT or CALL statement are bound to these variables when the statement is executed. The variables are bound starting from the left-most column listed in the statement. Binding of variables continues to the following column until all variables in the list of variables have been bound. For example to extend the sequence for the cursor *sel_tables* that was prepared earlier we need to run the following statements:

```
EXEC SQL PREPARE sel_tables
      SELECT  table_name
      FROM    sys_tables
      WHERE   table_name like 'SYS%'
```

```
EXEC SQL EXECUTE sel_tables INTO (tab);
```

The statement is now executed and the resulting table names will be returned into variable *tab* in the subsequent Fetch statements.

Fetching on the cursor

When a SELECT or CALL statement has been prepared and executed it is ready for fetching data from it. Other statements (UPDATE,INSERT,DELETE, DDL) do not require fetching as there will be no result set. Fetching results is done using the fetch syntax:

```
EXEC SQL FETCH cursor_name;
```

This command fetches a single row from the cursor to the variables that were bound with INTO keyword when the statement was executed.

To complete the previous example to actually get result rows back, the statements will look like:

```
EXEC SQL PREPARE sel_tables
      SELECT  table_name
      FROM    sys_tables
      WHERE   table_name like 'SYS%'
EXEC SQL EXECUTE sel_tables INTO (tab);
EXEC SQL FETCH sel_tables;
```

After this the variable *tab* will contain the table name of the first table found conforming to the WHERE-clause.

Subsequent calls to fetch on the cursor *sel_tables* will get the next row(s) if the select found more than one.

To fetch all table names a loop construct may be used:

```
WHILE expression LOOP
     EXEC SQL FETCH sel_tables;
END LOOP
```

Note that after the completion of the loop the variable *tab* will contain the last fetched table name.

4. Closing the cursor

Cursors may be closed by issuing the statement

```
EXEC SQL CLOSE cursor_name;
```

This will not remove the actual cursor definition from memory, it may be re-executed when the need arises.

5. Dropping the cursor

Cursors may be dropped from memory, releasing all resources by the statement :

```
EXEC SQL DROP cursor_name;
```

Error Handling

SQLSUCCESS

The return value of the latest EXEC SQL statement executed inside a procedure body is stored into variable SQLSUCCESS. This variable is automatically generated for every procedure. If the previous SQL statement was successful, the value 1 is stored into SQLSUCCESS. After a failed SQL statement, a value 0 is stored into SQLSUCCESS.

The value of SQLSUCCESS may be used, for instance, to determine when the cursor has reached the end of the result set as in the following example:

```
EXEC SQL FETCH sel_tab;
-- loop as long as last statement in loop is successful
WHILE SQLSUCCESS LOOP

     -- do something with the results like return the row
EXEC SQL FETCH sel_tab;

END LOOP
```

SQLERRCODE

This variable contains the error code from the last failed SQL statement.

SQLERRSTR

This variable contains the error string fro the last failed SQL statement.

SQLROWCOUNT

After the execution of UPDATE, INSERT and DELETE statements an additional variable is available to check the result of the statement. Variable SQLROWCOUNT contains the number of rows affected by the last statement.

SQLERROR OF *cursorname*

For error checking of EXEC SQL statements the SQLSUCCESS variable may be used as described under SQLSUCCESS in the beginning of this section. To return the actual error that caused the statement to fail to the calling application the following syntax may be used:

```
EXEC SQL PREPARE cursornname sql_statement

EXEC SQL EXECUTE cursorname

IF NOT SQLSUCCESS THEN

RETURN SQLERROR OF cursorname;

END IF
```

Processing will stop immediately when this statement is executed and the procedure return code is SQL_ERROR. The actual database error can be returned using SQLError function:

```
Solid Database error 10033: Primary key unique constraint violation
```

From SOLID *Embedded Engine* 2.2 (formerly SOLID *Server*) onward the need to code:

```
IF NOT SQLSUCCESS THEN…
```

after every SQL statement in a procedure can be diminished by using the following syntax:

```
EXEC SQL WHENEVER SQLERROR [ROLLBACK [WORK],] ABORT;
```

When this statement is included in a stored procedure all return values of executed SQL statements are checked for errors. If statement execution returns an error, the procedure is automatically aborted and SQLERROR of the last cursor is returned. Optionally the transaction can be rolled back.

The statement should be included before any EXEC SQL statements directly following the DECLARE section of variables.

Below is an example of a complete procedure returning all table names from SYS_TABLES that start with ‘SYS’:

```
"CREATE PROCEDURE  sys_tabs
RETURNS ( tab VARCHAR)
BEGIN
-- abort on errors
EXEC SQL WHENEVER SQLERROR ROLLBACK, ABORT;
-- prepare the cursor
EXEC SQL PREPARE sel_tables
     SELECT     table_name
     FROM       sys_tables
     WHERE      table_name like 'SYS%';
```

```
-- execute the cursor
EXEC SQL EXECUTE sel_tables INTO (tab);
-- loop through rows
EXEC SQL FETCH sel_tables;
WHILE sqlsuccess LOOP
      RETURN ROW;
      EXEC SQL FETCH sel_tables;
END LOOP
-- close and drop the used cursors
EXEC SQL CLOSE sel_tables;
EXEC SQL DROP sel_tables;
END";
```

Parameter markers in cursors

In order to make a cursor more dynamic, an SQL statement can contain parameter markers that indicate values that are bound to the actual parameter values at execute time. The '?' symbol is used as a parameter marker.

Syntax example:

```
EXEC SQL PREPARE sel_tabs
     SELECT table_name
     FROM sys_tables
     WHERE table_name LIKE ?
     AND table_schema LIKE ?;
```

The execution statement is adapted by including a USING keyword to accommodate the binding of a variable to the parameter marker.

```
EXEC SQL EXECUTE sel_tabs USING ( var1, var2 ) INTO ( tabs);
```

In this way a single cursor can be used multiple times without having to re-prepare the cursor. As preparing a cursor involves also the parsing and optimizing of the statement, significant performance gains can be achived by using re-usable cursors.

Note that the USING list only accepts variables, data can not be directly passed in this way. So if for example an insert into a table should be made, one column value of which should always be the same (status = ‘NEW’) then the following syntax would be wrong:

```
EXEC SQL EXECUTE ins_tab  USING (nr, desc, dat, 'NEW');
```

The correct way would be to define the constant value in the prepare section:

```
EXEC SQL PREPARE ins_tab
```

```
    INSERT INTO my_tab ( id,  descript, in_date, status)
    VALUES ( ?,?,?,'NEW');
EXEC SQL EXECUTE ins_tab USING ( nr, desc, dat);
```

Note that variables can be used multiple times in the using list.

The parameters in a SQL statement have no intrinsic data type or explicit declaration. Therefore, parameter markers can be included in an SQL statement only if their data types can be inferred from another operand in the statement.

For example, in an arithmetic expression such as ? + COLUMN1, the data type of the parameter can be inferred from the data type of the named column represented by COLUMN1. A procedure cannot use a parameter marker if the data type cannot be determined.

The following table describes how a data type is determined for several types of parameters.

Location of Parameter	**Assumed Data Type**
One operand of a binary arithmetic or comparison operator	Same as the other operand
The first operand in a BETWEEN clause	Same as the other operand
The second or third operand in a BETWEEN clause	Same as the first operand
An expression used with IN	Same as the first value or the result column of the subquery
A value used with IN	Same as the expression
A pattern value used with LIKE	VARCHAR
An update value used with UPDATE	Same as the update column

An application cannot place parameter markers in the following locations:

- As a SQL identifier (name of a table, name of a column etc.)
- In a SELECT list.
- As both expressions in a comparison-predicate.
- As both operands of a binary operator.
- As both the first and second operands of a BETWEEN operation.
- As both the first and third operands of a BETWEEN operation.

- As both the expression and the first value of an IN operation.
- As the operand of a unary + or - operation.
- As the argument of a set-function-reference.

For more information, see the ANSI SQL-92 specification.

In the following example, a stored procedure will read rows from one table and insert parts of them in another, using multiple cursors:

```
"CREATE PROCEDURE  tabs_in_schema (schema_nm VARCHAR)
RETURNS ( nr_of_rows INTEGER)
BEGIN
DECLARE tab_nm VARCHAR;
EXEC SQL PREPAREsel_tab
SELECT          table_name
FROM            sys_tables
WHERE           table_schema = ?;
EXEC SQL PREPARE ins_tab
     INSERT INTO my_table (table_name,schema) VALUES ( ?,?);

nr_of_rows := 0;

EXEC SQL EXECUTE sel_tab USING ( schema_nm) INTO (tab_nm);
EXEC SQL FETCH sel_tab;
WHILE SQLSUCCESS LOOP
     nr_of_rows := nr_of_rows + 1;
     EXEC SQL EXECUTE ins_tab USING(tab_nm, schema_nm);
     IF SQLROWCOUNT <> 1 THEN
       RETURN SQLERROR OF ins_tab;
     END IF
     EXEC SQL FETCH sel_tab;
END LOOP
END";
```

Calling other procedures

As calling a procedure forms a part of the supported SQL syntax, a stored procedure may be called from within another stored procedure. Like all SQL statements a cursor should be prepared and executed like:

```
EXEC SQL PREPARE  cp  call myproc( ?,?);

EXEC SQL EXECUTE cp USING ( var1, var2);
```

If procedure *myproc* returns one or more values, then subsequently a fetch should be done on the cursor *cp* to retrieve those values:

```
EXEC SQL PREPARE  cp  call myproc( ?,?);

EXEC SQL EXECUTE cp USING ( var1, var2) INTO ( ret_var1,
ret_var2);

EXEC SQL FETCH cp;
```

Note that if the called procedure uses a *return row* statement, the calling procedure should utilize a WHILE LOOP construct to fetch all results.

Recursive calls are possible, but discouraged because cursor names are unique at connection level and infinite recursion may crash the server process.

Positioned updates and deletes

In SOLID *Embedded Engine* procedures it is possible to use positioned updates and deletes. This means that an update or delete will be done to a row where a given cursor is currently positioned. The positioned updates and deletes can also be used within stored procedures using the cursor names used within the procedure.

The following syntax is used for positioned updates:

```
UPDATE table_name

SET column = value

WHERE CURRENT OF cursor_name
```

and for deletes

```
DELETE FROM table_name

WHERE CURRENT OF cursor_name
```

In both cases the *cursor_name* refers to a statement doing a SELECT on the table that is to be updated/deleted from.

Positioned cursor update is a semantically suspicious concept in SQL standard that may cause peculiarities also with SOLID *Embedded Engine*. Please note the following restriction when using positioned updates.

Below is an example written with pseudo code that will cause an endless loop with SOLID *Embedded Engine* (error handling, binding variables & other important tasks omitted for brevity and clarity):

```
"CREATE PROCEDURE ENDLESS_LOOP
BEGIN
```

```
EXEC SQL PREPARE MYCURSOR SELECT * FROM TABLE1;
EXEC SQL PREPARE MYCURSOR_UPDATE UPDATE TABLE1
     SET COLUMN2 = 'new data';
EXEC SQL EXECUTE MYCURSOR;
EXEC SQL FETCH MYCURSOR;
WHILE SQLSUCCESS LOOP
     EXEC SQL EXECUTE MYCURSOR_UPDATE;
     EXEC SQL COMMIT WORK;
     EXEC SQL FETCH MYCURSOR;
END LOOP
END";
```

The endless loop is caused by the fact that when the update is committed, a new version of the row becomes visible in the cursor and it is accessed in the next FETCH statement. This happens because the incremented row version number is included in the key value and the cursor finds the changed row as the next greater key value after the current position. The row gets updated again, the key value is changed and again it will be the next row found.

In the above example, the updated column2 is not assumed to be part of the primary key for the table, and the row version number was the only index entry changed. However, if such a column value is changed that is part of the index through which the cursor has searched the data, the changed row may jump further forward or backward in the search set.

For these reasons, using positioned update is not recommended in general and searched update should be used instead whenever possible. However, sometimes the update logic may be too complex to be expressed in SQL WHERE clause and in such cases positioned update can be used as follows:

Positioned cursor update works deterministically in SOLID, when the where clause is such that the updated row does not match the criteria and therefore does not reappear in the fetch loop. Constructing such a search criteria may require using additional column only for this purpose.

Note that other users' changes do not become visible in the open cursor, only those committed within the same database session.

Transactions

Stored procedures use transactions like any other interface to the database. A transaction may be committed or rolled back either inside the procedure or outside the procedure. Inside the procedure a commit or roll back is done using the following syntax:

```
EXEC SQL COMMIT WORK;

EXEC SQL ROLLBACK WORK;
```

These statements end the previous transaction and start a new one.

If a transaction is not committed inside the procedure, it may be ended externally using:

- a SOLID API,
- another stored procedure or
- by autocommit, if the connection has AUTOCOMMIT switch set to ON.

Note that when a connection has autocommit activated it does not force autocommit inside a procedure. The commit is done when the procedure exits.

Default cursor management

By default, when a procedure exits, all cursors opened in a procedure are closed. Closing cursors means that cursors are left in a prepared state and can be re-executed.

After exiting, the procedure is put in the procedure cache. When the procedure is dropped from the cache, all cursors are finally dropped.

The number of procedures kept in cache is determined by the SOLID.INI file setting :

```
[SQL]
ProcedureCache = nbr_of_procedures
```

This means that, as long as the procedure is in the procedure cache, all cursors can be re-used as long as they are not dropped. SOLID *Embedded Engine* itself manages the procedure cache by keeping track of the cursors declared, and notices if the statement a cursor contains has been prepared.

As cursor management, especially in a heavy multi-user environment, can use a considerable amount of server resources it is good practice to always close cursors immediately and preferably also drop all cursors that are not used anymore. Only the most frequently used procedures may be left non-dropped to reduce the cursor preparation effort.

Note that transactions are not related to procedures or other statements. Commit or rollback does therefore NOT release any resources in a procedure.

Notes on SQL

- There is no restriction on the SQL statements used. Any valid SQL statement can be used inside a stored procedure, including DDL and DML statements
- Cursors may be declared anywhere in a stored procedure. Cursors that are certainly going to be used are best prepared directly following the declare section.

- Cursors that are used inside control structures, and are therefore not always necessary, are best declared at the point where they are activated, to limit the amount of open cursors and hence the memory usage.
- The cursor name is an undeclared identifier, not a variable; it is used only to reference the query. You cannot assign values to a cursor name or use it in an expression.
- Cursors may be re-executed repeatedly without having to re-prepare them. Note that this can have a serious influence on performance; repetitively preparing cursors on similar statements may decrease the performance by around 40% in comparison to re-executing already prepared cursors!
- Any SQL statement will have to be preceded by the keywords EXEC SQL.

Using sequences

A sequence object is used to get sequence numbers. The syntax is:

```
CREATE [DENSE] SEQUENCE sequence_name
```

Depending on how the sequence is created, there may or may not be holes in the sequence (the sequence can be sparse or dense). Dense sequences guarantee that there are no holes in the sequence numbers. The sequence number allocation is bound to the current transaction. If the transaction rolls back, also the sequence number allocations are rolled back. The drawback of dense sequences is that the sequence is locked out from other transactions until the current transaction ends.

If there is no need for dense sequences, a sparse sequence can be used. A sparse sequence guarantees uniqueness of the returned values, but it is not bound to the current transaction. If a transaction allocates a sparse sequence number and later rolls back, the sequence number is simply lost.

A sequence object can be used, for example, to generate primary key numbers. The advantage of using a sequence object instead of a separate table is that the sequence object is specifically fine-tuned for fast execution and requires less overhead than normal update statements.

Both dense and sparse sequence numbers start from 1.

After creation of the sequence by:

```
CREATE [DENSE] SEQUENCE sequence_name
```

the current sequence value can be retrieved by using the following syntax:

```
EXEC SEQUENCE sequence_name.CURRENT INTO variable;
```

New sequence values can be retrieved using the following syntax:

```
EXEC SEQUENCE sequence_name.NEXT INTO variable;
```

It is also possible to set the current value of a sequence to a predefined value by using the following syntax:

```
EXEC SEQUENCE sequence_name SET VALUE USING variable;
```

An example of using a stored procedure to retrieve a new sequence number is given below:

```
"CREATE PROCEDURE get_my_seq
RETURNS (val INTEGER)
BEGIN
EXEC SEQUENCE my_sequence.NEXT INTO (val);
END";
```

Using events

Event alerts are special objects in a SOLID *Embedded Engine* database. They are used for sending events from one application to another. The use of event alerts removes resource consuming database polling from applications.

The system does not automatically generate events, they must be triggered by stored procedures. Similarly the events can only be received in stored procedures. When an application calls a stored procedure that waits for a specific event to happen, the application is blocked until the event is triggered and received. In multithreaded environments separate threads and connections can be used to access the database during the event standstill.

An event has a name that identifies it and a set of parameters. The name can be any user-specified alphanumeric string. An event object is created with the SQL statement:

```
CREATE EVENT event_name
   [(parameter_name datatype
      [parameter_name datatype ...])]
```

The parameter list specifies parameter names and parameter types. The parameter types are normal SQL types. Events are dropped with the SQL statement:

```
DROP EVENT event_name
```

Events are triggered and received inside stored procedures. Special stored procedure statements are used to trigger and receive events.

The event is triggered with the stored procedure statement

```
POST EVENT event_name (parameters)
```

Event parameters must be local variables or parameters in the stored procedure where the event is triggered. All clients that are waiting for the posted event will receive the event.

To make a procedure wait for an event to happen, the WAIT EVENT construct is used in the stored procedure:

```
wait_event_statement ::=
     WAIT EVENT
         [event_specification ...]
     END WAIT
event_specification ::=
     WHEN event_name (parameters) BEGIN
      statements
     END EVENT
```

Procedure privileges

Stored procedures are owned by the creator, and are part of the creator's schema. Users needing to run stored procedures in other schema's need to be granted EXECUTE privilege on the procedure:

```
GRANT EXECUTE ON Proc_name TO USER[,ROLE];
```

All database objects accessed within the granted procedure, even subsequently called procedures, are accessed according to the rights of the owner of the procedure. No special grants are necessary.

4

Using UNICODE in SOLID *Embedded Engine*

This chapter describes how to implement the UNICODE standard, providing the capability to encode characters used in the major languages of the world. Topics in this chapter include:

- What is UNICODE?
- UNICODE and SOLID *Embedded Engine*
- Setting up SOLID *Embedded Engine* for UNICODE data
- Using UNICODE with SOLID *SQL API* and **ODBC API**
- Using UNICODE with the SOLID *JDBC Driver*

What is Unicode?

The Unicode Standard is the universal character encoding standard used for representation of text for computer processing. Unicode provides a consistent way of encoding multilingual plain text and brings order to a chaotic state of affairs that has made it difficult to exchange text files internationally. Computer users who deal with multilingual text — business people, linguists, researchers, scientists, and others — will find that the Unicode Standard greatly simplifies their work. Mathematicians and technicians, who regularly use mathematical symbols and other technical characters, will also find the Unicode Standard valuable.

Unicode is fully compatible with the International Standard ISO/IEC 10646-1; 1993, and contains all the same characters and encoding points as ISO/IEC 10646. The Unicode Standard also provides additional information about the characters and their use. Any implementation that conforms to Unicode also conforms to ISO/IEC 10646.

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puter users who deal with multilingual text -- business people, linguists, researchers, scientists, and others -- will find that the Unicode Standard greatly simplifies their work. Mathematicians and technicians, who regularly use mathematical symbols and other technical characters, will also find the Unicode Standard valuable.

The design of Unicode is based on the simplicity and consistency of ASCII, but goes far beyond ASCII's limited ability to encode only the Latin alphabet. The Unicode Standard provides the capacity to encode all of the characters used for the written languages of the world. It uses a 16-bit encoding that provides code points for more than 65,000 characters. To keep character coding simple and efficient, the Unicode Standard assigns each character a unique 16-bit value, and does not use complex modes or escape codes.

While 65,000 characters are sufficient for encoding most of the many thousands of characters used in major languages of the world, the Unicode standard and ISO 10646 provide an extension mechanism called UTF-16 that allows for encoding as many as a million more characters, without use of escape codes. This is sufficient for all known character encoding requirements, including full coverage of all historic scripts of the world.

What Characters Does the Unicode Standard Include?

The Unicode Standard defines codes for characters used in the major languages written today.

The Unicode Standard also includes punctuation marks, diacritics, mathematical symbols, technical symbols, arrows, dingbats, etc. It provides codes for diacritics, which are modifying character marks such as the tilde (~), that are used in conjunction with base characters to encode accented or vocalized letters (ñ, for example). In all, the Unicode Standard provides codes for nearly 39,000 characters from the world's alphabets, ideograph sets, and symbol collections.

There are about 18,000 unused code values for future expansion in the basic 16-bit encoding, plus provision for another 917,504 code values through the UTF-16 extension mechanism. The Unicode Standard also reserves 6,400 code values for private use, which software and hardware developers can assign internally for their own characters and symbols. UTF-16 makes another 131,072 private use code values available, should 6,400 be insufficient for particular applications.

Encoding Forms

Character encoding standards define not only the identity of each character and its numeric value, or code position, but also how this value is represented in bits. The Unicode Standard endorses two forms that correspond to ISO 10646 transformation formats, UTF-8 and UTF-16.

The ISO/IEC 10646 transformation formats UTF-8 and UTF-16 are essentially ways of turning the encoding into the actual bits that are used in implementation. The first is known as UTF-16. It assumes 16-bit characters and allows for a certain range of characters to be used as an extension mechanism in order to access an additional million characters using 16-bit character pairs. The Unicode Standard, Version 2.0, has adopted this transformation format as defined in ISO/IEC 10646.

The other transformation format is known as UTF-8. This is a way of transforming all Unicode characters into a variable length encoding of bytes. It has the advantages that the Unicode characters corresponding to the familiar ASCII set end up having the same byte values as ASCII, and that Unicode characters transformed into UTF-8 can be used with much existing software without extensive software rewrites. The Unicode Consortium also endorses the use of UTF-8 as a way of implementing the Unicode Standard. Any Unicode character expressed in the 16-bit UTF-16 form can be converted to the UTF-8 form and back without loss of information.

Unicode and ISO/IEC 10646

The Unicode Standard is very closely aligned with the international standard ISO/IEC 10646-1; 1993 (also known as the Universal Character Set, or UCS, for short). In 1991 a formal convergence of the two standards was negotiated between the Unicode Technical Committee and JTC1/WC2/WG2, the ISO committee responsible for ISO/IEC 10646. Since that time, close cooperation and formal liaison between the committees has ensured that all additions to either standard are coordinated and kept in synch, so that the two standards maintain exactly the same character repertoire and encoding.

Version 2.0 of the Unicode Standard is code-for-code identical to ISO/IEC 10646-1; 1993, plus its first seven published amendments. This code-for-code identity is true for all encoded characters in the two standards, including the East Asian (Han) ideographic characters.

The international standard ISO/IEC 10646 allows for two forms of use, a two-octet (=byte) form known as UCS-2 and a four-octet form known as UCS-4. The Unicode Standard, as a profile of ISO/IEC 10646, chooses the two-octet form, which is equivalent to saying that characters are represented in 16-bits per character. When extended characters are used, Unicode is equivalent to UTF-16.

Implementing Unicode in SOLID *Embedded Engine*

This section contains pertinent information required to implement the Unicode standard in SOLID *Embedded Engine* 3.0. Please note the following implementation guidelines:

- **Unicode Data Types**

SQL data types WCHAR, WVARCHAR and LONG WVARCHAR are used to store Unicode data in the SOLID *Embedded Engine*. The "Wide-character" implementation conforms to ODBC 3.5 specification. The Unicode data types are interoperable with corresponding character data types (CHAR, VARCHAR and LONG VARCHAR), but conversions from Unicode data types to character data types fail, if the characters are beyond ISO Latin 1. All string operations are possible between Unicode and character data types with implicit type conversions.

- I**nternal Storage Format**

  The storage format in SOLID *Embedded Engine* 3.0 for Unicode column data is UCS-2. All character information in the data dictionary are stored as Unicode. This means that to support Unicode you must convert all databases created using SOLID *Server* (prior to the release of SOLID *Embedded Engine* version 3.0) to support Unicode. For details, please refer to the latest release notes.

  The wide character types require more storage space than normal character types. Therefore, use wide characters only where necessary.

- **Ordering**

  Unicode data columns are ordered based on the binary values of the UCS-2 format. If the binary order is different than what natural language users expect, developers need to provide a separate column to store the correct ordering information.

- **Unicode File Names**

  SOLID *Embedded Engine* does not support using Unicode strings in any file names.

Setting Up SOLID *Embedded Engine* for Unicode Data

Creating Columns for Storing Unicode Data

In order to start storing Unicode data in a SOLID *Embedded Engine* database, tables with Unicode data columns need to be created first as follows:

```
CREATE TABLE customer (c_id INTEGER, c_name WVARCHAR,…)
```

Loading Unicode Data

You can use the data import tool *Speedloader* from SOLID version 3.0 to import data to Unicode columns. The import files should contain Unicode data in UTF-8 format.

Alternatively, a separate client application for data loading can be produced using Unicode Client Library or JDBC Driver 3.0.

Using Unicode in Database Entity Names

It is possible to name tables, columns, procedures, etc. with Unicode strings, simply by enclosing the Unicode names with double quotes in all the SQL statements.

The SOLID tools, like teletype *SQL Editor*, will handle Unicode strings in UTF-8 format. In order to enter native Unicode strings, third-party database administration applications need to be used, or a special application using Unicode Client Library or JDBC Driver 3.0 should be written for this purpose.

Note that if there are Unicode strings in the data dictionary of a database, the client applications linked with the (old) Latin Client Library cannot generally be used to access the database.

Unicode User Names and Passwords

User names and passwords can also be Unicode strings. However, to avoid access problems from different tools, the original database administrator account information must be given as pure ASCII strings.

Converting Old Databases

Old SOLID *Embedded Engine (*formerly SOLID *Server)* 2.x databases can be converted to the new 3.0 format by starting SOLID *Embedded Engine* 3.0 with option -xconvert. After conversion, database is closed and SOLID *Embedded Engine* stops.

NOTE: The database conversion to the 3.0 format is an irrevocable operation. Converted databases cannot be opened anymore with SOLID *Embedded Engine (*formerly *SOLID*

Server) versions 2.x. It is recommended that before database conversion a backup is taken and stored in a safe place.

SOLID *Data Dictionary*, SOLID *Export*, and SOLID *Speedloader*

The SOLID Tools from SOLID *Embedded Engine* version 3.0 use UTF-8 as the external representation format of Unicode strings.

SOLID *Speedloader* (solload) accepts Unicode data in control and input files in UTF-8 format.

SOLID *Export* (solexp) extracts Unicode data from database to output files in UTF-8 format.

SOLID *Data Dictionary* (soldd) prints table, column, etc. names containing Unicode strings in UTF-8 format into the SQL DDL file.

The SQL files output by soldd can be used by the teletype SOLID *SQL Editor* (solsql) to create the tables, indices, etc. into a new database, also when there are Unicode strings in the data definition entries.

SOLID *Data Dictionary* and SOLID *Export* accept option -8 to allow exporting data dictionary information in 8-bit format for use with SOLID *Embedded Engine (*formerly *SOLID Server)* 2.x tools. The option -8 is needed, if there are scandinavian or other national non-ascii characters in the data dictionary names. If there are Unicode characters that cannot be converted to 8-bit format, moving back to using SOLID v.2.x is impossible anyway.

SOLID *SQL Editor* and *Remote Control*

Only the teletype versions of these tools, solsql and solcon, will function correctly in Unicode client environments.

The GUI versions of SOLID *SQL Editor* and *Remote Control* will not support using Unicode data in any way. Using third party administration tools through ODBC or JDBC interfaces is recommended instead in Unicode environments. Alternatively, a special administration application can be produced using Unicode Client Library or JDBC Driver 3.0.

UNICODE AND SOLID *SQL API / ODBC*

SOLID *SQL API* provides now a separate Unicode interface where SQL statements may contain Unicode strings in UCS-2 format. All database object names can be Unicode strings, but they need to be enclosed in double quotes. Date formats containing Unicode characters are not supported. See ODBC 3.5 documentation for details.

Client Libraries

There are two versions of the SQL API library available: SOLID Latin Client Library and the new SOLID Unicode Client Library.

The SOLID Latin Client Library handles SQL statements as ISO Latin 1 strings. It does not support Unicode strings as table or column names or as SQL literals. However, Unicode data types are recognized and programs using SOLID Latin Client Library can access Unicode data stored in Unicode columns in the database. Unicode values can be used in SQL statements, for example, in WHERE clauses, by having parameter markers in the prepared SQL strings and getting the Unicode data from variables in the execution phase.

If data dictionary names in the database contain Unicode characters, or if Unicode literals need to be used in the application, it must be linked with the SOLID Unicode Client Library, which is named:

```
scw{ooo}{Vv}.{ext}
```

where {ooo} is the operating system mnemonic, {Vv} is the SOLID version number and {ext} is the platform-dependent library file extension.

The SOLID Unicode Client Library has been designed to work as a Unicode ODBC Driver in combination with ODBC Driver Managers 3.x that support Unicode. However, in SOLID *Embedded Engine* 3.0 Beta release this mode of operation has not been tested, and it is recommended to link Unicode applications directly with the SOLID Unicode Client Library.

Old Client Versions

Old clients can connect to SOLID *Embedded Engine* version 3.0. All Unicode data is converted to ISO Latin 1 whenever possible. Thus, provided only ISO-Latin 1 data is used in the database, old clients can access the database engine.

NOTE: To avoid problems in the future, it is recommended that you upgrade your client applications to use version 3.0 client libraries.

Unicode Variables and Binding

Using string columns containing Unicode data work just like normal character columns. Note that the length of string buffers is given as the number of bytes required to store the value.

String Functions

String functions work as expected, also between ISO Latin 1 and Unicode strings. Conversions are provided implicitly, when necessary. The result is always of Unicode type, if either of the operands is Unicode.

The functions UPPER() and LOWER() work on Unicode strings when the contained characters can be mapped to ISO Latin 1 code page.

Translations

The character translations defined in client side solid.ini or by using SQL API function SQLSetConnectOption with SQL_TRANSLATE_OPTION do not affect the data stored in Unicode columns. Translations remain in effect for character columns.

Unicode and JDBC

Unicode is supported in the SOLID *JDBC Driver 3.0*.

As Java uses natively Unicode strings, supporting Unicode means primarily that when accessing Unicode columns in SOLID *Embedded Engine*, no data type conversions are necessary. Additionally, JDBC ResultSet Class methods **getUnicodeStream** and **setUnicodeStream** are supported now for handling large Unicode texts stored in the database engine.

To convert Java applications to support Unicode, the string columns in the database engine need to be redefined with Unicode data types.

5

Function Reference

Function Descriptions

The following pages describe each function in alphabetic order. Each function is defined as a C programming language function. Descriptions include the following:

- Purpose
- ODBC version
- Conformance level
- Syntax
- Arguments
- Return values
- Diagnostics
- Comments about usage and implementation
- Code example
- References to related functions

Error handling is described in the **SQLError** function description. The text associated with SQLSTATE values is included to provide a description of the condition, but is not intended to prescribe specific text.

Arguments

All function arguments use a naming convention of the following form:

[[*prefix*]...]*tag*[*qualifier*][*suffix*]

Optional elements are enclosed in square brackets ([]). The following prefixes are used:

Prefix	Description
c	Count of
h	Handle of
i	Index of
p	Pointer to
rg	Range (array) of

The following tags are used:

Tag	Description
b	Byte
col	Column (of a result set)
dbc	Database connection
env	Environment
f	Flag (enumerated type)
par	Parameter (of an SQL statement)
row	Row (of a result set)
stmt	Statement
sz	Character string (array of characters, terminated by zero)
v	Value of unspecified type

Prefixes and tags combine to correspond roughly to the ODBC C types listed below. Flags (f) and byte counts (cb) do not distinguish between SWORD, UWORD, SDWORD, and UDWORD.

Combined	Prefix	Tag	ODBC C Type(s)	Description
cb	c	b	SWORD, SDWORD, UDWORD	Count of bytes
crow	c	row	SDWORD, UDWORD, UWORD	Count of rows
f	–	f	SWORD, UWORD	Flag
hdbc	h	dbc	HDBC	Connection handle
henv	h	env	HENV	Environment handle
hstmt	h	stmt	HSTMT	Statement handle
hwnd	h	wnd	HWND	Window handle
ib	i	b	SWORD	Byte index
icol	i	col	UWORD	Column index
ipar	i	par	UWORD	Parameter index
irow	i	row	SDWORD, UWORD	Row index
pcb	pc	b	SWORD FAR *, SDWORD FAR *, UDWORD FAR *	Pointer to byte count
pccol	pc	col	SWORD FAR *	Pointer to column count
pcpar	pc	par	SWORD FAR *	Pointer to parameter count
pcrow	pc	row	SDWORD FAR *, UDWORD FAR *	Pointer to row count
pf	p	f	SWORD, SDWORD, UWORD	Pointer to flag
phdbc	ph	dbc	HDBC FAR *	Pointer to connection handle

phenv	ph	env	HENV FAR *	Pointer to environment handle
phstmt	ph	stmt	HSTMT FAR *	Pointer to statement handle
pib	pi	b	SWORD FAR *	Pointer to byte index
pirow	pi	row	UDWORD FAR *	Pointer to row index
prgb	prg	b	PTR FAR *	Pointer to range (array) of bytes
pv	p	v	PTR	Pointer to value of unspecified type
rgb	rg	b	PTR	Range (array) of bytes
rgf	rg	f	UWORD FAR *	Range (array) of flags
sz	–	sz	UCHAR FAR *	String, zero terminated
v	–	v	UDWORD	Value of unspecified type

Qualifiers are used to distinguish specific variables of the same type. Qualifiers consist of the concatenation of one or more capitalized English words or abbreviations.

ODBC defines one value for the suffix *Max*, which denotes that the variable represents the largest value of its type for a given situation.

For example, the argument *cbErrorMsgMax* contains the largest possible byte count for an error message; in this case, the argument corresponds to the size in bytes of the argument *szErrorMsg*, a character string buffer. The argument *pcbErrorMsg* is a pointer to the count of bytes available to return in the argument *szErrorMsg*, not including the null termination character.

SOLID *SQL API* Include Files

The files CLI0CORE.H, CLI0DEFS.H, CLI0ENV.H and CLI0EXT1.H contain function prototypes for all of the SOLID *SQL API* functions. They also contain all type definitions and **#define** names used by SOLID *SQL API*.

ODBC Include Files

The files SQL.H and SQLEXT.H contain function prototypes for all of the ODBC functions. They also contain all type definitions and **#define** names used by ODBC.

Diagnostics

The diagnostics provided with each function list the SQLSTATEs that may be returned for the function by the Driver Manager or a driver. Drivers can, however, return additional SQLSTATEs arising out of implementation-specific situations.

The character string value returned for an SQLSTATE consists of a two-character class value followed by a three-character subclass value. A class value of “01” indicates a warning and is accompanied by a return code of SQL_SUCCESS_WITH_INFO. Class values other than “01”, except for the class “IM”, indicate an error and are accompanied by a return code of SQL_ERROR. The class “IM” is specific to warnings and errors that derive from the implementation of ODBC itself. The subclass value “000” in any class is for implementation-defined conditions within the given class. The assignment of class and subclass values is defined by ANSI SQL-92.

Tables and Views

In ODBC functions, tables and views are interchangeable. The term *table* is used for both tables and views, except where view is used explicitly.

Catalog Functions

ODBC supports a set of functions that return information about the data source’s system tables or catalog. These are sometimes referred to collectively as the *catalog functions*. For more information about catalog functions, read “*Retrieving Information About the Data Source’s Catalog” on page 2-19* .

The catalog functions are:

SQLColumns

SQLPrimaryKeys

SQLSpecialColumns

SQLStatistics

SQLTables

Search Pattern Arguments

Each catalog function returns information in the form of a result set. The information returned by a function may be constrained by a search pattern passed as an argument to that function. These search patterns can contain the metacharacters underscore (_) and percent (%) and a driver-defined escape character as follows:

- The underscore character represents any single character.
- The percent character represents any sequence of zero or more characters.
- The escape character permits the underscore and percent metacharacters to be used as literal characters in search patterns. To use a metacharacter as a literal character in the search pattern, precede it with the escape character. To use the escape character as a literal character in the search pattern, include it twice. To obtain the escape character for a driver, an application must call **SQLGetInfo** with the SQL_SEARCH_PATTERN_ESCAPE option.
- All other characters represent themselves.

For example, if the search pattern for a table name is “%A%”, the function will return all tables with names that contain the character “A”. If the search pattern for a table name is “B__” (“B” followed by two underscores), the function will return all tables with names that are three characters long and start with the character “B”. If the search pattern for a table name is “%”, the function will return all tables.

Suppose the search pattern escape character for a driver is a backslash (\). If the search pattern for a table name is “ABC\%”, the function will return the table named “ABC%.” If the search pattern for a table name is “ \\%”, the function will return all tables with names that start with a backslash. Failing to precede a metacharacter used as a literal with an escape character may return more results than expected. For example, if a table identifier, “MY_TABLE” was returned as the result of a call to **SQLTables** and an application wanted to retrieve a list of columns for “MY_TABLE” using **SQLColumns**, **SQLColumns** would return all of the tables that matched MY_TABLE, such as MY_TABLE, MY1TABLE, MY2TABLE, and so on, unless the escape character precedes the underscore.

NOTE: A zero-length search pattern matches the empty string. A search pattern argument that is a null pointer means the search will not be constrained for that argument. (A null pointer and a search string of “%” should return the same values.)

SQLAllocConnect (ODBC 1.0, Core)

SQLAllocConnect allocates memory for a connection handle within the environment identified by *henv.*

Syntax

RETCODE **SQLAllocConnect**(*henv, phdbc*)

The **SQLAllocConnect** function accepts the following arguments.

Type	Argument	Use	Description
HENV	*henv*	Input	Environment handle.
HDBC FAR *	*phdbc*	Output	Pointer to storage for the connection handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

If **SQLAllocConnect** returns SQL_ERROR, it will set the *hdbc* referenced by *phdbc* to SQL_NULL_HDBC. To obtain additional information, the application can call **SQLError** with the specified *henv* and with *hdbc* and *hstmt* set to SQL_NULL_HDBC and SQL_NULL_HSTMT, respectively.

Diagnostics

When **SQLAllocConnect** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLAllocConnect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	(DM) The Driver Manager was unable to allocate memory for the connection handle. The driver was unable to allocate memory for the connection handle.
S1009	Invalid argument value	(DM) The argument *phdbc* was a null pointer.

Comments

A connection handle references information such as the valid statement handles on the connection and whether a transaction is currently open. To request a connection handle, an application passes the address of an *hdbc* to **SQLAllocConnect**. The driver allocates memory for the connection information and stores the value of the associated handle in the *hdbc*. On operating systems that support multiple threads, applications can use the same *hdbc* on different threads and drivers must therefore support safe, multithreaded access to this information. The application passes the *hdbc* value in all subsequent calls that require an *hdbc*.

The Driver Manager processes the **SQLAllocConnect** function and calls the driver's **SQLAllocConnect** function when the application calls **SQLConnect**, or **SQLDriverConnect**. (For more information, see the description of the **SQLConnect** function.)

If the application calls **SQLAllocConnect** with a pointer to a valid *hdbc*, the driver overwrites the *hdbc* without regard to its previous contents.

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Connecting to a data source	**SQLConnect**
Freeing a connection handle	**SQLFreeConnect**

SQLAllocEnv (ODBC 1.0, Core)

SQLAllocEnv allocates memory for an environment handle and initializes the ODBC call level interface for use by an application. An application must call **SQLAllocEnv** prior to calling any other ODBC function.

Syntax

RETCODE **SQLAllocEnv**(*phenv*)

The **SQLAllocEnv** function accepts the following argument.

Type	Argument	Use	Description
HENV FAR *	*phenv*	Output	Pointer to storage for the environment handle.

Returns

SQL_SUCCESS or SQL_ERROR.

If **SQLAllocEnv** returns SQL_ERROR, it will set the *henv* referenced by *phenv* to SQL_NULL_HENV. In this case, the application can assume that the error was a memory allocation error.

Diagnostics

A driver cannot return SQLSTATE values directly after the call to **SQLAllocEnv**, since no valid handle will exist with which to call **SQLError**.

There are two levels of **SQLAllocEnv** functions, one within the Driver Manager and one within each driver. The Driver Manager does not call the driver-level function until the application calls **SQLConnect**, or **SQLDriverConnect**. If an error occurs in the driver-level **SQLAllocEnv** function, then the Driver Manager-level **SQLConnect**, or **SQLDriverConnect** function returns SQL_ERROR. A subsequent call to **SQLError** with *henv*, SQL_NULL_HDBC, and SQL_NULL_HSTMT returns SQLSTATE IM004 (Driver's **SQLAllocEnv** failed), followed by one of the following errors from the driver:

SQLSTATE S1000 (General error).

A driver-specific SQLSTATE value, ranging from S1000 to S19ZZ. For example, SQLSTATE S1001 (Memory allocation failure) indicates that the Driver Manager's call to the driver-level **SQLAllocEnv** returned SQL_ERROR, and the Driver Manager's *henv* was set to SQL_NULL_HENV.

For additional information about the flow of function calls between the Driver Manager and a driver, see the **SQLConnect** function description.

Comments

An environment handle references global information such as valid connection handles and active connection handles. To request an environment handle, an application passes the address of an *henv* to **SQLAllocEnv**. The driver allocates memory for the environment information and stores the value of the associated handle in the *henv.* On operating systems that support multiple threads, applications can use the same *henv* on different threads and drivers must therefore support safe, multithreaded access to this information. The application passes the *henv* value in all subsequent calls that require an *henv.*

There should never be more than one *henv* allocated at one time and the application should not call **SQLAllocEnv** when there is a current valid *henv.* If the application calls **SQLAllocEnv** with a pointer to a valid *henv,* the driver overwrites the *henv* without regard to its previous contents.

When the Driver Manager processes the **SQLAllocEnv** function, it checks the **Trace** keyword in the [ODBC] section of the ODBC.INI file or the ODBC subkey in the registry. If it is set to 1, the Driver Manager enables tracing for all applications for the current application on Windows NT and Windows 95/98.

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Allocating a connection handle	**SQLAllocConnect**
Connecting to a data source	**SQLConnect**
Freeing an environment handle	**SQLFreeEnv**

SQLAllocStmt (ODBC 1.0, Core)

SQLAllocStmt allocates memory for a statement handle and associates the statement handle with the connection specified by *hdbc*.An application must call **SQLAllocStmt** prior to submitting SQL statements.

Syntax

RETCODE **SQLAllocStmt**(*hdbc*, *phstmt*)

The **SQLAllocStmt** function accepts the following arguments.

Type	Argument	Use	Description
HDBC	*hdbc*	Input	Connection handle.
HSTMT FAR *	*phstmt*	Output	Pointer to storage for the statement handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_INVALID_HANDLE, or SQL_ERROR.

If **SQLAllocStmt** returns SQL_ERROR, it will set the *hstmt* referenced by *phstmt* to SQL_NULL_HSTMT. The application can then obtain additional information by calling **SQLError** with the *hdbc* and SQL_NULL_HSTMT.

Diagnostics

When **SQLAllocStmt** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLAllocStmt** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

08003	Connection not open	(DM) The connection specified by the *hdbc* argument was not open. The connection process must be completed successfully (and the connection must be open) for the driver to allocate an *hstmt*.
IM001	Driver does not support this function	(DM) The driver associated with the *hdbc* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	(DM) The Driver Manager was unable to allocate memory for the statement handle. The driver was unable to allocate memory for the statement handle.
S1009	Invalid argument value	(DM) The argument *phstmt* was a null pointer.

Comments

A statement handle references statement information, such as network information, SQLSTATE values and error messages, cursor name, number of result set columns, and status information for SQL statement processing.

To request a statement handle, an application connects to a data source and then passes the address of an *hstmt* to **SQLAllocStmt**. The driver allocates memory for the statement information and stores the value of the associated handle in the *hstmt*. On operating systems that support multiple threads, applications can use the same *hstmt* on different threads and drivers must therefore support safe, multithreaded access to this information. The application passes the *hstmt* value in all subsequent calls that require an *hstmt*.

If the application calls **SQLAllocStmt** with a pointer to a valid *hstmt*, the driver overwrites the *hstmt* without regard to its previous contents.

Code Example

See **SQLConnect**, and **SQLSetCursorName**.

Related Functions

For information about	See
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Freeing a statement handle	**SQLFreeStmt**
Preparing a statement for execution	**SQLPrepare**

SQLBindCol (ODBC 1.0, Core)

SQLBindCol assigns the storage and data type for a column in a result set, including:

- A storage buffer that will receive the contents of a column of data
- The length of the storage buffer
- A storage location that will receive the actual length of the column of data returned by the fetch operation
- Data type conversion

Syntax

RETCODE **SQLBindCol**(*hstmt*, *icol*, *fCType*, *rgbValue*, *cbValueMax*, *pcbValue*)

The **SQLBindCol** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*icol*	Input	Column number of result data, ordered sequentially left to right, starting at 1. A column number of 0 is used to retrieve a bookmark for the row.

SWORD	*fCType*	Input	The C data type of the result data. This must be one of the following values: SQL_C_BINARY SQL_C_BIT SQL_C_BOOKMARK SQL_C_CHAR SQL_C_DATE SQL_C_DEFAULT SQL_C_DOUBLE SQL_C_FLOAT SQL_C_SLONG SQL_C_SSHORT SQL_C_STINYINT SQL_C_TIME SQL_C_TIMESTAMP SQL_C_ULONG SQL_C_USHORT SQL_C_UTINYINT SQL_C_DEFAULT specifies that data be transferred to its default C data type.

Note Drivers must also support the following values of *fCType* from ODBC 1.0. Applications must use these values, rather than the ODBC 2.0 values, when calling an ODBC 1.0 driver:

SQL_C_LONG

SQL_C_SHORT,

SQL_C_TINYINT

For more information, see "ODBC 1.0 C Data Types" in Appendix D, "Data Types."

For information about how data is converted, see "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."

PTR	*rgbValue*	Input	Pointer to storage for the data. If *rgbValue* is a null pointer, the driver unbinds the column. (To unbind all columns, an application calls **SQLFreeStmt** with the SQL_UNBIND option.)

SDWORD	*cbValueMax*	Input	Maximum length of the *rgbValue* buffer. For character data, *rgbValue* must also include space for the null-termination byte. For more information about length, see "Precision, Scale, Length, and Display Size" in Appendix D, "Data Types."
SDWORD FAR *	*pcbValue*	Input	SQL_NULL_DATA or the number of bytes (excluding the null termination byte for character data) available to return in *rgbValue* prior to calling **SQLExtendedFetch** or **SQLFetch**, or SQL_NO_TOTAL if the number of available bytes cannot be determined. For character data, if the number of bytes available to return is SQL_NO_TOTAL or is greater than or equal to *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* – 1 bytes and is null-terminated by the driver. For binary data, if the number of bytes available to return is SQL_NO_TOTAL or is greater than *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* bytes. For all other data types, the value of *cbValueMax* is ignored and the driver assumes the size of *rgbValue* is the size of the C data type specified with *fCType*. For more information about the value returned in *pcbValue* for each *fCType*, see "*Converting Data from SQL to C Data Types" on page D-19.*

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLBindCol** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLBindCol** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the

Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	The value specified for the argument *icol* exceeded the maximum number of columns supported by the data source.
S1003	Program type out of range	(DM) The argument *fCType* was not a valid data type or SQL_C_DEFAULT. The argument *icol* was 0 and the argument *fCType* was not SQL_C_BOOKMARK.

S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value specified for the argument *cbValueMax* was less than 0.
S1C00	Driver not capable	The driver does not support the data type specified in the argument *fCType*. The argument *icol* was 0 and the driver does not support bookmarks.

Comments

The ODBC interface provides two ways to retrieve a column of data:

- **SQLBindCol** assigns the storage location for a column of data before the data is retrieved. When **SQLFetch** or **SQLExtendedFetch** is called, the driver places the data for all bound columns in the assigned locations.
- **SQLGetData** (an extended function) assigns a storage location for a column of data after **SQLFetch** or **SQLExtendedFetch** has been called. It also places the data for the requested column in the assigned location. Because it can retrieve data from a column in parts, **SQLGetData** can be used to retrieve long data values.

An application may choose to bind every column with **SQLBindCol**, to do no binding and retrieve data only with **SQLGetData**, or to use a combination of the two. However, unless the driver provides extended functionality, **SQLGetData** can only be used to retrieve data from columns that occur after the last bound column.

An application calls **SQLBindCol** to pass the pointer to the storage buffer for a column of data to the driver and to specify how or if the data will be converted. It is the application's responsibility to allocate enough storage for the data. If the buffer will contain variable length data, the application must allocate as much storage as the maximum length of the

bound column or the data may be truncated. For a list of valid data conversion types, see "*Converting Data from SQL to C Data Types" on page D-19*.

At fetch time, the driver processes the data for each bound column according to the arguments specified in **SQLBindCol**. First, it converts the data according to the argument *fCType*. Next, it fills the buffer pointed to by *rgbValue*. Finally, it stores the available number of bytes in *pcbValue*; this is the number of bytes available prior to calling **SQLFetch** or **SQLExtendedFetch**.

- If SQL_MAX_LENGTH has been specified with **SQLSetStmtOption** and the available number of bytes is greater than SQL_MAX_LENGTH, the driver stores SQL_MAX_LENGTH in *pcbValue*.
- If the data is truncated because of SQL_MAX_LENGTH, but the user's buffer was large enough for SQL_MAX_LENGTH bytes of data, SQL_SUCCESS is returned.

NOTE: The SQL_MAX_LENGTH statement option is intended to reduce network traffic and may not be supported by all drivers. To guarantee that data is truncated, an application should allocate a buffer of the desired size and specify this size in the *cbValueMax* argument.

- If the user's buffer causes the truncation, the driver returns SQL_SUCCESS_WITH_INFO and SQLSTATE 01004 (Data truncated) for the fetch function.
- If the data value for a column is NULL, the driver sets *pcbValue* to SQL_NULL_DATA.
- If the number of bytes available to return cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL.

When an application uses **SQLExtendedFetch** to retrieve more than one row of data, it only needs to call **SQLBindCol** once for each column of the result set (just as when it binds a column in order to retrieve a single row of data with **SQLFetch**). The **SQLExtendedFetch** function coordinates the placement of each row of data into subsequent locations in the rowset buffers. For additional information about binding rowset buffers, see the "Comments" topic for **SQLExtendedFetch**.

An application can call **SQLBindCol** to bind a column to a new storage location, regardless of whether data has already been fetched. The new binding replaces the old binding. Note that the new binding does not apply to data already fetched; the next time data is fetched, the data will be placed in the new storage location.

To unbind a single bound column, an application calls **SQLBindCol** and specifies a null pointer for *rgbValue*; if *rgbValue* is a null pointer and the column is not bound, **SQLBindCol** returns SQL_SUCCESS. To unbind all bound columns, an application calls **SQLFreeStmt** with the SQL_UNBIND option.

Code Example

In the following example, an application executes a **SELECT** statement to return a result set of the employee names, ages, and birthdays, which is sorted by birthday. It then calls **SQLBindCol** to bind the columns of data to local storage locations. Finally, the application fetches each row of data with **SQLFetch** and prints each employee's name, age, and birthday.

For more code examples, see **SQLColumns**, **SQLExtendedFetch**, and **SQLSetPos**.

```
#define NAME_LEN 30
#define BDAY_LEN 11

UCHAR  szName[NAME_LEN], szBirthday[BDAY_LEN];
SWORD  sAge;
SDWORD cbName, cbAge, cbBirthday;

retcode = SQLExecDirect(hstmt,
     "SELECT NAME, AGE, BIRTHDAY FROM EMPLOYEE ORDER BY 3, 2, 1",
     SQL_NTS);

if (retcode == SQL_SUCCESS) {

/* Bind columns 1, 2, and 3 */

SQLBindCol(hstmt, 1, SQL_C_CHAR, szName, NAME_LEN, &cbName);
SQLBindCol(hstmt, 2, SQL_C_SSHORT, &sAge, 0, &cbAge);
SQLBindCol(hstmt, 3, SQL_C_CHAR, szBirthday, BDAY_LEN, &cbBirthday);

/* Fetch and print each row of data.  On */
/* an error, display a message and exit. */

while (TRUE) {
     retcode = SQLFetch(hstmt);
     if (retcode == SQL_ERROR || retcode == SQL_SUCCESS_WITH_INFO) {
          show_error();
     }
     if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){
          fprintf(out, "%-*s %-2d %*s", NAME_LEN-1, szName,
               sAge, BDAY_LEN-1, szBirthday);

     } else {
          break;
     }
   }
}
```

Related Functions

For information about	See
Returning information about a column in a result set	**SQLDescribeCol**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Freeing a statement handle	**SQLFreeStmt**
Fetching part or all of a column of data	**SQLGetData (extension)**
Returning the number of result set columns	**SQLNumResultCols**

SQLBindParameter (ODBC 2.0, Level 1)

SQLBindParameter binds a buffer to a parameter marker in an SQL statement.

Note This function replaces the ODBC 1.0 function **SQLSetParam**. For more information, see the "Comments" in this section.

Syntax

RETCODE **SQLBindParameter**(*hstmt*, *ipar*, *fParamType*, *fCType*, *fSqlType*, *cbColDef*, *ibScale*, *rgbValue*, *cbValueMax*, *pcbValue*)

The **SQLBindParameter** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*ipar*	Input	Parameter number, ordered sequentially left to right, starting at 1.
SWORD	*fParamType*	Input	The type of the parameter. For more information, see "fParamType Argument" in "Comments."
SWORD	*fCType*	Input	The C data type of the parameter. For more information, see "fCType Argument" in "Comments."
SWORD	*fSqlType*	Input	The SQL data type of the parameter. For more information, see "fSqlType Argument" in "Comments."
UDWORD	*cbColDef*	Input	The precision of the column or expression of the corresponding parameter marker. For more information, see "cbColDef Argument" in "Comments."
SWORD	*ibScale*	Input	The scale of the column or expression of the corresponding parameter marker. For further information concerning scale, see "Precision, Scale, Length, and Display Size," in Appendix D, "Data Types."
PTR	*rgbValue*	Input/ Output	A pointer to a buffer for the parameter's data. For more information, see "rgbValue Argument" in "Comments."

SDWORD	*cbValueMax*	Input	Maximum length of the *rgbValue* buffer. For more information, see "cbValueMax Argument" in "Comments."
SDWORD FAR *	*pcbValue*	Input/ Output	A pointer to a buffer for the parameter's length. For more information, see "pcb-Value Argument" in "Comments."

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLBindParameter** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLBindParameter** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQL-STATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
07006	Restricted data type attribute violation	The data value identified by the *fCType* argument cannot be converted to the data type identified by the *fSqlType* argument.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or comple-tion of the function.

S1003	Program type out of range	(DM) The value specified by the argument *fCType* was not a valid data type or SQL_C_DEFAULT.
S1004	SQL data type out of range	(DM) The value specified for the argument *fSqlType* was in the block of numbers reserved for ODBC SQL data type indicators but was not a valid ODBC SQL data type indicator.
S1009	Invalid argument value	(DM) The argument *rgbValue* was a null pointer, the argument *pcbValue* was a null pointer, and the argument *fParamType* was not SQL_PARAM_OUTPUT.
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value specified for the argument *cbValueMax* was less than 0.
S1093	Invalid parameter number	(DM) The value specified for the argument *ipar* was less than 1. The value specified for the argument *ipar* was greater than the maximum number of parameters supported by the data source.
S1094	Invalid scale value	The value specified for the argument *ibScale* was outside the range of values supported by the data source for a column of the SQL data type specified by the *fSqlType* argument.
S1104	Invalid precision value	The value specified for the argument *cbColDef* was outside the range of values supported by the data source for a column of the SQL data type specified by the *fSqlType* argument.

S1105	Invalid parameter type	(DM) The value specified for the argument *fParamType* was invalid (see "Comments"). The value specified for the argument *fParamType* was SQL_PARAM_OUTPUT and the parameter did not mark a return value from a procedure or a procedure parameter. The value specified for the argument *fParamType* was SQL_PARAM_INPUT and the parameter marked the return value from a procedure.
S1C00	Driver not capable	The driver or data source does not support the conversion specified by the combination of the value specified for the argument *fCType* and the driver-specific value specified for the argument *fSqlType*. The value specified for the argument *fSqlType* was a valid ODBC SQL data type indicator for the version of ODBC supported by the driver, but was not supported by the driver or data source. The value specified for the argument *fSqlType* was in the range of numbers reserved for driver-specific SQL data type indicators, but was not supported by the driver or data source.

Comments

An application calls **SQLBindParameter** to bind each parameter marker in an SQL statement. Bindings remain in effect until the application calls **SQLBindParameter** again or until the application calls **SQLFreeStmt** with the SQL_DROP or SQL_RESET_PARAMS option.

For more information concerning parameter data types and parameter markers, see *"Parameter Data Types" on page C-2*.

fParamType Argument

The *fParamType* argument specifies the type of the parameter. All parameters in SQL statements that do not call procedures, such as **INSERT** statements, are input parameters. Parameters in procedure calls can be input, input/output, or output parameters.

The *fParamType* argument is one of the following values:

- SQL_PARAM_INPUT. The parameter marks a parameter in an SQL statement that does not call a procedure, such as an **INSERT** statement, or it marks an input parameter in a procedure; these are collectively known as *input parameters*. For example, the parameters in **INSERT INTO Employee VALUES (?, ?, ?)** and **{call AddEmp(?, ?, ?)}** are input parameters.

  When the statement is executed, the driver sends data for the parameter to the data source; the *rgbValue* buffer must contain a valid input value or the *pcbValue* buffer must contain SQL_NULL_DATA, SQL_DATA_AT_EXEC, or the result of the SQL_LEN_DATA_AT_EXEC macro.

  If an application cannot determine the type of a parameter in a procedure call, it sets *fParamType* to SQL_PARAM_INPUT; if the data source returns a value for the parameter, the driver discards it.

- SQL_PARAM_INPUT_OUTPUT. The parameter marks an input/output parameter in a procedure. For example, the parameter in **{call GetEmpDept(?)}** is an input/output parameter that accepts an employee's name and returns the name of the employee's department.

  When the statement is executed, the driver sends data for the parameter to the data source; the *rgbValue* buffer must contain a valid input value or the *pcbValue* buffer must contain SQL_NULL_DATA, SQL_DATA_AT_EXEC, or the result of the SQL_LEN_DATA_AT_EXEC macro. After the statement is executed, the driver returns data for the parameter to the application; if the data source does not return a value for an input/output parameter, the driver sets the *pcbValue* buffer to SQL_NULL_DATA.

  NOTE: When an ODBC 1.0 application calls **SQLSetParam** in an ODBC 2.0 driver, the Driver Manager converts this to a call to **SQLBindParameter** in which the *fParamType* argument is set to SQL_PARAM_INPUT_OUTPUT.

- SQL_PARAM_OUTPUT. The parameter marks the return value of a procedure or an output parameter in a procedure; these are collectively known as *output parameters*. For example, the parameter in **{?=call GetNextEmpID}** is an output parameter that returns the next employee ID.

  After the statement is executed, the driver returns data for the parameter to the application, unless the *rgbValue* and *pcbValue* arguments are both null pointers, in which case the driver discards the output value. If the data source does not return a value for an output parameter, the driver sets the *pcbValue* buffer to SQL_NULL_DATA.

fCType Argument

The C data type of the parameter. This must be one of the following values:

SQL_C_BINARY

SQL_C_BIT

SQL_C_CHAR

SQL_C_DATE

SQL_C_DEFAULT

SQL_C_DOUBLE

SQL_C_FLOAT

SQL_C_SLONG

SQL_C_SSHORT

SQL_C_STINYINT

SQL_C_TIME

SQL_C_TIMESTAMP

SQL_C_ULONG

SQL_C_USHORT

SQL_C_UTINYINT

SQL_C_DEFAULT specifies that the parameter value be transferred from the default C data type for the SQL data type specified with *fSqlType*.

For more information, see “Default C Data Types” and “Converting Data from C to SQL Data Types” and “Converting Data from SQL to C Data Types” in Appendix D, “Data Types.”

NOTE: Drivers must also support the following values of *fCType* from ODBC 1.0. Applications must use these values, instead of the ODBC 2.0 values, when calling an ODBC 1.0 driver:

SQL_C_LONG
SQL_C_SHORT
SQL_C_TINYINT

For more information, *“ODBC 1.0 C Data Types” on page D-9.*

fSqlType Argument

This must be one of the following values:

SQL_BIGINT

SQL_BINARY

SQL_BIT

SQL_CHAR

SQL_DATE

SQL_DECIMAL

SQL_DOUBLE

SQL_FLOAT

SQL_INTEGER

SQL_LONGVARBINARY

SQL_LONGVARCHAR

SQL_NUMERIC

SQL_REAL

SQL_SMALLINT

SQL_TIME

SQL_TIMESTAMP

SQL_TINYINT

SQL_VARBINARY

SQL_VARCHAR

or a driver-specific value. Values greater than SQL_TYPE_DRIVER_START are reserved by ODBC; values less than or equal to SQL_TYPE_DRIVER_START are driver-specific.

For information about how data is converted, see "Converting Data from C to SQL Data Types" and "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."

cbColDef Argument

The *cbColDef* argument specifies the precision of the column or expression corresponding to the parameter marker, unless all of the following are true:

- An ODBC 2.0 application calls **SQLBindParameter** in an ODBC 1.0 driver or an ODBC 1.0 application calls **SQLSetParam** in an ODBC 2.0 driver. (Note that the Driver Manager converts these calls.)
- The *fSqlType* argument is SQL_LONGVARBINARY or SQL_LONGVARCHAR.

- The data for the parameter will be sent with **SQLPutData**.
- In this case, the *cbColDef* argument contains the total number of bytes that will be sent for the parameter. For more information, see "Passing Parameter Values" and SQL_DATA_AT_EXEC in "pcbValue Argument."

rgbValue Argument

The *rgbValue* argument points to a buffer that, when **SQLExecute** or **SQLExecDirect** is called, contains the actual data for the parameter. The data must be in the form specified by the *fCType* argument.

If *rgbValue* points to a character string that contains a literal quote character ('), the driver ensures that each literal quote is translated into the form required by the data source. For example, if the data source required that embedded literal quotes be doubled, the driver would replace each quote character (') with two quote characters (' ').

If *pcbValue* is the result of the SQL_LEN_DATA_AT_EXEC(*length*) macro or SQL_DATA_AT_EXEC, then *rgbValue* is an application-defined 32-bit value that is associated with the parameter. It is returned to the application through **SQLParamData**. For example, *rgbValue* might be a token such as a parameter number, a pointer to data, or a pointer to a structure that the application used to bind input parameters. Note, however, that if the parameter is an input/output parameter, *rgbValue* must be a pointer to a buffer where the output value will be stored. If **SQLParamOptions** was called to specify multiple values for the parameter, the application can use the value of the *pirow* argument in **SQLParamOptions** in conjunction with the *rgbValue*. For example, *rgbValue* might point to an array of values and the application might use *pirow* to retrieve the correct value from the array. For more information, see "Passing Parameter Values."

If the *fParamType* argument is SQL_PARAM_INPUT_OUTPUT or SQL_PARAM_OUTPUT, *rgbValue* points to a buffer in which the driver returns the output value. If the procedure returns one or more result sets, the *rgbValue* buffer is not guaranteed to be set until all results have been fetched. (If *fParamType* is SQL_PARAM_OUTPUT and *rgbValue* and *pcbValue* are both null pointers, the driver discards the output value.)

If the application calls **SQLParamOptions** to specify multiple values for each parameter, *rgbValue* points to an array. A single SQL statement processes the entire array of input values for an input or input/output parameter and returns an array of output values for an input/output or output parameter.

cbValueMax Argument

For character and binary C data, the *cbValueMax* argument specifies the length of the *rgbValue* buffer (if it is a single element) or the length of an element in the *rgbValue* array (if the application calls **SQLParamOptions** to specify multiple values for each parameter). If the

application specifies multiple values, *cbValueMax* is used to determine the location of values in the *rgbValue* array, both on input and on output. For input/output and output parameters, it is used to determine whether to truncate character and binary C data on output:

- For character C data, if the number of bytes available to return is greater than or equal to *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* – 1 bytes and is null-terminated by the driver.
- For binary C data, if the number of bytes available to return is greater than *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* bytes.

For all other types of C data, the *cbValueMax* argument is ignored. The length of the *rgbValue* buffer (if it is a single element) or the length of an element in the *rgbValue* array (if the application calls **SQLParamOptions** to specify multiple values for each parameter) is assumed to be the length of the C data type.

NOTE: When an ODBC 1.0 application calls **SQLSetParam** in an ODBC 2.0 driver, the Driver Manager converts this to a call to **SQLBindParameter** in which the *cbValueMax* argument is always SQL_SETPARAM_VALUE_MAX. Because the Driver Manager returns an error if an ODBC 2.0 application sets *cbValueMax* to SQL_SETPARAM_VALUE_MAX, an ODBC 2.0 driver can use this to determine when it is called by an ODBC 1.0 application.

In **SQLSetParam**, the way in which an application specifies the length of the *rgbValue* buffer so that the driver can return character or binary data and the way in which an application sends an array of character or binary parameter values to the driver are driver-defined.

pcbValue Argument

The *pcbValue* argument points to a buffer that, when **SQLExecute** or **SQLExecDirect** is called, contains one of the following:

- The length of the parameter value stored in *rgbValue*. This is ignored except for character or binary C data.
- SQL_NTS. The parameter value is a null-terminated string.
- SQL_NULL_DATA. The parameter value is NULL.
- SQL_DEFAULT_PARAM. A procedure is to use the default value of a parameter, rather than a value retrieved from the application. This value is valid only in a procedure call, and then only if the *fParamType* argument is SQL_PARAM_INPUT or SQL_PARAM_INPUT_OUTPUT. When *pcbValue* is SQL_DEFAULT_PARAM, the *fCType*, *fSqlType*, *cbColDef*, *ibScale*, *cbValueMax* and *rgbValue* arguments are ignored for input parameters and are used only to define the output parameter value for input/output parameters.

  NOTE: This value was introduced in ODBC 2.0.

- The result of the SQL_LEN_DATA_AT_EXEC(*length*) macro. The data for the parameter will be sent with **SQLPutData**. If the *fSqlType* argument is SQL_LONGVARBINARY, SQL_LONGVARCHAR, or a long, data source–specific data type and the driver returns "Y" for the SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo**, *length* is the number of bytes of data to be sent for the parameter; otherwise, *length* must be a nonnegative value and is ignored. For more information, see "Passing Parameter Values."

  For example, to specify that 10,000 bytes of data will be sent with **SQLPutData** for an SQL_LONGVARCHAR parameter, an application sets *pcbValue* to SQL_LEN_DATA_AT_EXEC(10000).

  NOTE: This macro was introduced in ODBC 2.0.

- SQL_DATA_AT_EXEC. The data for the parameter will be sent with **SQLPutData**. This value is used by ODBC 2.0 applications when calling ODBC 1.0 drivers and by ODBC 1.0 applications when calling ODBC 2.0 drivers. For more information, see "Passing Parameter Values" in the next section.

If *pcbValue* is a null pointer, the driver assumes that all input parameter values are non-NULL and that character and binary data are null-terminated. If *fParamType* is SQL_PARAM_OUTPUT and *rgbValue* and *pcbValue* are both null pointers, the driver discards the output value.

NOTE: Application developers are strongly discouraged from specifying a null pointer for *pcbValue* when the data type of the parameter is SQL_C_BINARY. For SQL_C_BINARY data, a driver sends only the data preceding an occurrence of the null-termination character, 0x00. To ensure that a driver does not unexpectedly truncate SQL_C_BINARY data, *pcbValue* should contain a pointer to a valid length value.

If the *fParamType* argument is SQL_PARAM_INPUT_OUTPUT or SQL_PARAM_OUTPUT, *pcbValue* points to a buffer in which the driver returns SQL_NULL_DATA, the number of bytes available to return in *rgbValue* (excluding the null termination byte of character data), or SQL_NO_TOTAL if the number of bytes available to return cannot be determined. If the procedure returns one or more result sets, the *pcbValue* buffer is not guaranteed to be set until all results have been fetched.

If the application calls **SQLParamOptions** to specify multiple values for each parameter, *pcbValue* points to an array of SDWORD values. These can be any of the values listed earlier in this section and are processed with a single SQL statement.

Passing Parameter Values

An application can pass the value for a parameter either in the *rgbValue* buffer or with one or more calls to **SQLPutData**. Parameters whose data is passed with **SQLPutData** are known

as *data-at-execution* parameters. These are commonly used to send data for SQL_LONGVARBINARY and SQL_LONGVARCHAR parameters and can be mixed with other parameters.

To pass parameter values, an application:

1. Calls **SQLBindParameter** for each parameter to bind buffers for the parameter's value (*rgbValue* argument) and length (*pcbValue* argument). For data-at-execution parameters, *rgbValue* is an application-defined 32-bit value such as a parameter number or a pointer to data. The value will be returned later and can be used to identify the parameter.
2. Places values for input and input/output parameters in the *rgbValue* and *pcbValue* buffers:
   - For normal parameters, the application places the parameter value in the *rgbValue* buffer and the length of that value in the *pcbValue* buffer.
   - For data-at-execution parameters, the application places the result of the SQL_LEN_DATA_AT_EXEC(*length*) macro (when calling an ODBC 2.0 driver) or SQL_DATA_AT_EXEC (when calling an ODBC 1.0 driver) in the *pcbValue* buffer.
3. Calls **SQLExecute** or **SQLExecDirect** to execute the SQL statement.
   - If there are no data-at-execution parameters, the process is complete.
   - If there are any data-at-execution parameters, the function returns SQL_NEED_DATA.
4. Calls **SQLParamData** to retrieve the application-defined value specified in the *rgbValue* argument for the first data-at-execution parameter to be processed.

   NOTE: Although data-at-execution parameters are similar to data-at-execution columns, the value returned by **SQLParamData** is different for each.

   Data-at-execution parameters are parameters in an SQL statement for which data will be sent with **SQLPutData** when the statement is executed with **SQLExecDirect** or **SQLExecute**. They are bound with **SQLBindParameter**. The value returned by **SQLParamData** is a 32-bit value passed to **SQLBindParameter** in the *rgbValue* argument.

   Data-at-execution columns are columns in a rowset for which data will be sent with **SQLPutData** when a row is updated or added with **SQLSetPos**. They are bound with **SQLBindCol**. The value returned by **SQLParamData** is the address of the row in the *rgbValue* buffer that is being processed.
5. Calls **SQLPutData** one or more times to send data for the parameter. More than one call is needed if the data value is larger than the *rgbValue* buffer specified in **SQLPutData**; note that multiple calls to **SQLPutData** for the same parameter are allowed only

when sending character C data to a column with a character, binary, or data source–specific data type or when sending binary C data to a column with a character, binary, or data source–specific data type.

6. Calls **SQLParamData** again to signal that all data has been sent for the parameter.

   - If there are more data-at-execution parameters, **SQLParamData** returns SQL_NEED_DATA and the application-defined value for the next data-at-execution parameter to be processed. The application repeats steps 5 and 6.
   - If there are no more data-at-execution parameters, the process is complete. If the statement was successfully executed, **SQLParamData** returns SQL_SUCCESS or SQL_SUCCESS_WITH_INFO; if the execution failed, it returns SQL_ERROR. At this point, **SQLParamData** can return any SQLSTATE that can be returned by the function used to execute the statement (**SQLExecDirect** or **SQLExecute**).
   - Output values for any input/output or output parameters will be available in the *rgbValue* and *pcbValue* buffers after the application retrieves any result sets generated by the statement.

After **SQLExecute** or **SQLExecDirect** returns SQL_NEED_DATA, and before data is sent for all data-at-execution parameters, the statement is canceled, or an error occurs in **SQLParamData** or **SQLPutData**, the application can only call **SQLCancel**, **SQLGetFunctions**, **SQLParamData**, or **SQLPutData** with the *hstmt* or the *hdbc* associated with the *hstmt*. If it calls any other function with the *hstmt* or the *hdbc* associated with the *hstmt*, the function returns SQL_ERROR and SQLSTATE S1010 (Function sequence error).

If the application calls **SQLCancel** while the driver still needs data for data-at-execution parameters, the driver cancels statement execution; the application can then call **SQLExecute** or **SQLExecDirect** again. If the application calls **SQLParamData** or **SQLPutData** after canceling the statement, the function returns SQL_ERROR and SQLSTATE S1008 (Operation canceled).

Conversion of Calls to and from SQLSetParam

When an ODBC 1.0 application calls **SQLSetParam** in an ODBC 2.0 driver, the ODBC 2.0 Driver Manager maps the call as follows:

Call by ODBC 1.0 Application	Call to ODBC 2.0 Driver
SQLSetParam(	SQLBindParameter
hstmt, ipar,	(hstmt, ipar,
fCType, fSqlType, cbColDef, ibScale,	SQL_PARAM_INPUT_OUTPUT,
rgbValue,	fCType, fSqlType, cbColDef, ibScale,
pcbValue);	rgbValue,
	SQL_SETPARAM_VALUE_MAX,
	pcbValue);

When an ODBC 2.0 application calls **SQLBindParameter** in an ODBC 1.0 driver, the ODBC 2.0 Driver Manager maps the calls as follows:

Call by ODBC 2.0 Application	Call to ODBC 1.0 Driver
SQLBindParameter(	SQLSetParam(
hstmt, ipar, fParamType,	hstmt, ipar,
fCType, fSqlType, cbColDef, ibScale,	fCType, fSqlType, cbColDef, ibScale,
rgbValue, cbValueMax, pcbValue);	rgbValue, pcbValue);

Code Example

In the following example, an application prepares an SQL statement to insert data into the EMPLOYEE table. The SQL statement contains parameters for the NAME, AGE, and BIRTHDAY columns. For each parameter in the statement, the application calls **SQLBind-Parameter** to specify the ODBC C data type and the SQL data type of the parameter and to bind a buffer to each parameter. For each row of data, the application assigns data values to each parameter and calls **SQLExecute** to execute the statement.

For more code examples, see **SQLParamOptions**, **SQLPutData**, and **SQLSetPos**.

```
#define NAME_LEN 30

UCHAR       szName[NAME_LEN];
SWORD       sAge;
SDWORD      cbName = SQL_NTS, cbAge = 0, cbBirthday = 0;
DATE_STRUCT dsBirthday;

retcode = SQLPrepare(hstmt,
"INSERT INTO EMPLOYEE (NAME, AGE, BIRTHDAY) VALUES (?, ?, ?)",
```

```
          SQL_NTS);
if (retcode == SQL_SUCCESS) {

      /* Specify data types and buffers.          */
      /* for Name, Age, Birthday parameter data.  */

      SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_CHAR,
                       SQL_CHAR, NAME_LEN, 0, szName, 0, &cbName);
      SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_SSHORT,
                       SQL_SMALLINT, 0, 0, &sAge, 0, &cbAge);
      SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT, SQL_C_DATE,
                       SQL_DATE, 0, 0, &dsBirthday, 0, &cbBirthday);
      strcpy(szName, "Smith, John D.");    /* Specify first row of   */
      sAge = 40;                           /* parameter data         */
      dsBirthday.year = 1952;
      dsBirthday.month = 2;
      dsBirthday.day = 29;
      retcode = SQLExecute(hstmt);         /* Execute statement with */
                                           /* first row              */

      strcpy(szName, "Jones, Bob K.");     /* Specify second row of  */
      sAge = 52;                           /* parameter data         */
      dsBirthday.year = 1940;
      dsBirthday.month = 3;
      dsBirthday.day = 31;
      SQLExecute(hstmt);                   /* Execute statement with  */
                                           /* second row              */
}
```

Related Functions

For information about	See
Returning information about a parameter in a statement	**SQLDescribeParam (extension)**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Returning the number of statement parameters	**SQLNumParams (extension)**
Returning the next parameter to send data for	**SQLParamData (extension)**
Specifying multiple parameter values	**SQLParamOptions (extension)**
Sending parameter data at execution time	**SQLPutData (extension)**

SQLCancel (ODBC 1.0, Core)

SQLCancel cancels the processing on an *hstmt*.

Syntax

RETCODE **SQLCancel**(*hstmt*)

The **SQLCancel** function accepts the following argument.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLCancel** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLCancel** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
70100	Operation aborted	The data source was unable to process the cancel request.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

Comments

SQLCancel can cancel the following types of processing on an *hstmt*:

- A function running asynchronously on the *hstmt*.
- A function on an *hstmt* that needs data.
- A function running on the *hstmt* on another thread.

If an application calls **SQLCancel** when no processing is being done on the *hstmt*, **SQLCancel** has the same effect as **SQLFreeStmt** with the SQL_CLOSE option; this behavior is defined only for completeness and applications should call **SQLFreeStmt** to close cursors.

Canceling Asynchronous Processing

After an application calls a function asynchronously, it calls the function repeatedly to determine whether it has finished processing. If the function is still processing, it returns SQL_STILL_EXECUTING. If the function has finished processing, it returns a different code.

After any call to the function that returns SQL_STILL_EXECUTING, an application can call **SQLCancel** to cancel the function. If the cancel request is successful, the driver returns SQL_SUCCESS. This message does not indicate that the function was actually canceled; it indicates that the cancel request was processed. When or if the function is actually canceled is driver- and data source–dependent. The application must continue to call the original function until the return code is not SQL_STILL_EXECUTING. If the function was successfully canceled, the return code is SQL_ERROR and SQLSTATE S1008 (Operation canceled). If the function completed its normal processing, the return code is SQL_SUCCESS or SQL_SUCCESS_WITH_INFO if the function succeeded or SQL_ERROR and a SQLSTATE other than S1008 (Operation canceled) if the function failed.

Canceling Functions that Need Data

After **SQLExecute** or **SQLExecDirect** returns SQL_NEED_DATA and before data has been sent for all data-at-execution parameters, an application can call **SQLCancel** to cancel the statement execution. After the statement has been canceled, the application can call **SQLExecute** or **SQLExecDirect** again. For more information, see **SQLBindParameter**.

After **SQLSetPos** returns SQL_NEED_DATA and before data has been sent for all data-at-execution columns, an application can call **SQLCancel** to cancel the operation. After the operation has been canceled, the application can call **SQLSetPos** again; canceling does not affect the cursor state or the current cursor position. For more information, see **SQLSetPos**.

Canceling Functions in Multithreaded Applications

In a multithreaded application, the application can cancel a function that is running synchronously on an *hstmt*. To cancel the function, the application calls **SQLCancel** with the same *hstmt* as that used by the target function, but on a different thread. As in canceling a function running asynchronously, the return code of the **SQLCancel** only indicates whether the driver processed the request successfully. The return code of the original function indicates whether it completed normally or was canceled.

Related Functions

For information about	See
Assigning storage for a parameter	**SQLBindParameter**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Freeing a statement handle	**SQLFreeStmt**
Positioning the cursor in a rowset	**SQLSetPos (extension)**
Returning the next parameter to send data for	**SQLParamData (extension)**
Sending parameter data at execution time	**SQLPutData (extension)**

SQLColAttributes (ODBC 1.0, Core)

SQLColAttributes returns descriptor information for a column in a result set; it cannot be used to return information about the bookmark column (column 0). Descriptor information is returned as a character string, a 32-bit descriptor-dependent value, or an integer value.

Syntax

RETCODE **SQLColAttributes**(*hstmt*, *icol*, *fDescType*, *rgbDesc*, *cbDescMax*, *pcbDesc*, *pfDesc*)

The **SQLColAttributes** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	icol	Input	Column number of result data, ordered sequentially from left to right, starting at 1. Columns may be described in any order.
UWORD	fDescType	Input	A valid descriptor type (see "Comments").
PTR	rgbDesc	Output	Pointer to storage for the descriptor information. The format of the descriptor information returned depends on the *fDescType*.
SWORD	cbDescMax	Input	Maximum length of the *rgbDesc* buffer.
SWORD FAR *	pcbDesc	Output	Total number of bytes (excluding the null termination byte for character data) available to return in *rgbDesc*. For character data, if the number of bytes available to return is greater than or equal to *cbDescMax*, the descriptor information in *rgbDesc* is truncated to *cbDescMax* – 1 bytes and is null-terminated by the driver. For all other types of data, the value of *cbValueMax* is ignored and the driver assumes the size of *rgbValue* is 32 bits.

SDWORD FAR *	pfDesc	Output	Pointer to an integer value to contain descriptor information for numeric descriptor types, such as SQL_COLUMN_LENGTH.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLColAttributes** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLColAttributes** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The buffer *rgbDesc* was not large enough to return the entire string value, so the string value was truncated. The argument *pcbDesc* contains the length of the untruncated string value. (Function returns SQL_SUCCESS_WITH_INFO.)
24000	Invalid cursor state	The statement associated with the *hstmt* did not return a result set. There were no columns to describe.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	(DM) The value specified for the argument *icol* was 0 and the argument *fDescType* was not SQL_COLUMN_COUNT. The value specified for the argument *icol* was greater than the number of columns in the result set and the argument *fDescType* was not SQL_COLUMN_COUNT.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLPrepare** or **SQLExecDirect** for the *hstmt*. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value specified for the argument *cbDescMax* was less than 0.
S1091	Descriptor type out of range	(DM) The value specified for the argument *fDescType* was in the block of numbers reserved for ODBC descriptor types but was not valid for the version of ODBC supported by the driver (see "Comments").

S1C00	Driver not capable	The value specified for the argument *fDescType* was in the range of numbers reserved for driver-specific descriptor types but was not supported by the driver.
S1T00	Timeout expired	The timeout period expired before the data source returned the requested information. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

SQLColAttributes can return any SQLSTATE that can be returned by **SQLPrepare** or **SQLExecute** when called after **SQLPrepare** and before **SQLExecute** depending on when the data source evaluates the SQL statement associated with the *hstmt*.

Comments

SQLColAttributes returns information either in *pfDesc* or in *rgbDesc*. Integer information is returned in *pfDesc* as a 32-bit, signed value; all other formats of information are returned in *rgbDesc*. When information is returned in *pfDesc*, the driver ignores *rgbDesc*, *cbDescMax*, and *pcbDesc*. When information is returned in *rgbDesc*, the driver ignores *pfDesc*.

The currently defined descriptor types, the version of ODBC in which they were introduced, and the arguments in which information is returned for them are shown below; it is expected that more descriptor types will be defined to take advantage of different data sources. Descriptor types from 0 to 999 are reserved by ODBC; driver developers must reserve values greater than or equal to SQL_COLUMN_DRIVER_START for driver-specific use.

A driver must return a value for each of the descriptor types defined in the following table. If a descriptor type does not apply to a driver or data source, then, unless otherwise stated, the driver returns 0 in *pcbDesc* or an empty string in *rgbDesc*.

fDescType	Info returned in	Description
SQL_COLUMN_AUTO_INCREMENT (ODBC 1.0)	pfDesc	TRUE if the column is autoincrement. FALSE if the column is not autoincrement or is not numeric. Auto increment is valid for numeric data type columns only. An application can insert values into an autoincrement column, but cannot update values in the column.
SQL_COLUMN_CASE_SENSITIVE (ODBC 1.0)	pfDesc	TRUE if the column is treated as case sensitive for collations and comparisons. FALSE if the column is not treated as case sensitive for collations and comparisons or is noncharacter.
SQL_COLUMN_COUNT (ODBC 1.0)	pfDesc	Number of columns available in the result set. The icol argument is ignored.
SQL_COLUMN_DISPLAY_SIZE (ODBC 1.0)	pfDesc	Maximum number of characters required to display data from the column. For more information on display size, see “Precision, Scale, Length, and Display Size” in Appendix D, “Data Types.”
SQL_COLUMN_LABEL (ODBC 2.0)	rgbDesc	The column label or title. For example, a column named EmpName might be labeled Employee Name. If a column does not have a label, the column name is returned. If the column is unlabeled and unnamed, an empty string is returned.

SQL_COLUMN_LENGTH (ODBC 1.0)	pfDesc	The length in bytes of data transferred on an **SQLGetData** or **SQLFetch** operation if SQL_C_DEFAULT is specified. For numeric data, this size may be different than the size of the data stored on the data source. For more length information, see "Precision, Scale, Length, and Display Size" in Appendix D, "Data Types."
SQL_COLUMN_MONEY (ODBC 1.0)	pfDesc	TRUE if the column is money data type. FALSE if the column is not money data type.
SQL_COLUMN_NAME (ODBC 1.0)	rgbDesc	The column name. If the column is unnamed, an empty string is returned.
SQL_COLUMN_NULLABLE (ODBC 1.0)	pfDesc	SQL_NO_NULLS if the column does not accept NULL values. SQL_NULLABLE if the column accepts NULL values. SQL_NULLABLE_UNKNOWN if it is not known if the column accepts NULL values.
SQL_COLUMN_OWNER_NAME (ODBC 2.0)	rgbDesc	The owner of the table that contains the column. The returned value is implementation-defined if the column is an expression or if the column is part of a view. If the data source does not support owners or the owner name cannot be determined, an empty string is returned.
SQL_COLUMN_PRECISION (ODBC 1.0)	pfDesc	The precision of the column on the data source. For more information on precision, see "*Precision, Scale, Length, and Display Size" on page D-14*."

SQL_COLUMN_QUALIFIER_NAME (ODBC 2.0)	rgbDesc	The qualifier of the table that contains the column. The returned value is implementation-defined if the column is an expression or if the column is part of a view. If the data source does not support qualifiers or the qualifier name cannot be determined, an empty string is returned.
SQL_COLUMN_SCALE (ODBC 1.0)	pfDesc	The scale of the column on the data source. For more information on scale, see "Precision, Scale, Length, and Display Size" in Appendix D, "Data Types."
SQL_COLUMN_SEARCHABLE (ODBC 1.0)	pfDesc	SQL_UNSEARCHABLE if the column cannot be used in a **WHERE** clause. SQL_LIKE_ONLY if the column can be used in a **WHERE** clause only with the **LIKE** predicate. SQL_ALL_EXCEPT_LIKE if the column can be used in a **WHERE** clause with all comparison operators except **LIKE**. SQL_SEARCHABLE if the column can be used in a **WHERE** clause with any comparison operator. Columns of type SQL_LONGVARCHAR and SQL_LONGVARBINARY usually return SQL_LIKE_ONLY.
SQL_COLUMN_TABLE_NAME (ODBC 2.0)	rgbDesc	The name of the table that contains the column. The returned value is implementation-defined if the column is an expression or if the column is part of a view. If the table name cannot be determined, an empty string is returned.

SQL_COLUMN_TYPE (ODBC 1.0)	pfDesc	SQL data type. This can be an ODBC SQL data type or a driver-specific SQL data type. For a list of valid ODBC SQL data types, see "*Precision, Scale, Length, and Display Size" on page D-14*. For information about driver-specific SQL data types, see the driver's documentation.
SQL_COLUMN_TYPE_NAME (ODBC 1.0)	rgbDesc	Data source–dependent data type name; for example, "CHAR", "VARCHAR", "MONEY", "LONG VARBINARY", or "CHAR ( ) FOR BIT DATA". If the type is unknown, an empty string is returned.
SQL_COLUMN_UNSIGNED (ODBC 1.0)	pfDesc	TRUE if the column is unsigned (or not numeric). FALSE if the column is signed.
SQL_COLUMN_UPDATABLE (ODBC 1.0)	pfDesc	Column is described by the values for the defined constants: SQL_ATTR_READONLY SQL_ATTR_WRITE SQL_ATTR_READWRITE_UNKNOWN SQL_COLUMN_UPDATABLE describes the updatability of the column in the result set. Whether a column is updatable can be based on the data type, user privileges, and the definition of the result set itself. If it is unclear whether a column is updatable, SQL_ATTR_READWRITE_UNKNOWN should be returned.

This function is an extensible alternative to **SQLDescribeCol**. **SQLDescribeCol** returns a fixed set of descriptor information based on ANSI-89 SQL. **SQLColAttributes** allows access to the more extensive set of descriptor information available in ANSI SQL-92 and DBMS vendor extensions.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLDescribeCol**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**

SQLColumns (ODBC 1.0, Level 1)

SQLColumns returns the list of column names in specified tables. The driver returns this information as a result set on the specified *hstmt*.

Syntax

RETCODE **SQLColumns**(*hstmt, szTableQualifier, cbTableQualifier, szTableOwner, cbTableOwner, szTableName, cbTableName, szColumnName, cbColumnName*)

The **SQLColumns** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UCHAR FAR *	*szTableQualifier*	Input	Qualifier name. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have qualifiers.
SWORD	*cbTableQualifier*	Input	Length of *szTableQualifier.*
UCHAR FAR *	*szTableOwner*	Input	String search pattern for owner names. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have owners.
SWORD	*cbTableOwner*	Input	Length of *szTableOwner.*
UCHAR FAR *	*szTableName*	Input	String search pattern for table names.
SWORD	*cbTableName*	Input	Length of *szTableName*.
UCHAR FAR *	*szColumnName*	Input	String search pattern for column names.
SWORD	*cbColumnName*	Input	Length of *szColumnName*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLColumns** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLColumns** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value of one of the name length arguments was less than 0, but not equal to SQL_NTS. The value of one of the name length arguments exceeded the maximum length value for the corresponding qualifier or name. The maximum length of each qualifier or name may be obtained by calling **SQLGetInfo** with the *fInfoType* values (see "Comments").
S1C00	Driver not capable	A table qualifier was specified and the driver or data source does not support qualifiers. A table owner was specified and the driver or data source does not support owners.

		A string search pattern was specified for the table owner, table name, or column name and the data source does not support search patterns for one or more of those arguments.
		The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

This function is typically used before statement execution to retrieve information about columns for a table or tables from the data source's catalog. Note by contrast, that the functions **SQLColAttributes** and **SQLDescribeCol** describe the columns in a result set and that the function **SQLNumResultCols** returns the number of columns in a result set.

Note **SQLColumns** might not return all columns. For example, a driver might not return information about pseudo-columns. Applications can use any valid column, regardless of whether it is returned by **SQLColumns**.

SQLColumns returns the results as a standard result set, ordered by TABLE_QUALIFIER, TABLE_OWNER, and TABLE_NAME. The following table lists the columns in the result set. Additional columns beyond column 12 (REMARKS) can be defined by the driver.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source. To determine the actual lengths of the TABLE_QUALIFIER, TABLE_OWNER, TABLE_NAME, and COLUMN_NAME columns, an application can call **SQLGetInfo** with the SQL_MAX_QUALIFIER_NAME_LEN, SQL_MAX_OWNER_NAME_LEN, SQL_MAX_TABLE_NAME_LEN, and SQL_MAX_COLUMN_NAME_LEN options.

Column Name	Data Type	Comments
TABLE_QUALIFIER	Varchar(128)	Table qualifier identifier; NULL if not applicable to the data source. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have qualifiers.
TABLE_OWNER	Varchar(128)	Table owner identifier; NULL if not applicable to the data source. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have owners.
TABLE_NAME	Varchar(128) not NULL	Table identifier.
COLUMN_NAME	Varchar(128) not NULL	Column identifier.
DATA_TYPE	Smallint not NULL	SQL data type. This can be an ODBC SQL data type or a driver-specific SQL data type. For a list of valid ODBC SQL data types, *"SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.
TYPE_NAME	Varchar(128) not NULL	Data source–dependent data type name; for example, "CHAR", "VARCHAR", "MONEY", "LONG VARBINARY", or "CHAR ( ) FOR BIT DATA".

PRECISION	Integer	The precision of the column on the data source. For precision information, see "*Precision, Scale, Length, and Display Size" on page D-14*.
LENGTH	Integer	The length in bytes of data transferred on an **SQLGetData** or **SQLFetch** operation if SQL_C_DEFAULT is specified. For numeric data, this size may be different than the size of the data stored on the data source. This value is the same as the PRECISION column for character or binary data. For more information about length, see "Precision, Scale, Length, and Display Size" in Appendix D, "Data Types."
SCALE	Smallint	The scale of the column on the data source. For more scale information, see "*Precision, Scale, Length, and Display Size" on page D-14*. NULL is returned for data types where scale is not applicable.
RADIX	Smallint	For numeric data types, either 10 or 2. If it is 10, the values in PRECISION and SCALE give the number of decimal digits allowed for the column. For example, a DECIMAL(12,5) column would return a RADIX of 10, a PRECISION of 12, and a SCALE of 5; A FLOAT column could return a RADIX of 10, a PRECISION of 15 and a SCALE of NULL. If it is 2, the values in PRECISION and SCALE give the number of bits allowed in the column. For example, a FLOAT column could return a RADIX of 2, a PRECISION of 53, and a SCALE of NULL. NULL is returned for data types where radix is not applicable.
NULLABLE	Smallint not NULL	SQL_NO_NULLS if the column does not accept NULL values. SQL_NULLABLE if the column accepts NULL values. SQL_NULLABLE_UNKNOWN if it is not known if the column accepts NULL values.
REMARKS	Varchar(254)	A description of the column.

The *szTableOwner*, *szTableName*, and *szColumnName* arguments accept search patterns. For more information about valid search patterns, see "Search Pattern Arguments" earlier in this chapter.

Code Example

In the following example, an application declares storage locations for the result set returned by **SQLColumns**. It calls **SQLColumns** to return a result set that describes each column in the EMPLOYEE table. It then calls **SQLBindCol** to bind the columns in the result set to the storage locations. Finally, the application fetches each row of data with **SQLFetch** and processes it.

```
#define STR_LEN 128+1
#define REM_LEN 254+1

/* Declare storage locations for result set data */

UCHAR  szQualifier[STR_LEN], szOwner[STR_LEN];
UCHAR  szTableName[STR_LEN], szColName[STR_LEN];
UCHAR  szTypeName[STR_LEN], szRemarks[REM_LEN];
SDWORD Precision, Length;
SWORD  DataType, Scale, Radix, Nullable;

/* Declare storage locations for bytes available to return */

SDWORD cbQualifier, cbOwner, cbTableName, cbColName;
SDWORD cbTypeName, cbRemarks, cbDataType, cbPrecision;
SDWORD cbLength, cbScale, cbRadix, cbNullable;

retcode = SQLColumns(hstmt,
                     NULL, 0,              /* All qualifiers */
                     NULL, 0,              /* All owners     */
                     "EMPLOYEE", SQL_NTS,  /* EMPLOYEE table */
                     NULL, 0);             /* All columns    */

if (retcode == SQL_SUCCESS) {

      /* Bind columns in result set to storage locations */

      SQLBindCol(hstmt, 1, SQL_C_CHAR, szQualifier, STR_LEN,&cbQualifier);
      SQLBindCol(hstmt, 2, SQL_C_CHAR, szOwner, STR_LEN, &cbOwner);
      SQLBindCol(hstmt, 3, SQL_C_CHAR, szTableName, STR_LEN,&cbTableName);
      SQLBindCol(hstmt, 4, SQL_C_CHAR, szColName, STR_LEN, &cbColName);
      SQLBindCol(hstmt, 5, SQL_C_SSHORT, &DataType, 0, &cbDataType);
      SQLBindCol(hstmt, 6, SQL_C_CHAR, szTypeName, STR_LEN, &cbTypeName);
```

```
        SQLBindCol(hstmt, 7, SQL_C_SLONG, &Precision, 0, &cbPrecision);
        SQLBindCol(hstmt, 8, SQL_C_SLONG, &Length, 0, &cbLength);
        SQLBindCol(hstmt, 9, SQL_C_SSHORT, &Scale, 0, &cbScale);
        SQLBindCol(hstmt, 10, SQL_C_SSHORT, &Radix, 0, &cbRadix);
        SQLBindCol(hstmt, 11, SQL_C_SSHORT, &Nullable, 0, &cbNullable);
        SQLBindCol(hstmt, 12, SQL_C_CHAR, szRemarks, REM_LEN, &cbRemarks);

        while(TRUE) {
           retcode = SQLFetch(hstmt);
           if (retcode == SQL_ERROR || retcode == SQL_SUCCESS_WITH_INFO) {
                show_error( );
           }
           if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){
                ...;  /* Process fetched data */
           } else {
                break;
           }
        }
}
```

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning privileges for a column or columns	**SQLColumnPrivileges (extension)**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning table statistics and indexes	**SQLStatistics (extension)**
Returning a list of tables in a data source	**SQLTables (extension)**

SQLConnect (ODBC 1.0, Core)

SQLConnect loads a driver and establishes a connection to a data source. The connection handle references storage of all information about the connection, including status, transaction state, and error information.

Syntax

RETCODE **SQLConnect**(*hdbc*, *szDSN*, *cbDSN*, *szUID*, *cbUID*, *szAuthStr*, *cbAuthStr*)

The **SQLConnect** function accepts the following arguments.

Type	Argument	Use	Description
HDBC	hdbc	Input	Connection handle.
UCHAR FAR *	szDSN	Input	Data source name.
SWORD	cbDSN	Input	Length of *szDSN*.
UCHAR FAR *	szUID	Input	User identifier.
SWORD	cbUID	Input	Length of *szUID*.
UCHAR FAR *	szAuthStr	Input	Authentication string (typically the password).
SWORD	cbAuthStr	Input	Length of *szAuthStr*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLConnect** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLConnect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description

01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08001	Unable to connect to data source	The driver was unable to establish a connection with the data source.
08002	Connection in use	(DM) The specified *hdbc* had already been used to establish a connection with a data source and the connection was still open.
08004	Data source rejected establishment of connection	The data source rejected the establishment of the connection for implementation-defined reasons.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was attempting to connect failed before the function completed processing.
28000	Invalid authorization specification	The value specified for the argument *szUID* or the value specified for the argument *szAuthStr* violated restrictions defined by the data source.
IM001	Driver does not support this function	(DM) The driver specified by the data source name does not support the function.
IM002	Data source not found and no default driver specified	(DM) The data source name specified in the argument *szDSN* was not found in the ODBC.INI file or registry, nor was there a default driver specification. (DM) The ODBC.INI file could not be found.
IM003	Specified driver could not be loaded	(DM) The driver listed in the data source specification in the ODBC.INI file or registry was not found or could not be loaded for some other reason.
IM004	Driver's SQLAllocEnv failed	(DM) During **SQLConnect**, the Driver Manager called the driver's **SQLAllocEnv** function and the driver returned an error.
IM005	Driver's SQLAllocConnect failed	(DM) During **SQLConnect**, the Driver Manager called the driver's **SQLAllocConnect** function and the driver returned an error.

IM006	Driver's SQLSetConnect-Option failed	(DM) During **SQLConnect**, the Driver Manager called the driver's **SQLSetConnectOption** function and the driver returned an error. (Function returns SQL_SUCCESS_WITH_INFO).
IM009	Unable to load translation DLL	The driver was unable to load the translation DLL that was specified for the data source.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	(DM) The Driver Manager was unable to allocate memory required to support execution or completion of the function. The driver was unable to allocate memory required to support execution or completion of the function.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbDSN* was less than 0, but not equal to SQL_NTS. (DM) The value specified for argument *cbDSN* exceeded the maximum length for a data source name. (DM) The value specified for argument *cbUID* was less than 0, but not equal to SQL_NTS. (DM) The value specified for argument *cbAuthStr* was less than 0, but not equal to SQL_NTS.
S1T00	Timeout expired	The timeout period expired before the connection to the data source completed. The timeout period is set through **SQLSetConnectOption**, SQL_LOGIN_TIMEOUT.

Comments

The Driver Manager does not load a driver until the application calls a function (**SQLConnect**, **SQLDriverConnect**) to connect to the driver. Until that point, the Driver Manager works with its own handles and manages connection information. When the application calls a connection function, the Driver Manager checks if a driver is currently loaded for the specified *hdbc*:

- If a driver is not loaded, the Driver Manager loads the driver and calls **SQLAllocEnv**, **SQLAllocConnect**, **SQLSetConnectOption** (if the application specified any connection options), and the connection function in the driver. The Driver Manager returns SQLSTATE IM006 (Driver's SQLSetConnectOption failed) and SQL_SUCCESS_WITH_INFO for the connection function if the driver returned an error for **SQLSetConnectOption**.
- If the specified driver is already loaded on the *hdbc*, the Driver Manager only calls the connection function in the driver. In this case, the driver must ensure that all connection options for the *hdbc* maintain their current settings.
- If a different driver is loaded, the Driver Manager calls **SQLFreeConnect** and **SQLFreeEnv** in the loaded driver and then unloads that driver. It then performs the same operations as when a driver is not loaded.

The driver then allocates handles and initializes itself.

NOTE: To resolve the addresses of the ODBC functions exported by the driver, the Driver Manager checks if the driver exports a dummy function with the ordinal 199. If it does not, the Driver Manager resolves the addresses by name. If it does, the Driver Manager resolves the addresses of the ODBC functions by ordinal, which is faster. The ordinal values of the ODBC functions must match the values of the *fFunction* argument in **SQLGetFunctions**; all other exported functions (such as **WEP**) must have ordinal values outside the range 1–199.

When the application calls **SQLDisconnect**, the Driver Manager calls **SQLDisconnect** in the driver. However, it does not unload the driver. This keeps the driver in memory for applications that repeatedly connect to and disconnect from a data source. When the application calls **SQLFreeConnect**, the Driver Manager calls **SQLFreeConnect** and **SQLFreeEnv** in the driver and then unloads the driver.

An ODBC application can establish more than one connection.

Driver Manager Guidelines

The contents of *szDSN* affect how the Driver Manager and a driver work together to establish a connection to a data source.

- If *szDSN* contains a valid data source name, the Driver Manager locates the corresponding data source specification in the ODBC.INI file or registry and loads the associated driver DLL. The Driver Manager passes each **SQLConnect** argument to the driver.
- If the data source name cannot be found or *szDSN* is a null pointer, the Driver Manager locates the default data source specification and loads the associated driver DLL. The Driver Manager passes each **SQLConnect** argument to the driver.
- If the data source name cannot be found or *szDSN* is a null pointer, and the default data source specification does not exist, the Driver Manager returns SQL_ERROR with SQLSTATE IM002 (Data source name not found and no default driver specified).

After being loaded by the Driver Manager, a driver can locate its corresponding data source specification in the ODBC.INI file or registry and use driver-specific information from the specification to complete its set of required connection information.

If a default translation DLL is specified in the ODBC.INI file or registry for the data source, the driver loads it. A different translation DLL can be loaded by calling **SQLSetConnectOption** with the SQL_TRANSLATE_DLL option. A translation option can be specified by calling **SQLSetConnectOption** with the SQL_TRANSLATE_OPTION option.

If a driver supports **SQLConnect**, the driver keyword section of the ODBC.INF file for the driver must contain the **ConnectFunctions** keyword with the first character set to "Y".

Code Example

In the following example, an application allocates environment and connection handles. It then connects to the EmpData data source with the user ID JohnS and the password Sesame and processes data. When it has finished processing data, it disconnects from the data source and frees the handles.

```
HENV    henv;
HDBC    hdbc;
HSTMT   hstmt;
RETCODE retcode;

retcode = SQLAllocEnv(&henv);              /* Environment handle */
if (retcode == SQL_SUCCESS) {
       retcode = SQLAllocConnect(henv, &hdbc); /* Connection handle */
       if (retcode == SQL_SUCCESS) {

          /* Set login timeout to 5 seconds. */

          SQLSetConnectOption(hdbc, SQL_LOGIN_TIMEOUT, 5);

          /* Connect to data source */
```

```
        retcode = SQLConnect(hdbc, "EmpData", SQL_NTS,
                                   "JohnS", SQL_NTS,
                                   "Sesame", SQL_NTS);


        if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){

            /* Process data after successful connection */

            retcode = SQLAllocStmt(hdbc, &hstmt); /* Statement handle */
            if (retcode == SQL_SUCCESS) {
            ...;
            ...;
            ...;
            SQLFreeStmt(hstmt, SQL_DROP);
            }
            SQLDisconnect(hdbc);
        }
        SQLFreeConnect(hdbc);
    }
    SQLFreeEnv(henv);
}
```

Related Functions

For information about	See
Allocating a connection handle	**SQLAllocConnect**
Allocating a statement handle	**SQLAllocStmt**
Disconnecting from a data source	**SQLDisconnect**
Connecting to a data source using a connection string or dialog box	**SQLDriverConnect** (extension)
Returning the setting of a connection option	**SQLGetConnectOption** (extension)
Setting a connection option	**SQLSetConnectOption** (extension)

SQLDataSources (ODBC 1.0, Level 2)

SQLDataSources lists data source names. This function is implemented solely by the Driver Manager.

NOTE: This function is not implemented in SOLID *SQL API*, but it is available through ODBC Driver Manager.

Syntax

RETCODE **SQLDataSources**(*henv, fDirection, szDSN, cbDSNMax, pcbDSN, szDescription, cbDescriptionMax, pcbDescription*)

The **SQLDataSources** function accepts the following arguments:

Type	Argument	Use	Description
HENV	*henv*	Input	Environment handle.
UWORD	*fDirection*	Input	Determines whether the Driver Manager fetches the next data source name in the list (SQL_FETCH_NEXT) or whether the search starts from the beginning of the list (SQL_FETCH_FIRST).
UCHAR FAR *	*szDSN*	Output	Pointer to storage for the data source name.
SWORD	*cbDSNMax*	Input	Maximum length of the *szDSN* buffer; this does not need to be longer than SQL_MAX_DSN_LENGTH + 1.
SWORD FAR *	*pcbDSN*	Output	Total number of bytes (excluding the null termination byte) available to return in *szDSN*. If the number of bytes available to return is greater than or equal to *cbDSNMax*, the data source name in *szDSN* is truncated to *cbDSNMax* – 1 bytes.
UCHAR FAR *	*szDescription*	Output	Pointer to storage for the description of the driver associated with the data source. For example, dBASE or SQL Server.

SWORD	*cbDescriptionMax*	Input	Maximum length of the *szDescription* buffer; this should be at least 255 bytes.
SWORD FAR *	*pcbDescription*	Output	Total number of bytes (excluding the null termination byte) available to return in *szDescription*. If the number of bytes available to return is greater than or equal to *cbDescriptionMax*, the driver description in *szDescription* is truncated to *cbDescriptionMax* – 1 bytes.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDataSources** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDataSources** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	(DM) Driver Manager–specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	(DM) The buffer *szDSN* was not large enough to return the entire data source name, so the name was truncated. The argument *pcbDSN* contains the length of the entire data source name. (Function returns SQL_SUCCESS_WITH_INFO.) (DM) The buffer *szDescription* was not large enough to return the entire driver description, so the description was truncated. The argument *pcbDescription* contains the length of the untruncated data source description. (Function returns SQL_SUCCESS_WITH_INFO.)

S1000	General error	(DM) An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	(DM) The Driver Manager was unable to allocate memory required to support execution or completion of the function.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbDSNMax* was less than 0. (DM) The value specified for argument *cbDescriptionMax* was less than 0.
S1103	Direction option out of range	(DM) The value specified for the argument *fDirection* was not equal to SQL_FETCH_FIRST or SQL_FETCH_NEXT.

Comments

Because **SQLDataSources** is implemented in the Driver Manager, it is supported for all drivers regardless of a particular driver's conformance level.

An application can call **SQLDataSources** multiple times to retrieve all data source names. The Driver Manager retrieves this information from the ODBC.INI file or the registry. When there are no more data source names, the Driver Manager returns SQL_NO_DATA_FOUND. If **SQLDataSources** is called with SQL_FETCH_NEXT immediately after it returns SQL_NO_DATA_FOUND, it will return the first data source name.

If SQL_FETCH_NEXT is passed to **SQLDataSources** the very first time it is called, it will return the first data source name.

The driver determines how data source names are mapped to actual data sources.

Related Functions

For information about	See
Connecting to a data source	**SQLConnect**
Connecting to a data source using a connection string or dialog box	**SQLDriverConnect (extension)**
Returning driver descriptions and attributes	**SQLDrivers (extension)**

SQLDescribeCol (ODBC 1.0, Core)

SQLDescribeCol returns the result descriptor — column name, type, precision, scale, and nullability — for one column in the result set; it cannot be used to return information about the bookmark column (column 0).

Syntax

RETCODE **SQLDescribeCol**(*hstmt*, *icol*, *szColName*, *cbColNameMax*, *pcbColName*, *pfSqlType*, *pcbColDef*, *pibScale*, *pfNullable*)

The **SQLDescribeCol** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	icol	Input	Column number of result data, ordered sequentially left to right, starting at 1.
UCHAR FAR *	szColName	Output	Pointer to storage for the column name. If the column is unnamed or the column name cannot be determined, the driver returns an empty string.
SWORD	cbColNameMax	Input	Maximum length of the *szColName* buffer.
SWORD FAR *	pcbColName	Output	Total number of bytes (excluding the null termination byte) available to return in *szColName*. If the number of bytes available to return is greater than or equal to *cbColNameMax*, the column name in *szColName* is truncated to *cbColNameMax* – 1 bytes.

SWORD FAR *	pfSqlType	Output	The SQL data type of the column. This must be one of the following values: SQL_BIGINT SQL_BINARY SQL_BIT SQL_CHAR SQL_DATE SQL_DECIMAL SQL_DOUBLE SQL_FLOAT SQL_INTEGER SQL_LONGVARBINARY SQL_LONGVARCHAR SQL_NUMERIC SQL_REAL SQL_SMALLINT SQL_TIME SQL_TIMESTAMP SQL_TINYINT SQL_VARBINARY SQL_VARCHAR or a driver-specific SQL data type. If the data type cannot be determined, the driver returns 0. For more information, see *"SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.

UDWORD FAR *	*pcbColDef*	Output	The precision of the column on the data source. If the precision cannot be determined, the driver returns 0. For more information on precision, see "*Precision, Scale, Length, and Display Size" on page D-14*.
SWORD FAR *	*pibScale*	Output	The scale of the column on the data source. If the scale cannot be determined or is not applicable, the driver returns 0. For more information on scale, see "*Precision, Scale, Length, and Display Size" on page D-14*.
SWORD FAR *	*pfNullable*	Output	Indicates whether the column allows NULL values. One of the following values: SQL_NO_NULLS: The column does not allow NULL values. SQL_NULLABLE: The column allows NULL values. SQL_NULLABLE_UNKNOWN: The driver cannot determine if the column allows NULL values.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDescribeCol** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDescribeCol** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The buffer *szColName* was not large enough to return the entire column name, so the column name was truncated. The argument *pcbColName* contains the length of the untruncated column name. (Function returns SQL_SUCCESS_WITH_INFO.)
24000	Invalid cursor state	The statement associated with the *hstmt* did not return a result set. There were no columns to describe.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	(DM) The value specified for the argument *icol* was 0. The value specified for the argument *icol* was greater than the number of columns in the result set.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.

S1010	Function sequence error	(DM) The function was called prior to calling **SQLPrepare** or **SQLExecDirect** for the *hstmt*. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbCol-NameMax* was less than 0.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

SQLDescribeCol can return any SQLSTATE that can be returned by **SQLPrepare** or **SQLExecute** when called after **SQLPrepare** and before **SQLExecute** depending on when the data source evaluates the SQL statement associated with the *hstmt*.

Comments

An application typically calls **SQLDescribeCol** after a call to **SQLPrepare** and before or after the associated call to **SQLExecute**. An application can also call **SQLDescribeCol** after a call to **SQLExecDirect**.

SQLDescribeCol retrieves the column name, type, and length generated by a **SELECT** statement. If the column is an expression, *szColName* is either an empty string or a driver-defined name.

NOTE: ODBC supports SQL_NULLABLE_UNKNOWN as an extension, even though the X/Open and SQL Access Group Call Level Interface specification does not specify the option for **SQLDescribeCol**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLColAttributes**
Fetching a row of data	**SQLFetch**
Returning the number of result set columns	**SQLNumResultCols**
Preparing a statement for execution	**SQLPrepare**

SQLDescribeParam (ODBC 1.0, Level 2)

SQLDescribeParam returns the description of a parameter marker associated with a prepared SQL statement.

Syntax

RETCODE **SQLDescribeParam**(*hstmt, ipar, pfSqlType, pcbColDef, pibScale, pfNullable*)

The **SQLDescribeParam** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	ipar	Input	Parameter marker number ordered sequentially left to right, starting at 1.
SWORD FAR *	*pfSqlType*	Output	The SQL data type of the parameter. This must be one of the following values: SQL_BIGINT SQL_BINARY SQL_BIT SQL_CHAR SQL_DATE SQL_DECIMAL SQL_DOUBLE SQL_FLOAT SQL_INTEGER SQL_LONGVARBINARY SQL_LONGVARCHAR SQL_NUMERIC SQL_REAL SQL_SMALLINT SQL_TIME SQL_TIMESTAMP SQL_TINYINT SQL_VARBINARY SQL_VARCHAR

SWORD FAR * (con'd)			or a driver-specific SQL data type. For more information, see "*SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.
UDWORD FAR *	*pcbColDef*	Output	The precision of the column or expression of the corresponding parameter marker as defined by the data source. For further information concerning precision, see "*Precision, Scale, Length, and Display Size" on page D-14*.
SWORD FAR *	*pibScale*	Output	The scale of the column or expression of the corresponding parameter as defined by the data source. For more information on scale, see "*Precision, Scale, Length, and Display Size" on page D-14*
SWORD FAR *	*pfNullable*	Output	Indicates whether the parameter allows NULL values. One of the following: SQL_NO_NULLS: The parameter does not allow NULL values (this is the default value). SQL_NULLABLE: The parameter allows NULL values. SQL_NULLABLE_UNKNOWN: The driver cannot determine if the parameter allows NULL values.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDescribeParam** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDescribeParam** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQL-

STATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation error	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLPrepare** or **SQLExecDirect** for the *hstmt*. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.

S1093	Invalid parameter number	(DM) The value specified for the argument *ipar* was 0. The value specified for the argument *ipar* was greater than the number of parameters in the associated SQL statement.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

Parameter markers are numbered from left to right in the order they appear in the SQL statement.

SQLDescribeParam does not return the type (input, input/output, or output) of a parameter in an SQL statement. Except in calls to procedures, all parameters in SQL statements are input parameters.

Related Functions

For information about	See
Canceling statement processing	**SQLCancel**
Executing a prepared SQL statement	**SQLExecute**
Preparing a statement for execution	**SQLPrepare**
Assigning storage for a parameter	**SQLBindParameter**

SQLDisconnect (ODBC 1.0, Core)

SQLDisconnect closes the connection associated with a specific connection handle.

Syntax

RETCODE **SQLDisconnect**(*hdbc*)

The **SQLDisconnect** function accepts the following argument.

Type	Argument	Use	Description
HDBC	*hdbc*	Input	Connection handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDisconnect** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDisconnect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01002	Disconnect error	An error occurred during the disconnect. However, the disconnect succeeded. (Function returns SQL_SUCCESS_WITH_INFO.)
08003	Connection not open	(DM) The connection specified in the argument *hdbc* was not open.
25000	Invalid transaction state	There was a transaction in process on the connection specified by the argument *hdbc*. The transaction remains active.
IM001	Driver does not support this function	(DM) The driver associated with the *hdbc* does not support the function.

S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) An asynchronously executing function was called for an *hstmt* associated with the *hdbc* and was still executing when **SQLDisconnect** was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for an *hstmt* associated with the *hdbc* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.

Comments

If an application calls **SQLDisconnect** while there is an incomplete transaction associated with the connection handle, the driver returns SQLSTATE 25000 (Invalid transaction state), indicating that the transaction is unchanged and the connection is open. An incomplete transaction is one that has not been committed or rolled back with **SQLTransact**.

If an application calls **SQLDisconnect** before it has freed all *hstmts* associated with the connection, the driver frees those *hstmts* after it successfully disconnects from the data source. However, if one or more of the *hstmts* associated with the connection are still executing asynchronously, **SQLDisconnect** will return SQL_ERROR with a SQLSTATE value of S1010 (Function sequence error).

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Allocating a connection handle	**SQLAllocConnect**
Connecting to a data source	**SQLConnect**
Connecting to a data source using a connection string or dialog box	**SQLDriverConnect (extension)**
Freeing a connection handle	**SQLFreeConnect**
Executing a commit or rollback operation	**SQLTransact**

SQLDriverConnect (ODBC 1.0, Level 1)

SQLDriverConnect is an alternative to **SQLConnect**. It supports data sources that require more connection information than the three arguments in **SQLConnect**; dialog boxes to prompt the user for all connection information; and data sources that are not defined in the ODBC.INI file or registry.

SQLDriverConnect provides the following connection options:

- Establish a connection using a connection string that contains the data source name, one or more user IDs, one or more passwords, and other information required by the data source.
- Establish a connection using a partial connection string or no additional information; in this case, the Driver Manager and the driver can each prompt the user for connection information.
- Establish a connection to a data source that is not defined in the ODBC.INI file or registry. If the application supplies a partial connection string, the driver can prompt the user for connection information.

Once a connection is established, **SQLDriverConnect** returns the completed connection string. The application can use this string for subsequent connection requests.

Syntax

RETCODE **SQLDriverConnect**(*hdbc*, *hwnd*, *szConnStrIn*, *cbConnStrIn*, *szConnStrOut*, *cbConnStrOutMax*, *pcbConnStrOut*, *fDriverCompletion*)

The **SQLDriverConnect** function accepts the following arguments:

Type	Argument	Use	Description
HDBC	hdbc	Input	Connection handle.
HWND	hwnd	Input	Window handle. The application can pass the handle of the parent window, if applicable, or a null pointer if either the window handle is not applicable or if **SQLDriverConnect** will not present any dialog boxes.
UCHAR FAR *	szConnStrIn	Input	A full connection string (see the syntax in "Comments"), a partial connection string, or an empty string.
SWORD	cbConnStrIn	Input	Length of *szConnStrIn*.

UCHAR FAR *	szConnStrOut	Output	Pointer to storage for the completed connection string. Upon successful connection to the target data source, this buffer contains the completed connection string. Applications should allocate at least 255 bytes for this buffer.
SWORD	cbConnStrOutMax	Input	Maximum length of the *szConnStrOut* buffer.
SWORD FAR *	pcbConnStrOut	Output	Pointer to the total number of bytes (excluding the null termination byte) available to return in *szConnStrOut*. If the number of bytes available to return is greater than or equal to *cbConnStrOutMax*, the completed connection string in *szConnStrOut* is truncated to *cbConnStrOutMax* – 1 bytes.
UWORD	fDriverCompletion	Input	Flag which indicates whether Driver Manager or driver must prompt for more connection information: SQL_DRIVER_PROMPT, SQL_DRIVER_COMPLETE, SQL_DRIVER_COMPLETE_REQUIRED, or SQL_DRIVER_NOPROMPT. (See "Comments," for additional information.)

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDriverConnect** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDriverConnect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQL-

STATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	**Error**	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The buffer *szConnStrOut* was not large enough to return the entire connection string, so the connection string was truncated. The argument *pcbConnStrOut* contains the length of the untruncated connection string. (Function returns SQL_SUCCESS_WITH_INFO.)
01S00	Invalid connection string attribute	An invalid attribute keyword was specified in the connection string (*szConnStrIn*) but the driver was able to connect to the data source anyway. (Function returns SQL_SUCCESS_WITH_INFO.)
08001	Unable to connect to data source	The driver was unable to establish a connection with the data source.
08002	Connection in use	(DM) The specified *hdbc* had already been used to establish a connection with a data source and the connection was still open.
08004	Data source rejected establishment of connection	The data source rejected the establishment of the connection for implementation-defined reasons.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was attempting to connect failed before the function completed processing.
28000	Invalid authorization specification	Either the user identifier or the authorization string or both as specified in the connection string (*szConnStrIn*) violated restrictions defined by the data source.
IM001	Driver does not support this function	(DM) The driver corresponding to the specified data source name does not support the function.

IM002	Data source not found and no default driver specified	(DM) The data source name specified in the connection string (*szConnStrIn*) was not found in the ODBC.INI file or registry and there was no default driver specification.
		(DM) The ODBC.INI file could not be found.
IM003	Specified driver could not be loaded	(DM) The driver listed in the data source specification in the ODBC.INI file or registry, or specified by the **DRIVER** keyword, was not found or could not be loaded for some other reason.
IM004	Driver's SQLAllocEnv failed	(DM) During **SQLDriverConnect**, the Driver Manager called the driver's **SQLAllocEnv** function and the driver returned an error.
IM005	Driver's SQLAllocConnect failed	(DM) During **SQLDriverConnect**, the Driver Manager called the driver's **SQLAllocConnect** function and the driver returned an error.
IM006	Driver's SQLSetConnectOption failed	(DM) During **SQLDriverConnect**, the Driver Manager called the driver's **SQLSetConnectOption** function and the driver returned an error.
IM007	No data source or driver specified; dialog prohibited	No data source name or driver was specified in the connection string and *fDriverCompletion* was SQL_DRIVER_NOPROMPT.
IM008	Dialog failed	(DM) The Driver Manager attempted to display the SQL Data Sources dialog box and failed.
		The driver attempted to display its login dialog box and failed.
IM009	Unable to load translation DLL	The driver was unable to load the translation DLL that was specified for the data source or for the connection.
IM010	Data source name too long	(DM) The attribute value for the DSN keyword was longer than SQL_MAX_DSN_LENGTH characters.
IM011	Driver name too long	(DM) The attribute value for the DRIVER keyword was longer than 255 characters.
IM012	DRIVER keyword syntax error	(DM) The keyword-value pair for the DRIVER keyword contained a syntax error.

S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The Driver Manager was unable to allocate memory required to support execution or completion of the function. The driver was unable to allocate memory required to support execution or completion of the function.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbConnStrIn* was less than 0 and was not equal to SQL_NTS. (DM) The value specified for argument *cbConnStrOutMax* was less than 0.
S1110	Invalid driver completion	(DM) The value specified for the argument *fDriverCompletion* was not equal to SQL_DRIVER_PROMPT, SQL_DRIVER_COMPLETE, SQL_DRIVER_COMPLETE_REQUIRED or SQL_DRIVER_NOPROMPT.
S1T00	Timeout expired	The timeout period expired before the connection to the data source completed. The timeout period is set through **SQLSetConnectOption**, SQL_LOGIN_TIMEOUT.

Comments

Connection Strings

A connection string has the following syntax:

connection-string ::= *empty-string*[;] | *attribute*[;] |
attribute; *connection-string*
empty-string ::=
attribute ::= *attribute-keyword=attribute-value* | DRIVER={*attribute-value*}

(The braces ({}) are literal; the application must specify them.)

attribute-keyword ::= DSN | UID | PWD |
driver-defined-attribute-keyword

attribute-value ::= *character-string*
driver-defined-attribute-keyword ::= *identifier*

where *character-string* has zero or more characters; *identifier* has one or more characters; *attribute-keyword* is case insensitive; *attribute-value* may be case sensitive; and the value of the **DSN** keyword does not consist solely of blanks. Because of connection string and initialization file grammar, keywords and attribute values that contain the characters **[]{}(),;?*=!@** should be avoided. Because of the registry grammar, keywords and data source names cannot contain the backslash (\) character.

Note The **DRIVER** keyword was introduced in ODBC 2.0 and is not supported by ODBC 1.0 drivers.

The connection string may include any number of driver-defined keywords. Because the **DRIVER** keyword does not use information from the ODBC.INI file or registry, the driver must define enough keywords so that a driver can connect to a data source using only the information in the connection string. (For more information, see "Driver Guidelines," later in this section.) The driver defines which keywords are required in order to connect to the data source.

If any keywords are repeated in the connection string, the driver uses the value associated with the first occurrence of the keyword. If the **DSN** and **DRIVER** keywords are included in the same connection string, the Driver Manager and the driver use whichever keyword appears first. The following table describes the attribute values of the **DSN**, **DRIVER**, **UID**, and **PWD** keywords.

Keyword	Attribute value description
DSN	Name of a data source as returned by **SQLDataSources** or the data sources dialog box of **SQLDriverConnect**.
DRIVER	Description of the driver as returned by the **SQLDrivers** function.
UID	A user ID.
PWD	The password corresponding to the user ID, or an empty string if there is no password for the user ID (PWD=;).

Driver Manager Guidelines

The Driver Manager constructs a connection string to pass to the driver in the *szConnStrIn* argument of the driver's **SQLDriverConnect** function. Note that the Driver Manager does not modify the *szConnStrIn* argument passed to it by the application.

If the connection string specified by the application contains the **DSN** keyword or does not contain either the **DSN** or **DRIVER** keywords, the action of the Driver Manager is based on the value of the *fDriverCompletion* argument:

- SQL_DRIVER_PROMPT: The Driver Manager displays the Data Sources dialog box. It constructs a connection string from the data source name returned by the dialog box and any other keywords passed to it by the application. If the data source name returned by the dialog box is empty, the Driver Manager specifies the keyword-value pair DSN=Default.
- SQL_DRIVER_COMPLETE or SQL_DRIVER_COMPLETE_REQUIRED: If the connection string specified by the application includes the **DSN** keyword, the Driver Manager copies the connection string specified by the application. Otherwise, it takes the same actions as it does when *fDriverCompletion* is SQL_DRIVER_PROMPT.
- SQL_DRIVER_NOPROMPT: The Driver Manager copies the connection string specified by the application.

If the connection string specified by the application contains the **DRIVER** keyword, the Driver Manager copies the connection string specified by the application.

Using the connection string it has constructed, the Driver Manager determines which driver to use, loads that driver, and passes the connection string it has constructed to the driver; for more information about the interaction of the Driver Manager and the driver, see the "Comments" section in **SQLConnect**. If the connection string contains the **DSN** keyword or does not contain either the **DSN** or the **DRIVER** keyword, the Driver Manager determines which driver to use as follows:

1. If the connection string contains the **DSN** keyword, the Driver Manager retrieves the driver associated with the data source from the ODBC.INI file or registry.
2. If the connection string does not contain the **DSN** keyword or the data source is not found, the Driver Manager retrieves the driver associated with the Default data source from the ODBC.INI file or registry. However, the Driver Manager does not change the value of the **DSN** keyword in the connection string.
3. If the data source is not found and the Default data source is not found, the Driver Manager returns SQL_ERROR with SQLSTATE IM002 (Data source not found and no default driver specified).

Driver Guidelines

The driver checks if the connection string passed to it by the Driver Manager contains the **DSN** or **DRIVER** keyword. If the connection string contains the **DRIVER** keyword, the driver cannot retrieve information about the data source from the ODBC.INI file or registry. If the connection string contains the **DSN** keyword or does not contain either the **DSN** or the

DRIVER keyword, the driver can retrieve information about the data source from the ODBC.INI file or registry as follows:

1. If the connection string contains the **DSN** keyword, the driver retrieves the information for the specified data source.
2. If the connection string does not contain the **DSN** keyword or the specified data source is not found, the driver retrieves the information for the Default data source.

The driver uses any information it retrieves from the ODBC.INI file or registry to augment the information passed to it in the connection string. If the information in the ODBC.INI file or registry duplicates information in the connection string, the driver uses the information in the connection string.

Based on the value of *fDriverCompletion*, the driver prompts the user for connection information, such as the user ID and password, and connects to the data source:

- SQL_DRIVER_PROMPT: The driver displays a dialog box, using the values from the connection string and ODBC.INI file or registry (if any) as initial values. When the user exits the dialog box, the driver connects to the data source. It also constructs a connection string from the value of the **DSN** or **DRIVER** keyword in *szConnStrIn* and the information returned from the dialog box. It places this connection string in the buffer referenced by *szConnStrOut*.
- SQL_DRIVER_COMPLETE or SQL_DRIVER_COMPLETE_REQUIRED: If the connection string contains enough information, and that information is correct, the driver connects to the data source and copies *szConnStrIn* to *szConnStrOut*. If any information is missing or incorrect, the driver takes the same actions as it does when *fDriverCompletion* is SQL_DRIVER_PROMPT, except that if *fDriverCompletion* is SQL_DRIVER_COMPLETE_REQUIRED, the driver disables the controls for any information not required to connect to the data source.
- SQL_DRIVER_NOPROMPT: If the connection string contains enough information, the driver connects to the data source and copies *szConnStrIn* to *szConnStrOut*. Otherwise, the driver returns SQL_ERROR for **SQLDriverConnect**.

On successful connection to the data source, the driver also sets *pcbConnStrOut* to the length of *szConnStrOut*.

If the user cancels a dialog box presented by the Driver Manager or the driver, **SQLDriverConnect** returns SQL_NO_DATA_FOUND.

For information about how the Driver Manager and the driver interact during the connection process, see **SQLConnect**.

If a driver supports **SQLDriverConnect**, the driver keyword section of the ODBC.INF file for the driver must contain the **ConnectFunctions** keyword with the second character set to "Y".

Connection Options

The SQL_LOGIN_TIMEOUT connection option, set using **SQLSetConnectOption**, defines the number of seconds to wait for a login request to complete before returning to the application. If the user is prompted to complete the connection string, a waiting period for each login request begins after the user has dismissed each dialog box.

The driver opens the connection in SQL_MODE_READ_WRITE access mode by default. To set the access mode to SQL_MODE_READ_ONLY, the application must call **SQLSetConnectOption** with the SQL_ACCESS_MODE option prior to calling **SQLDriverConnect**.

If a default translation DLL is specified in the ODBC.INI file or registry for the data source, the driver loads it. A different translation DLL can be loaded by calling **SQLSetConnectOption** with the SQL_TRANSLATE_DLL option. A translation option can be specified by calling **SQLSetConnectOption** with the SQL_TRANSLATE_OPTION option.

Related Functions

For information about	See
Allocating a connection handle	**SQLAllocConnect**
Connecting to a data source	**SQLConnect**
Disconnecting from a data source	**SQLDisconnect**
Returning driver descriptions and attributes	**SQLDrivers (extension)**
Freeing a connection handle	**SQLFreeConnect**
Setting a connection option	**SQLSetConnectOption (extension)**

SQLDrivers (ODBC 2.0, Level 2)

SQLDrivers lists driver descriptions and driver attribute keywords. This function is implemented solely by the Driver Manager.

NOTE: This function is not implemented in SOLID *SQL API*, but it is available through ODBC Driver Manager.

Syntax

RETCODE **SQLDrivers**(*henv, fDirection, szDriverDesc, cbDriverDescMax, pcbDriverDesc, szDriverAttributes, cbDrvrAttrMax, pcbDrvrAttr*)

The **SQLDrivers** function accepts the following arguments:

Type	Argument	Use	Description
HENV	*henv*	Input	Environment handle.
UWORD	*fDirection*	Input	Determines whether the Driver Manager fetches the next driver description in the list (SQL_FETCH_NEXT) or whether the search starts from the beginning of the list (SQL_FETCH_FIRST).
UCHAR FAR *	*szDriverDesc*	Output	Pointer to storage for the driver description.
SWORD	*cbDriverDescMax*	Input	Maximum length of the *szDriverDesc* buffer.
SWORD FAR *	*pcbDriverDesc*	Output	Total number of bytes (excluding the null termination byte) available to return in *szDriverDesc*. If the number of bytes available to return is greater than or equal to *cbDriverDescMax*, the driver description in *szDriverDesc* is truncated to *cbDriverDescMax* – 1 bytes.
UCHAR FAR *	*szDriverAttributes*	Output	Pointer to storage for the list of driver attribute value pairs (see "Comments").

SWORD	*cbDrvrAttrMax*	Input	Maximum length of the *szDriverAttributes* buffer.
SWORD FAR *	*pcbDrvrAttr*	Output	Total number of bytes (excluding the null termination byte) available to return in *szDriverAttributes*. If the number of bytes available to return is greater than or equal to *cbDrvrAttrMax*, the list of attribute value pairs in *szDriverAttributes* is truncated to *cbDrvrAttrMax* – 1 bytes.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLDrivers** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLDrivers** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	(DM) Driver Manager–specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	(DM) The buffer *szDriverDesc* was not large enough to return the entire driver description, so the description was truncated. The argument *pcbDriverDesc* contains the length of the entire driver description. (Function returns SQL_SUCCESS_WITH_INFO.)

		(DM) The buffer *szDriverAttributes* was not large enough to return the entire list of attribute value pairs, so the list was truncated. The argument *pcbDrvrAttr* contains the length of the untruncated list of attribute value pairs. (Function returns SQL_SUCCESS_WITH_INFO.)
S1000	General error	(DM) An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	(DM) The Driver Manager was unable to allocate memory required to support execution or completion of the function.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbDriverDescMax* was less than 0. (DM) The value specified for argument *cbDrvrAttrMax* was less than 0 or equal to 1.
S1103	Direction option out of range	(DM) The value specified for the argument *fDirection* was not equal to SQL_FETCH_FIRST or SQL_FETCH_NEXT.

Comments

SQLDrivers returns the driver description in the *szDriverDesc* argument. It returns additional information about the driver in the *szDriverAttributes* argument as a list of keyword-value pairs. Each pair is terminated with a null byte, and the entire list is terminated with a null byte (that is, two null bytes mark the end of the list). For example, a dBASE driver might return the following list of attributes ("\0" represents a null byte):

```
FileUsage=1\0FileExtns=*.dbf\0\0
```

If *szDriverAttributes* is not large enough to hold the entire list, the list is truncated, **SQLDrivers** returns SQLSTATE 01004 (Data truncated), and the length of the list (excluding the final null termination byte) is returned in *pcbDrvrAttr.*

Driver attribute keywords are added from the ODBC.INF file when the driver is installed.

An application can call **SQLDrivers** multiple times to retrieve all driver descriptions. The Driver Manager retrieves this information from the ODBCINST.INI file or the registry. When there are no more driver descriptions, **SQLDrivers** returns SQL_NO_DATA_FOUND. If **SQLDrivers** is called with SQL_FETCH_NEXT immediately after it returns SQL_NO_DATA_FOUND, it returns the first driver description.

If SQL_FETCH_NEXT is passed to **SQLDrivers** the very first time it is called, **SQLDrivers** returns the first data source name.

Because **SQLDrivers** is implemented in the Driver Manager, it is supported for all drivers regardless of a particular driver's conformance level.

Related Functions

For information about	See
Connecting to a data source	**SQLConnect**
Returning data source names	**SQLDataSources (extension)**
Connecting to a data source using a connection string or dialog box	**SQLDriverConnect (extension)**

SQLError (ODBC 1.0, Core)

SQLError returns error or status information.

Syntax

RETCODE **SQLError**(*henv, hdbc, hstmt, szSqlState, pfNativeError, szErrorMsg, cbErrorMsgMax, pcbErrorMsg*)

The **SQLError** function accepts the following arguments.

Type	Argument	Use	Description
HENV	*henv*	Input	Environment handle or SQL_NULL_HENV.
HDBC	*hdbc*	Input	Connection handle or SQL_NULL_HDBC.
HSTMT	*hstmt*	Input	Statement handle or SQL_NULL_HSTMT.
UCHAR FAR *	*szSqlState*	Output	SQLSTATE as null-terminated string. For a list of SQLSTATEs, see Appendix A, “ODBC Error Codes.”
SDWORD FAR *	*pfNativeError*	Output	Native error code (specific to the data source).
UCHAR FAR *	*szErrorMsg*	Output	Pointer to storage for the error message text.
SWORD	*cbErrorMsgMax*	Input	Maximum length of the *szErrorMsg* buffer. This must be less than or equal to SQL_MAX_MESSAGE_ LENGTH – 1.

SWORD FAR *	*pcbErrorMsg*	Output	Pointer to the total number of bytes (excluding the null termination byte) available to return in *szErrorMsg*. If the number of bytes available to return is greater than or equal to *cbErrorMsgMax*, the error message text in *szErrorMsg* is truncated to *cbErrorMsgMax* – 1 bytes.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

SQLError does not post error values for itself. **SQLError** returns SQL_NO_DATA_FOUND when it is unable to retrieve any error information, (in which case *szSqlState* equals 00000). If **SQLError** cannot access error values for any reason that would normally return SQL_ERROR, **SQLError** returns SQL_ERROR but does not post any error values. If the buffer for the error message is too short, **SQLError** returns SQL_SUCCESS_WITH_INFO but, again, does not return a SQLSTATE value for **SQLError**.

To determine that a truncation occurred in the error message, an application can compare *cbErrorMsgMax* to the actual length of the message text written to *pcbErrorMsg*.

Comments

An application typically calls **SQLError** when a previous call to an ODBC function returns SQL_ERROR or SQL_SUCCESS_WITH_INFO. However, any ODBC function can post zero or more errors each time it is called, so an application can call **SQLError** after any ODBC function call.

SQLError retrieves an error from the data structure associated with the rightmost non-null handle argument. An application requests error information as follows:

- To retrieve errors associated with an environment, the application passes the corresponding *henv* and includes SQL_NULL_HDBC and SQL_NULL_HSTMT in *hdbc* and *hstmt*, respectively. The driver returns the error status of the ODBC function most recently called with the same *henv.*

- To retrieve errors associated with a connection, the application passes the corresponding *hdbc* plus an *hstmt* equal to SQL_NULL_HSTMT. In such a case, the driver ignores the *henv* argument. The driver returns the error status of the ODBC function most recently called with the *hdbc*.
- To retrieve errors associated with a statement, an application passes the corresponding *hstmt*. If the call to **SQLError** contains a valid *hstmt*, the driver ignores the *hdbc* and *henv* arguments. The driver returns the error status of the ODBC function most recently called with the *hstmt*.
- To retrieve multiple errors for a function call, an application calls **SQLError** multiple times. For each error, the driver returns SQL_SUCCESS and removes that error from the list of available errors.

When there is no additional information for the rightmost non-null handle, **SQLError** returns SQL_NO_DATA_FOUND. In this case, *szSqlState* equals 00000 (Success), *pfNativeError* is undefined, *pcbErrorMsg* equals 0, and *szErrorMsg* contains a single null termination byte (unless *cbErrorMsgMax* equals 0).

The Driver Manager stores error information in its *henv*, *hdbc*, and *hstmt* structures. Similarly, the driver stores error information in its *henv*, *hdbc*, and *hstmt* structures. When the application calls **SQLError**, the Driver Manager checks if there are any errors in its structure for the specified handle. If there are errors for the specified handle, it returns the first error; if there are no errors, it calls **SQLError** in the driver.

The Driver Manager can store up to 64 errors with an *henv* and its associated *hdbcs* and *hstmts*. When this limit is reached, the Driver Manager discards any subsequent errors posted on the Driver Manager's *henv*, *hdbcs*, or *hstmts*. The number of errors that a driver can store is driver-dependent.

An error is removed from the structure associated with a handle when **SQLError** is called for that handle and returns that error. All errors stored for a given handle are removed when that handle is used in a subsequent function call. For example, errors on an *hstmt* that were returned by **SQLExecDirect** are removed when **SQLExecDirect** or **SQLTables** is called with that *hstmt*. The errors stored on a given handle are not removed as the result of a call to a function using an associated handle of a different type.

See *Appendix A, "Error Codes"* for more information on error codes.

Related Functions

None.

SQLExecDirect (ODBC 1.0, Core)

SQLExecDirect executes a preparable statement, using the current values of the parameter marker variables if any parameters exist in the statement. SQLExecDirect is the fastest way to submit an SQL statement for one-time execution.

Syntax

RETCODE **SQLExecDirect**(*hstmt*, *szSqlStr*, *cbSqlStr*)

The **SQLExecDirect** function uses the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UCHAR FAR *	*szSqlStr*	Input	SQL statement to be executed.
SDWORD	*cbSqlStr*	Input	Length of *szSqlStr*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NEED_DATA, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLExecDirect** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLExecDirect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

01004	Data truncated	The argument *szSqlStr* contained an SQL statement that contained a character or binary parameter or literal and the value exceeded the maximum length of the associated table column. The argument *szSqlStr* contained an SQL statement that contained a numeric parameter or literal and the fractional part of the value was truncated. The argument *szSqlStr* contained an SQL statement that contained a date or time parameter or literal and a timestamp value was truncated.
01006	Privilege not revoked	The argument *szSqlStr* contained a **REVOKE** statement and the user did not have the specified privilege. (Function returns SQL_SUCCESS_WITH_INFO.)
01S03	No rows updated or deleted	The argument *szSqlStr* contained a positioned update or delete statement and no rows were updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)
01S04	More than one row updated or deleted	The argument *szSqlStr* contained a positioned update or delete statement and more than one row was updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)
07001	Wrong number of parameters	The number of parameters specified in **SQLBindParameter** was less than the number of parameters in the SQL statement contained in the argument *szSqlStr.*
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
21S01	Insert value list does not match column list	The argument *szSqlStr* contained an **INSERT** statement and the number of values to be inserted did not match the degree of the derived table.
21S02	Degree of derived table does not match column list	The argument *szSqlStr* contained a **CREATE VIEW** statement and the number of names specified is not the same degree as the derived table defined by the query specification.

22003	Numeric value out of range	The argument *szSqlStr* contained an SQL statement which contained a numeric parameter or literal and the value caused the whole (as opposed to fractional) part of the number to be truncated when assigned to the associated table column.
22005	Error in assignment	The argument *szSqlStr* contained an SQL statement that contained a parameter or literal and the value was incompatible with the data type of the associated table column.
22008	Datetime field overflow	The argument *szSqlStr* contained an SQL statement that contained a date, time, or timestamp parameter or literal and the value was, respectively, an invalid date, time, or timestamp.
22012	Division by zero	The argument *szSqlStr* contained an SQL statement which contained an arithmetic expression which caused division by zero.
23000	Integrity constraint violation	The argument *szSqlStr* contained an SQL statement which contained a parameter or literal. The parameter value was NULL for a column defined as NOT NULL in the associated table column, a duplicate value was supplied for a column constrained to contain only unique values, or some other integrity constraint was violated.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called. The argument *szSqlStr* contained a positioned update or delete statement and the cursor was positioned before the start of the result set or after the end of the result set.
34000	Invalid cursor name	The argument *szSqlStr* contained a positioned update or delete statement and the cursor referenced by the statement being executed was not open.
37000	Syntax error or access violation	The argument *szSqlStr* contained an SQL statement that was not preparable or contained a syntax error.

40001	Serialization failure	The transaction to which the SQL statement contained in the argument *szSqlStr* belonged was terminated to prevent deadlock.
42000	Syntax error or access violation	The user did not have permission to execute the SQL statement contained in the argument *szSqlStr*.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S0001	Base table or view already exists	The argument *szSqlStr* contained a **CREATE TABLE** or **CREATE VIEW** statement and the table name or view name specified already exists.
S0002	Table or view not found	The argument *szSqlStr* contained a **DROP TABLE** or a **DROP VIEW** statement and the specified table name or view name did not exist. The argument *szSqlStr* contained an **ALTER TABLE** statement and the specified table name did not exist. The argument *szSqlStr* contained a **CREATE VIEW** statement and a table name or view name defined by the query specification did not exist. The argument *szSqlStr* contained a **CREATE INDEX** statement and the specified table name did not exist. The argument *szSqlStr* contained a **GRANT** or **REVOKE** statement and the specified table name or view name did not exist. The argument *szSqlStr* contained a **SELECT** statement and a specified table name or view name did not exist. The argument *szSqlStr* contained a **DELETE**, **INSERT**, or **UPDATE** statement and the specified table name did not exist. The argument *szSqlStr* contained a **CREATE TABLE** statement and a table specified in a constraint (referencing a table other than the one being created) did not exist.
S0011	Index already exists	The argument *szSqlStr* contained a **CREATE INDEX** statement and the specified index name already existed.

S0012	Index not found	The argument *szSqlStr* contained a **DROP INDEX** statement and the specified index name did not exist.
S0021	Column already exists	The argument *szSqlStr* contained an **ALTER TABLE** statement and the column specified in the **ADD** clause is not unique or identifies an existing column in the base table.
S0022	Column not found	The argument *szSqlStr* contained a **CREATE INDEX** statement and one or more of the column names specified in the column list did not exist. The argument *szSqlStr* contained a **GRANT** or **REVOKE** statement and a specified column name did not exist. The argument *szSqlStr* contained a **SELECT**, **DELETE**, **INSERT**, or **UPDATE** statement and a specified column name did not exist. The argument *szSqlStr* contained a **CREATE TABLE** statement and a column specified in a constraint (referencing a table other than the one being created) did not exist.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1009	Invalid argument value	(DM) The argument *szSqlStr* was a null pointer.

S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The argument *cbSqlStr* was less than or equal to 0, but not equal to SQL_NTS. A parameter value, set with **SQLBindParameter**, was a null pointer and the parameter length value was not 0, SQL_NULL_DATA, SQL_DATA_AT_EXEC, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET. A parameter value, set with **SQLBindParameter**, was not a null pointer and the parameter length value was less than 0, but was not SQL_NTS, SQL_NULL_DATA, SQL_DATA_AT_EXEC, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET.
S1109	Invalid cursor position	The argument *szSqlStr* contained a positioned update or delete statement and the cursor was positioned (by **SQLSetPos** or **SQLExtendedFetch**) on a row for which the value in the *rgfRowStatus* array in **SQLExtendedFetch** was SQL_ROW_DELETED or SQL_ROW_ERROR.
S1C00	Driver not capable	The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

The application calls **SQLExecDirect** to send an SQL statement to the data source. The driver modifies the statement to use the form of SQL used by the data source, then submits it

to the data source. In particular, the driver modifies the escape clauses used to define ODBC-specific SQL. For a description of SQL statement grammar, see Appendix C, "SQL Grammar."

The application can include one or more parameter markers in the SQL statement. To include a parameter marker, the application embeds a question mark (?) into the SQL statement at the appropriate position.

If the SQL statement is a **SELECT** statement, and if the application called **SQLSetCursorName** to associate a cursor with an *hstmt*, then the driver uses the specified cursor. Otherwise, the driver generates a cursor name.

If the data source is in manual-commit mode (requiring explicit transaction initiation), and a transaction has not already been initiated, the driver initiates a transaction before it sends the SQL statement.

If an application uses **SQLExecDirect** to submit a **COMMIT** or **ROLLBACK** statement, it will not be interoperable between DBMS products. To commit or roll back a transaction, call **SQLTransact**.

If **SQLExecDirect** encounters a data-at-execution parameter, it returns SQL_NEED_DATA. The application sends the data using **SQLParamData** and **SQLPutData**. See **SQLBindParameter**, **SQLParamOptions**, **SQLParamData**, and **SQLPutData** for more information.

Code Example

See **SQLBindCol**, **SQLExtendedFetch**, and **SQLGetData**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Executing a prepared SQL statement	**SQLExecute**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning a cursor name	**SQLGetCursorName**
Fetching part or all of a column of data	**SQLGetData (extension)**
Returning the next parameter to send data for	**SQLParamData (extension)**

Preparing a statement for execution	**SQLPrepare**
Sending parameter data at execution time	**SQLPutData (extension)**
Setting a cursor name	**SQLSetCursorName**
Setting a statement option	**SQLSetStmtOption (extension)**
Executing a commit or rollback operation	**SQLTransact**

SQLExecute (ODBC 1.0, Core)

SQLExecute executes a prepared statement, using the current values of the parameter marker variables if any parameter markers exist in the statement.

Syntax

RETCODE **SQLExecute**(*hstmt*)

The **SQLExecute** statement accepts the following argument.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NEED_DATA, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLExecute** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLExecute** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The prepared statement associated with the *hstmt* contained a character or binary parameter or literal and the value exceeded the maximum length of the associated table column. The prepared statement associated with the *hstmt* contained a numeric parameter or literal and the fractional part of the value was truncated. The prepared statement associated with the *hstmt* contained a date or time parameter or literal and a timestamp value was truncated.

01006	Privilege not revoked	The prepared statement associated with the *hstmt* was **REVOKE** and the user did not have the specified privilege. (Function returns SQL_SUCCESS_WITH_INFO.)
01S03	No rows updated or deleted	The prepared statement associated with the *hstmt* was a positioned update or delete statement and no rows were updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)
01S04	More than one row updated or deleted	The prepared statement associated with the *hstmt* was a positioned update or delete statement and more than one row was updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)
07001	Wrong number of parameters	The number of parameters specified in **SQLBindParameter** was less than the number of parameters in the prepared statement associated with the *hstmt*.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
22003	Numeric value out of range	The prepared statement associated with the *hstmt* contained a numeric parameter and the parameter value caused the whole (as opposed to fractional) part of the number to be truncated when assigned to the associated table column.
22005	Error in assignment	The prepared statement associated with the *hstmt* contained a parameter and the value was incompatible with the data type of the associated table column.
22008	Datetime field overflow	The prepared statement associated with the *hstmt* contained a date, time, or timestamp parameter or literal and the value was, respectively, an invalid date, time, or timestamp.
22012	Division by zero	The prepared statement associated with the *hstmt* contained an arithmetic expression which caused division by zero.

23000	Integrity constraint violation	The prepared statement associated with the *hstmt* contained a parameter. The parameter value was NULL for a column defined as NOT NULL in the associated table column, a duplicate value was supplied for a column constrained to contain only unique values, or some other integrity constraint was violated.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called. The prepared statement associated with the *hstmt* contained a positioned update or delete statement and the cursor was positioned before the start of the result set or after the end of the result set.
40001	Serialization failure	The transaction to which the prepared statement associated with the *hstmt* belonged was terminated to prevent deadlock.
42000	Syntax error or access violation	The user did not have permission to execute the prepared statement associated with the *hstmt*.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.

S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns. (DM) The *hstmt* was not prepared. Either the *hstmt* was not in an executed state, or a cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. The *hstmt* was not prepared. It was in an executed state and either no result set was associated with the *hstmt* or **SQLFetch** or **SQLExtendedFetch** had not been called.
S1090	Invalid string or buffer length	A parameter value, set with **SQLBindParameter**, was a null pointer and the parameter length value was not 0, SQL_NULL_DATA, SQL_DATA_AT_EXEC, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET. A parameter value, set with **SQLBindParameter**, was not a null pointer and the parameter length value was less than 0, but was not SQL_NTS, SQL_NULL_DATA, or SQL_DATA_AT_EXEC, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET.
S1109	Invalid cursor position	The prepared statement was a positioned update or delete statement and the cursor was positioned (by **SQLSetPos** or **SQLExtendedFetch**) on a row for which the value in the *rgfRowStatus* array in **SQLExtendedFetch** was SQL_ROW_DELETED or SQL_ROW_ERROR.
S1C00	Driver not capable	The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.

S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

SQLExecute can return any SQLSTATE that can be returned by **SQLPrepare** based on when the data source evaluates the SQL statement associated with the *hstmt*.

Comments

SQLExecute executes a statement prepared by **SQLPrepare**. Once the application processes or discards the results from a call to **SQLExecute**, the application can call **SQLExecute** again with new parameter values.

To execute a **SELECT** statement more than once, the application must call **SQLFreeStmt** with the SQL_CLOSE parameter before reissuing the **SELECT** statement.

If the data source is in manual-commit mode (requiring explicit transaction initiation), and a transaction has not already been initiated, the driver initiates a transaction before it sends the SQL statement.

If an application uses **SQLPrepare** to prepare and **SQLExecute** to submit a **COMMIT** or **ROLLBACK** statement, it will not be interoperable between DBMS products. To commit or roll back a transaction, call **SQLTransact**.

If **SQLExecute** encounters a data-at-execution parameter, it returns SQL_NEED_DATA. The application sends the data using **SQLParamData** and **SQLPutData**. See **SQLBindParameter**, **SQLParamData**, and **SQLPutData** for more information.

Code Example

See **SQLBindParameter**, **SQLPutData**, and **SQLSetPos**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Executing an SQL statement	**SQLExecDirect**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**

Fetching a row of data	**SQLFetch**
Freeing a statement handle	**SQLFreeStmt**
Returning a cursor name	**SQLGetCursorName**
Fetching part or all of a column of data	**SQLGetData (extension)**
Returning the next parameter to send data for	**SQLParamData (extension)**
Preparing a statement for execution	**SQLPrepare**
Sending parameter data at execution time	**SQLPutData (extension)**
Setting a cursor name	**SQLSetCursorName**
Setting a statement option	**SQLSetStmtOption (extension)**
Executing a commit or rollback operation	**SQLTransact**

SQLExtendedFetch (ODBC 1.0, Level 2)

SQLExtendedFetch extends the functionality of **SQLFetch** in the following ways:

- It returns rowset data (one or more rows), in the form of an array, for each bound column.
- It scrolls through the result set according to the setting of a scroll-type argument.

SQLExtendedFetch works in conjunction with **SQLSetStmtOption**.

To fetch one row of data at a time in a forward direction, an application should call **SQLFetch**.

For more information about scrolling through result sets, read "Using Block and Scrollable Cursors" in Chapter 2, "Retrieving Results."

NOTE: This function is not implement in SOLID *SQL API*, but it is available through ODBC Cursor Library.

Syntax

RETCODE **SQLExtendedFetch**(*hstmt*, *fFetchType*, *irow*, *pcrow*, *rgfRowStatus*)

The **SQLExtendedFetch** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*fFetchType*	Input	Type of fetch. For more information, see the "Comments" section.
SDWORD	*irow*	Input	Number of the row to fetch. For more information, see the "Comments" section.
UDWORD FAR *	*pcrow*	Output	Number of rows actually fetched.
UWORD FAR *	*rgfRowStatus*	Output	An array of status values. For more information, see the "Comments" section.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLExtendedFetch** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLExtendedFetch** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The data returned for one or more columns was truncated. String values are right truncated. For numeric values, the fractional part of number was truncated. (Function returns SQL_SUCCESS_WITH_INFO.)
01S01	Error in row	An error occurred while fetching one or more rows. (Function returns SQL_SUCCESS_WITH_INFO.)
07006	Restricted data type attribute violation	A data value could not be converted to the C data type specified by *fCType* in **SQLBindCol**.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
22003	Numeric value out of range	Returning the numeric value (as numeric or string) for one or more columns would have caused the whole (as opposed to fractional) part of the number to be truncated. Returning the binary value for one or more columns would have caused a loss of binary significance. See *Appendix D, "Data Types"* for more information.
22012	Division by zero	A value from an arithmetic expression was returned which resulted in division by zero.

24000	Invalid cursor state	The *hstmt* was in an executed state but no result set was associated with the *hstmt*.
40001	Serialization failure	The transaction in which the fetch was executed was terminated to prevent deadlock.
IM001	Driver does not support this function	(DM) The driver associated with the *hdbc* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	A column number specified in the binding for one or more columns was greater than the number of columns in the result set. Column 0 was bound with **SQLBindCol** and the SQL_USE_BOOKMARKS statement option was set to SQL_UB_OFF.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.

S1010	Function sequence error	(DM) The specified *hstmt* was not in an executed state. The function was called without first calling **SQLExecDirect**, **SQLExecute**, or a catalog function..
		(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called.
		(DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
		(DM) **SQLExtendedFetch** was called for an *hstmt* after **SQLFetch** was called and before **SQLFreeStmt** was called with the SQL_CLOSE option.
S1106	Fetch type out of range	(DM) The value specified for the argument *fFetchType* was invalid (see "Comments").
		The value of the SQL_CURSOR_TYPE statement option was SQL_CURSOR_FORWARD_ONLY and the value of argument *fFetchType* was not SQL_FETCH_NEXT.
S1107	Row value out of range	The value specified with the SQL_CURSOR_TYPE statement option was SQL_CURSOR_KEYSET_DRIVEN, but the value specified with the SQL_KEYSET_SIZE statement option was greater than 0 and less than the value specified with the SQL_ROWSET_SIZE statement option.
S1111	Invalid bookmark value	The argument *fFetchType* was SQL_FETCH_BOOKMARK and the bookmark specified in the *irow* argument was not valid.

S1C00	Driver not capable	Driver or data source does not support the specified fetch type. The driver or data source does not support the conversion specified by the combination of the *fCType* in **SQLBindCol** and the SQL data type of the corresponding column. This error only applies when the SQL data type of the column was mapped to a driver-specific SQL data type. The argument *fFetchType* was SQL_FETCH_RESUME and the driver supports ODBC 2.0.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLExtendedFetch returns one rowset of data to the application. An application cannot mix calls to **SQLExtendedFetch** and **SQLFetch** for the same cursor.

An application specifies the number of rows in the rowset by calling **SQLSetStmtOption** with the SQL_ROWSET_SIZE statement option.

Binding

If any columns in the result set have been bound with **SQLBindCol**, the driver converts the data for the bound columns as necessary and stores it in the locations bound to those columns. The result set can be bound in a column-wise (the default) or row-wise fashion.

Column-Wise Binding

To bind a result set in column-wise fashion, an application specifies SQL_BIND_BY_COLUMN for the SQL_BIND_TYPE statement option. (This is the default value.) For each column to be bound, the application:

1. Allocates an array of data storage buffers. The array has as many elements as there are rows in the rowset, plus an additional element if the application will search for key values or append new rows of data. Each buffer's size is the maximum size of the C data that can be returned for the column. For example, when the C data type is SQL_C_DEFAULT, each buffer's size is the column length. When the C data type is SQL_C_CHAR, each buffer's size is the display size of the data. For more information,

see "*Converting Data from SQL to C Data Types" on page D-19* and "*Precision, Scale, Length, and Display Size" on page D-14*.

2. Allocates an array of SDWORDs to hold the number of bytes available to return for each row in the column. The array has as many elements as there are rows in the rowset.
3. Calls **SQLBindCol**:
   - The *rgbValue* argument specifies the address of the data storage array.
   - The *cbValueMax* argument specifies the size of each buffer in the data storage array.
   - The *pcbValue* argument specifies the address of the number-of-bytes array.

When the application calls **SQLExtendedFetch**, the driver retrieves the data and the number of bytes available to return and stores them in the buffers allocated by the application:

- For each bound column, the driver stores the data in the *rgbValue* buffer bound to the column. It stores the first row of data at the start of the buffer and each subsequent row of data at an offset of *cbValueMax* bytes from the data for the previous row.
- For each bound column, the driver stores the number of bytes available to return in the *pcbValue* buffer bound to the column. This is the number of bytes available prior to calling **SQLExtendedFetch**. (If the number of bytes available to return cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL. If the data for the column is NULL, the driver sets *pcbValue* to SQL_NULL_DATA.) It stores the number of bytes available to return for the first row at the start of the buffer and the number of bytes available to return for each subsequent row at an offset of **sizeof(SDWORD)** from the value for the previous row.

Row-Wise Binding

To bind a result set in row-wise fashion, an application:

1. Declares a structure that can hold a single row of retrieved data and the associated data lengths. For each bound column, the structure contains one field for the data and one SDWORD field for the number of bytes available to return. The data field's size is the maximum size of the C data that can be returned for the column.
2. Calls **SQLSetStmtOption** with *fOption* set to SQL_BIND_TYPE and *vParam* set to the size of the structure.
3. Allocates an array of these structures. The array has as many elements as there are rows in the rowset, plus an additional element if the application will search for key values or append new rows of data.
4. Calls **SQLBindCol** for each column to be bound:

- The *rgbValue* argument specifies the address of the column's data field in the first array element.
- The *cbValueMax* argument specifies the size of the column's data field.
- The *pcbValue* argument specifies the address of the column's number-of-bytes field in the first array element.

When the application calls **SQLExtendedFetch**, the driver retrieves the data and the number of bytes available to return and stores them in the buffers allocated by the application:

- For each bound column, the driver stores the first row of data at the address specified by *rgbValue* for the column and each subsequent row of data at an offset of *vParam* bytes from the data for the previous row.
- For each bound column, the driver stores the number of bytes available to return for the first row at the address specified by *pcbValue* and the number of bytes available to return for each subsequent row at an offset of *vParam* bytes from the value for the previous row. This is the number of bytes available prior to calling **SQLExtendedFetch**. (If the number of bytes available to return cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL. If the data for the column is NULL, the driver sets *pcbValue* to SQL_NULL_DATA.)

Positioning the Cursor

The following operations require a cursor position:

- Positioned update and delete statements.
- Calls to **SQLGetData**.
- Calls to **SQLSetPos** with the SQL_DELETE, SQL_REFRESH, and SQL_UPDATE options.

An application can specify a cursor position when it calls **SQLSetPos**. Before it executes a positioned update or delete statement or calls **SQLGetData**, the application must position the cursor by calling **SQLExtendedFetch** to retrieve a rowset; the cursor points to the first row in the rowset. To position the cursor to a different row in the rowset, the application calls **SQLSetPos**.

The following table shows the rowset and return code returned when the application requests different rowsets.

Requested Rowset	Return Code	Cursor Position	Returned Rowset
Before start of result set	SQL_NO_DATA_FOUND	Before start of result set	None. The contents of the rowset buffers are undefined.
Overlaps start of result set	SQL_SUCCESS	Row 1 of rowset	First rowset in result set.
Within result set	SQL_SUCCESS	Row 1 of rowset	Requested rowset.
Overlaps end of result set	SQL_SUCCESS	Row 1 of rowset	For rows in the rowset that overlap the result set, data is returned. For rows in the rowset outside the result set, the contents of the *rgbValue* and *pcbValue* buffers are undefined and the *rgfRowStatus* array contains SQL_ROW_NOROW.
After end of result set	SQL_NO_DATA_FOUND	After end of result set	None. The contents of the rowset buffers are undefined.

For example, suppose a result set has 100 rows and the rowset size is 5. The following table shows the rowset and return code returned by **SQLExtendedFetch** for different values of *irow* when the fetch type is SQL_FETCH_RELATIVE:

Current Rowset	*irow*	Return Code	New Rowset
1 to 5	–5	SQL_NO_DATA_FOUND	None.
1 to 5	–3	SQL_SUCCESS	1 to 5
96 to 100	5	SQL_NO_DATA_FOUND	None.
96 to 100	3	SQL_SUCCESS	99 and 100. For rows 3, 4, and 5 in the rowset, the *rgfRowStatusArray* is set to SQL_ROW_NOROW.

Before **SQLExtendedFetch** is called the first time, the cursor is positioned before the start of the result set.

For the purpose of moving the cursor, deleted rows (that is, rows with an entry in the *rgfRowStatus* array of SQL_ROW_DELETED) are treated no differently than other rows. For example, calling **SQLExtendedFetch** with *fFetchType* set to SQL_FETCH_ABSOLUTE and *irow* set to 15 returns the rowset starting at row 15, even if the *rgfRowStatus* array for row 15 is SQL_ROW_DELETED.

Processing Errors

If an error occurs that pertains to the entire rowset, such as SQLSTATE S1T00 (Timeout expired), the driver returns SQL_ERROR and the appropriate SQLSTATE. The contents of the rowset buffers are undefined and the cursor position is unchanged.

If an error occurs that pertains to a single row, the driver:

- Sets the element in the *rgfRowStatus* array for the row to SQL_ROW_ERROR.
- Posts SQLSTATE 01S01 (Error in row) in the error queue.
- Posts zero or more additional SQLSTATEs for the error after SQLSTATE 01S01 (Error in row) in the error queue.

After it has processed the error or warning, the driver continues the operation for the remaining rows in the rowset and returns SQL_SUCCESS_WITH_INFO. Thus, for each error that pertains to a single row, the error queue contains SQLSTATE 01S01 (Error in row) followed by zero or more additional SQLSTATEs.

After it has processed the error, the driver fetches the remaining rows in the rowset and returns SQL_SUCCESS_WITH_INFO. Thus, for each row that returned an error, the error queue contains SQLSTATE 01S01 (Error in row) followed by zero or more additional SQLSTATEs.

If the rowset contains rows that have already been fetched, the driver is not required to return SQLSTATEs for errors that occurred when the rows were first fetched. It is, however, required to return SQLSTATE 01S01 (Error in row) for each row in which an error originally occurred and to return SQL_SUCCESS_WITH_INFO. For example, a static cursor that maintains a cache might cache row status information (so it can determine which rows contain errors) but might not cache the SQLSTATE associated with those errors.

Error rows do not affect relative cursor movements. For example, suppose the result set size is 100 and the rowset size is 10. If the current rowset is rows 11 through 20 and the element in the *rgfRowStatus* array for row 11 is SQL_ROW_ERROR, calling **SQLExtendedFetch** with the SQL_FETCH_NEXT fetch type still returns rows 21 through 30.

If the driver returns any warnings, such as SQLSTATE 01004 (Data truncated), it returns warnings that apply to the entire rowset or to unknown rows in the rowset before it returns error information applying to specific rows. It returns warnings for specific rows along with any other error information about those rows.

fFetchType Argument

The *fFetchType* argument specifies how to move through the result set. It is one of the following values:

SQL_FETCH_NEXT

SQL_FETCH_FIRST

SQL_FETCH_LAST

SQL_FETCH_PRIOR

SQL_FETCH_ABSOLUTE

SQL_FETCH_RELATIVE

SQL_FETCH_BOOKMARK

If the value of the SQL_CURSOR_TYPE statement option is SQL_CURSOR_FORWARD_ONLY, the *fFetchType* argument must be SQL_FETCH_NEXT.

NOTE: In ODBC 1.0, **SQLExtendedFetch** supported the SQL_FETCH_RESUME fetch type. In ODBC 2.0, SQL_FETCH_RESUME is obsolete and the Driver Manager returns SQLSTATE S1C00 (Driver not capable) if an application specifies it for an ODBC 2.0 driver.

The SQL_FETCH_BOOKMARK fetch type was introduced in ODBC 2.0; the Driver Manager returns SQLSTATE S1106 (Fetch type out of range) if it is specified for an ODBC 1.0 driver.

Moving by Row Position

SQLExtendedFetch supports the following values of the *fFetchType* argument to move relative to the current rowset:

fFetchType Argument	Action
SQL_FETCH_NEXT	The driver returns the next rowset. If the cursor is positioned before the start of the result set, this is equivalent to SQL_FETCH_FIRST.
SQL_FETCH_PRIOR	The driver returns the prior rowset. If the cursor is positioned after the end of the result set, this is equivalent to SQL_FETCH_LAST.
SQL_FETCH_RELATIVE	The driver returns the rowset irow rows from the start of the current rowset. If irow equals 0, the driver refreshes the current rowset. If the cursor is positioned before the start of the result set and irow is greater than 0 or if the cursor is positioned after the end of the result set and irow is less than 0, this is equivalent to SQL_FETCH_ABSOLUTE.

It supports the following values of the *fFetchType* argument to move to an absolute position in the result set:

fFetchType Argument	Action
SQL_FETCH_FIRST	The driver returns the first rowset in the result set.
SQL_FETCH_LAST	The driver returns the last complete rowset in the result set.
SQL_FETCH_ABSOLUTE	If irow is greater than 0, the driver returns the rowset starting at row irow. If irow equals 0, the driver returns SQL_NO_DATA_FOUND and the cursor is positioned before the start of the result set. If irow is less than 0, the driver returns the rowset starting at row n+irow+1, where n is the number of rows in the result set. For example, if irow is –1, the driver returns the rowset starting at the last row in the result set. If the result set size is 10 and irow is –10, the driver returns the rowset starting at the first row in the result set.

Positioning to a Bookmark

When an application calls **SQLExtendedFetch** with the SQL_FETCH_BOOKMARK fetch type, the driver retrieves the rowset starting with the row specified by the bookmark in the *irow* argument.

To inform the driver that it will use bookmarks, the application calls **SQLSetStmtOption** with the SQL_USE_BOOKMARKS option before opening the cursor. To retrieve the bookmark for a row, the application either positions the cursor on the row and calls **SQLGetStmtOption** with the SQL_GET_BOOKMARK option, or retrieves the bookmark from column 0 of the result set. If the application retrieves a bookmark from column 0 of the result set, it must set *fCType* in **SQLBindCol** or **SQLGetData** to SQL_C_BOOKMARK. The application stores the bookmarks for those rows in each rowset to which it will return later.

Bookmarks are 32-bit binary values; if a bookmark requires more than 32 bits, such as when it is a key value, the driver maps the bookmarks requested by the application to 32-bit binary values. The 32-bit binary values are then returned to the application. Because this mapping may require considerable memory, applications should only bind column 0 of the result set if they will actually use bookmarks for most rows. Otherwise, applications should call **SQLGetStmtOption** with the SQL_GET_BOOKMARK statement option or call **SQLGetData** for column 0.

irow Argument

For the SQL_FETCH_ABSOLUTE fetch type, **SQLExtendedFetch** returns the rowset starting at the row number specified by the *irow* argument.

For the SQL_FETCH_RELATIVE fetch type, **SQLExtendedFetch** returns the rowset starting *irow* rows from the first row in the current rowset.

For the SQL_FETCH_BOOKMARK fetch type, the *irow* argument specifies the bookmark that marks the first row in the requested rowset.

The *irow* argument is ignored for the SQL_FETCH_NEXT, SQL_FETCH_PRIOR, SQL_FETCH_FIRST, and SQL_FETCH_LAST, fetch types.

rgfRowStatus Argument

In the *rgfRowStatus* array, **SQLExtendedFetch** returns any changes in status to each row since it was last retrieved from the data source. Rows may be unchanged (SQL_ROW_SUCCESS), updated (SQL_ROW_UPDATED), deleted (SQL_ROW_DELETED), added (SQL_ROW_ADDED), or were unretrievable due to an error (SQL_ROW_ERROR). For static cursors, this information is available for all rows. For keyset, mixed, and dynamic cursors, this information is only available for rows in the keyset; the driver does not save data outside the keyset and therefore cannot compare the newly retrieved data to anything.

NOTE: Some drivers cannot detect changes to data. To determine whether a driver can detect changes to refetched rows, an application calls **SQLGetInfo** with the SQL_ROW_UPDATES option.

The number of elements must equal the number of rows in the rowset (as defined by the SQL_ROWSET_SIZE statement option). If the number of rows fetched is less than the number of elements in the status array, the driver sets remaining status elements to SQL_ROW_NOROW.

When an application calls **SQLSetPos** with *fOption* set to SQL_DELETE or SQL_UPDATE, **SQLSetPos** changes the *rgfRowStatus* array for the changed row to SQL_ROW_DELETED or SQL_ROW_UPDATED.

NOTE: For keyset, mixed, and dynamic cursors, if a key value is updated, the row of data is considered to have been deleted and a new row added.

Code Example

The following two examples show how an application could use column-wise or row-wise binding to bind storage locations to the same result set.

For more code examples, see **SQLSetPos**.

Column-Wise Binding

In the following example, an application declares storage locations for column-wise bound data and the returned numbers of bytes. Because column-wise binding is the default, there is no need, as in the row-wise binding example, to request column-wise binding with **SQLSetStmtOption**. However, the application does call **SQLSetStmtOption** to specify the number of rows in the rowset.

The application then executes a **SELECT** statement to return a result set of the employee names and birthdays, which is sorted by birthday. It calls **SQLBindCol** to bind the columns of data, passing the addresses of storage locations for both the data and the returned numbers of bytes. Finally, the application fetches the rowset data with **SQLExtendedFetch** and prints each employee's name and birthday.

```
#define ROWS 100
#define NAME_LEN 30
#define BDAY_LEN 11

UCHAR     szName[ROWS][NAME_LEN], szBirthday[ROWS][BDAY_LEN];
SWORD     sAge[ROWS];
SDWORD    cbName[ROWS], cbAge[ROWS], cbBirthday[ROWS];

UDWORD    crow, irow;
```

```
UWORD     rgfRowStatus[ROWS];

SQLSetStmtOption(hstmt, SQL_CONCURRENCY, SQL_CONCUR_READ_ONLY);
SQLSetStmtOption(hstmt, SQL_CURSOR_TYPE, SQL_CURSOR_KEYSET_DRIVEN);
SQLSetStmtOption(hstmt, SQL_ROWSET_SIZE, ROWS);
retcode = SQLExecDirect(hstmt,

      "SELECT NAME, AGE, BIRTHDAY FROM EMPLOYEE ORDER BY 3, 2, 1",

           SQL_NTS);

if (retcode == SQL_SUCCESS) {
      SQLBindCol(hstmt, 1, SQL_C_CHAR, szName, NAME_LEN, cbName);
      SQLBindCol(hstmt, 2, SQL_C_SSHORT, sAge, 0, cbAge);
      SQLBindCol(hstmt, 3, SQL_C_CHAR, szBirthday, BDAY_LEN,

                cbBirthday);

      /* Fetch the rowset data and print each row. */
      /* On an error, display a message and exit.  */

      while (TRUE) {
         retcode = SQLExtendedFetch(hstmt, SQL_FETCH_NEXT, 1, &crow,

                                    rgfRowStatus);
         if (retcode == SQL_ERROR || retcode == SQL_SUCCESS_WITH_INFO) {
              show_error();
         }
         if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){
              for (irow = 0; irow < crow; irow++) {
              if (rgfRowStatus[irow] != SQL_ROW_DELETED &&

                   rgfRowStatus[irow] != SQL_ROW_ERROR)
                   fprintf(out, "%-*s  %-2d  %*s",

                           NAME_LEN-1, szName[irow], sAge[irow],

                           BDAY_LEN-1, szBirthday[irow]);
              }
         } else {
              break;
         }
      }
}
```

Row-Wise Binding

In the following example, an application declares an array of structures to hold row-wise bound data and the returned numbers of bytes. Using **SQLSetStmtOption**, it requests row-wise binding and passes the size of the structure to the driver. The driver will use this size to find successive storage locations in the array of structures. Using **SQLSetStmtOption**, it specifies the size of the rowset.

The application then executes a **SELECT** statement to return a result set of the employee names and birthdays, which is sorted by birthday. It calls **SQLBindCol** to bind the columns of data, passing the addresses of storage locations for both the data and the returned numbers of bytes. Finally, the application fetches the rowset data with **SQLExtendedFetch** and prints each employee's name and birthday.

```
#define ROWS 100
#define NAME_LEN 30
#define BDAY_LEN 11

typedef struct {

      UCHAR     szName[NAME_LEN];

      SDWORD    cbName;

      SWORD     sAge;

      SDWORD    cbAge;

      UCHAR     szBirthday[BDAY_LEN];

      SDWORD    cbBirthday;

      }  EmpTable;

EmpTable rget[ROWS];
UDWORD   crow, irow;
UWORD    rgfRowStatus[ROWS];

SQLSetStmtOption(hstmt, SQL_BIND_TYPE, sizeof(EmpTable));
SQLSetStmtOption(hstmt, SQL_CONCURRENCY, SQL_CONCUR_READ_ONLY);
SQLSetStmtOption(hstmt, SQL_CURSOR_TYPE, SQL_CURSOR_KEYSET_DRIVEN);
SQLSetStmtOption(hstmt, SQL_ROWSET_SIZE, ROWS);
retcode = SQLExecDirect(hstmt,
      "SELECT NAME, AGE, BIRTHDAY FROM EMPLOYEE ORDER BY 3, 2, 1",
```

```
            SQL_NTS);

if (retcode == SQL_SUCCESS) {
      SQLBindCol(hstmt, 1, SQL_C_CHAR, rget[0].szName, NAME_LEN,

                &rget[0].cbName);
      SQLBindCol(hstmt, 2, SQL_C_SSHORT, &rget[0].sAge, 0,

                &rget[0].cbAge);
      SQLBindCol(hstmt, 3, SQL_C_CHAR, rget[0].szBirthday, BDAY_LEN,

                &rget[0].cbBirthday);
      /* Fetch the rowset data and print each row. */
      /* On an error, display a message and exit.  */

      while (TRUE) {
         retcode = SQLExtendedFetch(hstmt, SQL_FETCH_NEXT, 1, &crow,

                                    rgfRowStatus);
         if (retcode == SQL_ERROR || retcode == SQL_SUCCESS_WITH_INFO) {
              show_error();
         }
         if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){
              for (irow = 0; irow < crow; irow++) {
              if (rgfRowStatus[irow] != SQL_ROW_DELETED &&

                   rgfRowStatus[irow] != SQL_ROW_ERROR)
                   fprintf(out, "%-*s  %-2d  %*s",

                        NAME_LEN-1, rget[irow].szName, rget[irow].sAge,

                        BDAY_LEN-1, rget[irow].szBirthday);
              }
         } else {
              break;
         }
      }
}
```

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLDescribeCol**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Returning the number of result set columns	**SQLNumResultCols**
Positioning the cursor in a rowset	**SQLSetPos (extension)**
Setting a statement option	**SQLSetStmtOption (extension)**

SQLFetch (ODBC 1.0, Core)

SQLFetch fetches a row of data from a result set. The driver returns data for all columns that were bound to storage locations with **SQLBindCol**.

Syntax

RETCODE **SQLFetch**(*hstmt*)

The **SQLFetch** function accepts the following argument.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLFetch** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLFetch** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The data returned for one or more columns was truncated. String values are right truncated. For numeric values, the fractional part of number was truncated. (Function returns SQL_SUCCESS_WITH_INFO.)
07006	Restricted data type attribute violation	The data value could not be converted to the data type specified by *fCType* in **SQLBindCol**.

08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
22002	Indicator value required but not supplied	NULL data was fetched into a column whose *pcbValue* as set by **SQLBindCol** was a null pointer.
22003	Numeric value out of range	Returning the numeric value (as numeric or string) for one or more columns would have caused the whole (as opposed to fractional) part of the number to be truncated. Returning the binary value for one or more columns would have caused a loss of binary significance. For more information, see "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."
22012	Division by zero	A value from an arithmetic expression was returned which resulted in division by zero.
24000	Invalid cursor state	The *hstmt* was in an executed state but no result set was associated with the *hstmt*.
40001	Serialization failure	The transaction in which the fetch was executed was terminated to prevent deadlock.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1002	Invalid column number	A column number specified in the binding for one or more columns was greater than the number of columns in the result set. A column number specified in the binding for a column was 0; **SQLFetch** cannot be used to retrieve bookmarks.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multi-threaded application.
S1010	Function sequence error	(DM) The specified *hstmt* was not in an executed state. The function was called without first calling **SQLExecDirect**, **SQLExecute**, or a catalog function.. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns. (DM) **SQLExtendedFetch** was called for an *hstmt* after **SQLFetch** was called and before **SQLFreeStmt** was called with the SQL_CLOSE option.
S1C00	Driver not capable	The driver or data source does not support the conversion specified by the combination of the *fCType* in **SQLBindCol** and the SQL data type of the corresponding column. This error only applies when the SQL data type of the column was mapped to a driver-specific SQL data type.

S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLFetch positions the cursor on the next row of the result set. Before **SQLFetch** is called the first time, the cursor is positioned before the start of the result set. When the cursor is positioned on the last row of the result set, **SQLFetch** returns SQL_NO_DATA_FOUND and the cursor is positioned after the end of the result set. An application cannot mix calls to **SQLExtendedFetch** and **SQLFetch** for the same cursor.

If the application called **SQLBindCol** to bind columns, **SQLFetch** stores data into the locations specified by the calls to **SQLBindCol**. If the application does not call **SQLBindCol** to bind any columns, **SQLFetch** doesn't return any data; it just moves the cursor to the next row. An application can call **SQLGetData** to retrieve data that is not bound to a storage location.

The driver manages cursors during the fetch operation and places each value of a bound column into the associated storage. The driver follows these guidelines when performing a fetch operation:

- **SQLFetch** accesses column data in left-to-right order.
- After each fetch, *pcbValue* (specified in **SQLBindCol**) contains the number of bytes available to return for the column. This is the number of bytes available prior to calling **SQLFetch**. If the number of bytes available to return cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL. (If SQL_MAX_LENGTH has been specified with **SQLSetStmtOption** and the number of bytes available to return is greater than SQL_MAX_LENGTH, *pcbValue* contains SQL_MAX_LENGTH.)

  NOTE: The SQL_MAX_LENGTH statement option is intended to reduce network traffic and may not be supported by all drivers. To guarantee that data is truncated, an application should allocate a buffer of the desired size and specify this size in the *cbValueMax* argument.
- If *rgbValue* is not large enough to hold the entire result, the driver stores part of the value and returns SQL_SUCCESS_WITH_INFO. A subsequent call to **SQLError** indicates that a truncation occurred. The application can compare *pcbValue* to *cbValueMax* (specified in **SQLBindCol**) to determine which column or columns were truncated. If *pcbValue* is greater than or equal to *cbValueMax*, then truncation occurred.
- If the data value for the column is NULL, the driver stores SQL_NULL_DATA in *pcbValue*.

SQLFetch is valid only after a call that returns a result set.

For information about conversions allowed by **SQLBindCol** and **SQLGetData**, see "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."

Code Example

See **SQLBindCol**, **SQLColumns**, and **SQLGetData**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLDescribeCol**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Freeing a statement handle	**SQLFreeStmt**
Fetching part or all of a column of data	**SQLGetData (extension)**
Returning the number of result set columns	**SQLNumResultCols**
Preparing a statement for execution	**SQLPrepare**

SQLFetchPrev (SOLID Extension)

SQLFetchPrev fetches a row of data from a result set. The driver returns data for all columns that were bound to storage locations with **SQLBindCol**.

Syntax

RETCODE **SQLFetchPrev**(*hstmt*)

The **SQLFetchPrev** function accepts the following argument.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLFetchPrev** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLFetchPrev** and explains each one in the context of this function. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The data returned for one or more columns was truncated. String values are right truncated. For numeric values, the fractional part of number was truncated. (Function returns SQL_SUCCESS_WITH_INFO.)
07006	Restricted data type attribute violation	The data value could not be converted to the data type specified by *fCType* in **SQLBindCol**.

08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
22002	Indicator value required but not supplied	NULL data was fetched into a column whose *pcbValue* as set by **SQLBindCol** was a null pointer.
22003	Numeric value out of range	Returning the numeric value (as numeric or string) for one or more columns would have caused the whole (as opposed to fractional) part of the number to be truncated. Returning the binary value for one or more columns would have caused a loss of binary significance. For more information, see "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."
22012	Division by zero	A value from an arithmetic expression was returned which resulted in division by zero.
24000	Invalid cursor state	The *hstmt* was in an executed state but no result set was associated with the *hstmt*.
40001	Serialization failure	The transaction in which the fetch was executed was terminated to prevent deadlock.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	A column number specified in the binding for one or more columns was greater than the number of columns in the result set. A column number specified in the binding for a column was 0; **SQLFetch** cannot be used to retrieve bookmarks.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multi-threaded application.
S1010	Function sequence error	The specified *hstmt* was not in an executed state. The function was called without first calling **SQLExecDirect**, **SQLExecute**, or a catalog function.. An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1C00	Driver not capable	The driver or data source does not support the conversion specified by the combination of the *fCType* in **SQLBindCol** and the SQL data type of the corresponding column. This error only applies when the SQL data type of the column was mapped to a driver-specific SQL data type.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLFetchPrev positions the cursor on the previous row of the result set. **SQLFetchPrev** returns SQL_NO_DATA_FOUND and the cursor is positioned before the start of the result set if **SQLFetchPrev** is called before **SQLFetch** has been called. When the cursor is positioned on the first row of the result set, **SQLFetchPrev** returns the data of the first row

again. An application cannot mix calls to **SQLExtendedFetch** and **SQLFetchPrev** for the same cursor.

If the application called **SQLBindCol** to bind columns, **SQLFetchPrev** stores data into the locations specified by the calls to **SQLBindCol**. If the application does not call **SQLBindCol** to bind any columns, **SQLFetchPrev** doesn't return any data; it just moves the cursor to the next row. An application can call **SQLGetData** to retrieve data that is not bound to a storage location.

The driver manages cursors during the fetch operation and places each value of a bound column into the associated storage. The driver follows these guidelines when performing a fetch operation:

- **SQLFetchPrev** accesses column data in left-to-right order.
- After each fetch, *pcbValue* (specified in **SQLBindCol**) contains the number of bytes available to return for the column. This is the number of bytes available prior to calling **SQLFetchPrev**. If the number of bytes available to return cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL.
- If *rgbValue* is not large enough to hold the entire result, the driver stores part of the value and returns SQL_SUCCESS_WITH_INFO. A subsequent call to **SQLError** indicates that a truncation occurred. The application can compare *pcbValue* to *cbValueMax* (specified in **SQLBindCol**) to determine which column or columns were truncated. If *pcbValue* is greater than or equal to *cbValueMax*, then truncation occurred.
- If the data value for the column is NULL, the driver stores SQL_NULL_DATA in *pcbValue*.

SQLFetchPrev is valid only after a call that returns a result set.

For information about conversions allowed by **SQLBindCol** and **SQLGetData**, see "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."

Code Example

See **SQLBindCol**, **SQLColumns**, and **SQLGetData**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**

Returning information about a column in a result set	**SQLDescribeCol**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Fetching a row of data	**SQLFetch**
Freeing a statement handle	**SQLFreeStmt**
Fetching part or all of a column of data	**SQLGetData (extension)**
Returning the number of result set columns	**SQLNumResultCols**
Preparing a statement for execution	**SQLPrepare**

SQLFreeConnect (ODBC 1.0, Core)

SQLFreeConnect releases a connection handle and frees all memory associated with the handle.

Syntax

RETCODE **SQLFreeConnect**(*hdbc*)

The **SQLFreeConnect** function accepts the following argument.

Type	Argument	Use	**Description**
HDBC	*hdbc*	Input	Connection handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLFreeConnect** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLFreeConnect** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.

S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLDisconnect** for the *hdbc*.

Comments

Prior to calling **SQLFreeConnect,** an application must call **SQLDisconnect** for the *hdbc*. Otherwise, **SQLFreeConnect** returns SQL_ERROR and the *hdbc* remains valid. Note that **SQLDisconnect** automatically drops any *hstmts* open on the *hdbc*.

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Allocating a statement handle	**SQLAllocConnect**
Connecting to a data source	**SQLConnect**
Disconnecting from a data source	**SQLDisconnect**
Connecting to a data source using a connection string or dialog box	**SQLDriverConnect (extension)**
Freeing an environment handle	**SQLFreeEnv**
Freeing a statement handle	**SQLFreeStmt**

SQLFreeEnv (ODBC 1.0, Core)

SQLFreeEnv frees the environment handle and releases all memory associated with the environment handle.

Syntax

RETCODE **SQLFreeEnv**(*henv*)

The **SQLFreeEnv** function accepts the following argument.

Type	Argument	Use	Description
HENV	*henv*	Input	Environment handle.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLFreeEnv** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLFreeEnv** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1010	Function sequence error	(DM) There was at least one *hdbc* in an allocated or connected state. Call **SQLDisconnect** and **SQLFreeConnect** for each *hdbc* before calling **SQLFreeEnv**.

Comments

Prior to calling **SQLFreeEnv**, an application must call **SQLFreeConnect** for any *hdbc* allocated under the *henv.* Otherwise, **SQLFreeEnv** returns SQL_ERROR and the *henv* and any active *hdbc* remains valid.

When the Driver Manager processes the **SQLFreeEnv** function, it checks the **TraceAutoStop** keyword in the [ODBC] section of the ODBC.INI file or the ODBC subkey of the registry. If it is set to 1, the Driver Manager disables tracing for all applications and sets the **Trace** keyword in the [ODBC] section of the ODBC.INI file or the ODBC subkey of the registry to 0.

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Allocating an environment handle	**SQLAllocEnv**
Freeing a connection handle	**SQLFreeConnect**

SQLFreeStmt (ODBC 1.0, Core)

SQLFreeStmt stops processing associated with a specific *hstmt*, closes any open cursors associated with the *hstmt*, discards pending results, and, optionally, frees all resources associated with the statement handle.

Syntax

RETCODE **SQLFreeStmt**(*hstmt*, *fOption*)

The **SQLFreeStmt** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle
UWORD	fOption	Input	One of the following options: SQL_ CLOSE: Close the cursor associated with *hstmt* (if one was defined) and discard all pending results. The application can reopen this cursor later by executing a **SELECT** statement again with the same or different parameter values. If no cursor is open, this option has no effect for the application. SQL_DROP: Release the *hstmt*, free all resources associated with it, close the cursor (if one is open), and discard all pending rows. This option terminates all access to the *hstmt*. The *hstmt* must be reallocated to be reused. SQL_UNBIND: Release all column buffers bound by **SQLBindCol** for the given *hstmt*. SQL_RESET_PARAMS: Release all parameter buffers set by **SQLBindParameter** for the given *hstmt*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLFreeStmt** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the

SQLSTATE values commonly returned by **SQLFreeStmt** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1092	Option type out of range	(DM) The value specified for the argument *fOption* was not: SQL_CLOSE SQL_DROP SQL_UNBIND SQL_RESET_PARAMS

Comments

An application can call **SQLFreeStmt** to terminate processing of a **SELECT** statement with or without canceling the statement handle.

The SQL_DROP option frees all resources that were allocated by the **SQLAllocStmt** function.

Code Example

See **SQLConnect**.

Related Functions

For information about	See
Allocating a statement handle	**SQLAllocStmt**
Canceling statement processing	**SQLCancel**
Setting a cursor name	**SQLSetCursorName**

SQLGetConnectOption (ODBC 1.0, Level 1)

SQLGetConnectOption returns the current setting of a connection option.

Syntax

RETCODE **SQLGetConnectOption**(*hdbc*, *fOption*, *pvParam*)

The **SQLGetConnectOption** function accepts the following arguments:

Type	Argument	Use	Description
HDBC	*hdbc*	Input	Connection handle.
UWORD	*fOption*	Input	Option to retrieve.
PTR	*pvParam*	Output	Value associated with *fOption*. Depending on the value of *fOption*, a 32-bit integer value or a pointer to a null-terminated character string will be returned in *pvParam*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetConnectOption** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetConnectOption** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08003	Connection not open	(DM) An *fOption* value was specified that required an open connection.

IM001	Driver does not support this function	(DM) The driver corresponding to the *hdbc* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1092	Option type out of range	(DM) The value specified for the argument *fOption* was in the block of numbers reserved for ODBC connection and statement options, but was not valid for the version of ODBC supported by the driver.
S1C00	Driver not capable	The value specified for the argument *fOption* was a valid ODBC connection option for the version of ODBC supported by the driver, but was not supported by the driver. The value specified for the argument *fOption* was in the block of numbers reserved for driver-specific connection and statement options, but was not supported by the driver.

Comments

For a list of options, see **SQLSetConnectOption**. Note that if *fOption* specifies an option that returns a string, *pvParam* must be a pointer to storage for the string. The maximum length of the string will be SQL_MAX_OPTION_STRING_LENGTH bytes (excluding the null termination byte).

Depending on the option, an application does not need to establish a connection prior to calling **SQLGetConnectOption**. However, if **SQLGetConnectOption** is called and the specified option does not have a default and has not been set by a prior call to **SQLSetConnectOption**, **SQLGetConnnectOption** will return SQL_NO_DATA_FOUND.

While an application can set statement options using **SQLSetConnectOption**, an application cannot use **SQLGetConnectOption** to retrieve statement option values; it must call **SQLGetStmtOption** to retrieve the setting of statement options.

Related Functions

For information about	See
Returning the setting of a statement option	**SQLGetStmtOption (extension)**
Setting a connection option	**SQLSetConnectOption (extension)**
Setting a statement option	**SQLSetStmtOption (extension)**

SQLGetCursorName (ODBC 1.0, Core)

SQLGetCursorName returns the cursor name associated with a specified *hstmt*.

Syntax

RETCODE **SQLGetCursorName**(*hstmt*, *szCursor*, *cbCursorMax*, *pcbCursor*)

The **SQLGetCursorName** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UCHAR FAR *	szCursor	Output	Pointer to storage for the cursor name.
SWORD	cbCursorMax	Input	Length of *szCursor*.
SWORD FAR *	pcbCursor	Output	Total number of bytes (excluding the null termination byte) available to return in *szCursor*. If the number of bytes available to return is greater than or equal to *cbCursorMax*, the cursor name in *szCursor* is truncated to *cbCursorMax* – 1 bytes.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetCursorName** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetCursorName** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

01004	Data truncated	The buffer *szCursor* was not large enough to return the entire cursor name, so the cursor name was truncated. The argument *pcbCursor* contains the length of the untruncated cursor name. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1015	No cursor name available	(DM) There was no open cursor on the *hstmt* and no cursor name had been set with **SQLSetCursorName**.
S1090	Invalid string or buffer length	(DM) The value specified in the argument *cbCursorMax* was less than 0.

Comments

The only ODBC SQL statements that use a cursor name are positioned update and delete (for example, **UPDATE** *table-name* ...**WHERE CURRENT OF** *cursor-name*). If the application does not call **SQLSetCursorName** to define a cursor name, on execution of a

SELECT statement the driver generates a name that begins with the letters SQL_CUR and does not exceed 18 characters in length.

SQLGetCursorName returns the name of a cursor regardless of whether the name was created explicitly or implicitly.

A cursor name that is set either explicitly or implicitly remains set until the *hstmt* with which it is associated is dropped, using **SQLFreeStmt** with the SQL_DROP option.

Related Functions

For information about	See
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Preparing a statement for execution	**SQLPrepare**
Setting a cursor name	**SQLSetCursorName**
Setting cursor scrolling options	**SQLSetScrollOptions (extension)**

SQLGetData (ODBC 1.0, Level 1)

SQLGetData returns result data for a single unbound column in the current row. The application must call **SQLFetch**, or **SQLExtendedFetch** and (optionally) **SQLSetPos** to position the cursor on a row of data before it calls **SQLGetData**. It is possible to use **SQLBindCol** for some columns and use **SQLGetData** for others within the same row. This function can be used to retrieve character or binary data values in parts from a column with a character, binary, or data source–specific data type (for example, data from SQL_LONGVARBINARY or SQL_LONGVARCHAR columns).

Syntax

RETCODE **SQLGetData**(*hstmt*, *icol*, *fCType*, *rgbValue*, *cbValueMax*, *pcbValue*)

The **SQLGetData** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*icol*	Input	Column number of result data, ordered sequentially left to right, starting at 1. A column number of 0 is used to retrieve a bookmark for the row; bookmarks are not supported by ODBC 1.0 drivers or **SQLFetch**.

SWORD	fCType	Input	The C data type of the result data. This must be one of the following values: SQL_C_BINARY SQL_C_BIT SQL_C_BOOKMARK SQL_C_CHAR SQL_C_DATE SQL_C_DEFAULT SQL_C_DOUBLE SQL_C_FLOAT SQL_C_SLONG SQL_C_SSHORT SQL_C_STINYINT SQL_C_TIME SQL_C_TIMESTAMP SQL_C_ULONG SQL_C_USHORT SQL_C_UTINYINT SQL_C_DEFAULT specifies that data be converted to its default C data type. **Note** Drivers must also support the following values of *fCType* from ODBC 1.0. Applications must use these values, rather than the ODBC 2.0 values, when calling an ODBC 1.0 driver: SQL_C_LONG SQL_C_SHORT SQL_C_TINYINT For information about how data is converted, see "*Converting Data from SQL to C Data Types" on page D-19*.
PTR	rgbValue	Output	Pointer to storage for the data.

SDWORD	cbValueMax	Input	Maximum length of the *rgbValue* buffer. For character data, *rgbValue* must also include space for the null-termination byte. For character and binary C data, *cbValueMax* determines the amount of data that can be received in a single call to **SQLGetData**. For all other types of C data, *cbValueMax* is ignored; the driver assumes that the size of *rgbValue* is the size of the C data type specified with *fCType* and returns the entire data value. For more information about length, see "*Precision, Scale, Length, and Display Size" on page D-14*.
SDWORD FAR *	pcbValue	Output	SQL_NULL_DATA, the total number of bytes (excluding the null termination byte for character data) available to return in *rgbValue* prior to the current call to **SQLGetData**, or SQL_NO_TOTAL if the number of available bytes cannot be determined. For character data, if *pcbValue* is SQL_NO_TOTAL or is greater than or equal to *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* – 1 bytes and is null-terminated by the driver. For binary data, if *pcbValue* is SQL_NO_TOTAL or is greater than *cbValueMax*, the data in *rgbValue* is truncated to *cbValueMax* bytes. For all other data types, the value of *cbValueMax* is ignored and the driver assumes the size of *rgbValue* is the size of the C data type specified with *fCType*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetData** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table

lists the SQLSTATE values commonly returned by **SQLGetData** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	All of the data for the specified column, *icol*, could not be retrieved in a single call to the function. The argument *pcbValue* contains the length of the data remaining in the specified column prior to the current call to **SQLGetData**. (Function returns SQL_SUCCESS_WITH_INFO.) For more information on using multiple calls to **SQLGetData** for a single column, see "Comments."
07006	Restricted data type attribute violation	The data value cannot be converted to the C data type specified by the argument *fCType*.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
22002	Indicator variable required but not supplied	NULL data is retrieved and *pcbValue* is a null pointer.
22003	Numeric value out of range	Returning the numeric value (as numeric or string) for the column would have caused the whole (as opposed to fractional) part of the number to be truncated. Returning the binary value for the column would have caused a loss of binary significance. See *Appendix D, "Data Types"* for more information.
22005	Error in assignment	The data for the column was incompatible with the data type into which it was to be converted. See *Appendix D, "Data Types"* for more information.

22008	Datetime field overflow	The data for the column was not a valid date, time, or timestamp value. See *Appendix D, "Data Types"* for more information.
24000	Invalid cursor state	(DM) The *hstmt* was in an executed state but no result set was associated with the *hstmt*. (DM) A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called. A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called, but the cursor was positioned before the start of the result set or after the end of the result set.
IM001	Driver does not support this function	(DM) The driver corresponding to the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1002	Invalid column number	The value specified for the argument *icol* was 0 and the driver was an ODBC 1.0 driver. The value specified for the argument *icol* was 0 and **SQLFetch** was used to fetch the data. The value specified for the argument *icol* was 0 and the SQL_USE_BOOKMARKS statement option was set to SQL_UB_OFF. The specified column was greater than the number of result columns. The specified column was bound through a call to **SQLBindCol**. This description does not apply to drivers that return the SQL_GD_BOUND bitmask for the SQL_GETDATA_EXTENSIONS option in **SQLGetInfo**.

		The specified column was at or before the last bound column specified through **SQLBindCol**. This description does not apply to drivers that return the SQL_GD_ANY_COLUMN bitmask for the SQL_GETDATA_EXTENSIONS option in **SQLGetInfo**.
		The application has already called **SQLGetData** for the current row. The column specified in the current call was before the column specified in the preceding call. This description does not apply to drivers that return the SQL_GD_ANY_ORDER bitmask for the SQL_GETDATA_EXTENSIONS option in **SQLGetInfo**.
S1003	Program type out of range	(DM) The argument *fCType* was not a valid data type or SQL_C_DEFAULT. The argument *icol* was 0 and the argument *fCType* was not SQL_C_BOOKMARK.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1009	Invalid argument value	(DM) The argument *rgbValue* was a null pointer.

S1010	Function sequence error	(DM) The specified *hstmt* was not in an executed state. The function was called without first calling **SQLExecDirect**, **SQLExecute**, or a catalog function. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbValueMax* was less than 0.
S1109	Invalid cursor position	The cursor was positioned (by **SQLSetPos** or **SQLExtendedFetch**) on a row for which the value in the *rgfRowStatus* array in **SQLExtendedFetch** was SQL_ROW_DELETED or SQL_ROW_ERROR.

S1C00	Driver not capable	The driver or data source does not support use of **SQLGetData** with multiple rows in **SQLExtendedFetch**. This description does not apply to drivers that return the SQL_GD_BLOCK bitmask for the SQL_GETDATA_EXTENSIONS option in **SQLGetInfo**. The driver or data source does not support the conversion specified by the combination of the *fCType* argument and the SQL data type of the corresponding column. This error only applies when the SQL data type of the column was mapped to a driver-specific SQL data type. The argument *icol* was 0 and the driver does not support bookmarks. The driver only supports ODBC 1.0 and the argument *fCType* was one of the following: SQL_C_STINYINT SQL_C_UTINYINT SQL_C_SSHORT SQL_C_USHORT SQL_C_SLONG SQL_C_ULONG
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

With each call, the driver sets *pcbValue* to the number of bytes that were available in the result column prior to the current call to **SQLGetData**. (If SQL_MAX_LENGTH has been set with **SQLSetStmtOption**, and the total number of bytes available on the first call is greater than SQL_MAX_LENGTH, the available number of bytes is set to SQL_MAX_LENGTH. Note that the SQL_MAX_LENGTH statement option is intended to reduce network traffic and may not be supported by all drivers. To guarantee that data is truncated, an application should allocate a buffer of the desired size and specify this size in the *cbValueMax* argument.) If the total number of bytes in the result column cannot be determined in advance, the driver sets *pcbValue* to SQL_NO_TOTAL. If the data value for the column is NULL, the driver stores SQL_NULL_DATA in *pcbValue*.

SQLGetData can convert data to a different data type. The result and success of the conversion is determined by the rules for assignment specified in "Converting Data from SQL to C Data Types" in Appendix D, "Data Types."

If more than one call to **SQLGetData** is required to retrieve data from a single column with a character, binary, or data source–specific data type, the driver returns SQL_SUCCESS_WITH_INFO. A subsequent call to **SQLError** returns SQLSTATE 01004 (Data truncated). The application can then use the same column number to retrieve subsequent parts of the data until **SQLGetData** returns SQL_SUCCESS, indicating that all data for the column has been retrieved. **SQLGetData** will return SQL_NO_DATA_FOUND when it is called for a column after all of the data has been retrieved and before data is retrieved for a subsequent column. The application can ignore excess data by proceeding to the next result column.

Note An application can use **SQLGetData** to retrieve data from a column in parts only when retrieving character C data from a column with a character,binary, or data source–specific data type or when retrieving binary C data from a column with a character, binary, or data source–specific data type. If **SQLGetData** is called more than one time in a row for a column under any other conditions, it returns SQL_NO_DATA_FOUND for all calls after the first.

For maximum interoperability, applications should call **SQLGetData** only for unbound columns with numbers greater than the number of the last bound column. Within a single row of data, the column number in each call to **SQLGetData** should be greater than or equal to the column number in the previous call (that is, data should be retrieved in increasing order of column number). As extended functionality, drivers can return data through **SQLGetData** from bound columns, from columns before the last bound column, or from columns in any order. To determine whether a driver supports these extensions, an application calls **SQLGetInfo** with the SQL_GETDATA_EXTENSIONS option.

Furthermore, applications that use **SQLExtendedFetch** to retrieve data should call **SQLGetData** only when the rowset size is 1. As extended functionality, drivers can return data through **SQLGetData** when the rowset size is greater than 1. The application calls **SQLSetPos** to position the cursor on a row and calls **SQLGetData** to retrieve data from an unbound column. To determine whether a driver supports this extension, an application calls **SQLGetInfo** with the SQL_GETDATA_EXTENSIONS option.

Code Example

In the following example, an application executes a **SELECT** statement to return a result set of the employee names, ages, and birthdays sorted by birthday, age, and name. For each row of data, it calls **SQLFetch** to position the cursor to the next row. It calls **SQLGetData** to retrieve the fetched data; the storage locations for the data and the returned number of bytes

are specified in the call to **SQLGetData**. Finally, it prints each employee's name, age, and birthday.

```
#define NAME_LEN 30
#define BDAY_LEN 11

UCHAR     szName[NAME_LEN], szBirthday[BDAY_LEN];
SWORD     sAge;
SDWORD    cbName, cbAge, cbBirthday;

retcode = SQLExecDirect(hstmt,

            "SELECT NAME, AGE, BIRTHDAY FROM EMPLOYEE ORDER BY 3, 2, 1",

            SQL_NTS);

if (retcode == SQL_SUCCESS) {
      while (TRUE) {
         retcode = SQLFetch(hstmt);
         if (retcode == SQL_ERROR || retcode == SQL_SUCCESS_WITH_INFO) {
              show_error();
         }
         if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO){

              /* Get data for columns 1, 2, and 3 */
              /* Print the row of data            */

              SQLGetData(hstmt, 1, SQL_C_CHAR, szName, NAME_LEN, &cbName);
              SQLGetData(hstmt, 2, SQL_C_SSHORT, &sAge, 0, &cbAge);
              SQLGetData(hstmt, 3, SQL_C_CHAR, szBirthday, BDAY_LEN,

                         &cbBirthday);

              fprintf(out, "%-*s %-2d %*s", NAME_LEN-1, szName, sAge,

                      BDAY_LEN-1, szBirthday);
         } else {
              break;
         }
      }
}
```

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Sending parameter data at execution time	**SQLPutData (extension)**

SQLGetFunctions (ODBC 1.0, Level 1)

SQLGetFunctions returns information about whether a driver supports a specific ODBC function. This function is implemented in the Driver Manager; it can also be implemented in drivers. If a driver implements **SQLGetFunctions**, the Driver Manager calls the function in the driver. Otherwise, it executes the function itself.

Syntax

RETCODE **SQLGetFunctions**(*hdbc*, *fFunction*, *pfExists*)

The **SQLGetFunctions** function accepts the following arguments:

Type	Argument	Use	Description
HDBC	hdbc	Input	Connection handle.
UWORD	fFunction	Input	SQL_API_ALL_FUNCTIONS or a **#define** value that identifies the ODBC function of interest. For a list of **#define** values that identify ODBC functions, see the tables in "Comments."

UWORD FAR *	*pfExists*	Output	If *fFunction* is SQL_API_ALL_FUNCTIONS, *pfExists* points to a UWORD array with 100 elements. The array is indexed by **#define** values used by *fFunction* to identify each ODBC function; some elements of the array are unused and reserved for future use. An element is TRUE if it identifies an ODBC function supported by the driver. It is FALSE if it identifies an ODBC function not supported by the driver or does not identify an ODBC function. **Note** The *fFunction* value SQL_API_ALL_FUNCTIONS was added in ODBC 2.0. If *fFunction* identifies a single ODBC function, *pfExists* points to single UWORD. *pfExists* is TRUE if the specified function is supported by the driver; otherwise, it is FALSE.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetFunctions** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetFunctions** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description

01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) **SQLGetFunctions** was called before **SQLConnect**, or **SQLDriverConnect**.
S1095	Function type out of range	(DM) An invalid *fFunction* value was specified.

Comments

SQLGetFunctions always returns that **SQLGetFunctions**, **SQLDataSources**, and **SQLDrivers** are supported. It does this because these functions are implemented in the Driver Manager.

The following table lists valid values for *fFunction* for ODBC core functions.

SQL_API_SQLALLOCCONNECT	SQL_API_SQLFETCH
SQL_API_SQLALLOCSTMT	SQL_API_SQLFREEENV
SQL_API_SQLBINDCOL	SQL_API_SQLFREESTMT
SQL_API_SQLCANCEL	SQL_API_SQLGETCURSORNAME
SQL_API_SQLCOLATTRIBUTES	SQL_API_SQLNUMRESULTCOLS
SQL_API_SQLCONNECT	SQL_API_SQLPREPARE
SQL_API_SQLDESCRIBECOL	SQL_API_SQLROWCOUNT
SQL_API_SQLDISCONNECT	SQL_API_SQLSETCURSORNAME
SQL_API_SQLERROR	SQL_API_SQLSETPARAM
SQL_API_SQLEXECDIRECT	SQL_API_SQLTRANSACT

SQL_API_SQLEXECUTE

NOTE: For ODBC 1.0 drivers, **SQLGetFunctions** returns TRUE in *pfExists* if *fFunction* is SQL_API_SQLBINDPARAMETER or SQL_API_SQLSETPARAM and the driver supports **SQLSetParam**. For ODBC 2.0 drivers, **SQLGetFunctions** returns TRUE in *pfExists* if *fFunction* is SQL_API_SQLSETPARAM or SQL_API_SQLBINDPARAMETER and the driver supports **SQLBindParameter**.

The following table lists valid values for *fFunction* for ODBC extension level 1 functions.

SQL_API_SQLBINDPARAMETER	SQL_API_SQLGETTYPEINFO
SQL_API_SQLDRIVERCONNECT	SQL_API_SQLPUTDATA
SQL_API_SQLGETCONNECTOPTION	SQL_API_SQLSETCONNECTOPTION
SQL_API_SQLGETDATA	SQL_API_SQLSETSTMTOPTION
SQL_API_SQLGETFUNCTIONS	SQL_API_SQLSPECIALCOLUMNS
SQL_API_SQLGETINFO	SQL_API_SQLSTATISTICS
SQL_API_SQLGETSTMTOPTION	SQL_API_SQLTABLES

The following table lists valid values for *fFunction* for ODBC extension level 2 functions.

SQL_API_SQLDATASOURCES	SQL_API_SQLNUMPARAMS
SQL_API_SQLDESCRIBEPARAM	SQL_API_SQLPRIMARYKEYS
SQL_API_SQLDRIVERS	SQL_API_SQLSETPOS
SQL_API_SQLEXTENDEDFETCH	SQL_API_SQLSETSCROLLOPTIONS

Code Example

The following two examples show how an application uses **SQLGetFunctions** to determine if a driver supports **SQLTables**, **SQLColumns**, and **SQLStatistics**. If the driver does not support these functions, the application disconnects from the driver. The first example calls **SQLGetFunctions** once for each function.

```
UWORD TablesExists, ColumnsExists, StatisticsExists;

SQLGetFunctions(hdbc, SQL_API_SQLTABLES, &TablesExists);
SQLGetFunctions(hdbc, SQL_API_SQLCOLUMNS, &ColumnsExists);
SQLGetFunctions(hdbc, SQL_API_SQLSTATISTICS, &StatisticsExists);
```

```
if (TablesExists && ColumnsExists && StatisticsExists) {

      /* Continue with application */

}

SQLDisconnect(hdbc);
```

The second example calls **SQLGetFunctions** a single time and passes it an array in which **SQLGetFunctions** returns information about all ODBC functions.

```
UWORD fExists[100];

SQLGetFunctions(hdbc, SQL_API_ALL_FUNCTIONS, fExists);

if (fExists[SQL_API_SQLTABLES] &&

    fExists[SQL_API_SQLCOLUMNS] &&

    fExists[SQL_API_SQLSTATISTICS]) {

      /* Continue with application */

}

SQLDisconnect(hdbc);
```

Related Functions

For information about	See
Returning the setting of a connection option	**SQLGetConnectOption (extension)**
Returning information about a driver or data source	**SQLGetInfo (extension)**
Returning the setting of a statement option	**SQLGetStmtOption (extension)**

SQLGetInfo (ODBC 1.0, Level 1)

SQLGetInfo returns general information about the driver and data source associated with an *hdbc*.

Syntax

RETCODE **SQLGetInfo**(*hdbc*, *fInfoType*, *rgbInfoValue*, *cbInfoValueMax*, *pcbInfoValue*)

The **SQLGetInfo** function accepts the following arguments.

Type	Argument	Use	Description
HDBC	hdbc	Input	Connection handle.
UWORD	fInfoType	Input	Type of information. *fInfoType* must be a value representing the type of interest (see "Comments").
PTR	rgbInfoValue	Output	Pointer to storage for the information. Depending on the *fInfoType* requested, the information returned will be one of the following: a null-terminated character string, a 16-bit integer value, a 32-bit flag, or a 32-bit binary value.
SWORD	cbInfoValueMax	Input	Maximum length of the *rgbInfoValue* buffer.
SWORD FAR *	pcbInfoValue	Output	The total number of bytes (excluding the null termination byte for character data) available to return in *rgbInfoValue*. For character data, if the number of bytes available to return is greater than or equal to *cbInfoValueMax*, the information in *rgbInfoValue* is truncated to *cbInfoValueMax* – 1 bytes and is null-terminated by the driver. For all other types of data, the value of *cbValueMax* is ignored and the driver assumes the size of *rgbValue* is 32 bits.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetInfo** returns either SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetInfo** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The buffer *rgbInfoValue* was not large enough to return all of the requested information, so the information was truncated. The argument *pcbInfoValue* contains the length of the requested information in its untruncated form. (Function returns SQL_SUCCESS_WITH_INFO.)
08003	Connection not open	(DM) The type of information requested in *fInfoType* requires an open connection. Of the information types reserved by ODBC, only SQL_ODBC_VER can be returned without an open connection.
22003	Numeric value out of range	Returning the requested information would have caused a loss of numeric or binary significance.
IM001	Driver does not support this function	(DM) The driver corresponding to the *hdbc* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1009	Invalid argument value	(DM) The *fInfoType* was SQL_DRIVER_HSTMT, and the value pointed to by *rgbInfoValue* was not a valid statement handle.
S1090	Invalid string or buffer length	(DM) The value specified for argument *cbInfoValueMax* was less than 0.
S1096	Information type out of range	(DM) The value specified for the argument *fOption* was in the block of numbers reserved for ODBC information types, but was not valid for the version of ODBC supported by the driver.
S1C00	Driver not capable	The value specified for the argument *fOption* was in the range of numbers reserved for driver-specific information types, but was not supported by the driver.
S1T00	Timeout expired	The timeout period expired before the data source returned the requested information. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

The currently defined information types are shown below; it is expected that more will be defined to take advantage of different data sources. Information types from 0 to 999 are reserved by ODBC; driver developers must reserve values greater than or equal to SQL_INFO_DRIVER_START for driver-specific use.

The format of the information returned in *rgbInfoValue* depends on the *fInfoType* requested. **SQLGetInfo** will return information in one of five different formats:

- A null-terminated character string,
- A 16-bit integer value,
- A 32-bit bitmask,
- A 32-bit integer value,
- Or a 32-bit binary value.

The format of each of the following information types is noted in the type's description. The application must cast the value returned in *rgbInfoValue* accordingly. For an example of how an application could retrieve data from a 32-bit bitmask, see "Code Example."

A driver must return a value for each of the information types defined in the following tables. If an information type does not apply to the driver or data source, then the driver returns one of the following values:

Format of rgbInfoValue	**Returned value**
Character string ("Y" or "N")	"N"
Character string (not "Y" or "N")	Empty string
16-bit integer	0
32-bit bitmask or 32-bit binary value	0L

For example, if a data source does not support procedures, **SQLGetInfo** returns the following values for the values of *fInfoType* that are related to procedures:

fInfoType	Returned value
SQL_PROCEDURES	"N"
SQL_ACCESSIBLE_PROCEDURES	"N"
SQL_MAX_PROCEDURE_NAME_LEN	0
SQL_PROCEDURE_TERM	Empty string

SQLGetInfo returns SQLSTATE S1096 (Invalid argument value) for values of *fInfoType* that are in the range of information types reserved for use by ODBC but are not defined by the version of ODBC supported by the driver. To determine what version of ODBC a driver conforms to, an application calls **SQLGetInfo** with the SQL_DRIVER_ODBC_VER information type. **SQLGetInfo** returns SQLSTATE S1C00 (Driver not capable) for values of *fInfoType* that are in the range of information types reserved for driver-specific use but are not supported by the driver.

NOTE: Application developers should be aware that ODBC 1.0 drivers might return SQL_ERROR and SQLSTATE S1C00 (Driver not capable) for values of *fInfoType* that were defined in ODBC 1.0 but do not apply to the driver or the data source.

Information Types

This section lists the information types supported by **SQLGetInfo**. Information types are grouped categorically and listed alphabetically.

Driver Information

The following values of *fInfoType* return information about the ODBC driver, such as the number of active statements, the data source name, and the API conformance levels.

SQL_ACTIVE_CONNECTIONS

SQL_ACTIVE_STATEMENTS

SQL_DATA_SOURCE_NAME

SQL_DRIVER_HDBC

SQL_DRIVER_HENV

SQL_DRIVER_HLIB

SQL_DRIVER_HSTMT

SQL_DRIVER_NAME

SQL_DRIVER_ODBC_VER

SQL_DRIVER_VER

SQL_FETCH_DIRECTION

SQL_FILE_USAGE

SQL_GETDATA_EXTENSIONS

SQL_LOCK_TYPES

SQL_ODBC_API_CONFORMANCE

SQL_ODBC_SAG_CLI_CONFORMANCE

SQL_ODBC_VER

SQL_POS_OPERATIONS

SQL_ROW_UPDATES

SQL_SEARCH_PATTERN_ESCAPE

SQL_SERVER_NAME

DBMS Product Information

The following values of *fInfoType* return information about the DBMS product, such as the DBMS name and version.

SQL_DATABASE_NAME

SQL_DBMS_NAME

SQL_DBMS_VER

Data Source Information

The following values of *fInfoType* return information about the data source, such as cursor characteristics and transaction capabilities.

SQL_ACCESSIBLE_PROCEDURES

SQL_ACCESSIBLE_TABLES

SQL_BOOKMARK_PERSISTENCE

SQL_CONCAT_NULL_BEHAVIOR

SQL_CURSOR_COMMIT_BEHAVIOR

SQL_CURSOR_ROLLBACK_BEHAVIOR

SQL_DATA_SOURCE_READ_ONLY

SQL_DEFAULT_TXN_ISOLATION

SQL_MULT_RESULT_SETS

SQL_MULTIPLE_ACTIVE_TXN

SQL_NEED_LONG_DATA_LEN

SQL_NULL_COLLATION

SQL_OWNER_TERM

SQL_PROCEDURE_TERM

SQL_QUALIFIER_TERM

SQL_SCROLL_CONCURRENCY

SQL_SCROLL_OPTIONS

SQL_STATIC_SENSITIVITY

SQL_TABLE_TERM

SQL_TXN_CAPABLE

SQL_TXN_ISOLATION_OPTION

SQL_USER_NAME

Supported SQL

The following values of *fInfoType* return information about the SQL statements supported by the data source. These information types do not exhaustively describe the entire ODBC SQL grammar. Instead, they describe those parts of the grammar for which data sources commonly offer different levels of support.

Applications should determine the general level of supported grammar from the SQL_ODBC_SQL_CONFORMANCE information type and use the other information types to determine variations from the stated conformance level.

SQL_ALTER_TABLE

SQL_COLUMN_ALIAS

SQL_CORRELATION_NAME

SQL_EXPRESSIONS_IN_ORDERBY

SQL_GROUP_BY

SQL_IDENTIFIER_CASE

SQL_IDENTIFIER_QUOTE_CHAR

SQL_KEYWORDS

SQL_LIKE_ESCAPE_CLAUSE

SQL_NON_NULLABLE_COLUMNS

SQL_ODBC_SQL_CONFORMANCE

SQL_ODBC_SQL_OPT_IEF

SQL_ORDER_BY_COLUMNS_IN_SELECT

SQL_OUTER_JOINS

SQL_OWNER_USAGE

SQL_POSITIONED_STATEMENTS

SQL_PROCEDURES

SQL_QUALIFIER_LOCATION

SQL_QUALIFIER_NAME_SEPARATOR

SQL_QUALIFIER_USAGE

SQL_QUOTED_IDENTIFIER_CASE

SQL_SPECIAL_CHARACTERS

SQL_SUBQUERIES

SQL_UNION

SQL Limits

The following values of *fInfoType* return information about the limits applied to identifiers and clauses in SQL statements, such as the maximum lengths of identifiers and the maximum number of columns in a select list. Limitations may be imposed by either the driver or the data source.

SQL_MAX_BINARY_LITERAL_LEN

SQL_MAX_CHAR_LITERAL_LEN

SQL_MAX_COLUMN_NAME_LEN

SQL_MAX_COLUMNS_IN_GROUP_BY

SQL_MAX_COLUMNS_IN_ORDER_BY

SQL_MAX_COLUMNS_IN_INDEX

SQL_MAX_COLUMNS_IN_SELECT

SQL_MAX_COLUMNS_IN_TABLE

SQL_MAX_CURSOR_NAME_LEN

SQL_MAX_INDEX_SIZE

SQL_MAX_OWNER_NAME_LEN

SQL_MAX_PROCEDURE_NAME_LEN

SQL_MAX_QUALIFIER_NAME_LEN

SQL_MAX_ROW_SIZE

SQL_MAX_ROW_SIZE_INCLUDES_LONG

SQL_MAX_STATEMENT_LEN

SQL_MAX_TABLE_NAME_LEN

SQL_MAX_TABLES_IN_SELECT

SQL_MAX_USER_NAME_LEN

Scalar Function Information

The following values of *fInfoType* return information about the scalar functions supported by the data source and the driver. For more information about scalar functions. See *Appendix F, "Scalar Functions"* for more information about scalar functions.

SQL_CONVERT_FUNCTIONS

SQL_NUMERIC_FUNCTIONS

SQL_STRING_FUNCTIONS

SQL_SYSTEM_FUNCTIONS

SQL_TIMEDATE_ADD_INTERVALS

SQL_TIMEDATE_DIFF_INTERVALS

SQL_TIMEDATE_FUNCTIONS

Conversion Information

The following values of *fInfoType* return a list of the SQL data types to which the data source can convert the specified SQL data type with the **CONVERT** scalar function.

SQL_CONVERT_BIGINT

SQL_CONVERT_BINARY

SQL_CONVERT_BIT

SQL_CONVERT_CHAR

SQL_CONVERT_DATE

SQL_CONVERT_DECIMAL

SQL_CONVERT_DOUBLE

SQL_CONVERT_FLOAT

SQL_CONVERT_INTEGER

SQL_CONVERT_LONGVARBINARY

SQL_CONVERT_LONGVARCHAR

SQL_CONVERT_NUMERIC

SQL_CONVERT_REAL

SQL_CONVERT_SMALLINT

SQL_CONVERT_TIME

SQL_CONVERT_TIMESTAMP

SQL_CONVERT_TINYINT

SQL_CONVERT_VARBINARY

SQL_CONVERT_VARCHAR

Information Type Descriptions

The following table alphabetically lists each information type, the version of ODBC in which it was introduced, and its description.

InfoType	Returns
SQL_ACCESSIBLE_TABLES (ODBC 1.0)	A character string: "Y" if the user is guaranteed **SELECT** privileges to all tables returned by **SQLTables**, "N" if there may be tables returned that the user cannot access.
SQL_ACTIVE_ CONNECTIONS (ODBC 1.0)	A 16-bit integer value specifying the maximum number of active *hdbcs* that the driver can support. This value can reflect a limitation imposed by either the driver or the data source. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_ACTIVE_STATEMENTS (ODBC 1.0)	A 16-bit integer value specifying the maximum number of active *hstmts* that the driver can support for an *hdbc*. This value can reflect a limitation imposed by either the driver or the data source. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_ALTER_TABLE (ODBC 2.0)	A 32-bit bitmask enumerating the clauses in the **ALTER TABLE** statement supported by the data source. The following bitmask is used to determine which clauses are supported: SQL_AT_ADD_COLUMN SQL_AT_DROP_COLUMN

SQL_BOOKMARK_ PERSISTENCE (ODBC 2.0)	A 32-bit bitmask enumerating the operations through which bookmarks persist. The following bitmasks are used in conjunction with the flag to determine through which options bookmarks persist: SQL_BP_CLOSE = Bookmarks are valid after an application calls **SQLFreeStmt** with the SQL_CLOSE option to close the cursor associated with an *hstmt*. SQL_BP_DELETE = The bookmark for a row is valid after that row has been deleted. SQL_BP_DROP = Bookmarks are valid after an *hstmt* an application calls **SQLFreeStmt** with the SQL_DROP option to drop an *hstmt*. SQL_BP_SCROLL = Bookmarks are valid after any scrolling operation (call to **SQLExtendedFetch**). Because all bookmarks must remain valid after **SQLExtendedFetch** is called, this value can be used by applications to determine whether bookmarks are supported. SQL_BP_TRANSACTION = Bookmarks are valid after an application commits or rolls back a transaction. SQL_BP_UPDATE = The bookmark for a row is valid after any column in that row has been updated, including key columns. SQL_BP_OTHER_HSTMT = A bookmark associated with one *hstmt* can be used with another *hstmt*.
SQL_COLUMN_ALIAS (ODBC 2.0)	A character string: “Y” if the data source supports column aliases; otherwise, “N”.
SQL_CONCAT_NULL_ BEHAVIOR (ODBC 1.0)	A 16-bit integer value indicating how the data source handles the concatenation of NULL valued character data type columns with non-NULL valued character data type columns: SQL_CB_NULL = Result is NULL valued. SQL_CB_NON_NULL = Result is concatenation of non-NULL valued column or columns.

SQL_CONVERT_BIGINT
SQL_CONVERT_BINARY
SQL_CONVERT_BIT
SQL_CONVERT_CHAR
SQL_CONVERT_DATE
SQL_CONVERT_DECIMAL
SQL_CONVERT_DOUBLE
SQL_CONVERT_FLOAT
SQL_CONVERT_INTEGER
SQL_CONVERT_
LONGVARBINARY
SQL_CONVERT_
LONGVARCHAR
SQL_CONVERT_NUMERIC
SQL_CONVERT_REAL
SQL_CONVERT_SMALLINT
SQL_CONVERT_TIME
SQL_CONVERT_
TIMESTAMP
SQL_CONVERT_TINYINT
SQL_CONVERT_
VARBINARY
SQL_CONVERT_VARCHAR
(ODBC 1.0)

A 32-bit bitmask. The bitmask indicates the conversions supported by the data source with the CONVERT scalar function for data of the type named in the *fInfoType*. If the bitmask equals zero, the data source does not support any conversions for data of the named type, including conversion to the same data type.

For example, to find out if a data source supports the conversion of SQL_INTEGER data to the SQL_BIGINT data type, an application calls **SQLGetInfo** with the *fInfoType* of SQL_CONVERT_INTEGER. The application ANDs the returned bitmask with SQL_CVT_BIGINT. If the resulting value is nonzero, the conversion is supported.

The following bitmasks are used to determine which conversions are supported:

SQL_CVT_BIGINT
SQL_CVT_BINARY
SQL_CVT_BIT
SQL_CVT_CHAR
SQL_CVT_DATE
SQL_CVT_DECIMAL
SQL_CVT_DOUBLE
SQL_CVT_FLOAT
SQL_CVT_INTEGER
SQL_CVT_LONGVARBINARY
SQL_CVT_LONGVARCHAR
SQL_CVT_NUMERIC
SQL_CVT_REAL
SQL_CVT_SMALLINT
SQL_CVT_TIME
SQL_CVT_TIMESTAMP
SQL_CVT_TINYINT
SQL_CVT_VARBINARY
SQL_CVT_VARCHAR

SQL_CONVERT_ FUNCTIONS (ODBC 1.0)	A 32-bit bitmask enumerating the scalar conversion functions supported by the driver and associated data source. The following bitmask is used to determine which conversion functions are supported: SQL_FN_CVT_CONVERT
SQL_CORRELATION_NAME (ODBC 1.0)	A 16-bit integer indicating if table correlation names are supported: SQL_CN_NONE = Correlation names are not supported. SQL_CN_DIFFERENT = Correlation names are supported, but must differ from the names of the tables they represent. SQL_CN_ANY = Correlation names are supported and can be any valid user-defined name.
SQL_CURSOR_COMMIT_ BEHAVIOR (ODBC 1.0)	A 16-bit integer value indicating how a **COMMIT** operation affects cursors and prepared statements in the data source: SQL_CB_DELETE = Close cursors and delete prepared statements. To use the cursor again, the application must reprepare and reexecute the *hstmt*. SQL_CB_CLOSE = Close cursors. For prepared statements, the application can call **SQLExecute** on the *hstmt* without calling **SQLPrepare** again. SQL_CB_PRESERVE = Preserve cursors in the same position as before the **COMMIT** operation. The application can continue to fetch data or it can close the cursor and reexecute the *hstmt* without repreparing it.

SQL_CURSOR_ROLLBACK_ BEHAVIOR (ODBC 1.0)	A 16-bit integer value indicating how a **ROLLBACK** operation affects cursors and prepared statements in the data source: SQL_CB_DELETE = Close cursors and delete prepared statements. To use the cursor again, the application must reprepare and reexecute the *hstmt*. SQL_CB_CLOSE = Close cursors. For prepared statements, the application can call **SQLExecute** on the *hstmt* without calling **SQLPrepare** again. SQL_CB_PRESERVE = Preserve cursors in the same position as before the **ROLLBACK** operation. The application can continue to fetch data or it can close the cursor and reexecute the *hstmt* without repreparing it.
SQL_DATA_SOURCE_NAME (ODBC 1.0)	A character string with the data source name used during connection. If the application called **SQLConnect**, this is the value of the *szDSN* argument. If the application called **SQLDriverConnect**, this is the value of the DSN keyword in the connection string passed to the driver. If the connection string did not contain the DSN keyword (such as when it contains the DRIVER keyword), this is an empty string.
SQL_DATA_SOURCE_ READ_ONLY (ODBC 1.0)	A character string. "Y" if the data source is set to READ ONLY mode, "N" if it is otherwise. This characteristic pertains only to the data source itself, it is not a characteristic of the driver that enables access to the data source.
SQL_DATABASE_NAME (ODBC 1.0)	A character string with the name of the current database in use, if the data source defines a named object called "database." **Note** In ODBC 2.0, this value of *fInfoType* has been replaced by the SQL_CURRENT_QUALIFIER connection option. ODBC 2.0 drivers should continue to support the SQL_DATABASE_NAME information type, and ODBC 2.0 applications should only use it with ODBC 1.0 drivers.
SQL_DBMS_NAME (ODBC 1.0)	A character string with the name of the DBMS product accessed by the driver.

SQL_DBMS_VER
(ODBC 1.0)

A character string indicating the version of the DBMS product accessed by the driver. The version is of the form ##.##.####, where the first two digits are the major version, the next two digits are the minor version, and the last four digits are the release version. The driver must render the DBMS product version in this form, but can also append the DBMS product-specific version as well. For example, "03.00.0034 SOLID 3.0"

SQL_DEFAULT_TXN_
ISOLATION
(ODBC 1.0)

A 32-bit integer that indicates the default transaction isolation level supported by the driver or data source, or zero if the data source does not support transactions. The following terms are used to define transaction isolation levels:

Dirty Read Transaction 1 changes a row. Transaction 2 reads the changed row before transaction 1 commits the change. If transaction 1 rolls back the change, transaction 2 will have read a row that is considered to have never existed.

Nonrepeatable Read Transaction 1 reads a row. Transaction 2 updates or deletes that row and commits this change. If transaction 1 attempts to reread the row, it will receive different row values or discover that the row has been deleted.

Phantom Transaction 1 reads a set of rows that satisfy some search criteria. Transaction 2 inserts a row that matches the search criteria. If transaction 1 reexecutes the statement that read the rows, it receives a different set of rows.

If the data source supports transactions, the driver returns one of the following bitmasks:

SQL_TXN_READ_UNCOMMITTED = Dirty reads, nonrepeatable reads, and phantoms are possible.

SQL_TXN_READ_COMMITTED = Dirty reads are not possible. Nonrepeatable reads and phantoms are possible.

SQL_TXN_REPEATABLE_READ = Dirty reads and nonrepeatable reads are not possible. Phantoms are possible.

SQL_DEFAULT_TXN_ ISOLATION (ODBC 1.0)	SQL_TXN_SERIALIZABLE = Transactions are serializable. Dirty reads, nonrepeatable reads, and phantoms are not possible. SQL_TXN_VERSIONING = Transactions are serializable, but higher concurrency is possible than with SQL_TXN_SERIALIZABLE. Dirty reads are not possible. Typically, SQL_TXN_SERIALIZABLE is implemented by using locking protocols that reduce concurrency and SQL_TXN_VERSIONING is implemented by using a non-locking protocol such as record versioning.
SQL_DRIVER_HDBC SQL_DRIVER_HENV (ODBC 1.0)	A 32-bit value, the driver's environment handle or connection handle, determined by the argument *hdbc*. These information types are implemented by the Driver Manager alone.
SQL_DRIVER_HLIB (ODBC 2.0)	A 32-bit value, the library handle returned to the Driver Manager when it loaded the driver DLL. The handle is only valid for the *hdbc* specified in the call to **SQLGetInfo**. This information type is implemented by the Driver Manager alone.
SQL_DRIVER_HSTMT (ODBC 1.0)	A 32-bit value, the driver's statement handle determined by the Driver Manager statement handle, which must be passed on input in *rgbInfoValue* from the application. Note that in this case, *rgbInfoValue* is both an input and an output argument. The input *hstmt* passed in *rgbInfoValue* must have been an *hstmt* allocated on the argument *hdbc*. This information type is implemented by the Driver Manager alone.
SQL_DRIVER_NAME (ODBC 1.0)	A character string with the filename of the driver used to access the data source.

SQL_DRIVER_ODBC_VER (ODBC 2.0)	A character string with the version of ODBC that the driver supports. The version is of the form ##.##, where the first two digits are the major version and the next two digits are the minor version. SQL_SPEC_MAJOR and SQL_SPEC_MINOR define the major and minor version numbers. For the version of ODBC described in this manual, these are 2 and 0, and the driver should return "02.00". If a driver supports **SQLGetInfo** but does not support this value of the *fInfoType* argument, the Driver Manager returns "01.00".
SQL_DRIVER_VER (ODBC 1.0)	A character string with the version of the driver and, optionally a description of the driver. At a minimum, the version is of the form ##.##.####, where the first two digits are the major version, the next two digits are the minor version, and the last four digits are the release version.
SQL_EXPRESSIONS_IN_ ORDERBY (ODBC 1.0)	A character string: "Y" if the data source supports expressions in the **ORDER BY** list; "N" if it does not.
SQL_FETCH_DIRECTION (ODBC 1.0)	A 32-bit bitmask enumerating the supported fetch direction options.
The information type was introduced in ODBC 1.0; each bitmask is labeled with the version in which it was introduced.	The following bitmasks are used in conjunction with the flag to determine which options are supported: SQL_FD_FETCH_NEXT (ODBC 1.0) SQL_FD_FETCH_FIRST (ODBC 1.0) SQL_FD_FETCH_LAST (ODBC 1.0) SQL_FD_FETCH_PRIOR (ODBC 1.0) SQL_FD_FETCH_ABSOLUTE (ODBC 1.0) SQL_FD_FETCH_RELATIVE (ODBC 1.0) SQL_FD_FETCH_RESUME (ODBC 1.0) SQL_FD_FETCH_BOOKMARK (ODBC 2.0)

SQL_FILE_USAGE (ODBC 2.0)	A 16-bit integer value indicating how a single-tier driver directly treats files in a data source: SQL_FILE_NOT_SUPPORTED = The driver is not a single-tier driver. SQL_FILE_TABLE = A single-tier driver treats files in a data source as tables. SQL_FILE_QUALIFIER = A single-tier driver treats files in a data source as a qualifier. An application might use this to determine how users will select data.
SQL_GETDATA_ EXTENSIONS (ODBC 2.0)	A 32-bit bitmask enumerating extensions to **SQLGetData**. The following bitmasks are used in conjunction with the flag to determine what common extensions the driver supports for **SQLGetData**: SQL_GD_ANY_COLUMN = **SQLGetData** can be called for any unbound column, including those before the last bound column. Note that the columns must be called in order of ascending column number unless SQL_GD_ANY_ORDER is also returned. SQL_GD_ANY_ORDER = **SQLGetData** can be called for unbound columns in any order. Note that **SQLGetData** can only be called for columns after the last bound column unless SQL_GD_ANY_COLUMN is also returned. SQL_GD_BLOCK = **SQLGetData** can be called for an unbound column in any row in a block (more than one row) of data after positioning to that row with **SQLSetPos**. SQL_GD_BOUND = **SQLGetData** can be called for bound columns as well as unbound columns. A driver cannot return this value unless it also returns SQL_GD_ANY_COLUMN. **SQLGetData** is only required to return data from unbound columns that occur after the last bound column, are called in order of increasing column number, and are not in a row in a block of rows.

SQL_GROUP_BY (ODBC 2.0)	A 16-bit integer value specifying the relationship between the columns in the **GROUP BY** clause and the non-aggregated columns in the select list: SQL_GB_NOT_SUPPORTED = **GROUP BY** clauses are not supported. SQL_GB_GROUP_BY_EQUALS_SELECT = The **GROUP BY** clause must contain all non-aggregated columns in the select list. It cannot contain any other columns. For example, **SELECT DEPT, MAX(SALARY) FROM EMPLOYEE GROUP BY DEPT**. SQL_GB_GROUP_BY_CONTAINS_SELECT = The **GROUP BY** clause must contain all non-aggregated columns in the select list. It can contain columns that are not in the select list. For example, **SELECT DEPT, MAX(SALARY) FROM EMPLOYEE GROUP BY DEPT, AGE**. SQL_GB_NO_RELATION = The columns in the **GROUP BY** clause and the select list are not related. The meaning of non-grouped, non-aggregated columns in the select list is data source–dependent. For example, **SELECT DEPT, SALARY FROM EMPLOYEE GROUP BY DEPT, AGE**.
SQL_IDENTIFIER_CASE (ODBC 1.0)	A 16-bit integer value as follows: SQL_IC_UPPER = Identifiers in SQL are case insensitive and are stored in upper case in system catalog. SQL_IC_LOWER = Identifiers in SQL are case insensitive and are stored in lower case in system catalog. SQL_IC_SENSITIVE = Identifiers in SQL are case sensitive and are stored in mixed case in system catalog. SQL_IC_MIXED = Identifiers in SQL are case insensitive and are stored in mixed case in system catalog.
SQL_IDENTIFIER_QUOTE_CHAR (ODBC 1.0)	The character string used as the starting and ending delimiter of a quoted (delimited) identifiers in SQL statements. (Identifiers passed as arguments to ODBC functions do not need to be quoted.) If the data source does not support quoted identifiers, a blank is returned.

SQL_KEYWORDS (ODBC 2.0)	A character string containing a comma-separated list of all data source–specific keywords. This list does not contain keywords specific to ODBC or keywords used by both the data source and ODBC. For a list of ODBC keywords, see "List of Reserved Keywords" in Appendix C, "SQL Grammar." The **#define** value SQL_ODBC_KEYWORDS contains a comma-separated list of ODBC keywords.
SQL_LIKE_ESCAPE_CLAUSE (ODBC 2.0)	A character string: "Y" if the data source supports an escape character for the percent character (%) and underscore character (_) in a **LIKE** predicate and the driver supports the ODBC syntax for defining a **LIKE** predicate escape character; "N" otherwise.
SQL_LOCK_TYPES (ODBC 2.0)	A 32-bit bitmask enumerating the supported lock types for the *fLock* argument in **SQLSetPos**. The following bitmasks are used in conjunction with the flag to determine which lock types are supported: SQL_LCK_NO_CHANGE SQL_LCK_EXCLUSIVE SQL_LCK_UNLOCK
SQL_MAX_BINARY_ LITERAL_LEN (ODBC 2.0)	A 32-bit integer value specifying the maximum length (number of hexadecimal characters, excluding the literal prefix and suffix returned by **SQLGetTypeInfo**) of a binary literal in an SQL statement. For example, the binary literal 0xFFAA has a length of 4. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_CHAR_LITERAL_ LEN (ODBC 2.0)	A 32-bit integer value specifying the maximum length (number of characters, excluding the literal prefix and suffix returned by **SQLGetTypeInfo**) of a character literal in an SQL statement. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_COLUMN_ NAME_LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of a column name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.

SQL_MAX_COLUMNS_IN_GROUP_BY (ODBC 2.0)	A 16-bit integer value specifying the maximum number of columns allowed in a **GROUP BY** clause. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_COLUMNS_IN_INDEX (ODBC 2.0)	A 16-bit integer value specifying the maximum number of columns allowed in an index. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_COLUMNS_IN_ORDER_BY (ODBC 2.0)	A 16-bit integer value specifying the maximum number of columns allowed in an **ORDER BY** clause. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_COLUMNS_IN_SELECT (ODBC 2.0)	A 16-bit integer value specifying the maximum number of columns allowed in a select list. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_COLUMNS_IN_TABLE (ODBC 2.0)	A 16-bit integer value specifying the maximum number of columns allowed in a table. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_CURSOR_NAME_LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of a cursor name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_INDEX_SIZE (ODBC 2.0)	A 32-bit integer value specifying the maximum number of bytes allowed in the combined fields of an index. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_OWNER_NAME_LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of an owner name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_PROCEDURE_NAME_LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of a procedure name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_QUALIFIER_NAME_LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of a qualifier name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.

SQL_MAX_ROW_SIZE (ODBC 2.0)	A 32-bit integer value specifying the maximum length of a single row in a table. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_ROW_SIZE_ INCLUDES_ LONG (ODBC 2.0)	A character string: "Y" if the maximum row size returned for the SQL_MAX_ROW_SIZE information type includes the length of all SQL_LONGVARCHAR and SQL_LONGVARBINARY columns in the row; "N" otherwise.
SQL_MAX_STATEMENT_ LEN (ODBC 2.0)	A 32-bit integer value specifying the maximum length (number of characters, including white space) of an SQL statement. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_TABLE_NAME_ LEN (ODBC 1.0)	A 16-bit integer value specifying the maximum length of a table name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MAX_TABLES_IN_ SELECT (ODBC 2.0)	A 16-bit integer value specifying the maximum number of tables allowed in the **FROM** clause of a **SELECT** statement. If there is no specified limit or the limit is unknown, this value is set to zero.
SQL_MAX_USER_NAME_ LEN (ODBC 2.0)	A 16-bit integer value specifying the maximum length of a user name in the data source. If there is no maximum length or the length is unknown, this value is set to zero.
SQL_MULT_RESULT_SETS (ODBC 1.0)	A character string: "Y" if the data source supports multiple result sets, "N" if it does not.
SQL_MULTIPLE_ACTIVE_ TXN (ODBC 1.0)	A character string: "Y" if active transactions on multiple connections are allowed, "N" if only one connection at a time can have an active transaction.
SQL_NEED_LONG_DATA_ LEN (ODBC 2.0)	A character string: "Y" if the data source needs the length of a long data value (the data type is SQL_LONGVARCHAR, SQL_LONGVARBINARY, or a long, data source–specific data type) before that value is sent to the data source, "N" if it does not. For more information, see **SQLBindParameter** and **SQLSetPos**.

SQL_NON_NULLABLE_ COLUMNS (ODBC 1.0)	A 16-bit integer specifying whether the data source supports non-nullable columns: SQL_NNC_NULL = All columns must be nullable. SQL_NNC_NON_NULL = Columns may be non-nullable (the data source supports the **NOT NULL** column constraint in **CREATE TABLE** statements).
SQL_NULL_COLLATION (ODBC 2.0)	A 16-bit integer value specifying where NULLs are sorted in a list: SQL_NC_END = NULLs are sorted at the end of the list, regardless of the sort order. SQL_NC_HIGH = NULLs are sorted at the high end of the list. SQL_NC_LOW = NULLs are sorted at the low end of the list. SQL_NC_START = NULLs are sorted at the start of the list, regardless of the sort order.

SQL_NUMERIC_
FUNCTIONS
(ODBC 1.0)

The information type was introduced in ODBC 1.0; each bitmask is labeled with the version in which it was introduced.

A 32-bit bitmask enumerating the scalar numeric functions supported by the driver and associated data source.

The following bitmasks are used to determine which numeric functions are supported:

SQL_FN_NUM_ABS (ODBC 1.0)

SQL_FN_NUM_ACOS (ODBC 1.0)

SQL_FN_NUM_ASIN (ODBC 1.0)

SQL_FN_NUM_ATAN (ODBC 1.0)

SQL_FN_NUM_ATAN2 (ODBC 1.0)

SQL_FN_NUM_CEILING (ODBC 1.0)

SQL_FN_NUM_COS (ODBC 1.0)

SQL_FN_NUM_COT (ODBC 1.0)

SQL_FN_NUM_DEGREES (ODBC 2.0)

SQL_FN_NUM_EXP (ODBC 1.0)

SQL_FN_NUM_FLOOR (ODBC 1.0)

SQL_FN_NUM_LOG (ODBC 1.0)

SQL_FN_NUM_LOG10 (ODBC 2.0)

SQL_FN_NUM_MOD (ODBC 1.0)

SQL_FN_NUM_PI (ODBC 1.0)

SQL_FN_NUM_POWER (ODBC 2.0)

SQL_FN_NUM_RADIANS (ODBC 2.0)

SQL_FN_NUM_RAND (ODBC 1.0)

SQL_FN_NUM_ROUND (ODBC 2.0)

SQL_FN_NUM_SIGN (ODBC 1.0)

SQL_FN_NUM_SIN (ODBC 1.0)

SQL_FN_NUM_SQRT (ODBC 1.0)

SQL_FN_NUM_TAN (ODBC 1.0)

SQL_FN_NUM_TRUNCATE (ODBC 2.0)

SQL_ODBC_API_ CONFORMANCE (ODBC 1.0)	A 16-bit integer value indicating the level of ODBC conformance: SQL_OAC_NONE = None SQL_OAC_LEVEL1 = Level 1 supported SQL_OAC_LEVEL2 = Level 2 supported (For a list of functions and conformance levels, see the "Function Summary" in this chapter)
SQL_ODBC_SAG_CLI_ CONFORMANCE (ODBC 1.0)	A 16-bit integer value indicating compliance to the functions of the SAG specification: SQL_OSCC_NOT_COMPLIANT = Not SAG-compliant; one or more core functions are not supported SQL_OSCC_COMPLIANT = SAG-compliant
SQL_ODBC_SQL_ CONFORMANCE (ODBC 1.0)	A 16-bit integer value indicating SQL grammar supported by the driver: SQL_OSC_MINIMUM = Minimum grammar supported SQL_OSC_CORE = Core grammar supported SQL_OSC_EXTENDED = Extended grammar supported
SQL_ODBC_SQL_OPT_IEF (ODBC 1.0)	A character string: "Y" if the data source supports the optional Integrity Enhancement Facility; "N" if it does not.
SQL_ODBC_VER (ODBC 1.0)	A character string with the version of ODBC to which the Driver Manager conforms. The version is of the form ##.##, where the first two digits are the major version and the next two digits are the minor version. This is implemented solely in the Driver Manager.
SQL_ORDER_BY_ COLUMNS_IN_SELECT (ODBC 2.0)	A character string: "Y" if the columns in the **ORDER BY** clause must be in the select list; otherwise, "N".

SQL_OUTER_JOINS (ODBC 1.0) The information type was introduced in ODBC 1.0; each return value is labeled with the version in which it was introduced.	A character string: "N" = No. The data source does not support outer joins. (ODBC 1.0) "Y" = Yes. The data source supports two-table outer joins, and the driver supports the ODBC outer join syntax except for nested outer joins. However, columns on the left side of the comparison operator in the ON clause must come from the left-hand table in the outer join, and columns on the right side of the comparison operator must come from the right-hand table. (ODBC 1.0) "P" = Partial. The data source partially supports nested outer joins, and the driver supports the ODBC outer join syntax. However, columns on the left side of the comparison operator in the ON clause must come from the left-hand table in the outer join and columns on the right side of the comparison operator must come from the right-hand table. Also, the right-hand table of an outer join cannot be included in an inner join. (ODBC 2.0) "F" = Full. The data source fully supports nested outer joins, and the driver supports the ODBC outer join syntax. (ODBC 2.0)
SQL_OWNER_TERM (ODBC 1.0)	A character string with the data source vendor's name for an owner; for example, "owner", "Authorization ID", or "Schema".

SQL_OWNER_USAGE (ODBC 2.0)	A 32-bit bitmask enumerating the statements in which owners can be used: SQL_OU_DML_STATEMENTS = Owners are supported in all Data Manipulation Language statements: **SELECT**, **INSERT**, **UPDATE**, **DELETE**, and, if supported, **SELECT FOR UPDATE** and positioned update and delete statements. SQL_OU_PROCEDURE_INVOCATION = Owners are supported in the ODBC procedure invocation statement. SQL_OU_TABLE_DEFINITION = Owners are supported in all table definition statements: **CREATE TABLE**, **CREATE VIEW**, **ALTER TABLE**, **DROP TABLE**, and **DROP VIEW**. SQL_OU_INDEX_DEFINITION = Owners are supported in all index definition statements: **CREATE INDEX** and **DROP INDEX**. SQL_OU_PRIVILEGE_DEFINITION = Owners are supported in all privilege definition statements: **GRANT** and **REVOKE**.
SQL_POS_OPERATIONS (ODBC 2.0)	A 32-bit bitmask enumerating the supported operations in **SQLSetPos**. The following bitmasks are used to in conjunction with the flag to determine which options are supported: SQL_POS_POSITION SQL_POS_REFRESH SQL_POS_UPDATE SQL_POS_DELETE SQL_POS_ADD
SQL_POSITIONED_ STATEMENTS (ODBC 2.0)	A 32-bit bitmask enumerating the supported positioned SQL statements. The following bitmasks are used to determine which statements are supported: SQL_PS_POSITIONED_DELETE SQL_PS_POSITIONED_UPDATE SQL_PS_SELECT_FOR_UPDATE

SQL_PROCEDURE_TERM (ODBC 1.0)	A character string with the data source vendor's name for a procedure; for example, "database procedure", "stored procedure", or "procedure".
SQL_PROCEDURES (ODBC 1.0)	A character string: "Y" if the data source supports procedures and the driver supports the ODBC procedure invocation syntax; "N" otherwise.
SQL_QUALIFIER_LOCATION (ODBC 2.0)	A 16-bit integer value indicating the position of the qualifier in a qualified table name: SQL_QL_START SQL_QL_END
SQL_QUALIFIER_NAME_ SEPARATOR (ODBC 1.0)	A character string: the character or characters that the data source defines as the separator between a qualifier name and the qualified name element that follows it.
SQL_QUALIFIER_TERM (ODBC 1.0)	A character string with the data source vendor's name for a qualifier; for example, "database" or "directory".
SQL_QUALIFIER_USAGE (ODBC 2.0)	A 32-bit bitmask enumerating the statements in which qualifiers can be used. The following bitmasks are used to determine where qualifiers can be used: SQL_QU_DML_STATEMENTS = Qualifiers are supported in all Data Manipulation Language statements: **SELECT**, **INSERT**, **UPDATE**, **DELETE**, and, if supported, **SELECT FOR UPDATE** and positioned update and delete statements. SQL_QU_PROCEDURE_INVOCATION = Qualifiers are supported in the ODBC procedure invocation statement. SQL_QU_TABLE_DEFINITION = Qualifiers are supported in all table definition statements: **CREATE TABLE**, **CREATE VIEW**, **ALTER TABLE**, **DROP TABLE**, and **DROP VIEW**. SQL_QU_INDEX_DEFINITION = Qualifiers are supported in all index definition statements: **CREATE INDEX** and **DROP INDEX**. SQL_QU_PRIVILEGE_DEFINITION = Qualifiers are supported in all privilege definition statements: **GRANT** and **REVOKE**.

SQL_QUOTED_ IDENTIFIER_CASE (ODBC 2.0)	A 16-bit integer value as follows: SQL_IC_UPPER = Quoted identifiers in SQL are case insensitive and are stored in upper case in system catalog. SQL_IC_LOWER = Quoted identifiers in SQL are case insensitive and are stored in lower case in system catalog. SQL_IC_SENSITIVE = Quoted identifiers in SQL are case sensitive and are stored in mixed case in system catalog. SQL_IC_MIXED = Quoted identifiers in SQL are case insensitive and are stored in mixed case in system catalog.
SQL_ROW_UPDATES (ODBC 1.0)	A character string: "Y" if a keyset-driven or mixed cursor maintains row versions or values for all fetched rows and therefore can detect any changes made to a row by any user since the row was last fetched; otherwise, "N".
SQL_SCROLL_ CONCURRENCY (ODBC 1.0)	A 32-bit bitmask enumerating the concurrency control options supported for scrollable cursors. The following bitmasks are used to determine which options are supported: SQL_SCCO_READ_ONLY = Cursor is read only. No updates are allowed. SQL_SCCO_LOCK = Cursor uses the lowest level of locking sufficient to ensure that the row can be updated. SQL_SCCO_OPT_ROWVER = Cursor uses optimistic concurrency control, comparing row versions . SQL_SCCO_OPT_VALUES = Cursor uses optimistic concurrency control, comparing values. For information about cursor concurrency, see "*Specifying Cursor Concurrency" on page 2-36.*"

SQL_SCROLL_OPTIONS (ODBC 1.0) The information type was introduced in ODBC 1.0; each bitmask is labeled with the version in which it was introduced.	A 32-bit bitmask enumerating the scroll options supported for scrollable cursors. The following bitmasks are used to determine which options are supported: SQL_SO_FORWARD_ONLY = The cursor only scrolls forward. (ODBC 1.0) SQL_SO_STATIC = The data in the result set is static. (ODBC 2.0) SQL_SO_KEYSET_DRIVEN = The driver saves and uses the keys for every row in the result set. (ODBC 1.0) SQL_SO_DYNAMIC = The driver keeps the keys for every row in the rowset (the keyset size is the same as the rowset size). (ODBC 1.0) SQL_SO_MIXED = The driver keeps the keys for every row in the keyset, and the keyset size is greater than the rowset size. The cursor is keyset-driven inside the keyset and dynamic outside the keyset. (ODBC 1.0) For information about scrollable cursors, see "*Using Block and Scrollable Cursors" on page 2-34*."
SQL_SEARCH_PATTERN_ESCAPE (ODBC 1.0)	A character string specifying what the driver supports as an escape character that permits the use of the pattern match metacharacters underscore (_) and percent (%) as valid characters in search patterns. This escape character applies only for those catalog function arguments that support search strings. If this string is empty, the driver does not support a search-pattern escape character. This *fInfoType* is limited to catalog functions. For a description of the use of the escape character in search pattern strings, see "Search Pattern Arguments" earlier in this chapter.
SQL_SERVER_NAME (ODBC 1.0)	A character string with the actual data source–specific server name; useful when a data source name is used during **SQLConnect,** and **SQLDriverConnect**.
SQL_SPECIAL_CHARACTERS (ODBC 2.0)	A character string containing all special characters (that is, all characters except a through z, A through Z, 0 through 9, and underscore) that can be used in an object name, such as a table, column, or index name, on the data source. For example, "#$^".

SQL_STATIC_SENSITIVITY (ODBC 2.0)	A 32-bit bitmask enumerating whether changes made by an application to a static or keyset-driven cursor through **SQLSetPos** or positioned update or delete statements can be detected by that application: SQL_SS_ADDITIONS = Added rows are visible to the cursor; the cursor can scroll to these rows. Where these rows are added to the cursor is driver-dependent. SQL_SS_DELETIONS = Deleted rows are no longer available to the cursor and do not leave a "hole" in the result set; after the cursor scrolls from a deleted row, it cannot return to that row. SQL_SS_UPDATES = Updates to rows are visible to the cursor; if the cursor scrolls from and returns to an updated row, the data returned by the cursor is the updated data, not the original data. Because updating key values in a keyset-driven cursor is considered to be deleting the existing row and adding a new row, this value is always returned for keyset-driven cursors. Whether an application can detect changes made to the result set by other users, including other cursors in the same application, depends on the cursor type. For more information, see "*Using Block and Scrollable Cursors" on page 2-34*.

SQL_STRING_FUNCTIONS(ODBC 1.0) The information type was introduced in ODBC 1.0; each bitmask is labeled with the version in which it was introduced.	A 32-bit bitmask enumerating the scalar string functions supported by the driver and associated data source. The following bitmasks are used to determine which string functions are supported: SQL_FN_STR_ASCII (ODBC 1.0) SQL_FN_STR_CHAR (ODBC 1.0) SQL_FN_STR_CONCAT (ODBC 1.0) SQL_FN_STR_DIFFERENCE (ODBC 2.0) SQL_FN_STR_INSERT (ODBC 1.0) SQL_FN_STR_LCASE (ODBC 1.0) SQL_FN_STR_LEFT (ODBC 1.0) SQL_FN_STR_LENGTH (ODBC 1.0) SQL_FN_STR_LOCATE (ODBC 1.0) SQL_FN_STR_LOCATE_2 (ODBC 2.0) SQL_FN_STR_LTRIM (ODBC 1.0) SQL_FN_STR_REPEAT (ODBC 1.0) SQL_FN_STR_REPLACE (ODBC 1.0) SQL_FN_STR_RIGHT (ODBC 1.0) SQL_FN_STR_RTRIM (ODBC 1.0) SQL_FN_STR_SOUNDEX (ODBC 2.0) SQL_FN_STR_SPACE (ODBC 2.0) SQL_FN_STR_SUBSTRING (ODBC 1.0) SQL_FN_STR_UCASE (ODBC 1.0) If an application can call the LOCATE scalar function with the *string_exp1*, *string_exp2*, and *start* arguments, the driver returns the SQL_FN_STR_LOCATE bitmask. If an application can call the LOCATE scalar function with only the *string_exp1* and *string_exp2* arguments, the driver returns the SQL_FN_STR_LOCATE_2 bitmask. Drivers that fully support the LOCATE scalar function return both bitmasks.

SQL_SUBQUERIES (ODBC 2.0)	A 32-bit bitmask enumerating the predicates that support subqueries: SQL_SQ_CORRELATED_SUBQUERIES SQL_SQ_COMPARISON SQL_SQ_EXISTS SQL_SQ_IN SQL_SQ_QUANTIFIED The SQL_SQ_CORRELATED_SUBQUERIES bitmask indicates that all predicates that support subqueries support correlated subqueries.
SQL_SYSTEM_FUNCTIONS (ODBC 1.0)	A 32-bit bitmask enumerating the scalar system functions supported by the driver and associated data source. The following bitmasks are used to determine which system functions are supported: SQL_FN_SYS_DBNAME SQL_FN_SYS_IFNULL SQL_FN_SYS_USERNAME
SQL_TABLE_TERM (ODBC 1.0)	A character string with the data source vendor's name for a table; for example, "table" or "file".
SQL_TIMEDATE_ADD_INTERVALS (ODBC 2.0)	A 32-bit bitmask enumerating the timestamp intervals supported by the driver and associated data source for the TIMESTAMPADD scalar function. The following bitmasks are used to determine which intervals are supported: SQL_FN_TSI_FRAC_SECOND SQL_FN_TSI_SECOND SQL_FN_TSI_MINUTE SQL_FN_TSI_HOUR SQL_FN_TSI_DAY SQL_FN_TSI_WEEK SQL_FN_TSI_MONTH SQL_FN_TSI_QUARTER SQL_FN_TSI_YEAR

SQL_TIMEDATE_DIFF_INTERVALS (ODBC 2.0)	A 32-bit bitmask enumerating the timestamp intervals supported by the driver and associated data source for the TIMESTAMPDIFF scalar function. The following bitmasks are used to determine which intervals are supported: SQL_FN_TSI_FRAC_SECOND SQL_FN_TSI_SECOND SQL_FN_TSI_MINUTE SQL_FN_TSI_HOUR SQL_FN_TSI_DAY SQL_FN_TSI_WEEK SQL_FN_TSI_MONTH SQL_FN_TSI_QUARTER SQL_FN_TSI_YEAR

SQL_TIMEDATE_ FUNCTIONS (ODBC 1.0) The information type was introduced in ODBC 1.0; each bitmask is labeled with the version in which it was introduced.	A 32-bit bitmask enumerating the scalar date and time functions supported by the driver and associated data source. The following bitmasks are used to determine which date and time functions are supported: SQL_FN_TD_CURDATE (ODBC 1.0) SQL_FN_TD_CURTIME (ODBC 1.0) SQL_FN_TD_DAYNAME (ODBC 2.0) SQL_FN_TD_DAYOFMONTH (ODBC 1.0) SQL_FN_TD_DAYOFWEEK (ODBC 1.0) SQL_FN_TD_DAYOFYEAR (ODBC 1.0) SQL_FN_TD_HOUR (ODBC 1.0) SQL_FN_TD_MINUTE (ODBC 1.0) SQL_FN_TD_MONTH (ODBC 1.0) SQL_FN_TD_MONTHNAME (ODBC 2.0) SQL_FN_TD_NOW (ODBC 1.0) SQL_FN_TD_QUARTER (ODBC 1.0) SQL_FN_TD_SECOND (ODBC 1.0) SQL_FN_TD_TIMESTAMPADD (ODBC 2.0) SQL_FN_TD_TIMESTAMPDIFF (ODBC 2.0) SQL_FN_TD_WEEK (ODBC 1.0) SQL_FN_TD_YEAR (ODBC 1.0)

SQL_TXN_CAPABLE (ODBC 1.0) The information type was introduced in ODBC 1.0; each return value is labeled with the version in which it was introduced	A 16-bit integer value describing the transaction support in the driver or data source: SQL_TC_NONE = Transactions not supported. (ODBC 1.0) SQL_TC_DML = Transactions can only contain Data Manipulation Language (DML) statements (**SELECT**, **INSERT**, **UPDATE**, **DELETE**). Data Definition Language (DDL) statements encountered in a transaction cause an error. (ODBC 1.0) SQL_TC_DDL_COMMIT = Transactions can only contain DML statements. DDL statements (**CREATE TABLE**, **DROP INDEX**, an so on) encountered in a transaction cause the transaction to be committed. (ODBC 2.0) SQL_TC_DDL_IGNORE = Transactions can only contain DML statements. DDL statements encountered in a transaction are ignored. (ODBC 2.0) SQL_TC_ALL = Transactions can contain DDL statements and DML statements in any order. (ODBC 1.0)
SQL_TXN_ISOLATION_OPTION (ODBC 1.0)	A 32-bit bitmask enumerating the transaction isolation levels available from the driver or data source. The following bitmasks are used in conjunction with the flag to determine which options are supported: SQL_TXN_READ_UNCOMMITTED SQL_TXN_READ_COMMITTED SQL_TXN_REPEATABLE_READ SQL_TXN_SERIALIZABLE SQL_TXN_VERSIONING For descriptions of these isolation levels, see the description of SQL_DEFAULT_TXN_ISOLATION.

SQL_UNION (ODBC 2.0)	A 32-bit bitmask enumerating the support for the **UNION** clause: SQL_U_UNION = The data source supports the **UNION** clause. SQL_U_UNION_ALL = The data source supports the **ALL** keyword in the **UNION** clause. (**SQLGetInfo** returns both SQL_U_UNION and SQL_U_UNION_ALL in this case.)
SQL_USER_NAME (ODBC 1.0)	A character string with the name used in a particular database, which can be different than login name.

Code Example

SQLGetInfo returns lists of supported options as a 32-bit bitmask in *rgbInfoValue*. The bitmask for each option is used in conjunction with the flag to determine whether the option is supported.

For example, an application could use the following code to determine whether the SUBSTRING scalar function is supported by the driver associated with the *hdbc*:

```
UDWORD          fFuncs;

SQLGetInfo(hdbc,

           SQL_STRING_FUNCTIONS,

           (PTR)&fFuncs,

           sizeof(fFuncs),

           NULL);

if (fFuncs & SQL_FN_STR_SUBSTRING) /* SUBSTRING supported */

      ...;

else                               /* SUBSTRING not supported */

      ...;
```

Related Functions

For information about	See
Returning the setting of a connection option	**SQLGetConnectOption (extension)**
Determining if a driver supports a function	**SQLGetFunctions (extension)**
Returning the setting of a statement option	**SQLGetStmtOption (extension)**
Returning information about a data source's data types	**SQLGetTypeInfo (extension)**

SQLGetStmtOption (ODBC 1.0, Level 1)

SQLGetStmtOption returns the current setting of a statement option.

Syntax

RETCODE **SQLGetStmtOption**(*hstmt*, *fOption*, *pvParam*)

The **SQLGetStmtOption** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	fOption	Input	Option to retrieve.
PTR	pvParam	Output	Value associated with *fOption*. Depending on the value of *fOption*, a 32-bit integer value or a pointer to a null-terminated character string will be returned in *pvParam*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetStmtOption** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetStmtOption** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

24000	Invalid cursor state	The argument *fOption* was SQL_ROW_NUMBER or SQL_GET_BOOKMARK and the cursor was not open, or the cursor was positioned before the start of the result set or after the end of the result set.
IM001	Driver does not support this function	(DM) The driver corresponding to the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1011	Operation invalid at this time	The *fOption* argument was SQL_GET_BOOKMARK and the value of the SQL_USE_BOOKMARKS statement option was SQL_UB_OFF.
S1092	Option type out of range	(DM) The value specified for the argument *fOption* was in the block of numbers reserved for ODBC connection and statement options, but was not valid for the version of ODBC supported by the driver.

S1109	Invalid cursor position	The *fOption* argument was SQL_GET_BOOKMARK or SQL_ROW_NUMBER and the value in the *rgfRowStatus* array in **SQLExtendedFetch** for the current row was SQL_ROW_DELETED or SQL_ROW_ERROR.
S1C00	Driver not capable	The value specified for the argument *fOption* was a valid ODBC statement option for the version of ODBC supported by the driver, but was not supported by the driver. The value specified for the argument *fOption* was in the block of numbers reserved for driver-specific connection and statement options, but was not supported by the driver.

Comments

The following table lists statement options for which corresponding values can be returned, but not set. The table also lists the version of ODBC in which they were introduced. For a list of options that can be set and retrieved, see **SQLSetStmtOption**. If *fOption* specifies an option that returns a string, *pvParam* must be a pointer to storage for the string. The maximum length of the string will be SQL_MAX_OPTION_STRING_LENGTH bytes (excluding the null termination byte).

fOption	pvParam contents
SQL_GET_BOOKMARK (ODBC 2.0)	A 32-bit integer value that is the bookmark for the current row. Before using this option, an application must set the SQL_USE_BOOKMARKS statement option to SQL_UB_ON, create a result set, and call **SQLExtendedFetch**. To return to the rowset starting with the row marked by this bookmark, an application calls **SQLExtendedFetch** with the SQL_FETCH_BOOKMARK fetch type and irow set to this value. Bookmarks are also returned as column 0 of the result set.

SQL_ROW_NUMBER (ODBC 2.0)	A 32-bit integer value that specifies the number of the current row in the entire result set. If the number of the current row cannot be determined or there is no current row, the driver returns 0.

Related Functions

For information about	See
Returning the setting of a connection option	**SQLGetConnectOption** (extension)
Setting a connection option	**SQLSetConnectOption** (extension)
Setting a statement option	**SQLSetStmtOption** (extension)

SQLGetTypeInfo (ODBC 1.0, Level 1)

SQLGetTypeInfo returns information about data types supported by the data source. The driver returns the information in the form of an SQL result set.

Important applications must use the type names returned in the TYPE_NAME column in **ALTER TABLE** and **CREATE TABLE** statements; they must not use the sample type names listed in *Appendix C, "SQL Grammar"*. **SQLGetTypeInfo** may return more than one row with the same value in the DATA_TYPE column.

Syntax

RETCODE **SQLGetTypeInfo**(*hstmt*, *fSqlType*)

The **SQLGetTypeInfo** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle for the result set.

SWORD	fSqlType	Input	The SQL data type. This must be one of the following values: SQL_BIGINT SQL_BINARY SQL_BIT SQL_CHAR SQL_DATE SQL_DECIMAL SQL_DOUBLE SQL_FLOAT SQL_INTEGER SQL_LONGVARBINARY SQL_LONGVARCHAR SQL_NUMERIC SQL_REAL SQL_SMALLINT SQL_TIME SQL_TIMESTAMP SQL_TINYINT SQL_VARBINARY SQL_VARCHAR or a driver-specific SQL data type. SQL_ALL_TYPES specifies that information about all data types should be returned. For information about ODBC SQL data types, see *"SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLGetTypeInfo** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLGetTypeInfo** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had not been called. A result set was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver corresponding to the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1004	SQL data type out of range	(DM) The value specified for the argument *fSqlType* was in the block of numbers reserved for ODBC SQL data type indicators but was not a valid ODBC SQL data type indicator.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*, then the function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1C00	Driver not capable	The value specified for the argument *fSqlType* was in the range of numbers reserved for driver-specific SQL data type indicators, but was not supported by the driver or data source. The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLGetTypeInfo returns the results as a standard result set, ordered by DATA_TYPE and TYPE_NAME. The following table lists the columns in the result set.

NOTE: **SQLGetTypeInfo** might not return all data types. For example, a driver might not return user-defined data types. Applications can use any valid data type, regardless of

whether it is returned by **SQLGetTypeInfo**.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source.

Column Name	Data Type	Comments
TYPE_NAME	Varchar(128) not NULL	Data source–dependent data type name; for example, "CHAR", "VARCHAR", "MONEY", "LONG VARBINARY", or "CHAR ( ) FOR BIT DATA". Applications must use this name in **CREATE TABLE** and **ALTER TABLE** statements.
DATA_TYPE	Smallint not NULL	SQL data type. This can be an ODBC SQL data type or a driver-specific SQL data type. For a list of valid ODBC SQL data types, see *"SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.
PRECISION	Integer	The maximum precision of the data type on the data source. NULL is returned for data types where precision is not applicable. For more information on precision, see *"Precision, Scale, Length, and Display Size" on page D-14*.
LITERAL_PREFIX	Varchar(128)	Character or characters used to prefix a literal; for example, a single quote (') for character data types or 0x for binary data types; NULL is returned for data types where a literal prefix is not applicable.
LITERAL_SUFFIX	Varchar(128)	Character or characters used to terminate a literal; for example, a single quote (') for character data types; NULL is returned for data types where a literal suffix is not applicable.

CREATE_PARAMS	Varchar(128)	Parameters for a data type definition. For example, CREATE_PARAMS for DECIMAL would be “precision,scale”; CREATE_PARAMS for VARCHAR would equal “max length”; NULL is returned if there are no parameters for the data type definition, for example INTEGER. The driver supplies the CREATE_PARAMS text in the language of the country where it is used.
NULLABLE	Smallint not NULL	Whether the data type accepts a NULL value: SQL_NO_NULLS if the data type does not accept NULL values. SQL_NULLABLE if the data type accepts NULL values. SQL_NULLABLE_UNKNOWN if it is not known if the column accepts NULL values.
CASE_SENSITIVE	Smallint not NULL	Whether a character data type is case sensitive in collations and comparisons: TRUE if the data type is a character data type and is case sensitive. FALSE if the data type is not a character data type or is not case sensitive.
SEARCHABLE	Smallint not NULL	How the data type is used in a **WHERE** clause: SQL_UNSEARCHABLE if the data type cannot be used in a **WHERE** clause. SQL_LIKE_ONLY if the data type can be used in a **WHERE** clause only with the **LIKE** predicate. SQL_ALL_EXCEPT_LIKE if the data type can be used in a **WHERE** clause with all comparison operators except **LIKE**. SQL_SEARCHABLE if the data type can be used in a **WHERE** clause with any comparison operator.

UNSIGNED_ATTRIBUTE	Smallint	Whether the data type is unsigned: TRUE if the data type is unsigned. FALSE if the data type is signed. NULL is returned if the attribute is not applicable to the data type or the data type is not numeric.
MONEY	Smallint not NULL	Whether the data type is a money data type: TRUE if it is a money data type. FALSE if it is not.
AUTO_INCREMENT	Smallint	Whether the data type is autoincrementing: TRUE if the data type is autoincrementing. FALSE if the data type is not autoincrementing. NULL is returned if the attribute is not applicable to the data type or the data type is not numeric. An application can insert values into a column having this attribute, but cannot update the values in the column.
LOCAL_TYPE_NAME	Varchar(128)	Localized version of the data source–dependent name of the data type. NULL is returned if a localized name is not supported by the data source. This name is intended for display only, such as in dialog boxes.
MINIMUM_SCALE	Smallint	The minimum scale of the data type on the data source. If a data type has a fixed scale, the MINIMUM_SCALE and MAXIMUM_SCALE columns both contain this value. For example, an SQL_TIMESTAMP column might have a fixed scale for fractional seconds. NULL is returned where scale is not applicable. For more information, see “Precision, Scale, Length, and Display Size” in Appendix D, “Data Types.”

MAXIMUM_SCALE	Smallint	The maximum scale of the data type on the data source. NULL is returned where scale is not applicable. If the maximum scale is not defined separately on the data source, but is instead defined to be the same as the maximum precision, this column contains the same value as the PRECISION column. For more information, see "Precision, Scale, Length, and Display Size" in Appendix D, "Data Types."

NOTE: The MINIMUM_SCALE and MAXIMUM_SCALE columns were added in ODBC 2.0. ODBC 1.0 drivers may return different, driver-specific columns with the same column numbers.

Attribute information can apply to data types or to specific columns in a result set. **SQLGetTypeInfo** returns information about attributes associated with data types; **SQLColAttributes** returns information about attributes associated with columns in a result set.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLColAttributes**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch** (extension)
Fetching a row of data	**SQLFetch**
Returning information about a driver or data source	**SQLGetInfo** (extension)

SQLNumParams (ODBC 1.0, Level 2)

SQLNumParams returns the number of parameters in an SQL statement.

Syntax

RETCODE **SQLNumParams**(*hstmt*, *pcpar*)

The **SQLNumParams** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
SWORD FAR *	*pcpar*	Output	Number of parameters in the statement.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLNumParams** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLNumParams** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLPrepare** or **SQLExecDirect** for the *hstmt*. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLNumParams can only be called after **SQLPrepare** has been called.

If the statement associated with *hstmt* does not contain parameters, **SQLNumParams** sets *pcpar* to 0.

Related Functions

For information about	See
Returning information about a parameter in a statement	**SQLDescribeParam** (extension)

Assigning storage for a parameter	SQLBindParameter

SQLNumResultCols (ODBC 1.0, Core)

SQLNumResultCols returns the number of columns in a result set.

Syntax

RETCODE **SQLNumResultCols**(*hstmt*, *pccol*)

The **SQLNumResultCols** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
SWORD FAR *	*pccol*	Output	Number of columns in the result set.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLNumResultCols** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLNumResultCols** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.

S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLPrepare** or **SQLExecDirect** for the *hstmt*. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

SQLNumResultCols can return any SQLSTATE that can be returned by **SQLPrepare** or **SQLExecute** when called after **SQLPrepare** and before **SQLExecute** depending on when the data source evaluates the SQL statement associated with the *hstmt*.

Comments

SQLNumResultCols can be called successfully only when the *hstmt* is in the prepared, executed, or positioned state.

If the statement associated with *hstmt* does not return columns, **SQLNumResultCols** sets *pccol* to 0.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning information about a column in a result set	**SQLColAttributes**
Returning information about a column in a result set	**SQLDescribeCol**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch** (extension)
Fetching a row of data	**SQLFetch**
Fetching part or all of a column of data	**SQLGetData** (extension)
Setting cursor scrolling options	**SQLSetScrollOptions** (extension)

SQLParamData (ODBC 1.0, Level 1)

SQLParamData is used in conjunction with **SQLPutData** to supply parameter data at statement execution time.

Syntax

RETCODE **SQLParamData**(*hstmt*, *prgbValue*)

The **SQLParamData** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
PTR FAR *	prgbValue	Output	Pointer to storage for the value specified for the *rgbValue* argument in **SQLBindParameter** (for parameter data) or the address of the *rgbValue* buffer specified in **SQLBindCol** (for column data).

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NEED_DATA, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLParamData** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLParamData** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.

22026	String data, length mismatch	The SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo** was "Y" and less data was sent for a long parameter (the data type was SQL_LONGVARCHAR, SQL_LONGVARBINARY, or a long, data source–specific data type) than was specified with the *pcbValue* argument in **SQLBindParameter**. The SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo** was "Y" and less data was sent for a long column (the data type was SQL_LONGVARCHAR, SQL_LONGVARBINARY, or a long, data source–specific data type) than was specified in the length buffer corresponding to a column in a row of data that was added or updated with **SQLSetPos**.
IM001	Driver does not support this function	(DM) The driver that corresponds the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application. **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. **SQLCancel** was called before data was sent for all data-at-execution parameters or columns.
S1010	Function sequence error	(DM) The previous function call was not a call to **SQLExecDirect**, **SQLExecute**, or **SQLSetPos** where the return code was SQL_NEED_DATA or a call to **SQLPutData**. The previous function call was a call to **SQLParamData**. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called.
S1T00	Timeout expired	The timeout period expired before the data source completed processing the parameter value. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

If **SQLParamData** is called while sending data for a parameter in an SQL statement, it can return any SQLSTATE that can be returned by the function called to execute the statement (**SQLExecute** or **SQLExecDirect**). If it is called while sending data for a column being updated or added with **SQLSetPos**, it can return any SQLSTATE that can be returned by **SQLSetPos**.

Comments

For an explanation of how data-at-execution parameter data is passed at statement execution time, see "Passing Parameter Values" in **SQLBindParameter**. For an explanation of how data-at-execution column data is updated or added, see "Using SQLSetPos" in **SQLSetPos**.

Code Example

See **SQLPutData**.

Related Functions

For information about	See
Canceling statement processing	**SQLCancel**
Returning information about a parameter in a statement	**SQLDescribeParam** (extension)
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Sending parameter data at execution time	**SQLPutData** (extension)
Assigning storage for a parameter	**SQLBindParameter**

SQLPrepare (ODBC 1.0, Core)

SQLPrepare prepares an SQL string for execution.

Syntax

RETCODE **SQLPrepare**(*hstmt, szSqlStr, cbSqlStr*)

The **SQLPrepare** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UCHAR FAR *	*szSqlStr*	Input	SQL text string.
SDWORD	*cbSqlStr*	Input	Length of *szSqlStr*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLPrepare** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLPrepare** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
21S01	Insert value list does not match column list	The argument *szSqlStr* contained an **INSERT** statement and the number of values to be inserted did not match the degree of the derived table.

21S02	Degree of derived table does not match column list	The argument *szSqlStr* contained a **CREATE VIEW** statement and the number of names specified is not the same degree as the derived table defined by the query specification.
22005	Error in assignment	The argument *szSqlStr* contained an SQL statement that contained a literal or parameter and the value was incompatible with the data type of the associated table column.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
34000	Invalid cursor name	The argument *szSqlStr* contained a positioned **DELETE** or a positioned **UPDATE** and the cursor referenced by the statement being prepared was not open.
37000	Syntax error or access violation	The argument *szSqlStr* contained an SQL statement that was not preparable or contained a syntax error.
42000	Syntax error or access violation	The argument *szSqlStr* contained a statement for which the user did not have the required privileges.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S0001	Base table or view already exists	The argument *szSqlStr* contained a **CREATE TABLE** or **CREATE VIEW** statement and the table name or view name specified already exists.
S0002	Base table not found	The argument *szSqlStr* contained a **DROP TABLE** or a **DROP VIEW** statement and the specified table name or view name did not exist. The argument *szSqlStr* contained an **ALTER TABLE** statement and the specified table name did not exist.

		The argument *szSqlStr* contained a **CREATE VIEW** statement and a table name or view name defined by the query specification did not exist.
		The argument *szSqlStr* contained a **CREATE INDEX** statement and the specified table name did not exist.
		The argument *szSqlStr* contained a **GRANT** or **REVOKE** statement and the specified table name or view name did not exist.
		The argument *szSqlStr* contained a **SELECT** statement and a specified table name or view name did not exist.
		The argument *szSqlStr* contained a **DELETE**, **INSERT**, or **UPDATE** statement and the specified table name did not exist.
		The argument *szSqlStr* contained a **CREATE TABLE** statement and a table specified in a constraint (referencing a table other than the one being created) did not exist.
S0011	Index already exists	The argument *szSqlStr* contained a **CREATE INDEX** statement and the specified index name already existed.
S0012	Index not found	The argument *szSqlStr* contained a **DROP INDEX** statement and the specified index name did not exist.
S0021	Column already exists	The argument *szSqlStr* contained an **ALTER TABLE** statement and the column specified in the **ADD** clause is not unique or identifies an existing column in the base table.
S0022	Column not found	The argument *szSqlStr* contained a **CREATE INDEX** statement and one or more of the column names specified in the column list did not exist.
		The argument *szSqlStr* contained a **GRANT** or **REVOKE** statement and a specified column name did not exist.

		The argument *szSqlStr* contained a **SELECT**, **DELETE**, **INSERT**, or **UPDATE** statement and a specified column name did not exist. The argument *szSqlStr* contained a **CREATE TABLE** statement and a column specified in a constraint (referencing a table other than the one being created) did not exist.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1009	Invalid argument value	(DM) The argument *szSqlStr* was a null pointer.
S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The argument *cbSqlStr* was less than or equal to 0, but not equal to SQL_NTS.

S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

The application calls **SQLPrepare** to send an SQL statement to the data source for preparation. The application can include one or more parameter markers in the SQL statement. To include a parameter marker, the application embeds a question mark (?) into the SQL string at the appropriate position.

Note If an application uses **SQLPrepare** to prepare and **SQLExecute** to submit a **COMMIT** or **ROLLBACK** statement, it will not be interoperable between DBMS products. To commit or roll back a transaction, call **SQLTransact**.

The driver modifies the statement to use the form of SQL used by the data source, then submits it to the data source for preparation. In particular, the driver modifies the escape clauses used to define ODBC-specific SQL. (For a description of SQL statement grammar, see Appendix C, "SQL Grammar.") For the driver, an *hstmt* is similar to a statement identifier in embedded SQL code. If the data source supports statement identifiers, the driver can send a statement identifier and parameter values to the data source.

Once a statement is prepared, the application uses *hstmt* to refer to the statement in later function calls. The prepared statement associated with the *hstmt* may be reexecuted by calling **SQLExecute** until the application frees the *hstmt* with a call to **SQLFreeStmt** with the SQL_DROP option or until the *hstmt* is used in a call to **SQLPrepare**, **SQLExecDirect**, or one of the catalog functions (**SQLColumns**, **SQLTables**, and so on). Once the application prepares a statement, it can request information about the format of the result set.

Some drivers cannot return syntax errors or access violations when the application calls **SQLPrepare**. A driver may handle syntax errors and access violations, only syntax errors, or neither syntax errors nor access violations. Therefore, an application must be able to handle these conditions when calling subsequent related functions such as **SQLNumResultCols**, **SQLDescribeCol**, **SQLColAttributes**, and **SQLExecute**.

Depending on the capabilities of the driver and data source and on whether the application has called **SQLBindParameter**, parameter information (such as data types) might be checked when the statement is prepared or when it is executed. For maximum interoperability, an application should unbind all parameters that applied to an old SQL statement before preparing a new SQL statement on the same *hstmt*. This prevents errors that are due to old parameter information being applied to the new statement.

Important Committing or rolling back a transaction, either by calling **SQLTransact** or by using the SQL_AUTOCOMMIT connection option, can cause the data source to delete the access plans for all *hstmts* on an *hdbc*. For more information, see the SQL_CURSOR_COMMIT_BEHAVIOR and SQL_CURSOR_ROLLBACK_BEHAVIOR information types in **SQLGetInfo**.

Code Example

See **SQLBindParameter**, **SQLParamOptions**, **SQLPutData**, and **SQLSetPos**.

Related Functions

For information about	See
Allocating a statement handle	SQLAllocStmt
Assigning storage for a column in a result set	SQLBindCol
Canceling statement processing	SQLCancel
Executing an SQL statement	SQLExecDirect
Executing a prepared SQL statement	SQLExecute
Returning the number of rows affected by a statement	SQLRowCount
Setting a cursor name	SQLSetCursorName
Assigning storage for a parameter	SQLBindParameter
Executing a commit or rollback operation	SQLTransact

SQLPrimaryKeys (ODBC 1.0, Level 2)

SQLPrimaryKeys returns the column names that comprise the primary key for a table. The driver returns the information as a result set. This function does not support returning primary keys from multiple tables in a single call.

Syntax

RETCODE **SQLPrimaryKeys**(*hstmt*, *szTableQualifier*, *cbTableQualifier*, *szTableOwner*, *cbTableOwner*, *szTableName*, *cbTableName*)

The **SQLPrimaryKeys** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UCHAR FAR *	szTableQualifier	Input	Qualifier name. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have qualifiers.
SWORD	cbTableQualifier	Input	Length of *szTableQualifier*.
UCHAR FAR *	szTableOwner	Input	Table owner. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have owners.
SWORD	cbTableOwner	Input	Length of *szTableOwner*.
UCHAR FAR *	szTableName	Input	Table name.
SWORD	cbTableName	Input	Length of *szTableName*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLPrimaryKeys** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists

the SQLSTATE values commonly returned by **SQLPrimaryKeys** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.

S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value of one of the name length arguments was less than 0, but not equal to SQL_NTS. The value of one of the name length arguments exceeded the maximum length value for the corresponding qualifier or name.
S1C00	Driver not capable	A table qualifier was specified and the driver or data source does not support qualifiers. A table owner was specified and the driver or data source does not support owners. The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.
S1T00	Timeout expired	The timeout period expired before the data source returned the requested result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLPrimaryKeys returns the results as a standard result set, ordered by TABLE_QUALIFIER, TABLE_OWNER, TABLE_NAME, and KEY_SEQ. The following table lists the columns in the result set.

Note **SQLPrimaryKeys** might not return all primary keys. For example, a Paradox driver might only return primary keys for files (tables) in the current directory.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source. To determine the actual lengths of the TABLE_QUALIFIER, TABLE_OWNER, TABLE_NAME, and COLUMN_NAME columns, call **SQLGetInfo**

with the SQL_MAX_QUALIFIER_NAME_LEN, SQL_MAX_OWNER_NAME_LEN, SQL_MAX_TABLE_NAME_LEN, and SQL_MAX_COLUMN_NAME_LEN options.

Column Name	**Data Type**	Comments
TABLE_QUALIFIER	Varchar(128)	Primary key table qualifier identifier; NULL if not applicable to the data source. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have qualifiers.
TABLE_OWNER	Varchar(128)	Primary key table owner identifier; NULL if not applicable to the data source. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have owners.
TABLE_NAME	Varchar(128) not NULL	Primary key table identifier.
COLUMN_NAME	Varchar(128) not NULL	Primary key column identifier.
KEY_SEQ	Smallint not NULL	Column sequence number in key (starting with 1).
PK_NAME	Varchar(128)	Primary key identifier. NULL if not applicable to the data source.

NOTE: The PK_NAME column was added in ODBC 2.0. ODBC 1.0 drivers may return a different, driver-specific column with the same column number.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning table statistics and indexes	**SQLStatistics (extension)**

SQLPutData (ODBC 1.0, Level 1)

SQLPutData allows an application to send data for a parameter or column to the driver at statement execution time. This function can be used to send character or binary data values in parts to a column with a character, binary, or data source–specific data type (for example, parameters of the SQL_LONGVARBINARY or SQL_LONGVARCHAR types).

Syntax

RETCODE **SQLPutData**(*hstmt*, *rgbValue*, *cbValue*)

The **SQLPutData** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
PTR	rgbValue	Input	Pointer to storage for the actual data for the parameter or column. The data must use the C data type specified in the *fCType* argument of **SQLBindParameter** (for parameter data) or **SQLBindCol** (for column data).
SDWORD	cbValue	Input	Length of *rgbValue*. Specifies the amount of data sent in a call to **SQLPutData**. The amount of data can vary with each call for a given parameter or column. *cbValue* is ignored unless it is SQL_NTS, SQL_NULL_DATA, or SQL_DEFAULT_PARAM; the C data type specified in **SQLBindParameter** or **SQLBindCol** is SQL_C_CHAR or SQL_C_BINARY; or the C data type is SQL_C_DEFAULT and the default C data type for the specified SQL data type is SQL_C_CHAR or SQL_C_BINARY. For all other types of C data, if *cbValue* is not SQL_NULL_DATA or SQL_DEFAULT_PARAM, the driver assumes that the size of *rgbValue* is the size of the C data type specified with *fCType* and sends the entire data value. For more information, see "*Converting Data from C to SQL Data Types" on page D-33*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLPutData** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLPutData** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The data sent for a character or binary parameter or column in one or more calls to **SQLPutData** exceeded the maximum length of the associated character or binary column. The fractional part of the data sent for a numeric or bit parameter or column was truncated. Timestamp data sent for a date or time parameter or column was truncated.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.

22001	String data right truncation	The SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo** was "Y" and more data was sent for a long parameter (the data type was SQL_LONGVARCHAR, SQL_LONGVARBINARY, or a long, data source–specific data type) than was specified with the *pcbValue* argument in **SQLBindParameter**. The SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo** was "Y" and more data was sent for a long column (the data type was SQL_LONGVARCHAR, SQL_LONGVARBINARY, or a long, data source–specific data type) than was specified in the length buffer corresponding to a column in a row of data that was added or updated with **SQLSetPos**.
22003	Numeric value out of range	**SQLPutData** was called more than once for a parameter or column and it was not being used to send character C data to a column with a character, binary, or data source–specific data type or to send binary C data to a column with a character, binary, or data source–specific data type. The data sent for a numeric parameter or column caused the whole (as opposed to fractional) part of the number to be truncated when assigned to the associated table column.
22005	Error in assignment	The data sent for a parameter or column was incompatible with the data type of the associated table column.
22008	Datetime field overflow	The data sent for a date, time, or timestamp parameter or column was, respectively, an invalid date, time, or timestamp.

IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application. **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. **SQLCancel** was called before data was sent for all data-at-execution parameters or columns.
S1009	Invalid argument value	(DM) The argument *rgbValue* was a null pointer and the argument *cbValue* was not 0, SQL_DEFAULT_PARAM, or SQL_NULL_DATA.
S1010	Function sequence error	(DM) The previous function call was not a call to **SQLPutData** or **SQLParamData**. The previous function call was a call to **SQLExecDirect**, **SQLExecute**, or **SQLSetPos** where the return code was SQL_NEED_DATA.

		(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called.
S1090	Invalid string or buffer length	The argument *rgbValue* was not a null pointer and the argument *cbValue* was less than 0, but not equal to SQL_NTS or SQL_NULL_DATA.
S1T00	Timeout expired	The timeout period expired before the data source completed processing the parameter value. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

For an explanation of how data-at-execution parameter data is passed at statement execution time, see "Passing Parameter Values" in **SQLBindParameter**. For an explanation of how data-at-execution column data is updated or added, see "Using SQLSetPos" in **SQLSetPos**.

NOTE: An application can use **SQLPutData** to send data in parts only when sending character C data to a column with a character, binary, or data source–specific data type or when sending binary C data to a column with a character, binary, or data source–specific data type. If **SQLPutData** is called more than once under any other conditions, it returns SQL_ERROR and SQLSTATE 22003 (Numeric value out of range).

Code Example

In the following example, an application prepares an SQL statement to insert data into the EMPLOYEE table. The statement contains parameters for the NAME, ID, and PHOTO columns. For each parameter, the application calls **SQLBindParameter** to specify the C and SQL data types of the parameter. It also specifies that the data for the first and third parameters will be passed at execution time, and passes the values 1 and 3 for later retrieval by **SQLParamData**. These values will identify which parameter is being processed.

The application calls **GetNextID** to get the next available employee ID number. It then calls **SQLExecute** to execute the statement. **SQLExecute** returns SQL_NEED_DATA when it needs data for the first and third parameters. The application calls **SQLParamData** to retrieve the value it stored with **SQLBindParameter**; it uses this value to determine which parameter to send data for. For each parameter, the application calls **InitUserData** to initialize the data routine. It repeatedly calls **GetUserData** and **SQLPutData** to get and send the parameter data. Finally, it calls **SQLParamData** to indicate it has sent all the data for the

parameter and to retrieve the value for the next parameter. After data has been sent for both parameters, **SQLParamData** returns SQL_SUCCESS.

For the first parameter, **InitUserData** does not do anything and **GetUserData** calls a routine to prompt the user for the employee name. For the third parameter, **InitUserData** calls a routine to prompt the user for the name of a file containing a bitmap photo of the employee and opens the file. **GetUserData** retrieves the next MAX_DATA_LEN bytes of photo data from the file. After it has retrieved all the photo data, it closes the photo file.

Note that some application routines are omitted for clarity.

```
#define NAME_LEN 30
#define MAX_DATA_LEN 1024
SDWORD  cbNameParam, cbID = 0; cbPhotoParam, cbData;
SWORD   sID;
PTR     pToken, InitValue;
UCHAR   Data[MAX_DATA_LEN];

retcode = SQLPrepare(hstmt,
          "INSERT INTO EMPLOYEE (NAME, ID, PHOTO) VALUES (?, ?, ?)",
          SQL_NTS);
if (retcode == SQL_SUCCESS) {

      /* Bind the parameters. For parameters 1 and 3, pass the       */
      /* parameter number in rgbValue instead of a buffer address.   */

      SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,

                  NAME_LEN, 0, 1, 0, &cbNameParam);
      SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_SSHORT,

                      SQL_SMALLINT, 0, 0, &sID, 0, &cbID);
      SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT,

                      SQL_C_BINARY, SQL_LONGVARBINARY,

                      0, 0, 3, 0, &cbPhotoParam);

      /* Set values so data for parameters 1 and 3 will be passed  */
      /* at execution. Note that the length parameter in the macro */
      /* SQL_LEN_DATA_AT_EXEC is 0. This assumes that the driver   */
      /* returns "N" for the SQL_NEED_LONG_DATA_LEN information    */
      /* type in SQLGetInfo.                                       */

      cbNameParam = cbPhotoParam = SQL_LEN_DATA_AT_EXEC(0);
```

```
        sID = GetNextID();  /* Get next available employee ID number. */

        retcode = SQLExecute(hstmt);

        /* For data-at-execution parameters, call SQLParamData to get the */
        /* parameter number set by SQLBindParameter. Call InitUserData.   */
        /* Call GetUserData and SQLPutData repeatedly to get and put all  */
        /* data for the parameter. Call SQLParamData to finish processing */
        /* this parameter and start processing the next parameter.        */

        while (retcode == SQL_NEED_DATA) {
           retcode = SQLParamData(hstmt, &pToken);
           if (retcode == SQL_NEED_DATA) {
                InitUserData((SWORD)pToken, InitValue);
                while (GetUserData(InitValue, (SWORD)pToken, Data, &cbData))
                SQLPutData(hstmt, Data, cbData);
           }
        }
}

VOID InitUserData(sParam, InitValue)
SWORD sParam;
PTR   InitValue;
{
UCHAR  szPhotoFile[MAX_FILE_NAME_LEN];
switch sParam {
        case 3:

           /* Prompt user for bitmap file containing employee photo.    */
           /* OpenPhotoFile opens the file and returns the file handle. */

           PromptPhotoFileName(szPhotoFile);
           OpenPhotoFile(szPhotoFile, (FILE *)InitValue);
           break;
}
}

BOOL GetUserData(InitValue, sParam, Data, cbData)
PTR    InitValue;
SWORD  sParam;
UCHAR  *Data;
SDWORD *cbData;

{
```

```
switch sParam {
      case 1:
         /* Prompt user for employee name. */

         PromptEmployeeName(Data);
         *cbData = SQL_NTS;
         return (TRUE);

      case 3:
         /* GetNextPhotoData returns the next piece of photo data and  */
         /* the number of bytes of data returned (up to MAX_DATA_LEN). */

         Done = GetNextPhotoData((FILE *)InitValue, Data,

                                 MAX_DATA_LEN, &cbData);
         if (Done) {
              ClosePhotoFile((FILE *)InitValue);
              return (TRUE);
         }
         return (FALSE);
}
return (FALSE);
}
```

Related Functions

For information about	See
Canceling statement processing	**SQLCancel**
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Returning the next parameter to send data for	**SQLParamData (extension)**
Assigning storage for a parameter	**SQLBindParameter**

SQLRowCount (ODBC 1.0, Core)

SQLRowCount returns the number of rows affected by an **UPDATE**, **INSERT**, or **DELETE** statement or by a SQL_UPDATE, SQL_ADD, or SQL_DELETE operation in **SQLSetPos**.

Syntax

RETCODE **SQLRowCount**(*hstmt*, *pcrow*)

The **SQLRowCount** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
SDWORD FAR *	pcrow	Output	For **UPDATE**, **INSERT**, and **DELETE** statements and for the SQL_UPDATE, SQL_ADD, and SQL_DELETE operations in **SQLSetPos**, *pcrow* is the number of rows affected by the request or –1 if the number of affected rows is not available. For other statements and functions, the driver may define the value of *pcrow.* For example, some data sources may be able to return the number of rows returned by a **SELECT** statement or a catalog function before fetching the rows. **Note** Many data sources cannot return the number of rows in a result set before fetching them; for maximum interoperability, applications should not rely on this behavior.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLRowCount** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by

SQLRowCount and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) The function was called prior to calling **SQLExecute**, **SQLExecDirect**, **SQLSetPos** for the *hstmt*. (DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.

Comments

If the last executed statement associated with *hstmt* was not an **UPDATE**, **INSERT**, or **DELETE** statement, or if the *fOption* argument in the previous call to **SQLSetPos** was not SQL_UPDATE, SQL_ADD, or SQL_DELETE, the value of *pcrow* is driver-defined.

Related Functions

For information about	See
Executing an SQL statement	SQLExecDirect
Executing a prepared SQL statement	SQLExecute

SQLSetConnectOption (ODBC 1.0, Level 1)

SQLSetConnectOption sets options that govern aspects of connections.

Syntax

RETCODE **SQLSetConnectOption**(*hdbc, fOption, vParam*)

The **SQLSetConnectOption** function accepts the following arguments:

Type	Argument	Use	Description
HDBC	*hdbc*	Input	Connection handle.
UWORD	*fOption*	Input	Option to set, listed in "Comments."
UDWORD	*vParam*	Input	Value associated with *fOption*. Depending on the value of *fOption*, *vParam* will be a 32-bit integer value or point to a null-terminated character string.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSetConnectOption** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSetConnectOption** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

The driver can return SQL_SUCCESS_WITH_INFO to provide information about the result of setting an option. For example, setting SQL_ACCESS_MODE to read-only during a transaction might cause the transaction to be committed. The driver could use SQL_SUCCESS_WITH_INFO and information returned with **SQLError** to inform the application of the commit action.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)

01S02	Option value changed	The driver did not support the specified value of the *vParam* argument and substituted a similar value. (Function returns SQL_SUCCESS_WITH_INFO.)
08002	Connection in use	The argument *fOption* was SQL_ODBC_CURSORS and the driver was already connected to the data source.
08003	Connection not open	An *fOption* value was specified that required an open connection, but the *hdbc* was not in a connected state.
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
IM001	Driver does not support this function	(DM) The driver associated with the *hdbc* does not support the function.
IM009	Unable to load translation DLL	The driver was unable to load the translation DLL that was specified for the connection. This error can only be returned when *fOption* is SQL_TRANSLATE_DLL.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1009	Invalid argument value	Given the specified *fOption* value, an invalid value was specified for the argument *vParam*. (The Driver Manager returns this SQLSTATE only for connection and statement options that accept a discrete set of values, such as SQL_ACCESS_MODE or SQL_ASYNC_ENABLE. For all other connection and statement options, the driver must verify the value of the argument *vParam*.)
S1010	Function sequence error	(DM) An asynchronously executing function was called for an *hstmt* associated with the *hdbc* and was still executing when **SQLSetConnectOption** was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for an *hstmt* associated with the *hdbc* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.(
S1011	Operation invalid at this time	The argument *fOption* was SQL_TXN_ISOLATION and a transaction was open.
S1092	Option type out of range	(DM) The value specified for the argument *fOption* was in the block of numbers reserved for ODBC connection and statement options, but was not valid for the version of ODBC supported by the driver.
S1C00	Driver not capable	The value specified for the argument *fOption* was a valid ODBC connection or statement option for the version of ODBC supported by the driver, but was not supported by the driver. The value specified for the argument *fOption* was in the block of numbers reserved for driver-specific connection and statement options, but was not supported by the driver.

When *fOption* is a statement option, **SQLSetConnectOption** can return any SQLSTATEs returned by **SQLSetStmtOption**.

Comments

The currently defined options and the version of ODBC in which they were introduced are shown below; it is expected that more will be defined to take advantage of different data sources. Options from 0 to 999 are reserved by ODBC; driver developers must reserve values greater than or equal to SQL_CONNECT_OPT_DRVR_START for driver-specific use.

An application can call **SQLSetConnectOption** and include a statement option. The driver sets the statement option for any *hstmts* associated with the specified *hdbc* and establishes the statement option as a default for any *hstmts* later allocated for that *hdbc*. For a list of statement options, see **SQLSetStmtOption**.

All connection and statement options successfully set by the application for the *hdbc* persist until **SQLFreeConnect** is called on the *hdbc*. For example, if an application calls **SQLSetConnectOption** before connecting to a data source, the option persists even if **SQLSetConnectOption** fails in the driver when the application connects to the data source; if an application sets a driver-specific option, the option persists even if the application connects to a different driver on the *hdbc*.

Some connection and statement options support substitution of a similar value if the data source does not support the specified value of *vParam*. In such cases, the driver returns SQL_SUCCESS_WITH_INFO and SQLSTATE 01S02 (Option value changed). For example, if *fOption* is SQL_PACKET_SIZE and *vParam* exceeds the maximum packet size, the driver substitutes the maximum size. To determine the substituted value, an application calls **SQLGetConnectOption** (for connection options) or **SQLGetStmtOption** (for statement options).

The format of information set through *vParam* depends on the specified *fOption*. **SQLSetConnectOption** will accept option information in one of two different formats: a null-terminated character string or a 32-bit integer value. The format of each is noted in the option's description. Character strings pointed to by the *vParam* argument of **SQLSetConnectOption** have a maximum length of SQL_MAX_OPTION_STRING_LENGTH bytes (excluding the null termination byte).

fOption	vParam Contents

SQL_ACCESS_MODE (ODBC 1.0)	A 32-bit integer value. SQL_MODE_READ_ONLY is used by the driver or data source as an indicator that the connection is not required to support SQL statements that cause updates to occur. This mode can be used to optimize locking strategies, transaction management, or other areas as appropriate to the driver or data source. The driver is not required to prevent such statements from being submitted to the data source. The behavior of the driver and data source when asked to process SQL statements that are not read-only during a read-only connection is implementation defined. SQL_MODE_READ_WRITE is the default.
SQL_AUTOCOMMIT (ODBC 1.0)	A 32-bit integer value that specifies whether to use auto-commit or manual-commit mode: SQL_AUTOCOMMIT_OFF = The driver uses manual-commit mode, and the application must explicitly commit or roll back transactions with **SQLTransact**. SQL_AUTOCOMMIT_ON = The driver uses auto-commit mode. Each statement is committed immediately after it is executed. This is the default. Note that changing from manual-commit mode to auto-commit mode commits any open transactions on the connection. **Important** Some data sources delete the access plans and close the cursors for all hstmts on an hdbc each time a statement is committed; autocommit mode can cause this to happen after each statement is executed. For more information, see the SQL_CURSOR_COMMIT_BEHAVIOR and SQL_CURSOR_ROLLBACK_BEHAVIOR information types in **SQLGetInfo**.
SQL_CURRENT_QUALIFIER (ODBC 2.0)	A null-terminated character string containing the name of the qualifier to be used by the data source. For example, in SQL Server, the qualifier is a database, so the driver sends a **USE** database statement to the data source, where database is the database specified in vParam. For a single-tier driver, the qualifier might be a directory, so the driver changes its current directory to the directory specified in vParam.

SQL_LOGIN_TIMEOUT (ODBC 1.0)	A 32-bit integer value corresponding to the number of seconds to wait for a login request to complete before returning to the application. The default is driver-dependent and must be nonzero. If vParam is 0, the timeout is disabled and a connection attempt will wait indefinitely. If the specified timeout exceeds the maximum login timeout in the data source, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed).
SQL_ODBC_CURSORS (ODBC 2.0)	A 32-bit option specifying how the Driver Manager uses the ODBC cursor library: SQL_CUR_USE_IF_NEEDED = The Driver Manager uses the ODBC cursor library only if it is needed. If the driver supports the SQL_FETCH_PRIOR option in **SQLExtendedFetch**, the Driver Manager uses the scrolling capabilities of the driver. Otherwise, it uses the ODBC cursor library. SQL_CUR_USE_ODBC = The Driver Manager uses the ODBC cursor library. SQL_CUR_USE_DRIVER = The Driver Manager uses the scrolling capabilities of the driver. This is the default setting.

SQL_OPT_TRACE
(ODBC 1.0)

A 32-bit integer value telling the Driver Manager whether to perform tracing:

SQL_OPT_TRACE_OFF = Tracing off (the default)

SQL_OPT_TRACE_ON = Tracing on

When tracing is on, the Driver Manager writes each ODBC function call to the trace file. On Windows and WOW, the Driver Manager writes to the trace file each time any application calls a function. On Windows NT, the Driver Manager writes to the trace file only for the application that turned tracing on.

Note When tracing is on, the Driver Manager can return SQLSTATE IM013 (Trace file error) from any function.

An application specifies a trace file with the SQL_OPT_TRACEFILE option. If the file already exists, the Driver Manager appends to the file. Otherwise, it creates the file. If tracing is on and no trace file has been specified, the Driver Manager writes to the file \SQL.LOG. On Windows NT, tracing should only be used for a single application or each application should specify a different trace file. Otherwise, two or more applications will attempt to open the same trace file at the same time, causing an error.

If the **Trace** keyword in the [ODBC] section of the ODBC.INI file (or registry) is set to 1 when an application calls **SQLAllocEnv**, tracing is enabled. On Windows and WOW, it is enabled for all applications; on Windows NT it is enabled only for the application that called **SQLAllocEnv**.

SQL_OPT_TRACEFILE
(ODBC 1.0)

A null-terminated character string containing the name of the trace file.

The default value of the SQL_OPT_TRACEFILE option is specified with the TraceFile keyname in the [ODBC] section of the ODBC.INI file (or registry).

SQL_PACKET_SIZE (ODBC 2.0)	A 32-bit integer value specifying the network packet size in bytes. **Note** Many data sources either do not support this option or can only return the network packet size. If the specified size exceeds the maximum packet size or is smaller than the minimum packet size, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed).
SQL_QUIET_MODE (ODBC 2.0)	A 32-bit window handle (hwnd). If the window handle is a null pointer, the driver does not display any dialog boxes. If the window handle is not a null pointer, it should be the parent window handle of the application. The driver uses this handle to display dialog boxes. This is the default. If the application has not specified a parent window handle for this option, the driver uses a null parent window handle to display dialog boxes or return in **SQLGetConnectOption**. **Note** The SQL_QUIET_MODE connection option does not apply to dialog boxes displayed by **SQLDriverConnect**.
SQL_TRANSLATE_DLL (ODBC 1.0)	A null-terminated character string containing the name of a DLL containing the functions **SQLDriverToDataSource** and **SQLDataSourceToDriver** that the driver loads and uses to perform tasks such as character set translation. This option may only be specified if the driver has connected to the data source.

SQL_TRANSLATE_OPTION (ODBC 1.0)

This option may only be specified if the driver has connected to the data source.

The valid values are:

SQL_SOLID_XLATOPT_DEFAULT = The application uses the default character set conversion for the operating system used.

SQL_SOLID_XLATOPT_NOCNV = No conversion is done. The characters are stored as they are given.

SQL_SOLID_XLATOPT_ANSI = The charaters are considered to belong to ANSI (ISO Latin 1) character set. This character set is used i.e. in MS Windows.

SQL_SOLID_XLATOPT_PCOEM = This character set is used i.e. in MS DOS and OS/2.

SQL_SOLID_XLATOPT_7BITSCAND = This character set is used i.e. in VAX/VMS.

SQL_TXN_ISOLATION (ODBC 1.0)

A 32-bit bitmask that sets the transaction isolation level for the current hdbc. An application must call **SQLTransact** to commit or roll back all open transactions on an hdbc, before calling **SQLSetConnectOption** with this option.

The valid values for vParam can be determined by calling **SQLGetInfo** with fInfoType equal to SQL_TXN_ISOLATION_OPTIONS. The following terms are used to define transaction isolation levels:

Dirty Read Transaction 1 changes a row. Transaction 2 reads the changed row before transaction 1 commits the change. If transaction 1 rolls back the change, transaction 2 will have read a row that is considered to have never existed.

Nonrepeatable Read Transaction 1 reads a row. Transaction 2 updates or deletes that row and commits this change. If transaction 1 attempts to reread the row, it will receive different row values or discover that the row has been deleted.

SQL_TXN_ISOLATION (ODBC 1.0) (continued)	A **Phantom** Transaction 1 reads a set of rows that satisfy some search criteria. Transaction 2 inserts a row that matches the search criteria. If transaction 1 reexecutes the statement that read the rows, it receives a different set of rows. vParam must be one of the following values: SQL_TXN_READ_UNCOMMITTED = Dirty reads, nonrepeatable reads, and phantoms are possible. SQL_TXN_READ_COMMITTED = Dirty reads are not possible. Nonrepeatable reads and phantoms are possible. SQL_TXN_REPEATABLE_READ = Dirty reads and nonrepeatable reads are not possible. Phantoms are possible. SQL_TXN_SERIALIZABLE = Transactions are serializable. Dirty reads, nonrepeatable reads, and phantoms are not possible. SQL_TXN_VERSIONING = Transactions are serializable, but higher concurrency is possible than with SQL_TXN_SERIALIZABLE. Dirty reads are not possible. Typically, SQL_TXN_SERIALIZABLE is implemented by using locking protocols that reduce concurrency and SQL_TXN_VERSIONING is implemented by using a non-locking protocol such as record versioning.

Data Translation

Data translation will be performed for all data flowing between the driver and the data source.

The translation option (set with the SQL_TRANSLATE_OPTION option) can be any 32-bit value. Its meaning depends on the translation DLL being used. A new option can be set at any time. The new option will be applied to the next exchange of data following the call to **SQLSetConnectOption**. A default translation DLL may be specified for the data source in its data source specification in the ODBC.INI file or registry. The default translation DLL is loaded by the driver at connection time. A translation option (SQL_TRANSLATE_OPTION) may be specified in the data source specification as well.

To change the translation DLL for a connection, an application calls **SQLSetConnectOption** with the SQL_TRANSLATE_DLL option after it has connected to the data source. The

driver will attempt to load the specified DLL and, if the attempt fails, return SQL_ERROR with the SQLSTATE IM009 (Unable to load translation DLL).

If no translation DLL has been specified in the ODBC initialization file or by calling **SQLSetConnectOption**, the driver will not attempt to translate data. Any value set for the translation option will be ignored.

Code Example

See **SQLConnect** and **SQLParamOptions**.

Related Functions

For information about	See
Returning the setting of a connection option	**SQLGetConnectOption (extension)**
Returning the setting of a statement option	**SQLGetStmtOption (extension)**
Setting a statement option	**SQLSetStmtOption (extension)**

SQLSetCursorName (ODBC 1.0, Core)

SQLSetCursorName associates a cursor name with an active *hstmt*. If an application does not call **SQLSetCursorName**, the driver generates cursor names as needed for SQL statement processing.

Syntax

RETCODE **SQLSetCursorName**(*hstmt*, *szCursor*, *cbCursor*)

The **SQLSetCursorName** function accepts the following arguments.

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UCHAR FAR *	*szCursor*	Input	Cursor name.
SWORD	*cbCursor*	Input	Length of *szCursor*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSetCursorName** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSetCursorName** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
24000	Invalid cursor state	The statement corresponding to *hstmt* was already in an executed or cursor-positioned state.

34000	Invalid cursor name	The cursor name specified by the argument *szCursor* was invalid. For example, the cursor name exceeded the maximum length as defined by the driver.
3C000	Duplicate cursor name	The cursor name specified by the argument *szCursor* already exists.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1009	Invalid argument value	(DM) The argument *szCursor* was a null pointer.
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The argument *cbCursor* was less than 0, but not equal to SQL_NTS.

Comments

The only ODBC SQL statements that use a cursor name are a positioned update and delete (for example, **UPDATE** *table-name* ...**WHERE CURRENT OF** *cursor-name*). If the application does not call **SQLSetCursorName** to define a cursor name, on execution of a **SELECT** statement the driver generates a name that begins with the letters SQL_CUR and does not exceed 18 characters in length.

All cursor names within the *hdbc* must be unique. The maximum length of a cursor name is defined by the driver. For maximum interoperability, it is recommended that applications limit cursor names to no more than 18 characters.

A cursor name that is set either explicitly or implicitly remains set until the *hstmt* with which it is associated is dropped, using **SQLFreeStmt** with the SQL_DROP option.

Code Example

In the following example, an application uses **SQLSetCursorName** to set a cursor name for an *hstmt*. It then uses that *hstmt* to retrieve results from the EMPLOYEE table. Finally, it performs a positioned update to change the name of 25-year-old John Smith to John D. Smith. Note that the application uses different *hstmts* for the **SELECT** and **UPDATE** statements.

For more code examples, see **SQLSetPos**.

```
#define NAME_LEN 30

HSTMT     hstmtSelect,
HSTMT     hstmtUpdate;
UCHAR     szName[NAME_LEN];
SWORD     sAge;
SDWORD    cbName;
SDWORD    cbAge;

/* Allocate the statements and set the cursor name */

SQLAllocStmt(hdbc, &hstmtSelect);
SQLAllocStmt(hdbc, &hstmtUpdate);
SQLSetCursorName(hstmtSelect, "C1", SQL_NTS);

/* SELECT the result set and bind its columns to local storage */

SQLExecDirect(hstmtSelect,

              "SELECT NAME, AGE FROM EMPLOYEE FOR UPDATE",
              SQL_NTS);
SQLBindCol(hstmtSelect, 1, SQL_C_CHAR, szName, NAME_LEN, &cbName);
SQLBindCol(hstmtSelect, 2, SQL_C_SSHORT, &sAge, 0, &cbAge);

/* Read through the result set until the cursor is      */
/* positioned on the row for the 25-year-old John Smith */

do
   retcode = SQLFetch(hstmtSelect);
```

```
while ((retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO) &&
       (strcmp(szName, "Smith, John") != 0 || sAge != 25));

/* Perform a positioned update of John Smith's name */

if (retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO) {
      SQLExecDirect(hstmtUpdate,
      "UPDATE EMPLOYEE SET NAME=\"Smith, John D.\" WHERE CURRENT OF C1",
     SQL_NTS);
}
```

Related Functions

For information about	See
Executing an SQL statement	**SQLExecDirect**
Executing a prepared SQL statement	**SQLExecute**
Returning a cursor name	**SQLGetCursorName**
Setting cursor scrolling options	**SQLSetScrollOptions (extension)**

SQLSetParam (ODBC 1.0, Deprecated)

In ODBC 2.0, the ODBC 1.0 function **SQLSetParam** has been replaced by **SQLBindParameter**. For more information, see **SQLBindParameter**.

SQLSetPos (ODBC 1.0, Level 2)

SQLSetPos sets the cursor position in a rowset and allows an application to refresh, update, delete, or add data to the rowset.

NOTE: This function is not implement in SOLID *SQL API*, but it is available through ODBC Cursor Library.

Syntax

RETCODE **SQLSetPos**(*hstmt*, *irow*, *fOption*, *fLock*)

The **SQLSetPos** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	irow	Input	Position of the row in the rowset on which to perform the operation specified with the *fOption* argument. If *irow* is 0, the operation applies to every row in the rowset. For additional information, see "Comments."
UWORD	fOption	Input	Operation to perform: SQL_POSITION SQL_REFRESH SQL_UPDATE SQL_DELETE SQL_ADD For more information, see "Comments."
UWORD	fLock	Input	Specifies how to lock the row after performing the operation specified in the *fOption* argument. SQL_LOCK_NO_CHANGE SQL_LOCK_EXCLUSIVE SQL_LOCK_UNLOCK For more information, see "Comments."

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NEED_DATA, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSetPos** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSetPos** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01004	Data truncated	The argument *fOption* was SQL_ADD or SQL_UPDATE and the value specified for a character or binary column exceeded the maximum length of the associated table column. (Function returns SQL_SUCCESS_WITH_INFO.) The argument *fOption* was SQL_ADD or SQL_UPDATE and the fractional part of the value specified for a numeric column was truncated. (Function returns SQL_SUCCESS_WITH_INFO.) The argument *fOption* was SQL_ADD or SQL_UPDATE and a timestamp value specified for a date or time column was truncated. (Function returns SQL_SUCCESS_WITH_INFO.)
01S01	Error in row	The *irow* argument was 0 and an error occurred in one or more rows while performing the operation specified with the *fOption* argument. (Function returns SQL_SUCCESS_WITH_INFO.)
01S03	No rows updated or deleted	The argument *fOption* was SQL_UPDATE or SQL_DELETE and no rows were updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)

01S04	More than one row updated or deleted	The argument *fOption* was SQL_UPDATE or SQL_DELETE and more than one row was updated or deleted. (Function returns SQL_SUCCESS_WITH_INFO.)
21S02	Degree of derived table does not match column list	The argument *fOption* was SQL_ADD or SQL_UPDATE and no columns were bound with **SQLBindCol**.
22003	Numeric value out of range	The argument *fOption* was SQL_ADD or SQL_UPDATE and the whole part of a numeric value was truncated.
22005	Error in assignment	The argument *fOption* was SQL_ADD or SQL_UPDATE and a value was incompatible with the data type of the associated column.
22008	Datetime field overflow	The argument *fOption* was SQL_ADD or SQL_UPDATE and a date, time, or timestamp value was, respectively, an invalid date, time, or timestamp.
23000	Integrity constraint violation	The argument *fOption* was SQL_ADD or SQL_UPDATE and a value was NULL for a column defined as NOT NULL in the associated column or some other integrity constraint was violated. The argument *fOption* was SQL_ADD and a column that was not bound with **SQLBindCol** is defined as NOT NULL or has no default.

24000	Invalid cursor state	(DM) The *hstmt* was in an executed state but no result set was associated with the *hstmt*. (DM) A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called. A cursor was open on the *hstmt* and **SQLExtendedFetch** had been called, but the cursor was positioned before the start of the result set or after the end of the result set. The argument *fOption* was SQL_DELETE, SQL_REFRESH, or SQL_UPDATE and the cursor was positioned before the start of the result set or after the end of the result set.
42000	Syntax error or access violation	The driver was unable to lock the row as needed to perform the operation requested in the argument *fOption*. The driver was unable to lock the row as requested in the argument *fLock*.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S0023	No default for column	The *fOption* argument was SQL_ADD and a column that was not bound did not have a default value and could not be set to NULL. The *fOption* argument was SQL_ADD, the length specified in the *pcbValue* buffer bound by **SQLBindCol** was SQL_IGNORE, and the column did not have a default value.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multi-threaded application.
S1009	Invalid argument value	(DM) The value specified for the argument *fOption* was invalid. (DM) The value specified for the argument *fLock* was invalid. The argument *irow* was greater than the number of rows in the rowset and the *fOption* argument was not SQL_ADD. The value specified for the argument *fOption* was SQL_ADD, SQL_UPDATE, or SQL_DELETE, the value specified for the argument *fLock* was SQL_LOCK_NO_CHANGE, and the SQL_CONCURRENCY statement option was SQL_CONCUR_READ_ONLY.
S1010	Function sequence error	(DM) The specified *hstmt* was not in an executed state. The function was called without first calling **SQLExecDirect**, **SQLExecute**, or a catalog function. (DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.

S1090	Invalid string or buffer length	The *fOption* argument was SQL_ADD or SQL_UPDATE, a data value was a null pointer, and the column length value was not 0, SQL_DATA_AT_EXEC, SQL_IGNORE, SQL_NULL_DATA, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET. The *fOption* argument was SQL_ADD or SQL_UPDATE, a data value was not a null pointer, and the column length value was less than 0, but not equal to SQL_DATA_AT_EXEC, SQL_IGNORE, SQL_NTS, or SQL_NULL_DATA, or less than or equal to SQL_LEN_DATA_AT_EXEC_OFFSET.
S1107	Row value out of range	The value specified for the argument *irow* was greater than the number of rows in the rowset and the *fOption* argument was not SQL_ADD.
S1109	Invalid cursor position	The cursor associated with the *hstmt* was defined as forward only, so the cursor could not be positioned within the rowset. See the description for the SQL_CURSOR_TYPE option in **SQLSetStmtOption**. The *fOption* argument was SQL_REFRESH, SQL_UPDATE, or SQL_DELETE and the value in the *rgfRowStatus* array for the row specified by the *irow* argument was SQL_ROW_DELETED or SQL_ROW_ERROR.
S1C00	Driver not capable	The driver or data source does not support the operation requested in the *fOption* argument or the *fLock* argument.
S1T00	Timeout expired	The timeout period expired before the data source returned the result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

irow Argument

The *irow* argument specifies the number of the row in the rowset on which to perform the operation specified by the *fOption* argument. If *irow* is 0, the operation applies to every row in the rowset. Except for the SQL_ADD operation, *irow* must be a value from 0 to the number of rows in the rowset. For the SQL_ADD operation, *irow* can be any value; generally it is either 0 (to add as many rows as there are in the rowset) or the number of rows in the rowset plus 1 (to add the data from an extra row of buffers allocated for this purpose).

NOTE: In the C language, arrays are 0-based, while the *irow* argument is 1-based. For example, to update the fifth row of the rowset, an application modifies the rowset buffers at array index 4, but specifies an *irow* of 5.

All operations except for SQL_ADD position the cursor on the row specified by *irow*; the SQL_ADD operation does not change the cursor position. The following operations require a cursor position:

- Positioned update and delete statements.
- Calls to **SQLGetData**.
- Calls to **SQLSetPos** with the SQL_DELETE, SQL_REFRESH, and SQL_UPDATE options.

For example, if the cursor is positioned on the second row of the rowset, a positioned delete statement deletes that row; if it is positioned on the entire rowset (*irow* is 0), a positioned delete statement deletes every row in the rowset.

An application can specify a cursor position when it calls **SQLSetPos**. Generally, it calls **SQLSetPos** with the SQL_POSITION or SQL_REFRESH operation to position the cursor before executing a positioned update or delete statement or calling **SQLGetData**.

fOption Argument

The *fOption* argument supports the following operations. To determine which options are supported by a data source, an application calls **SQLGetInfo** with the SQL_POS_OPERATIONS information type.

***fOption* Argument**	Operation
SQL_POSITION	The driver positions the cursor on the row specified by *irow*. This is the same as the FALSE value of this argument in ODBC 1.0.

SQL_REFRESH	The driver positions the cursor on the row specified by *irow* and refreshes data in the rowset buffers for that row. For more information about how the driver returns data in the rowset buffers, see the descriptions of row-wise and column-wise binding in **SQLExtendedFetch**. This is the same as the TRUE value of this argument in ODBC 1.0.
SQL_UPDATE	The driver positions the cursor on the row specified by *irow* and updates the underlying row of data with the values in the rowset buffers (the *rgbValue* argument in **SQLBindCol**). It retrieves the lengths of the data from the number-of-bytes buffers (the *pcbValue* argument in **SQLBindCol**). If the length of any column is SQL_IGNORE, the column is not updated. After updating the row, the driver changes the *rgfRowStatus* array specified in **SQLExtendedFetch** to SQL_ROW_UPDATED.
SQL_DELETE	The driver positions the cursor on the row specified by *irow* and deletes the underlying row of data. It changes the *rgfRowStatus* array specified in **SQLExtendedFetch** to SQL_ROW_DELETED. After the row has been deleted, positioned update and delete statements, calls to **SQLGetData** and calls to **SQLSetPos** with *fOption* set to anything except SQL_POSITION are not valid for the row. Whether the row remains visible depends on the cursor type. For example, deleted rows are visible to static and keyset-driven cursors but invisible to dynamic cursors.

SQL_ADD	The driver adds a new row of data to the data source. Where the row is added to the data source and whether it is visible in the result set is driver-defined. The driver retrieves the data from the rowset buffers (the *rgbValue* argument in **SQLBindCol**) according to the value of the *irow* argument. It retrieves the lengths of the data from the number-of-bytes buffers (the *pcbValue* argument in **SQLBindCol**). Generally, the application allocates an extra row of buffers for this purpose. For columns not bound to the rowset buffers, the driver uses default values (if they are available) or NULL values (if default values are not available). For columns with a length of SQL_IGNORE, the driver uses default values. If *irow* is less than or equal to the rowset size, the driver changes the *rgfRowStatus* array specified in **SQLExtendedFetch** to SQL_ROW_ADDED after adding the row. At this point, the rowset buffers do not match the cursors for the row. To restore the rowset buffers to match the data in the cursor, an application calls **SQLSetPos** with the SQL_REFRESH option. This operation does not affect the cursor position.

fLock Argument

The *fLock* argument provides a way for applications to control concurrency and simulate transactions on data sources that do not support them. Generally, data sources that support concurrency levels and transactions will only support the SQL_LOCK_NO_CHANGE value of the *fLock* argument.

The *fLock* argument specifies the lock state of the row after **SQLSetPos** has been executed. To simulate a transaction, an application uses the SQL_LOCK_RECORD macro to lock each of the rows in the transaction. It then uses the SQL_UPDATE_RECORD or SQL_DELETE_RECORD macro to update or delete each row; the driver may temporarily change the lock state of the row while performing the operation specified by the *fOption* argument. Finally, it uses the SQL_LOCK_RECORD macro to unlock each row. For an example of how an application might do this, see the second code example. Note that if the driver is unable to lock the row either to perform the requested operation or to satisfy the *fLock* argument, it returns SQL_ERROR and SQLSTATE 42000 (Syntax error or access violation).

Although the *fLock* argument is specified for an *hstmt*, the lock accords the same privileges to all *hstmts* on the connection. In particular, a lock that is acquired by one *hstmt* on a connection can be unlocked by a different *hstmt* on the same connection.

A row locked through **SQLSetPos** remains locked until the application calls **SQLSetPos** for the row with *fLock* set to SQL_LOCK_UNLOCK or the application calls **SQLFreeStmt** with the SQL_CLOSE or SQL_DROP option.

The *fLock* argument supports the following types of locks. To determine which locks are supported by a data source, an application calls **SQLGetInfo** with the SQL_LOCK_TYPES information type.

***fLock* Argument**	Lock Type
SQL_LOCK_NO_CHANGE	The driver or data source ensures that the row is in the same locked or unlocked state as it was before **SQLSetPos** was called. This value of *fLock* allows data sources that do not support explicit row-level locking to use whatever locking is required by the current concurrency and transaction isolation levels. This is the same as the FALSE value of the *fLock* argument in ODBC 1.0.
SQL_LOCK_EXCLUSIVE	The driver or data source locks the row exclusively. An *hstmt* on a different *hdbc* or in a different application cannot be used to acquire any locks on the row. This is the same as the TRUE value of the *fLock* argument in ODBC 1.0.
SQL_LOCK_UNLOCK	The driver or data source unlocks the row.

For the add, update, and delete operations in **SQLSetPos**, the application uses the *fLock* argument as follows:

To guarantee that a row does not change after it is retrieved, an application calls **SQLSetPos** with *fOption* set to SQL_REFRESH and *fLock* set to SQL_LOCK_EXCLUSIVE.

- If the application sets *fLock* to SQL_LOCK_NO_CHANGE, the driver guarantees an update, or delete operation will succeed only if the application specified SQL_CONCUR_LOCK for the SQL_CONCURRENCY statement option.
- If the application specifies SQL_CONCUR_ROWVER or SQL_CONCUR_VALUES for the SQL_CONCURRENCY statement option, the driver compares row versions or values and rejects the operation if the row has changed since the application fetched the row.

- If the application specifies SQL_CONCUR_READ_ONLY for the SQL_CONCURRENCY statement option, the driver rejects any update or delete operation.

For more information about the SQL_CONCURRENCY statement option, see **SQLSetStmtOption**.

Using SQLSetPos

Before an application calls **SQLSetPos**, it must:

1. If the application will call **SQLSetPos** with *fOption* set to SQL_ADD or SQL_UPDATE, call **SQLBindCol** for each column to specify its data type and associate storage for the column's data and length.
2. Call **SQLExecDirect**, **SQLExecute**, or a catalog function to create a result set.
3. Call **SQLExtendedFetch** to retrieve the data.

To delete data with **SQLSetPos**, an application:

- Calls **SQLSetPos** with *irow* set to the number of the row to delete.

An application can pass the value for a column either in the *rgbValue* buffer or with one or more calls to **SQLPutData**. Columns whose data is passed with **SQLPutData** are known as *data-at-execution* columns. These are commonly used to send data for SQL_LONGVARBINARY and SQL_LONGVARCHAR columns and can be mixed with other columns.

To update or add data with **SQLSetPos**, an application:

1. 1.Places values in the *rgbValue* and *pcbValue* buffers bound with **SQLBindCol**:
   - For normal columns, the application places the new column value in the *rgbValue* buffer and the length of that value in the *pcbValue* buffer. If the row is being updated and the column is not to be changed, the application places SQL_IGNORE in the *pcbValue* buffer.
   - For data-at-execution columns, the application places an application-defined value, such as the column number, in the *rgbValue* buffer. The value can be used later to identify the column.

It places the result of the SQL_LEN_DATA_AT_EXEC(*length*) macro in the *pcbValue* buffer. If the SQL data type of the column is SQL_LONGVARBINARY, SQL_LONGVARCHAR, or a long, data source–specific data type and the driver returns "Y" for the SQL_NEED_LONG_DATA_LEN information type in **SQLGetInfo**, *length* is the number of bytes of data to be sent for the parameter; otherwise, it must be a nonnegative value and is ignored.

2. Calls **SQLSetPos** or uses an **SQLSetPos** macro to update or add the row of data.
   - If there are no data-at-execution columns, the process is complete.
   - If there are any data-at-execution columns, the function returns SQL_NEED_DATA.
3. Calls **SQLParamData** to retrieve the address of the *rgbValue* buffer for the first data-at-execution column to be processed. The application retrieves the application-defined value from the *rgbValue* buffer.

   NOTE: Although data-at-execution parameters are similar to data-at-execution columns, the value returned by **SQLParamData** is different for each.

   Data-at-execution parameters are parameters in an SQL statement for which data will be sent with **SQLPutData** when the statement is executed with **SQLExecDirect** or **SQLExecute**. They are bound with **SQLBindParameter**. The value returned by **SQLParamData** is a 32-bit value passed to **SQLBindParameter** in the *rgbValue* argument.

   Data-at-execution columns are columns in a rowset for which data will be sent with **SQLPutData** when a row is updated or added with **SQLSetPos**. They are bound with **SQLBindCol**. The value returned by **SQLParamData** is the address of the row in the *rgbValue* buffer that is being processed.
4. Calls **SQLPutData** one or more times to send data for the column. More than one call is needed if the data value is larger than the *rgbValue* buffer specified in **SQLPutData**; note that multiple calls to **SQLPutData** for the same column are allowed only when sending character C data to a column with a character, binary, or data source–specific data type or when sending binary C data to a column with a character, binary, or data source–specific data type.
5. Calls **SQLParamData** again to signal that all data has been sent for the column.
   - If there are more data-at-execution columns, **SQLParamData** returns SQL_NEED_DATA and the address of the *rgbValue* buffer for the next data-at-execution column to be processed. The application repeats steps 4 and 5.
   - If there are no more data-at-execution columns, the process is complete. If the statement was executed successfully, **SQLParamData** returns SQL_SUCCESS or SQL_SUCCESS_WITH_INFO; if the execution failed, it returns SQL_ERROR. At this point, **SQLParamData** can return any SQLSTATE that can be returned by **SQLSetPos**.

After **SQLSetPos** returns SQL_NEED_DATA, and before data is sent for all data-at-execution columns, the operation is canceled, or an error occurs in **SQLParamData** or **SQLPutData**, the application can only call **SQLCancel**, **SQLGetFunctions**, **SQLParamData**, or **SQLPutData** with the *hstmt* or the *hdbc* associated with the *hstmt*. If it calls any other func-

tion with the *hstmt* or the *hdbc* associated with the *hstmt*, the function returns SQL_ERROR and SQLSTATE S1010 (Function sequence error).

If the application calls **SQLCancel** while the driver still needs data for data-at-execution columns, the driver cancels the operation; the application can then call **SQLSetPos** again; canceling does not affect the cursor state or the current cursor position. If the application calls **SQLParamData** or **SQLPutData** after canceling the operation, the function returns SQL_ERROR and SQLSTATE S1008 (Operation canceled).

Performing Bulk Operations

If the *irow* argument is 0, the driver performs the operation specified in the *fOption* argument for every row in the rowset. If an error occurs that pertains to the entire rowset, such as SQLSTATE S1T00 (Timeout expired), the driver returns SQL_ERROR and the appropriate SQLSTATE. The contents of the rowset buffers are undefined and the cursor position is unchanged.

If an error occurs that pertains to a single row, the driver:

- Sets the element in the *rgfRowStatus* array for the row to SQL_ROW_ERROR.
- Posts SQLSTATE 01S01 (Error in row) in the error queue.
- Posts one or more additional SQLSTATEs for the error after SQLSTATE 01S01 (Error in row) in the error queue.

After it has processed the error or warning, the driver continues the operation for the remaining rows in the rowset and returns SQL_SUCCESS_WITH_INFO. Thus, for each row that returned an error, the error queue contains SQLSTATE 01S01 (Error in row) followed by zero or more additional SQLSTATEs.

If the driver returns any warnings, such as SQLSTATE 01004 (Data truncated), it returns warnings that apply to the entire rowset or to unknown rows in the rowset before it returns the error information that applies to specific rows. It returns warnings for specific rows along with any other error information about those rows.

SQLSetPos Macros

As an aid to programming, the following macros for calling **SQLSetPos** are defined in the SQLEXT.H file.

Macro name	Function call
SQL_POSITION_TO(*hstmt*, *irow*)	**SQLSetPos**(*hstmt*, *irow*, SQL_POSITION, SQL_LOCK_NO_CHANGE)

SQL_LOCK_RECORD(*hstmt*, *irow*, *fLock*)	**SQLSetPos**(*hstmt*, *irow*, SQL_POSITION, *fLock*)
SQL_REFRESH_RECORD(*hstmt*, *irow*, *fLock*)	**SQLSetPos**(*hstmt*, *irow*, SQL_REFRESH, *fLock*)
SQL_UPDATE_RECORD(*hstmt*, *irow*)	**SQLSetPos**(*hstmt*, *irow*, SQL_UPDATE, SQL_LOCK_NO_CHANGE)
SQL_DELETE_RECORD(*hstmt*, *irow*)	**SQLSetPos**(*hstmt*, *irow*, SQL_DELETE, SQL_LOCK_NO_CHANGE)
SQL_ADD_RECORD(*hstmt*, *irow*)	**SQLSetPos**(*hstmt*, *irow*, SQL_ADD, SQL_LOCK_NO_CHANGE)

Code Example

In the following example, an application allows a user to browse the EMPLOYEE table and update employee birthdays. The cursor is keyset-driven with a rowset size of 20 and uses optimistic concurrency control comparing row versions. After each rowset is fetched, the application prints them and allows the user to select and update an employee's birthday. The application uses **SQLSetPos** to position the cursor on the selected row and performs a positioned update of the row. (Error handling is omitted for clarity.)

```
#define ROWS 20
#define NAME_LEN 30
#define BDAY_LEN 11

UCHAR  szName[ROWS][NAME_LEN], szBirthday[ROWS][BDAY_LEN], szReply[3];
SDWORD cbName[ROWS], cbBirthday[ROWS];
UWORD  rgfRowStatus[ROWS];
UDWORD crow, irow;
HSTMT  hstmtS, hstmtU;

SQLSetStmtOption(hstmtS, SQL_CONCURRENCY, SQL_CONCUR_ROWVER);

SQLSetStmtOption(hstmtS, SQL_CURSOR_TYPE, SQL_CURSOR_KEYSET_DRIVEN);
SQLSetStmtOption(hstmtS, SQL_ROWSET_SIZE, ROWS);
SQLSetCursorName(hstmtS, "C1", SQL_NTS);
SQLExecDirect(hstmtS,

          "SELECT NAME, BIRTHDAY FROM EMPLOYEE FOR UPDATE OF BIRTHDAY",
          SQL_NTS);

SQLBindCol(hstmtS, 1, SQL_C_CHAR, szName, NAME_LEN, cbName);
SQLBindCol(hstmtS, 1, SQL_C_CHAR, szBirthday, BDAY_LEN,
```

```
            cbBirthday);

    while (SQLExtendedFetch(hstmtS, FETCH_NEXT, 0, &crow, rgfRowStatus) !=

          SQL_ERROR) {
          for (irow = 0; irow < crow; irow++) {
             if (rgfRowStatus[irow] != SQL_ROW_DELETED)
                  printf("%d %-*s %*s\n", irow, NAME_LEN-1, szName[irow],
                        BDAY_LEN-1, szBirthday[irow]);
          }
          while (TRUE) {
             printf("\nRow number to update?");
             gets(szReply);
             irow = atoi(szReply);
             if (irow > 0 && irow <= crow) {
                  printf("\nNew birthday?");
                  gets(szBirthday[irow-1]);
                  SQLSetPos(hstmtS, irow, SQL_POSITION, SQL_LOCK_NO_CHANGE);
                  SQLPrepare(hstmtU,
                     "UPDATE EMPLOYEE SET BIRTHDAY=? WHERE CURRENT OF C1",
                     SQL_NTS);
                  SQLBindParameter(hstmtU, 1, SQL_PARAM_INPUT,
                                   SQL_C_CHAR, SQL_DATE,
                                   BDAY_LEN, 0, szBirthday, 0, NULL);
                  SQLExecute(hstmtU);
             } else if (irow == 0) {
                  break;
             }
          }
    }
```

```
/* Lock rows 1 and 2                                          */

SQL_LOCK_RECORD(hstmt, 1, SQL_LOCK_EXCLUSIVE);
SQL_LOCK_RECORD(hstmt, 2, SQL_LOCK_EXCLUSIVE);


/* Modify the rowset buffers for rows 1 and 2 (not shown).*/
/* Update rows 1 and 2.                                       */

SQL_UPDATE_RECORD(hstmt, 1);
SQL_UPDATE_RECORD(hstmt, 2);


/* Unlock rows 1 and 2                                        */

SQL_LOCK_RECORD(hstmt, 1, SQL_LOCK_UNLOCK);
SQL_LOCK_RECORD(hstmt, 2, SQL_LOCK_UNLOCK);
```

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Setting a statement option	**SQLSetStmtOption (extension)**

SQLSetScrollOptions (ODBC 1.0, Level 2)

SQLSetScrollOptions sets options that control the behavior of cursors associated with an *hstmt*. **SQLSetScrollOptions** allows the application to specify the type of cursor behavior desired in three areas: concurrency control, sensitivity to changes made by other transactions, and rowset size.

Note In ODBC 2.0, **SQLSetScrollOptions** has been superceded by the SQL_CURSOR_TYPE, SQL_CONCURRENCY, SQL_KEYSET_SIZE, and SQL_ROWSET_SIZE statement options. ODBC 2.0 drivers must support this function for backwards compatibility; ODBC 2.0 applications should only call this function in ODBC 1.0 drivers.

If an application calls **SQLSetScrollOptions**, a driver must be able to return the values of the aforementioned statement options with **SQLGetStmtOption**. For more information, see **SQLSetStmtOption**.

NOTE: This function is not implement in SOLID *SQL API*, but it is available through ODBC Cursor Library.

Syntax

RETCODE **SQLSetScrollOptions**(*hstmt*, *fConcurrency*, *crowKeyset*, *crowRowset*)

The **SQLSetScrollOptions** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	fConcurrency	Input	Specifies concurrency control for the cursor and must be one of the following values: SQL_CONCUR_READ_ONLY: Cursor is read-only. No updates are allowed. SQL_CONCUR_LOCK: Cursor uses the lowest level of locking sufficient to ensure that the row can be updated. SQL_CONCUR_ROWVER: Cursor uses optimistic concurrency control, comparing row versions. SQL_CONCUR_VALUES: Cursor uses optimistic concurrency control, comparing values.

SDWORD	crowKeyset	Input	Number of rows for which to buffer keys. This value must be greater than or equal to *crowRowset* or one of the following values: SQL_SCROLL_FORWARD_ONLY: The cursor only scrolls forward. SQL_SCROLL_STATIC: The data in the result set is static. SQL_SCROLL_KEYSET_DRIVEN: The driver saves and uses the keys for every row in the result set. SQL_SCROLL_DYNAMIC: The driver sets *crowKeyset* to the value of *crowRowset*. If *crowKeyset* is a value greater than *crowRowset*, the value defines the number of rows in the keyset that are to be buffered by the driver. This reflects a mixed scrollable cursor; the cursor is keyset driven within the keyset and dynamic outside of the keyset.
UWORD	crowRowset	Input	Number of rows in a rowset. *crowRowset* defines the number of rows fetched by each call to **SQLExtendedFetch**; the number of rows that the application buffers.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSetScrollOptions** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSetScrollOptions** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) The specified *hstmt* was in a prepared or executed state. The function must be called before calling **SQLPrepare** or **SQLExecDirect**. (DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1107	Row value out of range	(DM) The value specified for the argument *crowKeyset* was less than 1, but was not equal to SQL_SCROLL_FORWARD_ONLY, SQL_SCROLL_STATIC, SQL_SCROLL_KEYSET_DRIVEN, or SQL_SCROLL_DYNAMIC. (DM) The value specified for the argument *crowKeyset* is greater than 0, but less than *crowRowset*. (DM) The value specified for the argument *crowRowset* was 0.

S1108	Concurrency option out of range	(DM) The value specified for the argument *fConcurrency* was not equal to SQL_CONCUR_READ_ONLY, SQL_CONCUR_LOCK, SQL_CONCUR_ROWVER, or SQL_CONCUR_VALUES.
S1C00	Driver not capable	The driver or data source does not support the concurrency control option specified in the argument *fConcurrency.* The driver does not support the cursor model specified in the argument *crowKeyset*.

Comments

If an application calls **SQLSetScrollOptions** for an *hstmt*, it must do so before it calls **SQLPrepare** or **SQLExecDirect** or creating a result set with a catalog function.

The application must specify a buffer in a call to **SQLBindCol** that is large enough to hold the number of rows specified in *crowRowset*.

If the application does not call **SQLSetScrollOptions**, *crowRowset* has a default value of 1, *crowKeyset* has a default value of SQL_SCROLL_FORWARD_ONLY, and *fConcurrency* equals SQL_CONCUR_READ_ONLY.

For more information concerning scrollable cursors, see "Using Block and Scrollable Cursors" in Chapter 2, "Retrieving Results."

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Positioning the cursor in a rowset	**SQLSetPos (extension)**
Setting a statement option	**SQLSetStmtOption**

SQLSetStmtOption (ODBC 1.0, Level 1)

SQLSetStmtOption sets options related to an *hstmt*. To set an option for all statements associated with a specific *hdbc*, an application can call **SQLSetConnectOption**.

Syntax

RETCODE **SQLSetStmtOption**(*hstmt, fOption, vParam*)

The **SQLSetStmtOption** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	fOption	Input	Option to set, listed in "Comments."
UDWORD	vParam	Input	Value associated with *fOption*. Depending on the value of *fOption*, *vParam* will be a 32-bit integer value or point to a null-terminated character string.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSetStmtOption** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSetStmtOption** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
01S02	Option value changed	The driver did not support the specified value of the *vParam* argument and substituted a similar value. (Function returns SQL_SUCCESS_WITH_INFO.)

08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	The *fOption* was SQL_CONCURRENCY, SQL_CURSOR_TYPE, SQL_SIMULATE_CURSOR, or SQL_USE_BOOKMARKS and the cursor was open.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1009	Invalid argument value	Given the specified *fOption* value, an invalid value was specified for the argument *vParam*. (The Driver Manager returns this SQLSTATE only for statement options that accept a discrete set of values, such as SQL_ASYNC_ENABLE. For all other statement options, the driver must verify the value of the argument *vParam*.)
S1010	Function sequence error	(DM) An asynchronously executing function was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1011	Operation invalid at this time	The *fOption* was SQL_CONCURRENCY, SQL_CURSOR_TYPE, SQL_SIMULATE_CURSOR, or SQL_USE_BOOKMARKS and the statement was prepared.

S1092	Option type out of range	(DM) The value specified for the argument *fOption* was in the block of numbers reserved for ODBC connection and statement options, but was not valid for the version of ODBC supported by the driver.
S1C00	Driver not capable	The value specified for the argument *fOption* was a valid ODBC statement option for the version of ODBC supported by the driver, but was not supported by the driver. The value specified for the argument *fOption* was in the block of numbers reserved for driver-specific connection and statement options, but was not supported by the driver.

Comments

Statement options for an *hstmt* remain in effect until they are changed by another call to **SQLSetStmtOption** or the *hstmt* is dropped by calling **SQLFreeStmt** with the SQL_DROP option. Calling **SQLFreeStmt** with the SQL_CLOSE, SQL_UNBIND, or SQL_RESET_PARAMS options does not reset statement options.

Some statement options support substitution of a similar value if the data source does not support the specified value of *vParam*. In such cases, the driver returns SQL_SUCCESS_WITH_INFO and SQLSTATE 01S02 (Option value changed). For example, if *fOption* is SQL_CONCURRENCY, *vParam* is SQL_CONCUR_ROWVER, and the data source does not support this, the driver substitutes SQL_CONCUR_VALUES. To determine the substituted value, an application calls **SQLGetStmtOption**.

The currently defined options and the version of ODBC in which they were introduced are shown below; it is expected that more will be defined to take advantage of different data sources. Options from 0 to 999 are reserved by ODBC; driver developers must reserve values greater than or equal to SQL_CONNECT_OPT_DRVR_START for driver-specific use.

The format of information set with *vParam* depends on the specified *fOption*. **SQLSetStmtOption** accepts option information in one of two different formats: a null-terminated character string or a 32-bit integer value. The format of each is noted in the option's description. This format applies to the information returned for each option in **SQLGetStmtOption**. Character strings pointed to by the *vParam* argument of **SQLSetStmtOption** have a maximum length of SQL_MAX_OPTION_STRING_LENGTH bytes (excluding the null termination byte).

fOption	vParam Contents
SQL_ASYNC_ENABLE (ODBC 1.0)	A 32-bit integer value that specifies whether a function called with the specified hstmt is executed asynchronously: SQL_ASYNC_ENABLE_OFF = Off (the default) SQL_ASYNC_ENABLE_ON = On Once a function has been called asynchronously, no other functions can be called on the hstmt or the hdbc associated with the hstmt except for the original function, **SQLAllocStmt**, **SQLCancel**, or **SQLGetFunctions**, until the original function returns a code other than SQL_STILL_EXECUTING. Any other function called on the hstmt returns SQL_ERROR with an SQLSTATE of S1010 (Function sequence error). Functions can be called on other hstmts. For more information, see "Executing Functions Asynchronously" in Chapter 2. The following functions can be executed asynchronously: **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLDescribeCol** **SQLDescribeParam** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLGetData** **SQLGetTypeInfo** **SQLNumParams** **SQLNumResultCols** **SQLParamData** **SQLPrepare** **SQLPrimaryKeys** **SQLPutData** **SQLSetPos** **SQLSpecialColumns** **SQLStatistics** SQLTables

SQL_BIND_TYPE (ODBC 1.0)

A 32-bit integer value that sets the binding orientation to be used when **SQLExtendedFetch** is called on the associated hstmt. Column-wise binding is selected by supplying the defined constant SQL_BIND_BY_COLUMN for the argument vParam. Row-wise binding is selected by supplying a value for vParam specifying the length of a structure or an instance of a buffer into which result columns will be bound.

The length specified in vParam must include space for all of the bound columns and any padding of the structure or buffer to ensure that when the address of a bound column is incremented with the specified length, the result will point to the beginning of the same column in the next row. When using the **sizeof** operator with structures or unions in ANSI C, this behavior is guaranteed.

Column-wise binding is the default binding orientation for **SQLExtendedFetch**.

SQL_CONCURRENCY (ODBC 2.0)

A 32-bit integer value that specifies the cursor concurrency:

SQL_CONCUR_READ_ONLY = Cursor is read-only. No updates are allowed.

SQL_CONCUR_LOCK = Cursor uses the lowest level of locking sufficient to ensure that the row can be updated.

SQL_CONCUR_ROWVER = Cursor uses optimistic concurrency control, comparing row versions.

SQL_CONCUR_VALUES = Cursor uses optimistic concurrency control, comparing values.

The default value is SQL_CONCUR_READ_ONLY. This option cannot be specified for an open cursor and can also be set through the fConcurrency argument in **SQLSetScrollOptions**.

If the specified concurrency is not supported by the data source, the driver substitutes a different concurrency and returns SQLSTATE 01S02 (Option value changed). For SQL_CONCUR_VALUES, the driver substitutes SQL_CONCUR_ROWVER, and vice versa. For SQL_CONCUR_LOCK, the driver substitutes, in order, SQL_CONCUR_ROWVER or SQL_CONCUR_VALUES.

SQL_CURSOR_TYPE (ODBC 2.0)	A 32-bit integer value that specifies the cursor type: SQL_CURSOR_FORWARD_ONLY = The cursor only scrolls forward. SQL_CURSOR_STATIC = The data in the result set is static. SQL_CURSOR_KEYSET_DRIVEN = The driver saves and uses the keys for the number of rows specified in the SQL_KEYSET_SIZE statement option. SQL_CURSOR_DYNAMIC = The driver only saves and uses the keys for the rows in the rowset. The default value is SQL_CURSOR_FORWARD_ONLY. This option cannot be specified for an open cursor and can also be set through the crowKeyset argument in **SQLSetScrollOptions**. If the specified cursor type is not supported by the data source, the driver substitutes a different cursor type and returns SQLSTATE 01S02 (Option value changed). For a mixed or dynamic cursor, the driver substitutes, in order, a keyset-driven or static cursor. For a keyset-driven cursor, the driver substitutes a static cursor.
SQL_KEYSET_SIZE (ODBC 2.0)	A 32-bit integer value that specifies the number of rows in the keyset for a keyset-driven cursor. If the keyset size is 0 (the default), the cursor is fully keyset-driven. If the keyset size is greater than 0, the cursor is mixed (keyset-driven within the keyset and dynamic outside of the keyset). The default keyset size is 0. If the specified size exceeds the maximum keyset size, the driver substitutes that size and returns SQLSTATE 01S02 (Option value changed). **SQLExtendedFetch** returns an error if the keyset size is greater than 0 and less than the rowset size.

SQL_MAX_LENGTH (ODBC 1.0)	A 32-bit integer value that specifies the maximum amount of data that the driver returns from a character or binary column. If vParam is less than the length of the available data, **SQLFetch** or **SQLGetData** truncates the data and returns SQL_SUCCESS. If vParam is 0 (the default), the driver attempts to return all available data. If the specified length is less than the minimum amount of data that the data source can return (the minimum is 254 bytes on many data sources), or greater than the maximum amount of data that the data source can return, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed). This option is intended to reduce network traffic and should only be supported when the data source (as opposed to the driver) in a multiple-tier driver can implement it. To truncate data, an application should specify the maximum buffer length in the cbValueMax argument in **SQLBindCol** or **SQLGetData**. **Note** In ODBC 1.0, this statement option only applied to SQL_LONGVARCHAR and SQL_LONGVARBINARY columns.
SQL_MAX_ROWS (ODBC 1.0)	A 32-bit integer value corresponding to the maximum number of rows to return to the application for a **SELECT** statement. If vParam equals 0 (the default), then the driver returns all rows. This option is intended to reduce network traffic. Conceptually, it is applied when the result set is created and limits the result set to the first vParam rows. If the specified number of rows exceeds the number of rows that can be returned by the data source, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed).
SQL_NOSCAN (ODBC 1.0)	A 32-bit integer value that specifies whether the driver does not scan SQL strings for escape clauses: SQL_NOSCAN_OFF = The driver scans SQL strings for escape clauses (the default). SQL_NOSCAN_ON = The driver does not scan SQL strings for escape clauses. Instead, the driver sends the statement directly to the data source.

SQL_QUERY_ TIMEOUT (ODBC 1.0)	A 32-bit integer value corresponding to the number of seconds to wait for an SQL statement to execute before returning to the application. If vParam equals 0 (the default), then there is no time out. If the specified timeout exceeds the maximum timeout in the data source or is smaller than the minimum timeout, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed). Note that the application need not call **SQLFreeStmt** with the SQL_CLOSE option to reuse the hstmt if a **SELECT** statement timed out.
SQL_RETRIEVE_DATA (ODBC 2.0)	A 32-bit integer value: SQL_RD_ON = **SQLExtendedFetch** retrieves data after it positions the cursor to the specified location. This is the default. SQL_RD_OFF = **SQLExtendedFetch** does not retrieve data after it positions the cursor. By setting SQL_RETRIEVE_DATA to SQL_RD_OFF, an application can verify if a row exists or retrieve a bookmark for the row without incurring the overhead of retrieving rows.
SQL_ROWSET_SIZE (ODBC 2.0)	A 32-bit integer value that specifies the number of rows in the rowset. This is the number of rows returned by each call to **SQLExtendedFetch**. The default value is 1. If the specified rowset size exceeds the maximum rowset size supported by the data source, the driver substitutes that value and returns SQLSTATE 01S02 (Option value changed). This option can be specified for an open cursor and can also be set through the crowRowset argument in **SQLSetScrollOptions**.

SQL_SIMULATE_CURSOR (ODBC 2.0)

A 32-bit integer value that specifies whether drivers that simulate positioned update and delete statements guarantee that such statements affect only one single row.

To simulate positioned update and delete statements, most drivers construct a searched **UPDATE** or **DELETE** statement containing a **WHERE** clause that specifies the value of each column in the current row. Unless these columns comprise a unique key, such a statement may affect more than one row.

To guarantee that such statements affect only one row, the driver determines the columns in a unique key and adds these columns to the result set. If an application guarantees that the columns in the result set comprise a unique key, the driver is not required to do so. This may reduce execution time.

SQL_SC_NON_UNIQUE = The driver does not guarantee that simulated positioned update or delete statements will affect only one row; it is the application's responsibility to do so. If a statement affects more than one row, **SQLExecute** or **SQLExecDirect** returns SQLSTATE 01000 (General warning).

SQL_SC_TRY_UNIQUE = The driver attempts to guarantee that simulated positioned update or delete statements affect only one row. The driver always executes such statements, even if they might affect more than one row, such as when there is no unique key. If a statement affects more than one row, **SQLExecute** or **SQLExecDirect** returns SQLSTATE 01000 (General warning).

SQL_SC_UNIQUE = The driver guarantees that simulated positioned update or delete statements affect only one row. If the driver cannot guarantee this for a given statement, **SQLExecDirect** or **SQLPrepare** returns an error.

If the specified cursor simulation type is not supported by the data source, the driver substitutes a different simulation type and returns SQLSTATE 01S02 (Option value changed). For SQL_SC_UNIQUE, the driver substitutes, in order, SQL_SC_TRY_UNIQUE or SQL_SC_NON_UNIQUE. For SQL_SC_TRY_UNIQUE, the driver substitutes SQL_SC_NON_UNIQUE.

If a driver does not simulate positioned update and delete statements, it returns SQLSTATE S1C00 (Driver not capable).

SQL_USE_ BOOKMARKS (ODBC 2.0)	A 32-bit integer value that specifies whether an application will use bookmarks with a cursor: SQL_UB_OFF = Off (the default) SQL_UB_ON = On To use bookmarks with a cursor, the application must specify this option with the SQL_UB_ON value before opening the cursor.

Code Example

See **SQLExtendedFetch**.

Related Functions

For information about	See
Canceling statement processing	**SQLCancel**
Returning the setting of a connection option	**SQLGetConnectOption (extension)**
Returning the setting of a statement option	**SQLGetStmtOption (extension)**
Setting a connection option	**SQLSetConnectOption (extension)**

SQLSpecialColumns (ODBC 1.0, Level 1)

SQLSpecialColumns retrieves the following information about columns within a specified table:

- The optimal set of columns that uniquely identifies a row in the table.
- Columns that are automatically updated when any value in the row is updated by a transaction.

Syntax

RETCODE **SQLSpecialColumns**(*hstmt, fColType, szTableQualifier, cbTableQualifier, szTableOwner, cbTableOwner, szTableName, cbTableName, fScope, fNullable*)

The **SQLSpecialColumns** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UWORD	fColType	Input	Type of column to return. Must be one of the following values: SQL_BEST_ROWID: Returns the optimal column or set of columns that, by retrieving values from the column or columns, allows any row in the specified table to be uniquely identified. A column can be either a pseudocolumn specifically designed for this purpose or the column or columns of any unique index for the table. SQL_ROWVER: Returns the column or columns in the specified table, if any, that are automatically updated by the data source when any value in the row is updated by any transaction.
UCHAR FAR *	szTableQualifier	Input	Qualifier name for the table. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have qualifiers.
SWORD	cbTableQualifier	Input	Length of *szTableQualifier*.

UCHAR FAR *	szTableOwner	Input	Owner name for the table. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have owners.
SWORD	cbTableOwner	Input	Length of *szTableOwner*.
UCHAR FAR *	szTableName	Input	Table name.
SWORD	cbTableName	Input	Length of *szTableName*.
UWORD	fScope	Input	Minimum required scope of the rowid. The returned rowid may be of greater scope. Must be one of the following: SQL_SCOPE_CURROW: The rowid is guaranteed to be valid only while positioned on that row. A later reselect using rowid may not return a row if the row was updated or deleted by another transaction. SQL_SCOPE_TRANSACTION: The rowid is guaranteed to be valid for the duration of the current transaction. SQL_SCOPE_SESSION: The rowid is guaranteed to be valid for the duration of the session (across transaction boundaries).
UWORD	fNullable	Input	Determines whether to return special columns that can have a NULL value. Must be one of the following: SQL_NO_NULLS: Exclude special columns that can have NULL values. SQL_NULLABLE: Return special columns even if they can have NULL values.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLSpecialColumns** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLSpecialColumns** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.
S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value of one of the length arguments was less than 0, but not equal to SQL_NTS. The value of one of the length arguments exceeded the maximum length value for the corresponding qualifier or name. The maximum length of each qualifier or name may be obtained by calling **SQLGetInfo** with the *fInfoType* values: SQL_MAX_QUALIFIER_NAME_LEN, SQL_MAX_OWNER_NAME_LEN, or SQL_MAX_TABLE_NAME_LEN.
S1097	Column type out of range	(DM) An invalid *fColType* value was specified.
S1098	Scope type out of range	(DM) An invalid *fScope* value was specified.
S1099	Nullable type out of range	(DM) An invalid *fNullable* value was specified.

S1C00	Driver not capable	A table qualifier was specified and the driver or data source does not support qualifiers. A table owner was specified and the driver or data source does not support owners. The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.
S1T00	Timeout expired	The timeout period expired before the data source returned the requested result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLSpecialColumns is provided so that applications can provide their own custom scrollable-cursor functionality, similar to that provided by **SQLExtendedFetch** and **SQLSetStmtOption**.

When the *fColType* argument is SQL_BEST_ROWID, **SQLSpecialColumns** returns the column or columns that uniquely identify each row in the table. These columns can always be used in a *select-list* or **WHERE** clause. However, **SQLColumns** does not necessarily return these columns. If there are no columns that uniquely identify each row in the table, **SQLSpecialColumns** returns a rowset with no rows; a subsequent call to **SQLFetch** or **SQLExtendedFetch** on the *hstmt* returns SQL_NO_DATA_FOUND.

If the *fColType*, *fScope*, or *fNullable* arguments specify characteristics that are not supported by the data source, **SQLSpecialColumns** returns a result set with no rows (as opposed to the function returning SQL_ERROR with SQLSTATE S1C00 (Driver not capable)). A subsequent call to **SQLFetch** or **SQLExtendedFetch** on the *hstmt* will return SQL_NO_DATA_FOUND.

SQLSpecialColumns returns the results as a standard result set, ordered by SCOPE. The following table lists the columns in the result set.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source. To determine the actual length of the COLUMN_NAME col-

umn, an application can call **SQLGetInfo** with the SQL_MAX_COLUMN_NAME_LEN option.

Column Name	Data Type	Comments
SCOPE	Smallint	Actual scope of the rowid. Contains one of the following values: SQL_SCOPE_CURROW SQL_SCOPE_TRANSACTION SQL_SCOPE_SESSION NULL is returned when *fColType* is SQL_ROWVER. For a description of each value, see the description of *fScope* in the "Syntax" section above.
COLUMN_NAME	Varchar(128) not NULL	Column identifier.
DATA_TYPE	Smallint not NULL	SQL data type. This can be an ODBC SQL data type or a driver-specific SQL data type. For a list of valid ODBC SQL data types, see "*SQL Data Types" on page D-2*. For information about driver-specific SQL data types, see the driver's documentation.
TYPE_NAME	Varchar(128) not NULL	Data source–dependent data type name; for example, "CHAR", "VARCHAR", "MONEY", "LONG VARBINARY", or "CHAR ( ) FOR BIT DATA".
PRECISION	Integer	The precision of the column on the data source. NULL is returned for data types where precision is not applicable. For more information concerning precision, see "*Precision, Scale, Length, and Display Size" on page D-14*."

LENGTH	Integer	The length in bytes of data transferred on an **SQLGetData** or **SQLFetch** operation if SQL_C_DEFAULT is specified. For numeric data, this size may be different than the size of the data stored on the data source. This value is the same as the PRECISION column for character or binary data. For more information, see "*Precision, Scale, Length, and Display Size" on page D-14*.
SCALE	Smallint	The scale of the column on the data source. NULL is returned for data types where scale is not applicable. For more information concerning scale, see "*Precision, Scale, Length, and Display Size" on page D-14*."
PSEUDO_COLUMN	Smallint	Indicates whether the column is a pseudo-column: SQL_PC_UNKNOWN SQL_PC_PSEUDO SQL_PC_NOT_PSEUDO **Note** For maximum interoperability, pseudo-columns should not be quoted with the identifier quote character returned by **SQLGetInfo**.

NOTE: The PSEUDO_COLUMN column was added in ODBC 2.0. ODBC 1.0 drivers might return a different, driver-specific column with the same column number.

Once the application retrieves values for SQL_BEST_ROWID, the application can use these values to reselect that row within the defined scope. The **SELECT** statement is guaranteed to return either no rows or one row.

If an application reselects a row based on the rowid column or columns and the row is not found, then the application can assume that the row was deleted or the rowid columns were

modified. The opposite is not true: even if the rowid has not changed, the other columns in the row may have changed.

Columns returned for column type SQL_BEST_ROWID are useful for applications that need to scroll forwards and backwards within a result set to retrieve the most recent data from a set of rows. The column or columns of the rowid are guaranteed not to change while positioned on that row.

The column or columns of the rowid may remain valid even when the cursor is not positioned on the row; the application can determine this by checking the SCOPE column in the result set.

Columns returned for column type SQL_ROWVER are useful for applications that need the ability to check if any columns in a given row have been updated while the row was reselected using the rowid. For example, after reselecting a row using rowid, the application can compare the previous values in the SQL_ROWVER columns to the ones just fetched. If the value in a SQL_ROWVER column differs from the previous value, the application can alert the user that data on the display has changed.

Code Example

For a code example of a similar function, see **SQLColumns**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning the columns in a table or tables	**SQLColumns (extension)**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning the columns of a primary key	**SQLPrimaryKeys (extension)**

SQLStatistics (ODBC 1.0, Level 1)

SQLStatistics retrieves a list of statistics about a single table and the indexes associated with the table. The driver returns the information as a result set.

Syntax

RETCODE **SQLStatistics**(*hstmt, szTableQualifier, cbTableQualifier, szTableOwner, cbTableOwner, szTableName, cbTableName, fUnique, fAccuracy*)

The **SQLStatistics** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle.
UCHAR FAR *	szTableQualifier	Input	Qualifier name. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have qualifiers.
SWORD	cbTableQualifier	Input	Length of *szTableQualifier.*
UCHAR FAR *	szTableOwner	Input	Owner name. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have owners.
SWORD	cbTableOwner	Input	Length of *szTableOwner.*
UCHAR FAR *	szTableName	Input	Table name.
SWORD	cbTableName	Input	Length of *szTableName*.
UWORD	fUnique	Input	Type of index: SQL_INDEX_UNIQUE or SQL_INDEX_ALL.

UWORD	fAccuracy	Input	The importance of the CARDINALITY and PAGES columns in the result set: SQL_ENSURE requests that the driver unconditionally retrieve the statistics. SQL_QUICK requests that the driver retrieve results only if they are readily available from the server. In this case, the driver does not ensure that the values are current.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLStatistics** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLStatistics** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.

24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multithreaded application.

S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value of one of the name length arguments was less than 0, but not equal to SQL_NTS. The value of one of the name length arguments exceeded the maximum length value for the corresponding qualifier or name.
S1100	Uniqueness option type out of range	(DM) An invalid *fUnique* value was specified.
S1101	Accuracy option type out of range	(DM) An invalid *fAccuracy* value was specified.
S1C00	Driver not capable	A table qualifier was specified and the driver or data source does not support qualifiers. A table owner was specified and the driver or data source does not support owners. The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.

S1T00	Timeout expired	The timeout period expired before the data source returned the requested result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLStatistics returns information about a single table as a standard result set, ordered by NON_UNIQUE, TYPE, INDEX_QUALIFIER, INDEX_NAME, and SEQ_IN_INDEX. The result set combines statistics information for the table with information about each index. The following table lists the columns in the result set.

Note **SQLStatistics** might not return all indexes. Applications can use any valid index, regardless of whether it is returned by **SQLStatistics**.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source. To determine the actual lengths of the TABLE_QUALIFIER, TABLE_OWNER, TABLE_NAME, and COLUMN_NAME columns, an application can call **SQLGetInfo** with the SQL_MAX_QUALIFIER_NAME_LEN, SQL_MAX_OWNER_NAME_LEN, SQL_MAX_TABLE_NAME_LEN, and SQL_MAX_COLUMN_NAME_LEN options.

Column Name	Data Type	Comments
TABLE_QUALIFIER	Varchar(128)	Table qualifier identifier of the table to which the statistic or index applies; NULL if not applicable to the data source. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have qualifiers.
TABLE_OWNER	Varchar(128)	Table owner identifier of the table to which the statistic or index applies; NULL if not applicable to the data source. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have owners.

TABLE_NAME	Varchar(128) not NULL	Table identifier of the table to which the statistic or index applies.
NON_UNIQUE	Smallint	Indicates whether the index prohibits duplicate values: TRUE if the index values can be nonunique. FALSE if the index values must be unique. NULL is returned if TYPE is SQL_TABLE_STAT.
INDEX_QUALIFIER	Varchar(128)	The identifier that is used to qualify the index name doing a **DROP INDEX**; NULL is returned if an index qualifier is not supported by the data source or if TYPE is SQL_TABLE_STAT. If a non-null value is returned in this column, it must be used to qualify the index name on a **DROP INDEX** statement; otherwise the TABLE_OWNER name should be used to qualify the index name.
INDEX_NAME	Varchar(128)	Index identifier; NULL is returned if TYPE is SQL_TABLE_STAT.
TYPE	Smallint not NULL	Type of information being returned: SQL_TABLE_STAT indicates a statistic for the table. SQL_INDEX_CLUSTERED indicates a clustered index. SQL_INDEX_HASHED indicates a hashed index. SQL_INDEX_OTHER indicates another type of index.
SEQ_IN_INDEX	Smallint	Column sequence number in index (starting with 1); NULL is returned if TYPE is SQL_TABLE_STAT.

COLUMN_NAME	Varchar(128)	Column identifier. If the column is based on an expression, such as SALARY + BENEFITS, the expression is returned; if the expression cannot be determined, an empty string is returned. If the index is a filtered index, each column in the filter condition is returned; this may require more than one row. NULL is returned if TYPE is SQL_TABLE_STAT.
COLLATION	Char(1)	Sort sequence for the column; "A" for ascending; "D" for descending; NULL is returned if column sort sequence is not supported by the data source or if TYPE is SQL_TABLE_STAT.
CARDINALITY	Integer	Cardinality of table or index; number of rows in table if TYPE is SQL_TABLE_STAT; number of unique values in the index if TYPE is not SQL_TABLE_STAT; NULL is returned if the value is not available from the data source.
PAGES	Integer	Number of pages used to store the index or table; number of pages for the table if TYPE is SQL_TABLE_STAT; number of pages for the index if TYPE is not SQL_TABLE_STAT; NULL is returned if the value is not available from the data source, or if not applicable to the data source.
FILTER_CONDITION	Varchar(128)	If the index is a filtered index, this is the filter condition, such as SALARY > 30000; if the filter condition cannot be determined, this is an empty string. NULL if the index is not a filtered index, it cannot be determined whether the index is a filtered index, or TYPE is SQL_TABLE_STAT.

NOTE: The FILTER_CONDITION column was added in ODBC 2.0. ODBC 1.0 drivers might return a different, driver-specific column with the same column number.

If the row in the result set corresponds to a table, the driver sets TYPE to SQL_TABLE_STAT and sets NON_UNIQUE, INDEX_QUALIFIER, INDEX_NAME, SEQ_IN_INDEX, COLUMN_NAME, and COLLATION to NULL. If CARDINALITY or PAGES are not available from the data source, the driver sets them to NULL.

Code Example

For a code example of a similar function, see **SQLColumns**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning the columns of a primary key	**SQLPrimaryKeys (extension)**

SQLTables (ODBC 1.0, Level 1)

SQLTables returns the list of table names stored in a specific data source. The driver returns the information as a result set.

Syntax

RETCODE **SQLTables**(*hstmt, szTableQualifier, cbTableQualifier, szTableOwner, cbTable-Owner, szTableName, cbTableName, szTableType, cbTableType*)

The **SQLTables** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	hstmt	Input	Statement handle for retrieved results.
UCHAR FAR *	szTableQualifier	Input	Qualifier name. If a driver supports qualifiers for some tables but not for others, such as when a driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have qualifiers.
SWORD	cbTableQualifier	Input	Length of *szTableQualifier.*
UCHAR FAR *	szTableOwner	Input	String search pattern for owner names.
SWORD	cbTableOwner	Input	Length of *szTableOwner.*
UCHAR FAR *	szTableName	Input	String search pattern for table names. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, an empty string ("") denotes those tables that do not have owners.
SWORD	cbTableName	Input	Length of *szTableName*.
UCHAR FAR *	szTableType	Input	List of table types to match.
SWORD	cbTableType	Input	Length of *szTableType*.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_STILL_EXECUTING, SQL_ERROR or SQL_INVALID_HANDLE.

Diagnostics

When **SQLTables** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLTables** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08S01	Communication link failure	The communication link between the driver and the data source to which the driver was connected failed before the function completed processing.
24000	Invalid cursor state	(DM) A cursor was open on the *hstmt* and **SQLFetch** or **SQLExtendedFetch** had been called. A cursor was open on the *hstmt* but **SQLFetch** or **SQLExtendedFetch** had not been called.
IM001	Driver does not support this function	(DM) The driver associated with the *hstmt* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.

S1008	Operation canceled	Asynchronous processing was enabled for the *hstmt*. The function was called and before it completed execution, **SQLCancel** was called on the *hstmt*. Then the function was called again on the *hstmt*. The function was called and, before it completed execution, **SQLCancel** was called on the *hstmt* from a different thread in a multi-threaded application.
S1010	Function sequence error	(DM) An asynchronously executing function (not this one) was called for the *hstmt* and was still executing when this function was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for the *hstmt* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1090	Invalid string or buffer length	(DM) The value of one of the name length arguments was less than 0, but not equal to SQL_NTS. The value of one of the name length arguments exceeded the maximum length value for the corresponding qualifier or name.
S1C00	Driver not capable	A table qualifier was specified and the driver or data source does not support qualifiers. A table owner was specified and the driver or data source does not support owners. A string search pattern was specified for the table owner or table name and the data source does not support search patterns for one or more of those arguments. The combination of the current settings of the SQL_CONCURRENCY and SQL_CURSOR_TYPE statement options was not supported by the driver or data source.

S1T00	Timeout expired	The timeout period expired before the data source returned the requested result set. The timeout period is set through **SQLSetStmtOption**, SQL_QUERY_TIMEOUT.

Comments

SQLTables lists all tables in the requested range. A user may or may not have SELECT privileges to any of these tables. To check accessibility, an application can:

- Call **SQLGetInfo** and check the SQL_ACCESSIBLE_TABLES info value.

Otherwise, the application must be able to handle a situation where the user selects a table for which SELECT privileges are not granted.

The *szTableOwner* and *szTableName* arguments accept search patterns. For more information about valid search patterns, see "Search Pattern Arguments" earlier in this chapter.

To support enumeration of qualifiers, owners, and table types, **SQLTables** defines the following special semantics for the *szTableQualifier*, *szTableOwner*, *szTableName*, and *szTableType* arguments:

- If *szTableQualifier* is a single percent character (%) and *szTableOwner* and *szTableName* are empty strings, then the result set contains a list of valid qualifiers for the data source. (All columns except the TABLE_QUALIFIER column contain NULLs.)
- If *szTableOwner* is a single percent character (%) and *szTableQualifier* and *szTableName* are empty strings, then the result set contains a list of valid owners for the data source. (All columns except the TABLE_OWNER column contain NULLs.)
- If *szTableType* is a single percent character (%) and *szTableQualifier*, *szTableOwner*, and *szTableName* are empty strings, then the result set contains a list of valid table types for the data source. (All columns except the TABLE_TYPE column contain NULLs.)

If *szTableType* is not an empty string, it must contain a list of comma-separated, values for the types of interest; each value may be enclosed in single quotes (') or unquoted. For example, "'TABLE','VIEW'" or "TABLE, VIEW". If the data source does not support a specified table type, **SQLTables** does not return any results for that type.

SQLTables returns the results as a standard result set, ordered by TABLE_TYPE, TABLE_QUALIFIER, TABLE_OWNER, and TABLE_NAME. The following table lists the columns in the result set.

Note **SQLTables** might not return all qualifiers, owners, or tables. For example, an Xbase driver, for which a qualifier is a directory, might only return the current directory instead of all directories on the system. It might also only return files (tables) in the current directory.

Applications can use any valid qualifier, owner, or table, regardless of whether it is returned by **SQLTables**.

The lengths of VARCHAR columns shown in the table are maximums; the actual lengths depend on the data source. To determine the actual lengths of the TABLE_QUALIFIER, TABLE_OWNER, and TABLE_NAME columns, an application can call **SQLGetInfo** with the SQL_MAX_QUALIFIER_NAME_LEN, SQL_MAX_OWNER_NAME_LEN, and SQL_MAX_TABLE_NAME_LEN options.

Column Name	Data Type	Comments
TABLE_QUALIFIER	Varchar(128)	Table qualifier identifier; NULL if not applicable to the data source. If a driver supports qualifiers for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have qualifiers.
TABLE_OWNER	Varchar(128)	Table owner identifier; NULL if not applicable to the data source. If a driver supports owners for some tables but not for others, such as when the driver retrieves data from different DBMSs, it returns an empty string ("") for those tables that do not have owners.
TABLE_NAME	Varchar(128)	Table identifier.
TABLE_TYPE	Varchar(128)	Table type identifier; one of the following: "TABLE", "VIEW", "SYSTEM TABLE", "GLOBAL TEMPORARY", "LOCAL TEMPORARY", "ALIAS", "SYNONYM" or a data source – specific type identifier.
REMARKS	Varchar(254)	A description of the table.

Code Example

For a code example of a similar function, see **SQLColumns**.

Related Functions

For information about	See
Assigning storage for a column in a result set	**SQLBindCol**
Canceling statement processing	**SQLCancel**
Returning the columns in a table or tables	**SQLColumns (extension)**

Fetching a block of data or scrolling through a result set	**SQLExtendedFetch (extension)**
Fetching a row of data	**SQLFetch**
Returning table statistics and indexes	**SQLStatistics (extension)**

SQLTransact (ODBC 1.0, Core)

SQLTransact requests a commit or rollback operation for all active operations on all *hstmts* associated with a connection. **SQLTransact** can also request that a commit or rollback operation be performed for all connections associated with the *henv.*

Syntax

RETCODE **SQLTransact**(*henv, hdbc, fType*)

The **SQLTransact** function accepts the following arguments.

Type	Argument	Use	Description
HENV	henv	Input	Environment handle.
HDBC	hdbc	Input	Connection handle.
UWORD	fType	Input	One of the following two values: SQL_COMMIT SQL_ROLLBACK

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

When **SQLTransact** returns SQL_ERROR or SQL_SUCCESS_WITH_INFO, an associated SQLSTATE value may be obtained by calling **SQLError**. The following table lists the SQLSTATE values commonly returned by **SQLTransact** and explains each one in the context of this function; the notation "(DM)" precedes the descriptions of SQLSTATEs returned by the Driver Manager. The return code associated with each SQLSTATE value is SQL_ERROR, unless noted otherwise.

SQLSTATE	Error	Description
01000	General warning	Driver-specific informational message. (Function returns SQL_SUCCESS_WITH_INFO.)
08003	Connection not open	(DM) The *hdbc* was not in a connected state.

08007	Connection failure during transaction	The connection associated with the *hdbc* failed during the execution of the function and it cannot be determined whether the requested **COMMIT** or **ROLLBACK** occurred before the failure.
IM001	Driver does not support this function	(DM) The driver associated with the *hdbc* does not support the function.
S1000	General error	An error occurred for which there was no specific SQLSTATE and for which no implementation-specific SQLSTATE was defined. The error message returned by **SQLError** in the argument *szErrorMsg* describes the error and its cause.
S1001	Memory allocation failure	The driver was unable to allocate memory required to support execution or completion of the function.
S1010	Function sequence error	(DM) An asynchronously executing function was called for an *hstmt* associated with the *hdbc* and was still executing when **SQLTransact** was called. (DM) **SQLExecute**, **SQLExecDirect**, or **SQLSetPos** was called for an *hstmt* associated with the *hdbc* and returned SQL_NEED_DATA. This function was called before data was sent for all data-at-execution parameters or columns.
S1012	Invalid transaction operation code	(DM) The value specified for the argument *fType* was neither SQL_COMMIT nor SQL_ROLLBACK.
S1C00	Driver not capable	The driver or data source does not support the **ROLLBACK** operation.

Comments

If *hdbc* is SQL_NULL_HDBC and *henv* is a valid environment handle, then the Driver Manager will attempt to commit or roll back transactions on all *hdbcs* that are in a connected state. The Driver Manager calls **SQLTransact** in the driver associated with each *hdbc*. The Driver Manager will return SQL_SUCCESS only if it receives SQL_SUCCESS for each *hdbc*. If the Driver Manager receives SQL_ERROR on one or more *hdbcs*, it will return

SQL_ERROR to the application. To determine which connection(s) failed during the commit or rollback operation, the application can call **SQLError** for each *hdbc*.

Note The Driver Manager does not simulate a global transaction across all *hdbcs* and therefore does not use two-phase commit protocols.

If *hdbc* is a valid connection handle, *henv* is ignored and the Driver Manager calls **SQLTransact** in the driver for the *hdbc*.

If *hdbc* is SQL_NULL_HDBC and *henv* is SQL_NULL_HENV, **SQLTransact** returns SQL_INVALID_HANDLE.

If *fType* is SQL_COMMIT, **SQLTransact** issues a commit request for all active operations on any *hstmt* associated with an affected *hdbc*. If *fType* is SQL_ROLLBACK, **SQLTransact** issues a rollback request for all active operations on any *hstmt* associated with an affected *hdbc*. If no transactions are active, **SQLTransact** returns SQL_SUCCESS with no effect on any data sources.

If the driver is in manual-commit mode (by calling **SQLSetConnectOption** with the SQL_AUTOCOMMIT option set to zero), a new transaction is implicitly started when an SQL statement that can be contained within a transaction is executed against the current data source.

To determine how transaction operations affect cursors, an application calls **SQLGetInfo** with the SQL_CURSOR_ROLLBACK_BEHAVIOR and SQL_CURSOR_COMMIT_BEHAVIOR options.

If the SQL_CURSOR_ROLLBACK_BEHAVIOR or SQL_CURSOR_COMMIT_BEHAVIOR value equals SQL_CB_DELETE, **SQLTransact** closes and deletes all open cursors on all *hstmts* associated with the *hdbc* and discards all pending results. **SQLTransact** leaves any *hstmt* present in an allocated (unprepared) state; the application can reuse them for subsequent SQL requests or can call **SQLFreeStmt** to deallocate them.

If the SQL_CURSOR_ROLLBACK_BEHAVIOR or SQL_CURSOR_COMMIT_BEHAVIOR value equals SQL_CB_CLOSE, **SQLTransact** closes all open cursors on all *hstmts* associated with the *hdbc*. **SQLTransact** leaves any *hstmt* present in a prepared state; the application can call **SQLExecute** for an *hstmt* associated with the *hdbc* without first calling **SQLPrepare**.

If the SQL_CURSOR_ROLLBACK_BEHAVIOR or SQL_CURSOR_COMMIT_BEHAVIOR value equals SQL_CB_PRESERVE, **SQLTransact** does not affect open cursors associated with the *hdbc*. Cursors remain at the row they pointed to prior to the call to **SQLTransact**.

For drivers and data sources that support transactions, calling **SQLTransact** with either SQL_COMMIT or SQL_ROLLBACK when no transaction is active will return SQL_SUCCESS (indicating that there is no work to be committed or rolled back) and have no effect on the data source.

Drivers or data sources that do not support transactions (**SQLGetInfo** *fOption* SQL_TXN_CAPABLE is 0) are effectively always in autocommit mode. Therefore, calling **SQLTransact** with SQL_COMMIT will return SQL_SUCCESS. However, calling **SQLTransact** with SQL_ROLLBACK will result in SQLSTATE S1C00 (Driver not capable), indicating that a rollback can never be performed.

Code Example

See **SQLParamOptions**.

Related Functions

For information about	See
Returning information about a driver or data source	**SQLGetInfo** (extension)
Freeing a statement handle	SQLFreeStmt

6

Using SOLID *Light Client*

This chapter describes how to use SOLID *Light Client*, a very small footprint database client library and a subset of ODBC API, especially designed for implementing embedded solutions with limited memory resources. With SOLID *Light Client*, lightweight client applications can use the full power of SOLID *Embedded Engine*.

The topics included in this chapter are:

- What is SOLID *Light Client*?
- Getting started with SOLID *Light Client*
- Running SQL Statements on SOLID *Light Client*
- SOLID *Light Client* Functions
- Sample code

What is SOLID *Light Client*?

The SOLID *Light Client* library is a 21-function subset of the *ODBC API*, providing full SQL capabilities for application developers accessing SOLID *Embedded Engine* databases. It provides functions for controlling database connections, executing SQL statements, retrieving result sets, committing transactions, and other SOLID *Embedded Engine* functionality.

SOLID *Light Client* is suited for target environments with a small amount of memory. Its API library is 33-41 Kb on all target platforms.

Currently, SOLID *Light Client* is available for DOS, ChorusOS (ix86 and PowerPC) and VXWorks (ix86 and PowerPC), the development environment being Windows NT, Windows 95/98, and SUN Solaris. Versions for certain mobile device OSs and realtime OSs may be released later on.

Getting started with SOLID *Light Client*

To get started with SOLID *Light Client*, be sure you have:

1. Downloaded the SOLID *Light Client* package for your environment from the SOLID *Light Client* Web page and followed all installation instructions at the Web site.
2. Set up the TCP/IP infrastructure as instructed in the installation procedures and your platform specific documentation.

Setting up the Development Environment and Building a Sample Program

Building a program using SOLID *Light Client* library is identical to bulding any normal C/C++ program. If necessary, check our development environment documentation on the following:

- Insert the library file to your project
- Include header file
- Compile the source code
- Link the program

The first two issues are described in more detail in the following sections.

Insert the library file into your project

Check your development environment's documentation on how to link a library to a program. Link the correct *Light Client* library to your program. The libraries are:

Platform	Link the library....
DOS	slcdos30.lib
NT	slcw3230.lib
Solaris	slcssx30.a
VxWorks	slcvxw30.a (ix86) slcvpx30.a (PowerPC)
ChorusOS	slccrx30.z (ix86) slccpx30.a (PowerPC)

Include header files

The following line needs to be included in a *Light Client* program:

```
#include "cli0lcli.h"
```

Other necessary *Light Client* headers are included by this header file. Insert the directory containing all the *Light Client* headers into your development environment's include directories setting.

Verifying the Development Environment Setup

The easiest way to do this is to build a *Light Client* sample program. This enables you to verify your development environment without writing any code. Please note the following that applies to your development environment:

- In the NT environment, the TCP/IP services are provided by standard DLL wsock32.dll. To link these services into your project, add wsock32.lib into linker's lib file list.
- In the NT environment, some development tools link odbc32.lib providing the standard ODBC service as a default library to any project. Because the functions in ODBC have similar names and interfaces as the SOLID *Light Client*, the program may be linked to use ODBC instead of *Light Client*. Remove odbc32.lib from the linker's file list.
- On ChorusOS and VxWorks target machines, you should run a kernal that has a working TCP/IP stack running. Usually you can verify this by checking that the target machine responds to ping requests. For example, if you have configured your target machine to have an IP address 192.168.1.111, you would run "ping 192.168.1.111" from another workstation in your LAN for a response that proves the target is alive:

  ```
  C:\>ping 192.168.1.111
  Pinging 192.168.1.111 with 32 bytes of data:
  Reply from 192.168.1.111: bytes=32 time=260ms TTL=62
  ```

  After verification, your *Light Client* application should work on that target machine.

Connecting to a Database using the Sample Application

Establishing a connection to a database using SOLID *Light Client* library is similar to establishing connections using ODBC. An application needs to obtain an environment handle, allocate space for a connection and establish a connection. Run the sample program to check whether it can obtain a connection to a SOLID *Embedded Engine* in your environment.

The following code establishes a connection to a SOLID *Embedded Engine* database running in a machine 192.168.1.111 and listening to tcp/ip at port 1313. User account DBA with password DBA has been defined in the database.

```
HENV henv; /* pointer to environment object        */
HDBC hdbc; /* pointer to database connection object */
```

```
RETCODE rc; /* variable for return code            */

rc = SQLAllocEnv(henv);
if (SQL_SUCCESS != rc)
{
     printf("SQLAllocEnv fails.\n");
     return;
}

rc = SQLAllocConnect(henv,&hdbc);
if (SQL_SUCCESS != rc)
{
     printf("SQLAllocConnect fails.\n");
     return;
}

rc = SQLConnect(hdbc,(UCHAR*)192.168.1.111 1313,SQL_NTS,
(UCHAR*)DBA,SQL_NTS,(UCHAR*)"DBA", SQL_NTS);
if (SQL_SUCCESS != rc)
{
     printf("SQLConnect fails.\n");
     return;
}
```

The connection established above can be cleared using the code below. To make it easier to read no return code checking is included.

```
SQLDisconnect(hdbc);
SQLFreeConnect(hdbc);
SQLFreeEnv(henv);
```

Running SQL Statements on SOLID *Light Client*

This section describes briefly how to do basic database operations with SQL. The following operations are presented here:

- Executing statements through SOLID *Light Client*
- Reading result sets
- Transactions and autocommit mode
- Handling database errors

Executing Statements with SOLID *Light Client*

The code below executes a simple SQL statement `INSERT INTO TESTTABLE (I,C) VALUES (100,'HUNDRED')`. The code expects a valid HENV henv and a valid HDBC hdbc to exist and variable rc of type RETCODE to be defined. The code also expects a table `TESTTABLE` with columns I and C to exist in the database.

```
rc = SQLAllocStmt(hdbc, &hstmt);

if (SQL_SUCCESS != rc)
{
     printf("SQLAllocStmt failed \n");
}
rc = SQLExecDirect(hstmt,(UCHAR*)INSERT INTO TESTTABLE (I,C) VALUES
(100,'HUNDRED'),"SQL_NTS);
if (SQL_SUCCESS != rc)
{
     printf("SQLExecDirect failed \n");
}

rc = SQLTransact(SQL_NULL_HENV,hdbc,SQL_COMMIT);
if ((SQL_SUCCESS != rc))
{
     printf("SQLTransact failed \n");
}

rc = SQLFreeStmt(hstmt,SQL_DROP);
if ((SQL_SUCCESS != rc))
{
     printf("SQLFreeStmt failed \n");
}
```

Statement with parameters

The code example below prepares a simple statement INSERT INTO TESTTABLE (I,C) VALUES (?,?) to be executed several times with different parameter values. Note, that the *Light Client* does not provide ODBC-like parameter binding. Instead, the values for parameters need to be assigned using the SQLSetParamValue function. The following variable definitions are expected:

```
char buf[255];
SDWORD dwPar;
```

As above, the code also expects a valid HENV henv and a valid HDBC hdbc to exist and variable rc of type RETCODE to be defined and a table TESTTABLE with columns I and C to exist in the database.

```
     rc = SQLAllocStmt(hdbc, &hstmt);

     if (SQL_SUCCESS != rc) {
          printf("Alloc statement failed. \n");
     }

     rc = SQLPrepare(hstmt,(UCHAR*)"INSERT INTO TESTTABLE(I,C)
VALUES (?,?)",SQL_NTS);

     if (SQL_SUCCESS != rc) {
         printf("Prepare failed. \n");
     }

     for (i=1;i<100;i++)
     {
         dwPar = i;
         sprintf(buf,"line%i",i);


     rc = m_lc->LC_SQLSetParamValue(
hstmt,1,SQL_C_LONG,SQL_INTEGER,0,0,&dwPar,NULL );
     if (SQL_SUCCESS != rc) {
          printf("(SetParamValue 1 failed) \n");
          return 0;
     }
     rc = m_lc->LC_SQLSetParamValue(
hstmt,2,SQL_C_CHAR,SQL_CHAR,0,0,buf,NULL );
     if (SQL_SUCCESS != rc) {
          printf("(SetParamValue 1 failed) \n");
          return 0;
     }

     rc = m_lc->LC_SQLExecute(hstmt);

     if (SQL_SUCCESS != rc) {
          printf("SQLExecute failed \n");
     }
     }
     rc = SQLFreeStmt(hstmt,SQL_DROP);
     if ((SQL_SUCCESS != rc)) {
          printf("SQLFreeStmt failed. \n");
```

```
    }
```

Reading Result Sets

The following code excerpt prepares an SQL Statement SELECT I,C FROM TESTTABLE, executes it and fetches all the rows the database returns. The example code below expects valid definitions for `rc`, `hdbc`, `hstmt`, `henv`.

```
    rc = SQLAllocStmt(hdbc, &hstmt);

    if (SQL_SUCCESS != rc) {
        printf("SQLAllocStmt failed. \n");
        }

    rc = SQLPrepare(hstmt,(UCHAR*)"SELECT I,C
FROM TESTTABLE",SQL_NTS);

    if (SQL_SUCCESS != rc) {
        printf("SQLPrepare failed. \n");
    }

    rc = SQLExecute(hstmt);

    if (SQL_SUCCESS != rc) {
        printf("SQLExecute failed. \n");
    }

    rc = SQLFetch(hstmt);

if ((SQL_SUCCESS != rc) && (SQL_NO_DATA_FOUND != rc)) {
    printf("SQLFetch returned an unexpected error code . \n");
}

while (SQL_NO_DATA_FOUND != rc)
{
    rc = SQLGetCol(hstmt,1,SQL_C_LONG,&lbuf,sizeof(lbuf),NULL);
    if (SQL_SUCCESS == rc)
    {
        printf("LC_SQLGetCol(1) returns %d \n",lbuf);
       }
       else printf("Error in SQLGetCol(1) \n");
        rc = SQLGetCol(hstmt,2,SQL_C_CHAR,buf,sizeof(buf),NULL);
        if (SQL_SUCCESS == rc)
        {
```

```
            printf("SQLGetCol(2) returns %s \n",buf);
        }
        else printf("Error in SQL_GetCol(2) \n");

        rc = SQLFetch(hstmt);
    }

    rc = m_lc->LC_SQLFreeStmt(hstmt,SQL_DROP);
    if ((SQL_SUCCESS != rc))
    {
        printf("SQLFreeStmt failed. ");
    }
```

Also the following *Light Client* API functions may be useful when processing result sets:

- SQLDescribeCol
- SQLGetCursorName
- SQLNumResultCols
- SQLSetCursorName

Transactions and Autocommit Mode

All SOLID *Light Client* connections have the autocommit option set off. There is no method in *Light Client* to set the option on. Every transaction has to be committed explicitly. This can be achieved by calling the function SQLTransact.

To commit the transaction, call the function as follows

```
rc = SQLTransact(SQL_NULL_HENV,hdbc,SQL_COMMIT);
```

To roll the transaction back, call it as follows.

```
rc = SQLTransact(SQL_NULL_HENV,hdbc,SQL_ROLLBACK);
```

Handling Database Errors

When a *Light Client* API function has returned SQL_ERROR or SQL_SUCCESS_WITH_INFO more information about the error or warning can be obtained by calling the SQLError function. If the following code is run against a database where no table TESTTABLE is defined, it will produce the appropriate error information.

As usual, the code expects a valid HENV henv and a valid HDBC hdbc to exist and variable `rc` of type `RETCODE` to be defined .

```
     rc = SQLPrepare(hstmt,(UCHAR*)"SELECT I,C FROM
TESTTABLE",SQL_NTS);

     if (SQL_SUCCESS != rc)
     {
          char buf[255];
          RETCODE rc;

          char szSQLState[255];
          char szErrorMsg[255];
          SDWORD nativeerror = 0;
          SWORD maxerrmsg = 0;

          memset(szSQLState,0,sizeof(szSQLState));
          memset(szErrorMsg,0,sizeof(szErrorMsg));

          rc = SQLError(
SQL_NULL_HENV,hdbc,hstmt,(UCHAR*)szSQLState,&nativeerror,

(UCHAR*)szErrorMsg,sizeof(szErrorMsg),&maxerrmsg);

          if (SQL_ERROR == rc)
          {
             printf("SQLError failed \n.");
          }
          else
          {
              printf("Error information dump begins:-------------\n");
              printf("SQLState '%s' \n",szSQLState);
              printf("nativeerror %i \n",nativeerror);
              printf("Errormsg '%s' \n", szErrorMsg);
              printf("maxerrmsg %i \n",maxerrmsg);
              printf("Error information dump ends:---------------\n");
         }
}
```

Check *Appendix A* for possible error codes.

Special Notes about SOLID *Embedded Engine* and SOLID *Light Client*

Network Traffic in Fetching Data

SOLID *Light Client* communication does not support SOLID *Embedded Engine's* RowsPerMessage setting. Every *Light Client* call to SQLFetch causes a network message to be sent between client and server. This affects performance when fetching large amounts of data.

Notes for Programmers Familiar with ODBC

Migrating ODBC Applications to using *Light Client API*

If you are using ODBC functions not provided by the *Light Client API*, migrating to SOLID *Light Client* from the standard ODBC database interface requires some programming. Roughly, the migration steps are as follows.

1. Rewiew how your application uses ODBC and estimate whether *Light Client API* functionality is sufficient for you. Some minor changes in your own code are to be expected, basically:
   - Calls to ODBC Extension Level 1 functions should be converted to ODBC Core level functions
   - Rewriting the application without SQLBindParameter and SQLBindCol
2. Download SOLID *Light Client* package.
3. Verify your environment using SOLID *Light Client* samples.
4. Modify the ODBC calls in your own code, rebuild and test your program.

SOLID *Light Client* Functions

This section lists the functions in SOLID *Light Client API*, which is a subset of the ODBC API. Refer to Chapter 5, *"Function Reference"* for a detailed description, parameter list, parameter values, and example, for each of the functions listed in the following table.

NOTE: SOLID *Light Client* does not provide any ODBC Extension Level functionality for setting parameter values (for example, SQLBindParameter) or data binding (for example, SQLBindCol). Instead SOLID *Light Client* provides SAG CLI compliant functions SQLSetParamValue for setting parameter values and SQLGetCol for reading data from result sets. Read the following section, *"Non-ODBC SOLID Light Client Functions"* for descriptions of these functions.

For a complete example program on how to use SOLID *Light Client API*, see SOLID *Light Client* Examples.

Task	Function
Connecting to a data source	SQLAllocEnv
	SQLAllocConnect
	SQLConnect
Preparing SQL Statements	SQLAllocStmt
	SQLPrepare
	SQLSetParamValue
	Note this function is unique to SOLID Client Light. For details on this function, see the section which follows this table.
	SQLSetCursorName
	SQLGetCursorName
Submitting Requests	SQLExecute
	SQLExecDirect
Retrieving Results and Information about Results	SQLRowCount
	SQLNumResultCols
	SQLDescribeCol
	SQLGetCol
	Note that this function is identical to the ODBC compliant function SQLGetData.
	SQLFetch
	SQLGetData
	Note that this function is identical to its SAG CLI counterpart SQLGetCol.
	SQLError
Terminating a Statement	SQLFreeStmt
	SQLTransact

Terminating a Connection	SQLDisconnect
	SQLFreeConnect
	SQLFreeEnv

Non-ODBC SOLID *Light Client* Functions

This sections describes the two non-ODBC functions supported in SOLID *Light Client*:

- SQLGetCol
- SQLSetParamValue

SQLGetCol

SQLGetCol gets result data for a single column in the current row. This function allows the application to retrieve the data one column at a time. It may also be used to retrieve large data values in easily manageable blocks.

SQLGetCol functionality is identical to its ODBC API counterpart SQLGetData. Read "*SQLGetData (ODBC 1.0, Level 1)"* in *Chapter 5, Function Reference*.

Syntax

RETCODE **SQLGetData**(*hstmt, icol, fCType, rgbValue, cbValueMax, pcbValue*)

The **SQLGetData** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*icol*	Input	Column number.
SWORD	fCType	Input	The C data type of the result data. Check the allowed data type conversions at the end of this chapter. This must be one of the following values: SQL_C_BINARY SQL_C_CHAR SQL_C_DOUBLE SQL_C_FLOAT SQL_C_LONG SQL_C_SHORT

PTR	rgbValue	Output	Output data.
SDWORD	cbValueMax	Input	Maximum length of the *rgbValue* buffer. Determines the amount of data that can be received by a single call to SQLGetCol.
SDWORD FAR *	pcbValue	Output	Total number of bytes. If *pcbValue* is is greater than *cbValueMax*, there is no more data to fetch.

Returns

SQL_SUCCESS, SQL_SUCCESS_WITH_INFO, SQL_NO_DATA_FOUND, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

- If more data is available to be retrieved, SQL_SUCCESS_WITH_INFO is returned ('01004' -- Data truncated).
- If the data cannot be converted to the type specified fcType, SQL_ERROR is returned ('07006' -- Restricted data type attribute violation).
- If the communication link failed before the function completed processing, SQL_ERROR is returned ('08S01' -- Communication link failure).
- If the previous SQL statement executed on the hstmt was not a SELECT, SQL_ERROR is returned ('24000' -- Invalid cursor state.)

Comments

SQLFetch must be called before calling SQLGetCol. SQLGetCol can then be used to retrieve data for specific columns, in order. SQLGetCol cannot be used to retrieve a column that resides at or before the last column retrieved with SQLGetCol.

If a call to SQLGetCol does not retrieve all data for the given column, pcbValue is set to the total number of bytes in the result and SQL_SUCCESS_WITH_INFO is returned with the SQLSTATE value '01004' -- Data truncated. SQLGetCol may then be called repeatedly with the same column number until SQLGetCol returns SQL_SUCCESS, or with a different column number to ignore the remainder of the data for the original column.

Code Example

```
rc = SQLPrepare(hstmt,(UCHAR*)
"SELECT I,C FROM TESTTABLE",SQL_NTS);
...
rc = SQLExecute(hstmt);
...
```

```
rc = SQLFetch(hstmt);
if ((SQL_SUCCESS != rc) && (SQL_NO_DATA_FOUND != rc)) {
     printf("SQLFetch returned an unexpected error code . \");
}
while (SQL_NO_DATA_FOUND != rc)
{
     rc = SQLGetCol(hstmt,1,SQL_C_LONG,lbuf,sizeof(lbuf),NULL);
     if (SQL_SUCCESS == rc)
     {
          printf("SQLGetCol(1) returns %d \n",lbuf);
      }
     else printf("Error in SQLGetCol(1) \");

     rc = SQLGetCol(hstmt,2,SQL_C_CHAR,buf,sizeof(buf),NULL);

     if (SQL_SUCCESS == rc)
     {
          printf("SQLGetCol(2) returns %s \",buf);
     }
     else printf("Error in SQL_GetCol(2) \n");

     rc = SQLFetch(hstmt);
}
rc = m_lc->LC_SQLFreeStmt(hstmt,SQL_DROP);
...
```

SQLSetParamValue

Sets the value of a parameter marker in the SQL statement specified in SQLPrepare. Parameter markers are numbered sequentially from left-to-right, starting with one, and may be set in any order. The value of argument rgbValue will be used for the parameter marker when SQLExecute is called.

Syntax

RETCODE **SQLSetParamValue**(*hstmt*, *ipar*, *fCType*, *fSqlType*, *cbColDef*, *ibScale*, *rgbValue*, *pcbValue*)

The **SQLSetParamValue** function accepts the following arguments:

Type	Argument	Use	Description
HSTMT	*hstmt*	Input	Statement handle.
UWORD	*ipar*	Input	Parameter number, ordered squentially left to right, starting at 1.

SWORD	fCType	Input	The C data type of the result data. Check the allowed data type conversions at the end of this chapter. This must be one of the following values: SQL_C_BINARY SQL_C_CHAR SQL_C_DOUBLE SQL_C_FLOAT SQL_C_LONG SQL_C_SHORT
SDWORD	fSqlType	Input	The SQL data type of the parameter. Check the allowed data type conversions following this table. This must be one of the following values: SQL_C_BINARY SQL_C_CHAR SQL_DATE SQL_DECIMAL SQL_C_DOUBLE SQL_C_FLOAT SQL_INTEGER SQL_LONGVARBINARY SQL_LONGVARCHAR SQL_NUMERIC SQL_REAL SQL_SMALLINT SQL_TIME SQL_TIMESTAMP SQL_TINYINT SQL_VARBINARY SQL_VARCHAR

UDWORD	cbColDef	Input	The precision of the column or expression of the corresponding parameter marker.
SWORD	ibScale	Input	The scale of the column or expression of the corresponding parameter marker.
PTR	rgbValue	Input	Output data.
SDWORD *	pcbValue	Input	Length of data in rgbValue

fCType describes the contents of rgbValue. fCType must either be SQL_C_CHAR ot the C equivalent of argument fSqlType. If fCType is SQL_C_CHAR and fSqlType is a numeric type, rgbValue will be converted from a character string to the type specified by fSqlType.

fSqlType is the data type of the column or expression referenced by the parameter marker. At execute time, the value in rgbValue will be read and converted from fCType to fSqlType, and then sent to SOLID Server. Note that the value of rgbValue remains unchanged.

cbColDef is the length or precision of the column definition for the column or expression referenced. cbColDef differs depending on the class of data as follows:

Type	Description
SQL_CHAR SQL_VARCHAR	maximum length of the column
SQL_DECIMAL SQL_NUMERIC	maximum decimal precision (that is, total number of digits possible)

ibScale is the total number of digits to the right of the decimal point for the column referenced. ibScale is defined only for the SQL_DECIMAL and SQL_NUMERIC data types. rgbValue is a character string that must contain the actual data for the parameter marker. The data must be of the form specified by the fCType argument.

pcbValue is an integer that is the length of the parameter marker value in rgbValue. It is only used when fCType is SQL_C_CHAR or when specifying a null database value. The variable must be set to SQL_NULL_DATA if a null value is to be specified for the parameter marker. If the variable is set to SQL_NTS then rgbValue will be treated as a null terminated string.

Returns

SQL_SUCCESS, SQL_ERROR, or SQL_INVALID_HANDLE.

Diagnostics

- If the data identified by the fcType argument cannot be converted to the data value identified by the fSqlType argument, SQL_ERROR is returned ('07006' -- Restricted data type attribute violation)
- If the fcType argument is not valid, SQL_ERROR is returned ('S1003' -- Program type out of range).
- If the fSqlType argument is not valid, SQL_ERROR is returned ('S1004' -- SQL data type out of range).
- If the ipar argument is less than 1, SQL_ERROR is returned ('S1009' -- Invalid argument value).

Comments

All parameters set by this function remain in effect until either SQLFreeStmt is called with the SQL_UNBIND_PARAMS or SQL_DROP option or SQLSetParamValue is called again for the same parameter number. When an SQL statement containing parameters is executed, the set values of the parameters are sent to SOLID *Embedded Engine*.

Note that the number of parameters must match exactly the number of parameter markers present in the statement that was prepared. If less parameter values are set than there were parameter markers in the SQL statement, NULL values will be used instead.

Code Example

The code example below prepares a simple statement INSERT INTO TESTTABLE (I,C) VALUES (?,?) to be executed several times with different parameter values.

```
...
     char buf[255];
     SDWORD dwPar;
...
     rc = SQLPrepare(hstmt,(UCHAR*)"INSERT INTO TESTTABLE(I,C)
VALUES (?,?)",SQL_NTS);
     if (SQL_SUCCESS != rc) {
         printf("Prepare failed. \n");
     }
     for (i=1;i<100;i++)
     {
         dwPar = i;
         sprintf(buf,"line%i",i);
```

```
          rc = m_lc->LC_SQLSetParamValue(
hstmt,1,SQL_C_LONG,SQL_INTEGER,0,0,&dwPar,NULL );
          if (SQL_SUCCESS != rc) {
               printf("(SetParamValue 1 failed) \n");
               return 0;
          }

          rc =
        m_lc->LC_SQLSetParamValue(
hstmt,2,SQL_C_CHAR,SQL_CHAR,0,0,buf,NULL );
          if (SQL_SUCCESS != rc) {
               printf("(SetParamValue 1 failed) \n");
               return 0;> >
         }
```

Related Functions

For information about	See
Preparing a statement for execution	SQLPrepare
Executing a prepared SQL statement	SQLExecute
Executing an SQL statement	SQLExecDirect

SOLID *Light Client* Samples

Sample 1:

```
#include "sample1.h"

/*****************************************************************************
 *
 * File:           SAMPLE1.C
 *
 * Description:    Sample program for SOLID Light Client API
 *
 * Author:         SOLID / ATH
 * Date:           1997-11-18
 *
 *
 * SOLID Light Client sample program does the following.
 *
 * 1. Checks that there are enough input parameters to contain sufficient
 *    connect information
```

```
 * 2. Prepares to connect SOLID Embedded Engine through Light Client by
 * allocating memory for HENV and HDBC objects
 * 3. Connects to SOLID Embedded Engine using Light Client Library
 * 4. Creates a statement for one query,
 *    'SELECT TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM TABLES' for reading
 *    data from one of SOLID Embedded Engine's system tables.
 * 5. Executes the query
 * 6. Fetches and outputs all the rows of a result set.
 * 7. Closes the connection gracefully.
 *
 *
*****************************************************************************/
void __cdecl main(int argc, char *argv[])
{
  HENV henv;      /* pointer to environment object            */
  HDBC hdbc;      /* pointer to database connection object    */
  RETCODE rc;     /* variable for return code                 */
  HSTMT hstmt;    /* pointer to database statement object     */
  char buf[255];  /* buffer for data to be obtained from db   */
  char buf2[255]; /* buffer for a printable row to be created */
  int iCount = 0; /* counter for rows to be fetched.          */


  /* 1. Checks that there are enough input parameters to contain sufficient */
  /*    connect information                                                 */
  if (argc != 4)
  {
    printf("Proper usage \"connect string\" uid pwd \n");
    printf("argc %i \n",argc);
    return;
  }
  printf("Will connect SOLID Embedded Engine at %s with uid %s and pwd
         %s.\n",argv[1],argv[2],argv[3]);


  /* 2. Prepares to connect SOLID Embedded Engine through Light Client by * /
  /* allocating memory for HENV and HDBC objects                          */

  rc = SQLAllocEnv(&henv);
  if (SQL_SUCCESS != rc)
  {
    printf("SQLAllocEnv fails.\n");
    return;
  }
```

```
  rc = SQLAllocConnect(henv,&hdbc);
  if (SQL_SUCCESS != rc)
  {
    printf("SQLAllocConnect fails.\n");
    return;
  }

  /* 3. Connects to SOLID Embedded Engine using Light Client Library */
  rc = SQLConnect(hdbc,(UCHAR*)argv[1],SQL_NTS, (UCHAR*)argv[2],SQL_NTS,
     (UCHAR*)argv[3], SQL_NTS);
  if (SQL_SUCCESS != rc)
  {
    printf("SQLConnect fails.\n");
    return;
  }
  else printf("Connect ok.\n");


  /* 4. Creates a statement for one query,                                */
  /*    'SELECT TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM TABLES' for reading  */
  /*    data from one of SOLID Embedded Engine's system tables.           */

  rc = SQLAllocStmt(hdbc, &hstmt);
  if (SQL_SUCCESS != rc) {
    printf("SQLAllocStmt failed. \n");
   }

  rc = SQLPrepare(hstmt,(UCHAR*)"SELECT TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM
TABLES",SQL_NTS);

  if (SQL_SUCCESS != rc) {
    printf("SQLPrepare failed. \n");
  }
  else printf("SQLPrepare succeeded. \n");


  /* 5. Executes the query                                                */
  rc = SQLExecute(hstmt);
  if (SQL_SUCCESS != rc) {
    printf("SQLExecute failed. \n");
  }
  else printf("SQLExecute succeeded. \n");


  /* 6. Fetches and outputs all the rows of a result set.                 */
```

```
rc = SQLFetch(hstmt);
if ((SQL_SUCCESS != rc) && (SQL_NO_DATA_FOUND != rc)) {
  printf("SQLFetch returned an unexpected error code . \n");
}
else printf("Starting to fetch data.\n");

while (SQL_NO_DATA_FOUND != rc)
{
  iCount++;
  sprintf(buf2,"Row %i :",iCount);

  rc = SQLGetCol(hstmt,1,SQL_C_CHAR,buf,sizeof(buf),NULL);
  if (SQL_SUCCESS == rc)
  {
    strcat(buf2,buf);
    strcat(buf2,",");
  }
  else printf("Error in SQL_GetCol(1) \n");

  rc = SQLGetCol(hstmt,2,SQL_C_CHAR,buf,sizeof(buf),NULL);
  if (SQL_SUCCESS == rc)
  {
    strcat(buf2,buf);
    strcat(buf2,",");
  }
  else printf("Error in SQL_GetCol(2) \n");

  rc = SQLGetCol(hstmt,3,SQL_C_CHAR,buf,sizeof(buf),NULL);
  if (SQL_SUCCESS == rc)
  {
    strcat(buf2,buf);
  }
  else printf("Error in SQL_GetCol(3) \n");

  printf("%s \n",buf2);


  rc = SQLFetch(hstmt);
}

rc = SQLFreeStmt(hstmt,SQL_DROP);
if ((SQL_SUCCESS != rc))
{
  printf("SQLFreeStmt failed. ");
}
```

```
  /* 7. Closes the connection gracefully.                              */
  SQLDisconnect(hdbc);
  SQLFreeConnect(hdbc);
  SQLFreeEnv(henv);

  printf("Sample program ends successfully.\n");

}
```

Sample 2

```
#ifndef SAMPLE1_H
#define SAMPLE1_H

/*****************************************************************************
 *
 * File:           SAMPLE1.H
 *
 * Description:    Sample program for SOLID Light Client API, header file
 *
 * Author:         SOLID / ATH
 * Date:           1997-11-18
 *
 *
 *****************************************************************************
/


#include <stdio.h>
#include <string.h>

#include "cli0lcli.h"

#endif
```

Sample 3

```
C:\solid\lcli\samples>sample1 "fb1 1313" DBA DBA
Will connect SOLID Embedded Engine at fb1 1313 with uid DBA and pwd DBA.
Connect ok.
SQLPrepare succeeded.
SQLExecute succeeded.
Starting to fetch data.
```

```
Row 1 :_SYSTEM,SYS_TABLES,BASE TABLE
Row 2 :_SYSTEM,SYS_COLUMNS,BASE TABLE
Row 3 :_SYSTEM,SYS_USERS,BASE TABLE
Row 4 :_SYSTEM,SYS_UROLE,BASE TABLE
Row 5 :_SYSTEM,SYS_RELAUTH,BASE TABLE
Row 6 :_SYSTEM,SYS_ATTAUTH,BASE TABLE
Row 7 :_SYSTEM,SYS_VIEWS,BASE TABLE
Row 8 :_SYSTEM,SYS_KEYPARTS,BASE TABLE
Row 9 :_SYSTEM,SYS_KEYS,BASE TABLE
Row 10 :_SYSTEM,SYS_CARDINAL,BASE TABLE
Row 11 :_SYSTEM,SYS_INFO,BASE TABLE
Row 12 :_SYSTEM,SYS_SYNONYM,BASE TABLE
Row 13 :_SYSTEM,TABLES,VIEW
Row 14 :_SYSTEM,COLUMNS,VIEW
Row 15 :_SYSTEM,SQL_LANGUAGES,BASE TABLE
Row 16 :_SYSTEM,SERVER_INFO,VIEW
Row 17 :_SYSTEM,SYS_TYPES,BASE TABLE
Row 18 :_SYSTEM,SYS_FORKEYS,BASE TABLE
Row 19 :_SYSTEM,SYS_FORKEYPARTS,BASE TABLE
Row 20 :_SYSTEM,SYS_PROCEDURES,BASE TABLE
Row 21 :_SYSTEM,SYS_TABLEMODES,BASE TABLE
Row 22 :_SYSTEM,SYS_EVENTS,BASE TABLE
Row 23 :_SYSTEM,SYS_SEQUENCES,BASE TABLE
Row 24 :_SYSTEM,SYS_TMP_HOTSTANDBY,BASE TABLE
Sample program ends successfully.
```

SOLID *Light Client* Type Conversion Matrix

The table below describes the type conversions provided by the SOLID *Light Client* functions `SQLGetCol` and `SQLSetParamValue`.

Abbreviations used in the tables for the C variable data types are as follows:

Abbreviation	API parameter definition	C variable data types
Bin	SQL_C_BINARY	voidd*
Char	SQL_C_CHAR	char[], char*
Long	SQL_C_LONG	long int (*), 32 bits
Short	SQL_C_SHORT	short int (*), 16 bits
Float	SQL_C_FLOAT	float (*)
Double	SQL_C_DOUBLE	double (*)

(*) Note that when variables of these data types are used as parameters in *Light Client* functions calls, actually the pointer to the variable must be passed instead.

For a description of the SQL data types please refer to *Appendix C, Data Types* of the **SOLID Administrator Guide**.

Functions SQLGetCol and SQLGetData perform the following data type conversions between database colum types and C variable data types:

SQL data type \ C variable data type	Bin	Char	Long	Short	Float	Double
TINYINT	*	*	*	*	*	*
LONG VARBINARY	*	*				
VARBINARY	*	*				
BINARY	*	*				
LONG VARCHAR	*	*				
CHAR	*	*				
NUMERIC		*	*	*	*	*
DECIMAL		*	*	*	*	*
INTEGER	*	*	*	*	*	*
SMALLINT	*	*	*	*	*	*
FLOAT	*	*	*	*	*	*
REAL	*	*	*	*	*	*
DOUBLE	*	*	*	*	*	*
DATE		*				
TIME		*				
TIMESTAMP		*				
VARCHAR	*	*				

Function SQLSetParamValue provides the following type conversions between C data types and the database column types.

SQL data type \ C variable data type	Bin	Char	Long	Short	Float	Double
TINYINT		*	*	*		
LONG VARBINARY	*					

VARBINARY	*					
BINARY	*					
LONG VARCHAR		*				
CHAR		*				
NUMERIC		*	*	*	*	*
DECIMAL		*	*	*	*	*
INTEGER		*	*	*		
SMALLINT		*	*	*		
FLOAT		*	*	*	*	*
REAL		*	*	*	*	*
DOUBLE		*	*	*	*	*
DATE		*				
TIME		*				
TIMESTAMP		*				
VARCHAR		*				

7

Using the SOLID *JDBC Driver*

This chapter describes how to use the SOLID *JDBC Driver*, a 100% Pure Java™ implementation of the Java Database Connectivity (JDBC™) standard. The chapter covers the following information:

- What is SOLID *JDBC Driver*?
- Getting started with SOLID *JDBC Driver*
- Running SQL Statement with SOLID *JDBC Driver*
- Connecting SOLID *Embedded Engine* through JDBC
- SOLID *JDBC Driver* Classes and Methods
- Sample code

What is SOLID *JDBC Driver*?

The JDBC API, JavaSoft's core API for JDK 1.1, defines Java classes to represent database connections, SQL statements, result sets, database metadata, etc. It allows a Java programmer to issue SQL statements and process the results. JDBC is the primary API for database access in Java.

JDBC drivers can either be entirely written in Java so that they can be downloaded as part of an applet, or they can be implemented using native methods to bridge to existing database access libraries. SOLID *JDBC Driver* provides Java developers with native database access to SOLID *Embedded Engine*. SOLID *JDBC Driver* is written entirely in Java and communicates to a SOLID database server through SOLID *Embedded Engine's* native network protocol.

SOLID *JDBC Driver* can be downloaded quickly (with a compact bytecode of 49 KB), enabling efficient SOLID database use in thin-client Java applications. It offers JDBC standard compliance and is 100% pure Java certified. It is usable in all Java environments supporting JDK 1.1.

Getting started with SOLID *JDBC Driver*

To get started with SOLID *JDBC Driver*, be sure you have:

1. Installed the *JDBC Driver* and verified the installation. For details, follow the instructions on the SOLID *JDBC Driver* Web site.
2. Set up the development environment so that it support JDBC properly. SOLID *JDBC Driver* expects support for JDBC version 1.20. The JDBC interface is included in the `java.sql` package. To import this package, be sure to include the following line in the application program:

```
import java.sql.*;
```

Registering SOLID *JDBC Driver*

The JDBC driver manager, which is written entirely in Java, handles loading and unloading drivers and interfacing connection requests with the appropriate driver. It was JavaSoft's intention to make the use of a specific JDBC driver as transparent as possible to the programmer and user. The driver can be registered with the three alternative ways, which are shown below. The parameter required byClass.forName and Properties.put functions is the name of the driver, which is solid.jdbc.SolidDriver.

```
// registration using Class.forName service
Driver)Class.forName("solid.jdbc.SolidDriver")
// a workaround to a bug in some JDK1.1
implementations
Driver d =
(Driver)Class.forName("solid.jdbc.SolidDriver").newInstance();

// Registration using system properties
variable also
Properties p = System.getProperties();
p.put("jdbc.drivers","solid.jdbc.SolidDriver");
System.setProperties(p);
```

See source code for example application sample1.

Connecting to the Database

Once the driver is successfully registered with the driver manager a connection is established by creating a Java Connection object with the following code. The parameter required by the DriverManager.getConnection function is the JDBC connection string.

```
Connection conn = null;
try {
```

```
     conn =  DriverManager.getConnection(sCon);
}
catch (Exception e) {
     System.out.println("Connect failed : " +
e.getMessage());
     throw new Exception("Halted.");
}
```

The connect string structure is jdbc:solid://<machine> name>:<port>/<user name>/<password>. The string "jdbc:solid://fb9:1314/dba/dba" attempts to connect a SOLID server in machine fb9 listening tcp/ip protocol at port 1314.

The application can establish several Connection objects to database. Connections can be closed be the following code.

```
conn.close();
```

See source code for example application sample1.

Running SQL Statements With JDBC

This section describes briefly how to do basic database operations with the SQL. The following operations are presented here:

- Executing statements through JDBC
- Reading result sets
- Transactions and autocommit mode
- Handling database errors
- Using DatabaseMetadata

For more detailed description on these subjects see JDBC and SOLID documentation.

Executing a Simple Statement

The following code expects that a *Connection* object *conn* is established before calling the code.

```
stmt= conn.createStatement();
stmt.execute("INSERT INTO JDB_TEST (I1,I2)
VALUES (2,3)");
```

Note that the insert is not committed by the code unless the database is in autocommit mode.

See source code for example application sample1.

Statement with Parameters

The code below creates a `PreparedStatement object` for a query, assigns values for its parameters and executes the query. Check the available methods for setting values to different column types from JDBC Type Conversion Matrix. The code expects a `Connection` object `conn` to be established.

```
PreparedStatement pstmt;
int count, cnt;
int i;

sQuery = "INSERT INTO ALLTYPES
(TI,SI,II,RR,FF,DP,DE,NU,CH,VC,DT,TM,TS) VALUES";
sQuery = sQuery + "(?,?,?,?,?,?,?,?,?,?,?,?,?)";

pstmt= conn.prepareStatement(sQuery);
pstmt.setInt(1,101);
pstmt.setInt(2,102);
pstmt.setInt(3,103);
pstmt.setDouble(4,2104.56);
pstmt.setDouble(5,104.56);
pstmt.setDouble(6,3104.56);
pstmt.setDouble(7,204.56);
pstmt.setDouble(8,304.56);
pstmt.setString(9,"cccc");
pstmt.setString(10,"longer string");

java.sql.Time pTime = new
java.sql.Time(11,11,11);
java.sql.Date pDate = new java.sql.Date(96,1,2);

java.sql.Timestamp pTimestamp = new
java.sql.Timestamp(96,1,2,11,11,11,0);
pstmt.setDate(11,pDate);
pstmt.setTime(12,pTime);
pstmt.setTimestamp(13,pTimestamp);

pstmt.executeUpdate();
```

See source code for example application sample3.

Note that the insert is not committed by the code unless the database is in autocommit mode.

Reading result sets

The code below obtains a result set for the SQL

```
SELECT TABLE_CATALOG,TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM
SYS_TABLES WHERE ID < 10000
```

and prints out column name and type information for each column in the result set using the `ResultSetMetaData` object. Then the code loops through the result set and prints the data in each column in each row by using `getString` method. Check the available methods for accessing data of different column types from JDBC Type Conversion Matrix. The code expects a `Connection` object `conn` to be established.

```
String sQuery;

ResultSetMetaData meta;
Statement stmt;
ResultSet result;
int count, cnt;
int i;

// the query to be executed
sQuery = "SELECT
TABLE_CATALOG,TABLE_SCHEMA,TABLE_NAME," ;
sQuery = sQuery + "TABLE_TYPE FROM
SYS_TABLES WHERE ID < 10000";

// we create statement for the query
stmt= conn.createStatement();
// execute it and obtain a result set
result = stmt.executeQuery(sQuery);

// to see what we got we obtain a
ResultSetMetaData object meta = result.getMetaData();
// check the number of columns
count = meta.getColumnCount();

// print some information about the columns
for (i=1; i &lt;= count; i++)
{
     String sName = meta.getColumnName(i);
     int iType = meta.getColumnType(i);
     String sTypeName = meta.getColumnTypeName(i);

     System.out.println("Col:"+i+" "+sName+ "," + iType + "," +
```

```
sTypeName);
}

// and finally, loop through the ResultSet and
print the data out
int cnt = 1;
while(result.next())
{
     for (i=1; i &lt;= count; i++)
     {
       System.out.println("Row:"+cnt+ " column:" +i+"
: "+result.getString(i));
     }
     cnt++;
}
```

Note1: There is no JDBC method to step backwards in ResultSets. There is next() but no prev(). The primary reason is because many databases do not support bi-directional cursors. Many database servers only support stepping through the result set in a single direction and therefore prev() has been left out of the standard. Many have argued, though, that a well-written object oriented program should not need to step backwards through a ResultSet, and that doing so may be either inefficient or result in unreliable data results.

Note2: It is possible to improve the performance of reading large result sets by instructing SOLID *Embedded Engine* to return several rows of the result set in one network message. This functionality is activated by editing configuration `RowsPerMessage` in section [Srv] in SOLID *Embedded Engine* configuration file *solid.ini*. The default value is 10. This is new functionality in JDBC Driver 2.3. In prior versions, the rows of the result set were always returned one by one.

See source code for example application sample1.

Transactions and Autocommit Mode

A SOLID database can be in either autocommit or non-autocommit mode. When not in autocommit mode each transaction needs to be explicitly committed before the modifications it made can be seen to other database connections. The autocommit state can be monitored by `Connection.getAutoCommit()` function. The state can be set by `Connection.setAutoCommit()`. If autocommit mode is off the transactions can be committed by two ways. SOLID *Embedded Engine's* default setting for autocommit state is `true`.

- using Connection.commit() function or
- executing a statement for SQL 'COMMIT WORK'

Handling Database Errors

In some cases it is necessary for the application to recover from a database error. For example, a unique key constraint violation can be recovered by assigning the row a different key. The code below expects a `Statement` object stmt to exist and `String sQuery` to contain SQL that may cause an error. A database native error code will be assigned to variable `ec`. See SOLID *Embedded Engine* documentation for SOLID *Embedded Engine* native error codes.

```
try {
     result = stmt.executeQuery(sQuery);

}
catch (SQLException e) {
     int ec = e.getErrorCode();
     String ss = e.getSQLState();
     String s2 = e.toString();
     System.out.println("Native error code:" + ec);
}
```

Using DatabaseMetadata

Class `DatabaseMetadData` contains information about the database behind the connection. Usually this information is necessary for application development tools not actual applications. If you are developing an application on JDBC interface for one kind of database engine this is seldom if ever necessary. If you are developing an application to run on several database engines the application can obtain necessary information about the database through `DatabaseMetadData`.

A `DatabaseMetaData` object can be obtained from the `Connection` object by the code below. The code also extracts database product name to string sName and all the views in the database to `ResultSet rTables`. As usual, the code expects that a `Connection` object `conn` is established before calling it.

```
DatabaseMetaData meta;

String sName;
ResultSet rTables;

String types[] = new String[1];
types[0] = "VIEW";

meta = conn.getMetaData();
sName = meta.getDatabaseProductName();
rTables =
```

```
meta.getTables(null,"","",types);
```

Special Notes About SOLID and JDBC

JDBC does not really specify what SQL you can use, it simply passes the SQL on to the driver and lets the driver either pass it on directly to the database, or parse the SQL itself. Because of this of the SOLID *JDBC Driver* behavior is particular to SOLID database. In some functions the JDBC specification leaves some details open. Check *SOLID JDBC Driver* Classes and Methods for the details particular to SOLID implementation of the methods.

Executing stored procedures

In SOLID *Embedded Engine* database stored procedures can be called by executing statements 'CALL proc_name [parameter ...] ' just like any other SQL. Procedures are thus used in JDBC in the same way as any statement. Note, that SOLID stored procedures can return result sets. Calling procedures through JDBC CallableStatement class is not necessary. See source code for example application sample3 on calling SOLID *Embedded Engine* procedures on JDBC.

Class CallableStatement

A JDBC `CallableStatement` class is intended to support calling database stored procedures. The class is not necessary when writing applications on SOLID *Embedded Engine* only. Portability reasons, for instance, can make using `CallableStatement` a good decision. The example below illustrates running a simple SQL using this class.

```
CallableStatement csta;
int i1,i2;
String s1;
ResultSet res;

// creating a CallableStatement object
csta = conn.prepareCall("select * from
keytest where i1 = ?");

// assigning a value for parameter
csta.setInt(1,1);

// obtaining a result set
res = csta.executeQuery();

while (res.next())
{
```

```
        i1 = csta.getInt(1);
        i2 = csta.getInt(2);
        s1 = csta.getString(3);
        System.out.println("Row contains " + i1 + "," + i2 +
"," + s1);
}
```

JDBC Driver Classes and Methods

This section lists the Java classes contained by the SOLID *JDBC Driver* and their methods. JDBC is a standard interface provided by JavaSoft. JavaSoft provides the official documentation of JDBC interface classes and methods at their Web site.

SOLID *JDBC Driver* conforms to the JDBC standard and thus SOLID will neither repeat nor maintain the JDBC interface documentation. Instead, this section lists all behavior specific to SOLID *JDBC Driver* and SOLID *Embedded Engine*.

For a description of how different data types are supported by SOLID *JDBC Driver*, see the JDBC Driver Type Conversion Matrix at the end of this chapter.

SolidCallableStatement

A JDBC `CallableStatement` class is intended to support calling database stored procedures. SOLID Embedded Engine procedures are thus used in JDBC in the same way as anystatement and the class `CallableStatement` is not necessary when writing applications on SOLID Embedded Engine only. Portability reasons, for instance, can make using `CallableStatement` a good decision.

Method name	Notes
getBigDecimal(int, int)	Works as specified by Java Soft
getBoolean(int)	Works as specified by Java Soft
getByte(int)	Works as specified by Java Soft
getBytes(int)	Works as specified by Java Soft
getDate(int)	Works as specified by Java Soft
getDouble(int)	Works as specified by Java Soft
getFloat(int)	Works as specified by Java Soft
getInt(int)	Works as specified by Java Soft

getLong(int)	Works as specified by Java Soft
getObject(int)	Works as specified by Java Soft
getShort(int)	Works as specified by Java Soft
getString(int)	Works as specified by Java Soft
getTime(int)	Works as specified by Java Soft
getTimestamp(int)	Works as specified by Java Soft
registerOutParameter(int, int)	Works as specified by Java Soft
registerOutParameter(int, int, int)	Works as specified by Java Soft
wasNull()	Works as specified by Java Soft

SolidConnection

Method name	Notes
clearWawrnings()	Works as specified by Java Soft
close()	Works as specified by Java Soft. Note that connections should be explicitly closed when not used anymore.
commit()	Works as specified by Java Soft
createstatement()	Works as specified by Java Soft
getAutoCommit()	Works as specified by Java Soft
getCatalog()	Works as specified by Java Soft
getMetaData()	Works as specified by Java Soft
getTransactionIsolation()	Works as specified by Java Soft
getWarnings()	Works as specified by Java Soft
isClosed()	Works as specified by Java Soft
isReadOnly()	SOLID Embedded only supports read-only database and read-only transactions, not read-only connections. This method always returns false.

nativeSQL(String)	Works as specified by Java Soft. SOLID JDBC Driver does not change the SQL passed to SOLID Embedded Engine.
prepareCall(String)	Works as specified by JavaSoft. Note that the escape call syntax is not supported.
prepareStatement(String)	Works as specified by Java Soft
rollback()	Works as specified by Java Soft
setAutoCommit(boolean)	Works as specified by Java Soft
setCatalog(String)	No operation
setReadOnly(boolean)	SOLID Embedded Engine only supports read-only database and read-only connections. This method exists but does not affect the connection behavior.
setTransactionIsolation(int)	Works as specified by JavaSoft

SolidConnection

Method name	Notes
clearWarnings()	Works as specified by Java Soft
close()	Works as specified by Java Soft. Note that connections should be explicitly closed when not used anymore.
commit()	Works as specified by Java Soft
createstatement()	Works as specified by Java Soft
getAutoCommit()	Works as specified by Java Soft
getCatalog()	Works as specified by Java Soft
getMetaData()	Works as specified by Java Soft
getTransactionIsolation()	Works as specified by Java Soft
getWarnings()	Works as specified by Java Soft
isClosed()	Works as specified by Java Soft
isReadOnly()	SOLID Embedded only supports read-only database and read-only transactions, not read-only connections. This method always returns false.
nativeSQL(String)	Works as specified by Java Soft. SOLID JDBC Driver does not change the SQL passed to SOLID Embedded Engine.
prepareCall(String)	Works as specified by JavaSoft. Note that the escape call syntax is not supported.
prepareStatement(String)	Works as specified by Java Soft
rollback()	Works as specified by Java Soft
setAutoCommit(boolean)	Works as specified by Java Soft
setCatalog(String)	No operation
setReadOnly(boolean)	SOLID Embedded Engine only supports read-only database and read-only connections. This method exists but does not affect the connection behavior.
setTransactionIsolation(int)	Works as specified by JavaSoft

SolidDatabaseMetaData

Method name	Notes
allProceduresAreCallable()	Works as specified by Java Soft
allTablesAreSelectable()	Works as specified by Java Soft
dataDefinitionCausesTransactionCommit()	Works as specified by Java Soft
dataDefinitionIgnoredInTransactions()	Works as specified by Java Soft
doesMaxRowSizeIncludeBlobs()	Works as specified by JavaSoft (returns false)
getBestRowIdentifier(String, String, String, int, boolean)	Throws SQL state 'IM001'
getCatalogs()	Throws SQL state 'IM001'. SOLID Embedded Engine does not support catalogs
getCatalogSeparator()	Works as specified by JavaSoft
getCatalogTerm()	Works as specified by JavaSoft
getColumnPrivileges(String, String, String, String)	Throws SQL state 'IM001'
getCrossReference(String, String, String, String, String, String)	Throws SQL state 'IM001'
getDatabaseProductName()	Works as specified by JavaSoft
getDatabaseProductVersion()	Works as specified by JavaSoft
getDefaultTransactionIsolation()	Works as specified by JavaSoft
getDriverMajorVersion()	Works as specified by JavaSoft
getDriverMinorVersion()	Works as specified by JavaSoft
getDriverName()	Works as specified by JavaSoft
getDriverVersion()	Works as specified by JavaSoft
getExportedKeys(String, String, String)	Throws SQL state 'IM001'
getExtraNameCharacters()	Works as specified by JavaSoft
getIdentifierQuoteString()	Works as specified by JavaSoft
getImportedKeys(String, String, String)	Throws SQL state 'IM001'

getIndexInfo(String, String, String, boolean, boolean)	Throws SQL state 'IM001'
getMaxBinaryLiteralLength()	Works as specified by JavaSoft
getMaxCatalogNameLength()	Works as specified by JavaSoft
getMaxCharLiteralLength()	Works as specified by JavaSoft
getMaxColumnNameLength()	Works as specified by JavaSoft
getMaxColumnsInGroupBy()	Works as specified by JavaSoft
getMaxColumnsInIndex()	Works as specified by JavaSoft
getMaxColumnsInOrderBy()	Works as specified by JavaSoft
getMaxColumnsInSelect()	Works as specified by JavaSoft
getMaxColumnsInTable()	Works as specified by JavaSoft
getMaxConnections()	Works as specified by JavaSoft
getMaxCursorNameLength()	Works as specified by JavaSoft
getMaxIndexLength()	Works as specified by JavaSoft
getMaxProcedureNameLength()	Works as specified by JavaSoft
getMaxRowSize()	Works as specified by JavaSoft
getMaxSchemaNameLength()	Works as specified by JavaSoft
getMaxStatementLength()	Works as specified by JavaSoft
getMaxStatements()	Works as specified by JavaSoft
getMaxTableNameLength()	Works as specified by JavaSoft
getMaxTablesInSelect()	Works as specified by JavaSoft
getMaxUserNameLength()	Works as specified by JavaSoft
getNumericFunctions()	Works as specified by JavaSoft
getPrimaryKeys(String, String, String)	Works as specified by JavaSoft
getProcedureColumns(String, String, String, String	Throws SQL state 'IM001'
getProcedures(String, String, String)	Works as specified by JavaSoft
getProcedureTerm()	Works as specified by JavaSoft
getSchemas()	Throws SQL state 'IM001'
getSchemaTerm()	Works as specified by JavaSoft

getSearchStringEscape()	Works as specified by JavaSoft
getSQLKeywords()	Works as specified by JavaSoft
getStringFunctions()	Works as specified by JavaSoft
getSystemFunctions()	Works as specified by JavaSoft
getTablePrivileges(String, String, String)	Works as specified by JavaSoft
getTables(String, String, STring, STring[])	Works as specified by JavaSoft
getTableTypes()	Works as specified by JavaSoft
getTimeDateFunctions()	Works as specified by JavaSoft
getTypeInfo()	Works as specified by JavaSoft
getURL()	Works as specified by JavaSoft
getUserName()	Works as specified by JavaSoft
getVersionColumns(String, String, String)	Works as specified by JavaSoft
isCatalogAtStart()	Works as specified by JavaSoft
isReadOnly()	Will always return false regardless of the status of server
nullPlusNonNullIsNull()	Works as specified by JavaSoft
nullsAreSortedAtEnd()	Works as specified by JavaSoft
nullsAreSortedAtStart()	Works as specified by JavaSoft
nullsAreSortedHigh()	Works as specified by JavaSoft
nullsAreSortedLow()	Works as specified by JavaSoft
storesLowerCaseIdentifiers()	Works as specified by JavaSoft
storesLowerCaseQuotedIdentifiers()	Works as specified by JavaSoft
storesMixedCaseIdentifiers()	Works as specified by JavaSoft
storesMixedCaseQuotedIdentifiers()	Works as specified by JavaSoft
storesUpperCaseIdentifiers	Works as specified by JavaSoft
storesUpperCaseQuotedIdentifiers()	Works as specified by JavaSoft
supportsAlterTableWithAddColumn()	Works as specified by JavaSoft
supportAlterTableWithDropColumn()	Works as specified by JavaSoft
supportsANSI92EntryLevelSQL()	Works as specified by JavaSoft

supportsANSI92FullSQL()	Works as specified by JavaSoft
supportsANSI92IntermediateSQL()	Works as specified by JavaSoft
supportsCatalogsInDataManipulation()	Works as specified by JavaSoft
supportsCatalogsInIndexDefinitions()	Works as specified by JavaSoft
supportsCatalogsInPrivilegeDefinitions()	Works as specified by JavaSoft
supportsCatalogsInProcedureCalls()	Works as specified by JavaSoft
supportssCatalogsInTableDefinitions()	Works as specified by JavaSoft
supportsColumnAliasing()	Works as specified by JavaSoft
supportsConvert()	Always returns true.
supportsConvert(int, int)	Always returns false.
supportsCoreSQLGrammar()	Works as specified by JavaSoft
supportsCorrelatedSubqueries()	Works as specified by JavaSoft
supportsDataDefinitionAndData-ManipulationTransactions()	Works as specified by JavaSoft
supportsDifferentTableCorrelationNames()	Works as specified by JavaSoft
supportsExpressionsInOrderBy()	Works as specified by JavaSoft
supportsExtendedSQLGrammar()	Works as specified by JavaSoft
supportsFullOuterJoins()	Works as specified by JavaSoft
supportsGroupBy()	Works as specified by JavaSoft
supportsGroupByBeyondSelect()	Works as specified by JavaSoft
supportsGroupByUnrelated()	Works as specified by JavaSoft
supportsIntegrityEnhancementFacility()	Works as specified by JavaSoft
supportsLikeEscapeClause()	Works as specified by JavaSoft
supportsLimitedOuterJoins()	Works as specified by JavaSoft
supportsMinimumSQLGrammar()	Works as specified by JavaSoft
supportsMixedCaseIdentifiers()	Works as specified by JavaSoft
supportsMixedCaseQuotedIdentifiers()	Works as specified by JavaSoft
supportsMultipleResultSets()	Works as specified by JavaSoft
supportsMultipleTransactions()	Works as specified by JavaSoft

supportsNonNullableColumns()	Works as specified by JavaSoft
supportsOpenCursorsAcrossCommit()	Works as specified by JavaSoft
supportsOpenCursorsAcrossRollback()	Works as specified by JavaSoft
supportsOpenStatementsAcrossCommit()	Works as specified by JavaSoft
supportsOpenStatementsAcrossRollback()	Works as specified by JavaSoft
supportsOrderByUnrelated	Works as specified by JavaSoft
supportsOuterJoins()	Works as specified by JavaSoft
supportsPositionedDelete()	Works as specified by JavaSoft
supportsPositionedUpdate()	Works as specified by JavaSoft
supportsSchemasInDataManipulation()	Works as specified by JavaSoft
supportsSchemasInIndexDefinitions()	Works as specified by JavaSoft
supportsSchemasInPrivilegeDefinitions()	Works as specified by JavaSoft
supportsSchemasInProcedureCalls()	Works as specified by JavaSoft
supportsSchemasInTableDefinitions()	Works as specified by JavaSoft
supportsSelectForUpdate()	Works as specified by JavaSoft
supportsStoredProcedures()	Works as specified by JavaSoft
supportsSubqueriesInComparisons()	Works as specified by JavaSoft
supportsSubqueriesInExists()	Works as specified by JavaSoft
supportsSubqueriesInIns()	Works as specified by JavaSoft
supportsSubqueriesInQuantifieds()	Works as specified by JavaSoft
supportsTableCorrelationNames()	Works as specified by JavaSoft
supportsTransactionIsolationLevel(int)	Works as specified by JavaSoft
supportsTransactions()	Works as specified by JavaSoft
supportsUnion()	Works as specified by JavaSoft
supportsUnionAll()	Works as specified by JavaSoft
usesLocalFilePerTable()	Works as specified by JavaSoft
usesLocalFiles()	Works as specified by JavaSoft

SolidDriver

Method name	Notes
acceptsURL(String)	Works as specified by Java Soft
connect(String, Properties)	Always to be called through Driver Manager
getMajorVersion()	Works as specified by Java Soft
getMinorVersion()	Works as specified by Java Soft
getPropertyInfo(String, Properties)	Works as specified by Java Soft
jdbcCompliant()	Works as specified by Java Soft
clearParameters()	Works as specified by Java Soft
execute()	Works as specified by Java Soft
executeQuery()	Works as specified by Java Soft
executeUpdate()	Works as specified by Java Soft
setAsciiStream(int, InputStream, int)	Works as specified by Java Soft
setBigDecimal(int, BigDecimal)	Works as specified by Java Soft
setBinaryStream(int, InputStream, int)	Works as specified by Java Soft
setBoolean(int, boolean)	Works as specified by Java Soft
setByte(int, byte)	Works as specified by JavaSoft
setBytes(int, byte[])	Works as specified by JavaSoft
setDate(int, Date)	Works as specified by JavaSoft
setDouble(int, double)	Works as specified by JavaSoft
setFloat(int, float)	Works as specified by JavaSoft
setInt(int, int)	Works as specified by JavaSoft
setLong(int, long)	Works as specified by JavaSoft
setNull(int, int)	Works as specified by JavaSoft
setObject(int, Object)	Works as specified by JavaSoft
setObject(int, Object, int)	Works as specified by JavaSoft
setObject(int, Object, int, int)	Works as specified by JavaSoft

setShort(int, short)	Works as specified by JavaSoft
setString(int, String)	Works as specified by JavaSoft
setTime(int, Time)	Works as specified by JavaSoft
setTimestamp(int, Timestamp)	Works as specified by JavaSoft
setUnicodeStream(int, InputStream, int)	Unicode attributes not supported by SOLID Embedded Engine.

SolidResultSet

Method name	Notes
clearWarnings()	Works as specified by JavaSoft
close()	Works as specified by JavaSoft
findColumn(String)	Works as specified by JavaSoft
getAsciiStream(int)	Works as specified by JavaSoft
getAsciiStream(String)	Works as specified by JavaSoft
getBigDecimal(int, int)	Works as specified by JavaSoft
getBigDecimal(String, int)	Works as specified by JavaSoft
getBinaryStream(int)	Works as specified by JavaSoft
getBinaryStrem(String)	Works as specified by JavaSoft
getBoolean(int)	Works as specified by JavaSoft
getBoolean(String)	Works as specified by JavaSoft
getByte(int)	Works as specified by JavaSoft
getByte(String)	Works as specified by JavaSoft
getBytes(int)	Works as specified by JavaSoft
getBytes(String)	Works as specified by JavaSoft
getCursorName()	Works as specified by JavaSoft
getDate(int)	Works as specified by JavaSoft
getDate(String)	Works as specified by JavaSoft
getDouble(int)	Works as specified by JavaSoft

getDouble(String)	Works as specified by JavaSoft
getFloat(int)	Works as specified by JavaSoft
getFloat(String)	Works as specified by JavaSoft
getInt(int)	Works as specified by JavaSoft
getInt(String)	Works as specified by JavaSoft
getLong(int)	Works as specified by JavaSoft
getLong(String)	Works as specified by JavaSoft
getMetaData()	Works as specified by JavaSoft
getObject(int)	Works as specified by JavaSoft
getObject(String)	Works as specified by JavaSoft
getShort(int)	Works as specified by JavaSoft
getShort(String)	Works as specified by JavaSoft
getString(int)	Works as specified by JavaSoft
getString(String)	Works as specified by JavaSoft
getTime(int)	Works as specified by JavaSoft
getTime(String)	Works as specified by JavaSoft
getTimestamp(int)	Works as specified by JavaSoft
getTimestamp(String)	Works as specified by JavaSoft
getUnicodeStream(int)	Unicode attributes not supported by SOLID Embedded Engine.
getUnicodeStream(String)	Unicode attributes not supported by SOLID Embedded Engine.
getWarnings()	Works as specified by JavaSoft
next()	Works as specified by JavaSoft
wasNull()	Works as specified by JavaSoft

SolidResultSetMetaData

Method name	Notes
getCatalogName(int)	Works as specified by JavaSoft

getColumnCount()	Works as specified by JavaSoft
getColumnDisplaySize(int)	Works as specified by JavaSoft
getColumnLabel(int)	Works as specified by JavaSoft
getColumnName(int)	Works as specified by JavaSoft
getColumnType(int)	Works as specified by JavaSoft
getColumnTypeName(int)	Works as specified by JavaSoft
getPrecision(int)	Works as specified by JavaSoft
getScale(int)	Works as specified by JavaSoft
getSchemaName(int)	Works as specified by JavaSoft
getTableName(int)	Works as specified by JavaSoft
isAutoIncrement(int)	Works as specified by JavaSoft
isCaseSensitive(int)	Works as specified by JavaSoft
isCurrency(int)	Works as specified by JavaSoft
isDefinitelyWritable(int)	Works as specified by JavaSoft
isNullable(int)	Works as specified by JavaSoft
isReadOnly(int)	Works as specified by JavaSoft
isSearchable(int)	Works as specified by JavaSoft
isSigned(int)	Works as specified by JavaSoft
isWritable(int)	Works as specified by JavaSoft

SolidStatement

Method name	Notes
cancel()	No operation in SOLID JDBC Driver
clearWarnings()	Works as specified by JavaSoft
close()	Works as specified by JavaSoft
execute(String)	Works as specified by JavaSoft
executeQuery(String)	Works as specified by JavaSoft
executeUpdate(String)	Works as specified by JavaSoft

getMaxFieldSize()	Maxfield size does not affect SOLID server behavior
getMaxRows()	Works as specified by JavaSoft
getMoreResults()	Works as specified by JavaSoft
getQueryTimeout()	Works as specified by JavaSoft
getResultSet()	Works as specified by JavaSoft
getUpdateCount()	Works as specified by JavaSoft
getWarnings()	Works as specified by JavaSoft
setCursorName(String)	Works as specified by JavaSoft
setEscapeProcessing(boolean)	Works as specified by JavaSoft
setMaxFieldSize(int)	Maxfield size does not affect SOLID server behavior
setMaxRows(int)	Works as specified by JavaSoft
setQueryTimeout(int)	No operation.

Code Examples

Sample 1:

```
/**
 *      sample1 JDBC sample application
 *
 *      Sep 24 1997 JP
 *
 *      This simple JDBC application does the following using
 *      SOLID native JDBC driver.
 *
 *  1. Registers the driver using JDBC driver manager services
 *  2. Prompts the user for a valid JDBC connect string
 *  3. Connects to SOLID Embedded Engine using the driver
 *  4. Creates a statement for one query,
 *     'SELECT TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM TABLES'
 *     for reading data from one of SOLID Embedded Engine's system tables.
 *  5. Executes the query
 *  6. Fetches and dumps all the rows of a result set.
 *  7. Closes connection
 *
 *  To build and run the application
```

```
 *
 *  1. Make sure you have a working Java Development environment
 *  2. Install and start Solid Embedded Engine to connect. Ensure that the
 *     server is up and running.
 *  3. Append SolidDriver.zip into the CLASSPATH definition used
 *     by your development/running environment.
 *  4. Create a java project based on the file sample1.java.
 *  5. Build and run the application.
 *
 *  For more information read the readme.htm file contained by
 *  SOLID JDBC Driver package.
 *
 */

import java.io.*;

public class sample1 {

    public static void main (String args[]) throws Exception
    {
        java.sql.Connection conn;
        java.sql.ResultSetMetaData meta;
        java.sql.Statement stmt;
        java.sql.ResultSet result;
        int i;

        System.out.println("JDBC sample application starts...");
        System.out.println("Application tries to register the driver.");

        // this is the recommended way for registering Drivers
        java.sql.Driver d =
(java.sql.Driver)Class.forName("solid.jdbc.SolidDriver").newInstance();

        System.out.println("Driver succesfully registered.");

        // the user is asked for a connect string
        System.out.println("Now sample application needs a connectstring in
format:\n");
        System.out.println("jdbc:solid://<host>:<port>/<user name>/
<password>\n");
        System.out.print("\nPlease enter the connect string >");
        BufferedReader reader = new BufferedReader(new
InputStreamReader(System.in));
        String sCon = reader.readLine();
```

```
            // next, the connection is attempted
            System.out.println("Attempting to connect :" + sCon);
            conn = java.sql.DriverManager.getConnection(sCon);

            System.out.println("SolidDriver succesfully connected.");

            String sQuery = "SELECT TABLE_SCHEMA,TABLE_NAME,TABLE_TYPE FROM TABLES";

            stmt= conn.createStatement();

            result = stmt.executeQuery(sQuery);
            System.out.println("Query executed and result set obtained.");

            // we get a metadataobject containing information about the
            // obtained result set
            System.out.println("Obtaining metadata information.");
            meta = result.getMetaData();
            int cols = meta.getColumnCount();

            System.out.println("Metadata information for columns is as follows:");
            // we dump the column information about the result set
            for (i=1; i <= cols; i++)
            {
                System.out.println("Column i:"+i+"  "+meta.getColumnName(i)+ "," +
    meta.getColumnType(i) + "," + meta.getColumnTypeName(i));
            }

            // and finally, we dump the result set
            System.out.println("Starting to dump resultset.");
            int cnt = 1;
            while(result.next())
            {
                System.out.print("\nRow "+cnt+" : ");
                for (i=1; i <= cols; i++) {
                    System.out.print(result.getString(i)+"\t");
                }
                cnt++;
            }

            stmt.close();

            conn.close();
            // and not it is all over
            System.out.println("\nResult set dumped. Sample application finishes.");
        }
```

```
}
```

Sample 1 output

```
K:\projects\jdbc\prod10\samples>java sample1
JDBC sample application starts...
Application tries to register the driver.
Driver succesfully registered.
Now sample application needs a connectstring in format:

jdbc:solid://<host>:<port>/<user name>/<password>


Please enter the connect string >jdbc:solid://localhost:1313/dba/dba
Attempting to connect :jdbc:solid://localhost:1313/dba/dba
SolidDriver succesfully connected.
Query executed and result set obtained.
Obtaining metadata information.
Metadata information for columns is as follows:
Column i:1  TABLE_SCHEMA,12,VARCHAR
Column i:2  TABLE_NAME,12,VARCHAR
Column i:3  TABLE_TYPE,12,VARCHAR
Starting to dump resultset.

Row 1 : _SYSTEM SYS_TABLES      BASE TABLE
Row 2 : _SYSTEM SYS_COLUMNS     BASE TABLE
Row 3 : _SYSTEM SYS_USERS       BASE TABLE
Row 4 : _SYSTEM SYS_UROLE       BASE TABLE
Row 5 : _SYSTEM SYS_RELAUTH     BASE TABLE
Row 6 : _SYSTEM SYS_ATTAUTH     BASE TABLE
Row 7 : _SYSTEM SYS_VIEWS       BASE TABLE
Row 8 : _SYSTEM SYS_KEYPARTS    BASE TABLE
Row 9 : _SYSTEM SYS_KEYS        BASE TABLE
Row 10 : _SYSTEM        SYS_CARDINAL    BASE TABLE
Row 11 : _SYSTEM        SYS_INFO        BASE TABLE
Row 12 : _SYSTEM        SYS_SYNONYM     BASE TABLE
Row 13 : _SYSTEM        TABLES  VIEW
Row 14 : _SYSTEM        COLUMNS VIEW
Row 15 : _SYSTEM        SQL_LANGUAGES   BASE TABLE
Row 16 : _SYSTEM        SERVER_INFO     VIEW
Row 17 : _SYSTEM        SYS_TYPES       BASE TABLE
Row 18 : _SYSTEM        SYS_FORKEYS     BASE TABLE
Row 19 : _SYSTEM        SYS_FORKEYPARTS BASE TABLE
Row 20 : _SYSTEM        SYS_PROCEDURES  BASE TABLE
Row 21 : _SYSTEM        SYS_TABLEMODES  BASE TABLE
```

```
Row 22 : _SYSTEM        SYS_EVENTS      BASE TABLE
Row 23 : _SYSTEM        SYS_SEQUENCES   BASE TABLE
Row 24 : _SYSTEM        SYS_TMP_HOTSTANDBY      BASE TABLE
Result set dumped. Sample application finishes.
```

Sample 2

```
/**
 *      sample2 JDBC sample applet
 *
 *      Sep 24 1997 JP
 *
 *      This simple JDBC applet does the following using
 *      Solid native JDBC driver.
 *
 *  1. Registers the driver using JDBC driver manager services
 *  2. Connects to Solid Embedded Engine using the driver.
 *     Used url is read from sample2.html
 *  3. Executes given SQL statements
 *
 *  To build and run the application
 *
 *  1. Make sure you have a working Java Development environment
 *  2. Install and start SOLID Embedded Engine to connect. Ensure that the
 *     server is up and running.
 *  3. Append SolidDriver.zip into the CLASSPATH definition used
 *     by your development/running environment.
 *  4. Create a java project based on the file sample2.java.
 *  5. Build and run the application. Check that sample2.html
 *     defines valid url to your environment.
 *
 *  For more information read the readme.htm file contained by
 *  SOLID JDBC Driver package.
 *
 */

import java.util.*;
import java.awt.*;
import java.applet.Applet;
import java.net.URL;
import java.sql.*;

public class sample2 extends Applet {
    TextField textField;
    static TextArea textArea;
```

```
    String url = null;
    Connection con = null;

    public void init() {
        // a valid value for url could be
        // url = "jdbc:solid://localhost:1313/dba/dba";

        url = getParameter("url");

        textField = new TextField(40);
        textArea = new TextArea(10, 40);
        textArea.setEditable(false);

        Font font = textArea.getFont();
        Font newfont = new Font("Monospaced", font.PLAIN, 12);
        textArea.setFont(newfont);

        // Add Components to the Applet.
        GridBagLayout gridBag = new GridBagLayout();
        setLayout(gridBag);
        GridBagConstraints c = new GridBagConstraints();
        c.gridwidth = GridBagConstraints.REMAINDER;

        c.fill = GridBagConstraints.HORIZONTAL;
        gridBag.setConstraints(textField, c);
        add(textField);

        c.fill = GridBagConstraints.BOTH;
        c.weightx = 1.0;
        c.weighty = 1.0;
        gridBag.setConstraints(textArea, c);
        add(textArea);

        validate();

        try {
            // Load the SOLID JDBC Driver
            Driver d = (Driver)Class.forName
("solid.jdbc.SolidDriver").newInstance();

            // Attempt to connect to a driver.
            con = DriverManager.getConnection (url);

            // If we were unable to connect, an exception
```

```
                // would have been thrown.  So, if we get here,
                // we are successfully connected to the url

                // Check for, and display and warnings generated
                // by the connect.
                checkForWarning (con.getWarnings ());

                // Get the DatabaseMetaData object and display
                // some information about the connection
                DatabaseMetaData dma = con.getMetaData ();

                textArea.appendText("Connected to " + dma.getURL() + "\n");
                textArea.appendText("Driver       " + dma.getDriverName() + "\n");
                textArea.appendText("Version      " + dma.getDriverVersion() +
"\n");
            }
            catch (SQLException ex) {
                printSQLException(ex);
            }
            catch (Exception e) {
                textArea.appendText("Exception:  " + e + "\n");
            }
        }

        public void destroy() {
            if (con != null) {
                try {
                    con.close();
                }
                catch (SQLException ex) {
                    printSQLException(ex);
                }
                catch (Exception e) {
                    textArea.appendText("Exception:  " + e + "\n");
                }
            }
        }

        public boolean action(Event evt, Object arg) {
            if (con != null) {
                String sqlstmt = textField.getText();
                textArea.setText("");
                try {
                    // Create a Statement object so we can submit
                    // SQL statements to the driver
```

```
            Statement stmt = con.createStatement ();
            // set row limit
            stmt.setMaxRows(50);
            // Submit a query, creating a ResultSet object
            ResultSet rs = stmt.executeQuery (sqlstmt);

            // Display all columns and rows from the result set
            textArea.setVisible(false);
            dispResultSet (stmt,rs);
            textArea.setVisible(true);

            // Close the result set
            rs.close();

            // Close the statement
            stmt.close();
        }
        catch (SQLException ex) {
            printSQLException(ex);
        }
        catch (Exception e) {
            textArea.appendText("Exception:  " + e + "\n");
        }
        textField.selectAll();
    }
    return true;
}

//---------------------------------------------------------------------
// checkForWarning
// Checks for and displays warnings.  Returns true if a warning
// existed
//---------------------------------------------------------------------

private static boolean checkForWarning (SQLWarning warn)
        throws SQLException
{
    boolean rc = false;

    // If a SQLWarning object was given, display the
    // warning messages.  Note that there could be
    // multiple warnings chained together

    if (warn != null) {
        textArea.appendText("\n*** Warning ***\n");
```

```
            rc = true;
            while (warn != null) {
                textArea.appendText("SQLState: " +
                    warn.getSQLState () + "\n");
                textArea.appendText("Message:  " +
                    warn.getMessage () + "\n");
                textArea.appendText("Vendor:   " +
                    warn.getErrorCode () + "\n");
                textArea.appendText("\n");
                warn = warn.getNextWarning ();
            }
        }
        return rc;
    }

    //-------------------------------------------------------------------
    // dispResultSet
    // Displays all columns and rows in the given result set
    //-------------------------------------------------------------------

    private static void dispResultSet (Statement sta, ResultSet rs)
        throws SQLException
    {
        int i;

        // Get the ResultSetMetaData.  This will be used for
        // the column headings
        ResultSetMetaData rsmd = rs.getMetaData ();

        // Get the number of columns in the result set
        int numCols = rsmd.getColumnCount ();
        if (numCols == 0) {
            textArea.appendText("Updatecount is "+sta.getUpdateCount());
            return;
        }

        // Display column headings
        for (i=1; i<=numCols; i++) {
            if (i > 1) {
                textArea.appendText("\t");
            }
            try {
                textArea.appendText(rsmd.getColumnLabel(i));
            }
            catch(NullPointerException ex) {
```

```
                textArea.appendText("null");
            }
        }
        textArea.appendText("\n");

        // Display data, fetching until end of the result set
        boolean more = rs.next ();
        while (more) {

            // Loop through each column, get the
            // column datza and display it
            for (i=1; i<=numCols; i++) {
                if (i > 1) {
                    textArea.appendText("\t");
                }
                try {
                    textArea.appendText(rs.getString(i));
                }
                catch(NullPointerException ex) {
                    textArea.appendText("null");
                }
            }
            textArea.appendText("\n");

            // Fetch the next result set row
            more = rs.next ();
        }
    }

    private static void printSQLException(SQLException ex)
    {
            // A SQLException was generated.  Catch it and
            // display the error information.  Note that there
            // could be multiple error objects chained
            // together

            textArea.appendText("\n*** SQLException caught ***\n");

            while (ex != null) {
                textArea.appendText("SQLState: " +
                    ex.getSQLState () + "\n");
                textArea.appendText("Message:  " +
                    ex.getMessage () + "\n");
                textArea.appendText("Vendor:   " +
                    ex.getErrorCode () + "\n");
```

```
                textArea.appendText("\n");
                ex = ex.getNextException ();
            }
        }
}
```

Sample 3

```
/**
 *      sample3 JDBC sample application
 *
 *      Sep 24 1997 JP
 *
 *      This simple JDBC application does the following using
 *      SOLID native JDBC driver.
 *
 *  1. Registers the driver using JDBC driver manager services
 *  2. Prompts the user for a valid JDBC connect string
 *  3. Connects to SOLID Embedded Engine using the driver
 *  4. Drops and creates a procedure sample3. If the procedure
 *     does not exist dumps the related exception.
 *  5. Calls that procedure using java.sql.Statement
 *  6. Fetches and dumps all the rows of a result set.
 *  7. Closes connection
 *
 *  To build and run the application
 *
 *  1. Make sure you have a working Java Development environment
 *  2. Install and start SOLID Embedded Engine to connect. Ensure that the
 *     server is up and running.
 *  3. Append SolidDriver.zip into the CLASSPATH definition used
 *     by your development/running environment.
 *  4. Create a java project based on the file sample3.java.
 *  5. Build and run the application.
 *
 *  For more information read the readme.htm file contained by
 *  SOLID JDBC Driver package.
 *
 */

import java.io.*;
import java.sql.*;

public class sample3 {
```

```
    static Connection conn;
    public static void main (String args[]) throws Exception
    {
        System.out.println("JDBC sample application starts...");
        System.out.println("Application tries to register the driver.");

        // this is the recommended way for registering Drivers
        Driver d =
(Driver)Class.forName("solid.jdbc.SolidDriver").newInstance();

        System.out.println("Driver succesfully registered.");

        // the user is asked for a connect string
        System.out.println("Now sample application needs a connectstring in
format:\n");
        System.out.println("jdbc:solid://<host>:<port>/<user name>/
<password>\n");
        System.out.print("\nPlease enter the connect string >");
        BufferedReader reader = new BufferedReader(new
InputStreamReader(System.in));
        String sCon = reader.readLine();

        // next, the connection is attempted
        System.out.println("Attempting to connect :" + sCon);
        conn = DriverManager.getConnection(sCon);

        System.out.println("SolidDriver succesfully connected.");

        DoIt();

        conn.close();
        // and now it is all over
        System.out.println("\nResult set dumped. Sample application finishes.");
    }


    static void DoIt() {
        try {
            createprocs();
            PreparedStatement pstmt = conn.prepareStatement("call sample3(?)");
            // set parameter value
            pstmt.setInt(1,10);

            ResultSet rs = pstmt.executeQuery();
```

```
            if (rs != null) {
                ResultSetMetaData md = rs.getMetaData();
                int cols = md.getColumnCount();
                int row = 0;
                while (rs.next()) {
                    row++;
                    String ret = "row "+row+": ";
                    for (int i=1;i<=cols;i++) {
                        ret = ret + rs.getString(i) + " ";
                    }
                    System.out.println(ret);
                }
            }
            conn.commit();
        }
        catch (SQLException ex) {
            printexp(ex);
        }
        catch (java.lang.Exception ex) {
            ex.printStackTrace ();
        }

    }

    static void createprocs() {
        Statement stmt = null;
        String proc = "create procedure sample3 (limit integer)" +
                      "returns (c1 integer, c2 integer) " +
                      "begin " +
                      "  c1 := 0;" +
                      "  while c1 < limit loop " +
                      "    c2 := 5 * c1;" +
                      "    return row;" +
                      "    c1 := c1 + 1;" +
                      "  end loop;" +
                      "end";

        try {
            stmt = conn.createStatement();
            stmt.execute("drop procedure sample3");
        } catch (SQLException ex) {
            printexp(ex);
        }

        try {
```

```
            stmt.execute(proc);
        } catch (SQLException ex) {
            printexp(ex);
            System.exit(-1);
        }
    }

    public static void printexp(SQLException ex) {
        System.out.println("\n*** SQLException caught ***");
        while (ex != null) {
            System.out.println("SQLState: " + ex.getSQLState());
            System.out.println("Message:  " + ex.getMessage());
            System.out.println("Vendor:   " + ex.getErrorCode());
            ex = ex.getNextException ();
        }
    }

}
```

Sample 4

```
/**
 *      sample4 JDBC sample application
 *
 *      Sep 24 1997 JP
 *
 *      This simple JDBC application does the following using
 *      SOLID native JDBC driver.
 *
 *  1. Registers the driver using JDBC driver manager services
 *  2. Prompts the user for a valid JDBC connect string
 *  3. Connects to SOLID Embedded Engine using the driver
 *  4. Drops and creates a table sample4. If the table
 *     does not exist dumps the related exception.
 *  5. Inserts file given as an argument to database (method Store)
 *  6. Reads this 'blob' back to file out.tmp (method Restore)
 *  7. Closes connection
 *
 *  To build and run the application
 *
 *  1. Make sure you have a working Java Development environment
 *  2. Install and start Solid Embedded Engine to connect. Ensure that the
 *     server is up and running.
 *  3. Append SolidDriver.zip into the CLASSPATH definition used
 *     by your development/running environment.
```

```
 *  4. Create a java project based on the file sample4.java.
 *  5. Build and run the application.
 *
 *  For more information read the readme.htm file contained by
 *  SOLID JDBC Driver package.
 *
 */

import java.io.*;
import java.sql.*;

public class sample4 {

    static Connection conn;
    public static void main (String args[]) throws Exception
    {
        String filename = null;
        String tmpfilename = null;

        if (args.length < 1) {
            System.out.println("usage: java sample4 <infile>");
            System.exit(0);
        }
        filename = args[0];
        tmpfilename = "out.tmp";
        System.out.println("JDBC sample application starts...");
        System.out.println("Application tries to register the driver.");

        // this is the recommended way for registering Drivers
        Driver d =
(Driver)Class.forName("solid.jdbc.SolidDriver").newInstance();

        System.out.println("Driver succesfully registered.");

        // the user is asked for a connect string
        System.out.println("Now sample application needs a connectstring in
format:\n");
        System.out.println("jdbc:solid://<host>:<port>/<user name>/
<password>\n");
        System.out.print("\nPlease enter the connect string >");
        BufferedReader reader = new BufferedReader(new
InputStreamReader(System.in));
        String sCon = reader.readLine();

        // next, the connection is attempted
```

```
        System.out.println("Attempting to connect :" + sCon);
        conn = DriverManager.getConnection(sCon);

        System.out.println("SolidDriver succesfully connected.");

        // drop and create table sample4
        createsample4();
        // insert data into it
        Store(filename);
        // and restore it
        Restore(tmpfilename);

        conn.close();
        // and it is all over
        System.out.println("\nSample application finishes.");
    }


    static void Store(String filename) {
        String sql = "insert into sample4 values(?,?)";
        FileInputStream inFileStream ;
        try {
            File f1 = new File(filename);
            int blobsize = (int)f1.length();
            System.out.println("Inputfile size is "+blobsize);
            inFileStream = new FileInputStream(f1);

            PreparedStatement stmt = conn.prepareStatement(sql);
            stmt.setLong(1, System.currentTimeMillis());
            stmt.setBinaryStream(2, inFileStream, blobsize);
            int rows = stmt.executeUpdate();
            stmt.close();
            System.out.println(""+rows+" inserted.");
            conn.commit();
        }
        catch (SQLException ex) {
            printexp(ex);
        }
        catch (java.lang.Exception ex) {
            ex.printStackTrace ();
        }

    }

    static void Restore(String filename) {
```

```
    String sql = "select id,blob from sample4";
    FileOutputStream outFileStream ;
    try {
        File f1 = new File(filename);
        outFileStream = new FileOutputStream(f1);

        PreparedStatement stmt = conn.prepareStatement(sql);
        ResultSet rs = stmt.executeQuery();
        int readsize = 0;
        while (rs.next()) {
            InputStream in = rs.getBinaryStream(2);
            byte bytes[] = new byte[8*1024];
            int nRead = in.read(bytes);
            while (nRead != -1) {
                readsize = readsize + nRead;
                outFileStream.write(bytes,0,nRead);
                nRead = in.read(bytes);
            }

        }
        stmt.close();
        System.out.println("Read "+readsize+" bytes from database");
    }
    catch (SQLException ex) {
        printexp(ex);
    }
    catch (java.lang.Exception ex) {
        ex.printStackTrace ();
    }

}


static void createsample4() {
    Statement stmt = null;
    String proc = "create table sample4 (" +
                  "id numeric not null primary key,"+
                  "blob long varbinary)";

    try {
        stmt = conn.createStatement();
        stmt.execute("drop table sample4");
    } catch (SQLException ex) {
        printexp(ex);
    }
```

```
            try {
                stmt.execute(proc);
            } catch (SQLException ex) {
                printexp(ex);
                System.exit(-1);
            }
        }

        static void printexp(SQLException ex) {
            System.out.println("\n*** SQLException caught ***");
            while (ex != null) {
                System.out.println("SQLState: " + ex.getSQLState());
                System.out.println("Message:  " + ex.getMessage());
                System.out.println("Vendor:   " + ex.getErrorCode());
                ex = ex.getNextException ();
            }
        }

    }
```

SOLID *JDBC Driver* Type Conversion Matrix

The following JDBC Driver type conversion matrix shows how different data types are suppored by SOLID *JDBC Driver*. Note that this matrix applies to both ResultSet.getXXX and ResultSet.setXXX methods for getting and setting data. An X indicates that the method is supported by SOLID *JDBC driver.*

	TINYINT	SMALLINT	INTEGER	REAL	FLOAT	DOUBLE	DECIMAL	NUMERIC	CHAR	VARCHAR	BINARY	LONGVARCHAR	VARBINARY	LONGVARBINARY	DATE	TIME	TIMESTAMP
getByte	X	X	X	X	X	X	X	X	X	X	X	X					
getShort	X	X	X	X	X	X	X	X	X	X	X	X					
getInt	X	X	X	X	X	X	X	X	X	X	X	X					
getLong	X	X	X	X	X	X	X	X	X	X	X	X					
getFloat	X	X	X	X	X	X	X	X	X	X	X	X					
getDouble	X	X	X	X	X	X	X	X	X	X	X	X					
getBigDecimal	X	X	X	X	X	X	X	X	X	X	X	X					
getBoolean	X	X	X	X	X	X	X	X	X	X	X	X					
getString	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
getBytes									X	X	X	X	X	X			
getDate									X	X	X				X		X
getTime									X	X	X					X	X
getTimeStamp									X	X	X	X	X		X		X
getAsciiStream																	
getUnicodeStream									X	X	X	X	X				
getObject	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X

A

Error Codes

SQLError returns SQLSTATE values as defined by the X/Open and SQL Access Group SQL CAE specification (1992). SQLSTATE values are strings that contain five characters. The following table lists SQLSTATE values that a driver can return for **SQLError**.

The character string value returned for an SQLSTATE consists of a two character class value followed by a three character subclass value. A class value of "01" indicates a warning and is accompanied by a return code of SQL_SUCCESS_WITH_INFO. Class values other than "01", except for the class "IM", indicate an error and are accompanied by a return code of SQL_ERROR. The class "IM" is specific to warnings and errors that derive from the implementation of ODBC itself. The subclass value "000" in any class is for implementation defined conditions within the given class. The assignment of class and subclass values is defined by ANSI SQL-92.

Note Although successful execution of a function is normally indicated by a return value of SQL_SUCCESS, the SQLSTATE 00000 also indicates success.

SQLSTATE	Error	Can be returned from
01000	General warning	All ODBC functions except: **SQLAllocEnv** **SQLError**
01002	Disconnect error	**SQLDisconnect**

01004	Data truncated	**SQLBrowseConnect** **SQLColAttributes** **SQLDataSources** **SQLDescribeCol** **SQLDriverConnect** **SQLDrivers** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLGetCursorName** **SQLGetData** **SQLGetInfo** **SQLNativeSql** **SQLPutData** **SQLSetPos**
01006	Privilege not revoked	**SQLExecDirect** **SQLExecute**
01S00	Invalid connection string attribute	**SQLBrowseConnect** **SQLDriverConnect**
01S01	Error in row	**SQLExtendedFetch** **SQLSetPos**
01S02	Option value changed	**SQLSetConnectOption** **SQLSetStmtOption**
01S03	No rows updated or deleted	**SQLExecDirect** **SQLExecute** **SQLSetPos**
01S04	More than one row updated or deleted	**SQLExecDirect** **SQLExecute** **SQLSetPos**
07001	Wrong number of parameters	**SQLExecDirect** **SQLExecute**
07006	Restricted data type attribute violation	**SQLBindParameter** **SQLExtendedFetch** **SQLFetch** **SQLGetData**
08001	Unable to connect to data source	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**

08002	Connection in use	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect** **SQLSetConnectOption**
08003	Connection not open	**SQLAllocStmt** **SQLDisconnect** **SQLGetConnectOption** **SQLGetInfo** **SQLNativeSql** **SQLSetConnectOption** **SQLTransact**
08004	Data source rejected establishment of connection	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
08007	Connection failure during transaction	**SQLTransact**
08S01	Communication link failure	**SQLBrowseConnect** **SQLColumnPrivileges** **SQLColumns** **SQLConnect** **SQLDriverConnect** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLFreeConnect** **SQLGetData** **SQLGetTypeInfo** **SQLParamData** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLPutData** **SQLSetConnectOption** **SQLSetStmtOption** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables**

21S01	Insert value list does not match column list	**SQLExecDirect** **SQLPrepare**
21S02	Degree of derived table does not match column list	**SQLExecDirect** **SQLPrepare** **SQLSetPos**
22001	String data right truncation	**SQLPutData**
22002	Indicator variable required but not supplied	**SQLFetch** **SQLGetData**
22003	Numeric value out of range	**SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLGetData** **SQLGetInfo** **SQLPutData** **SQLSetPos**
22005	Error in assignment	**SQLExecDirect** **SQLExecute** **SQLGetData** **SQLPrepare** **SQLPutData** **SQLSetPos**
22008	Datetime field overflow	**SQLExecDirect** **SQLExecute** **SQLGetData** **SQLPutData** **SQLSetPos**
22012	Division by zero	**SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch**
22026	String data, length mismatch	**SQLParamData**
23000	Integrity constraint violation	**SQLExecDirect** **SQLExecute** **SQLSetPos**

24000	Invalid cursor state	**SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLDescribeCol** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLGetData** **SQLGetStmtOption** **SQLGetTypeInfo** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLSetCursorName** **SQLSetPos** **SQLSetStmtOption** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables**
25000	Invalid transaction state	**SQLDisconnect**
28000	Invalid authorization specification	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
34000	Invalid cursor name	**SQLExecDirect** **SQLPrepare** **SQLSetCursorName**
37000	Syntax error or access violation	**SQLExecDirect** **SQLNativeSql** **SQLPrepare**
3C000	Duplicate cursor name	**SQLSetCursorName**
40001	Serialization failure	**SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch**

42000	Syntax error or access violation	**SQLExecDirect** **SQLExecute** **SQLPrepare** **SQLSetPos**
70100	Operation aborted	**SQLCancel**
IM001	Driver does not support this function	All ODBC functions except: **SQLAllocConnect** **SQLAllocEnv** **SQLDataSources** **SQLDrivers** **SQLError** **SQLFreeConnect** **SQLFreeEnv** **SQLGetFunctions**
IM002	Data source name not found and no default driver specified	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
IM003	Specified driver could not be loaded	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
IM004	Driver's **SQLAllocEnv** failed	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
IM005	Driver's **SQLAllocConnect** failed	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
IM006	Driver's **SQLSetConnect-Option** failed	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect**
IM007	No data source or driver specified; dialog prohibited	**SQLDriverConnect**
IM008	Dialog failed	**SQLDriverConnect**
IM009	Unable to load translation DLL	**SQLBrowseConnect** **SQLConnect** **SQLDriverConnect** **SQLSetConnectOption**
IM010	Data source name too long	**SQLBrowseConnect** **SQLDriverConnect**

IM011	Driver name too long	**SQLBrowseConnect** **SQLDriverConnect**
IM012	DRIVER keyword syntax error	**SQLBrowseConnect** **SQLDriverConnect**
IM013	Trace file error	**All ODBC functions.**
S0001	Base table or view already exists	**SQLExecDirect** **SQLPrepare**
S0002	Base table not found	**SQLExecDirect** **SQLPrepare**
S0011	Index already exists	**SQLExecDirect** **SQLPrepare**
S0012	Index not found	**SQLExecDirect** **SQLPrepare**
S0021	Column already exists	**SQLExecDirect** **SQLPrepare**
S0022	Column not found	**SQLExecDirect** **SQLPrepare**
S0023	No default for column	**SQLSetPos**
S1000	General error	All ODBC functions except: **SQLAllocEnv** **SQLError**
S1001	Memory allocation failure	All ODBC functions except: **SQLAllocEnv** **SQLError** **SQLFreeConnect** **SQLFreeEnv**
S1002	Invalid column number	**SQLBindCol** **SQLColAttributes** **SQLDescribeCol** **SQLExtendedFetch** **SQLFetch** **SQLGetData**
S1003	Program type out of range	**SQLBindCol** **SQLBindParameter** **SQLGetData**

S1004	SQL data type out of range	**SQLBindParameter** **SQLGetTypeInfo**
S1008	Operation canceled	All ODBC functions that can be processed asynchronously: **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLDescribeCol** **SQLDescribeParam** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLGetData** **SQLGetTypeInfo** **SQLMoreResults** **SQLNumParams** **SQLNumResultCols** **SQLParamData** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLPutData** **SQLSetPos** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables**

S1009	Invalid argument value	**SQLAllocConnect** **SQLAllocStmt** **SQLBindCol** **SQLBindParameter** **SQLExecDirect** **SQLForeignKeys** **SQLGetData** **SQLGetInfo** **SQLNativeSql** **SQLPrepare** **SQLPutData** **SQLSetConnectOption** **SQLSetCursorName** **SQLSetPos** **SQLSetStmtOption**

S1010	Function sequence error	**SQLBindCol** **SQLBindParameter** **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLDescribeCol** **SQLDescribeParam** **SQLDisconnect** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLFreeConnect** **SQLFreeEnv** **SQLFreeStmt** **SQLGetConnectOption** **SQLGetCursorName** **SQLGetData** **SQLGetFunctions** **SQLGetStmtOption** **SQLGetTypeInfo** **SQLMoreResults** **SQLNumParams** **SQLNumResultCols** **SQLParamData** **SQLParamOptions** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLPutData** **SQLRowCount** **SQLSetConnectOption** **SQLSetCursorName** **SQLSetPos** **SQLSetScrollOptions** **SQLSetStmtOption** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables** **SQLTransact**

S1011	Operation invalid at this time	**SQLGetStmtOption** **SQLSetConnectOption** **SQLSetStmtOption**
S1012	Invalid transaction operation code specified	**SQLTransact**
S1015	No cursor name available	**SQLGetCursorName**
S1090	Invalid string or buffer length	**SQLBindCol** **SQLBindParameter** **SQLBrowseConnect** **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLConnect** **SQLDataSources** **SQLDescribeCol** **SQLDriverConnect** **SQLDrivers** **SQLExecDirect** **SQLExecute** **SQLForeignKeys** **SQLGetCursorName** **SQLGetData** **SQLGetInfo** **SQLNativeSql** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLPutData** **SQLSetCursorName** **SQLSetPos** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables**
S1091	Descriptor type out of range	**SQLColAttributes**
S1092	Option type out of range	**SQLFreeStmt** **SQLGetConnectOption** **SQLGetStmtOption** **SQLSetConnectOption** **SQLSetStmtOption**

S1093	Invalid parameter number	**SQLBindParameter** **SQLDescribeParam**
S1094	Invalid scale value	**SQLBindParameter**
S1095	Function type out of range	**SQLGetFunctions**
S1096	Information type out of range	**SQLGetInfo**
S1097	Column type out of range	**SQLSpecialColumns**
S1098	Scope type out of range	**SQLSpecialColumns**
S1099	Nullable type out of range	**SQLSpecialColumns**
S1100	Uniqueness option type out of range	**SQLStatistics**
S1101	Accuracy option type out of range	**SQLStatistics**
S1103	Direction option out of range	**SQLDataSources** **SQLDrivers**
S1104	Invalid precision value	**SQLBindParameter**
S1105	Invalid parameter type	**SQLBindParameter**
S1106	Fetch type out of range	**SQLExtendedFetch**
S1107	Row value out of range	**SQLExtendedFetch** **SQLParamOptions** **SQLSetPos** **SQLSetScrollOptions**
S1108	Concurrency option out of range	**SQLSetScrollOptions**
S1109	Invalid cursor position	**SQLExecute** **SQLExecDirect** **SQLGetData** **SQLGetStmtOption** **SQLSetPos**
S1110	Invalid driver completion	**SQLDriverConnect**
S1111	Invalid bookmark value	**SQLExtendedFetch**

S1C00	Driver not capable	**SQLBindCol** **SQLBindParameter** **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLGetConnectOption** **SQLGetData** **SQLGetInfo** **SQLGetStmtOption** **SQLGetTypeInfo** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLSetConnectOption** **SQLSetPos** **SQLSetScrollOptions** **SQLSetStmtOption** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables** **SQLTransact**

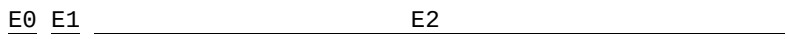
S1T00	Timeout expired	**SQLBrowseConnect** **SQLColAttributes** **SQLColumnPrivileges** **SQLColumns** **SQLConnect** **SQLDescribeCol** **SQLDescribeParam** **SQLDriverConnect** **SQLExecDirect** **SQLExecute** **SQLExtendedFetch** **SQLFetch** **SQLForeignKeys** **SQLGetData** **SQLGetInfo** **SQLGetTypeInfo** **SQLMoreResults** **SQLNumParams** **SQLNumResultCols** **SQLParamData** **SQLPrepare** **SQLPrimaryKeys** **SQLProcedureColumns** **SQLProcedures** **SQLPutData** **SQLSetPos** **SQLSpecialColumns** **SQLStatistics** **SQLTablePrivileges** **SQLTables**

B

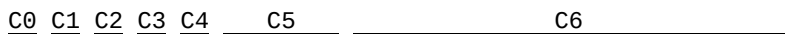
ODBC State Transition Tables

The tables in this appendix show how ODBC functions cause transitions of the environment, connection, and statement states. Generally speaking, the state of the environment, connection, or statement dictates when functions that use the corresponding type of handle (*henv*, *hdbc*, or *hstmt*) can be called. The environment, connection, and statement states overlap as follows, although the exact overlap of connection states C5 and C6 and statement states S1 through S12 is data source–dependent, since transactions begin at different times on different data sources. For a description of each state, see "Environment Transitions," "Connection Transitions," and "Statement Transitions," later in this appendix.

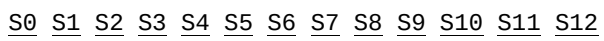
Environment:



Connection:



Statement:



Each entry in a transition table can be one of the following values:

- --. The state is unchanged after executing the function.
- **E*n***, **C*n***, or **S*n***. The environment, connection, or statement state moves to the specified state.
- **(IH)**. The function returned SQL_INVALID_HANDLE. Although this error is possible in any state, it is shown only when it is the only possible outcome of calling the function in the specified state. This error does not change the state and is always detected by the Driver Manager, as indicated by the parentheses.
- **NS**. Next State. The statement transition is the same as if the statement had not gone through the asynchronous states. For example, suppose a statement that creates a result set enters state S11 from state S1 because **SQLExecDirect** returned

SQL_STILL_EXECUTING. The NS notation in state S11 means that the transitions for the statement are the same as those for a statement in state S1 that creates a result set: if **SQLExecDirect** returns an error; the statement remains in state S1; if it succeeds, the statement moves to state S5; if it needs data, the statement moves to state S8; and if it is still executing, it remains in state S11.

- ***XXXXX*** or **(*XXXXX*)**. An SQLSTATE that is related to the transition table; SQLSTATEs detected by the Driver Manager are enclosed in parentheses. The function returned SQL_ERROR and the specified SQLSTATE, but the state does not change. For example, if **SQLExecute** is called before **SQLPrepare**, it returns SQLSTATE S1010 (Function sequence error).

NOTE: The tables do not show errors unrelated to the transition tables that do not change the state. For example, when **SQLAllocConnect** is called in environment state E1 and returns SQLSTATE S1001 (Memory allocation failure), the environment remains in state E1; this is not shown in the environment transition table for **SQLAllocConnect**.

If the environment, connection, or statement can move to more than one state, each possible state is shown and one or more footnotes explains the conditions under which each transition takes place. The following footnotes may appear in any table:

Footnote	Meaning
b	Before or after. The cursor was positioned before the start of the result set or after the end of the result set.
c	Current function. The current function was executing asynchronously.
d	Need data. The function returned SQL_NEED_DATA.
e	Error. The function returned SQL_ERROR.
i	Invalid row. The cursor was positioned on a row in the result set and the value in the *rgfRowStatus* array in **SQLExtendedFetch** for the row was SQL_DELETED or SQL_ERROR.
nf	Not found. The function returned SQL_NO_DATA_FOUND.
np	Not prepared. The statement was not prepared.
nr	No results. The statement will not or did not create a result set.
o	Other function. Another function was executing asynchronously.
p	Prepared. The statement was prepared.
r	Results. The statement will or did create a (possibly empty) result set.
s	Success. The function returned SQL_SUCCESS_WITH_INFO or SQL_SUCCESS.

v	Valid row. The cursor was positioned on a row in the result set and the value in the *rgfRowStatus* array in **SQLExtendedFetch** for the row was SQL_ADDED, SQL_SUCCESS, or SQL_UPDATED.
x	Executing. The function returned SQL_STILL_EXECUTING.

For example, the environment state transition table for **SQLFreeEnv** is:

SQLFreeEnv **E0** **Unallocated**	**E1** **Allocated**	**E2** ***hdbc***
(IH)	**E0**	**(S1010)**

If **SQLFreeEnv** is called in environment state E0, the Driver Manager returns SQL_INVALID_HANDLE. If it is called in state E1, the environment moves to state E0 if the function succeeds and remains in state E1 if the function fails. If it is called in state E2, the Driver Manager always returns SQL_ERROR and SQLSTATE S1010 (Function sequence error) and the environment remains in state E2.

Environment Transitions

The ODBC environment has the following three states:

State	Description
E0	Unallocated *henv*
E1	Allocated *henv*, unallocated *hdbc*
E2	Allocated *henv*, allocated *hdbc*

The following tables show how each ODBC function affects the environment state.

SQLAllocConnect

E0 Unallocated	E1 Allocated	E2 *hdbc*
(IH)	**E2**	**-- [1]**

1 Calling **SQLAllocConnect** with a pointer to a valid *hdbc* overwrites that *hdbc*. This may be an application programming error.

SQLAllocEnv

E0 Unallocated	E1 Allocated	E2 *hdbc*
E1	**-- [1]**	**E1 [1]**

1 Calling **SQLAllocEnv** with a pointer to a valid *henv* overwrites that *henv*. This may be an application programming error.

SQLDataSources and SQLDrivers

E0 Unallocated	E1 Allocated	E2 *hdbc*
(IH)	**--**	**--**

SQLError

E0 **Unallocated**	**E1** **Allocated**	E2 *hdbc*
(IH) [1]	**--**	**--**

1 This row shows transitions when *henv* was non-null, *hdbc* was SQL_NULL_HDBC, and *hstmt* was SQL_NULL_HSTMT.

SQLFreeConnect

E0 **Unallocated**	**E1** **Allocated**	**E2** ***hdbc***
(IH)	**(IH)**	**--** [1] **E1** [2]

1 There were other allocated *hdbcs*.
2 The *hdbc* was the only allocated *hdbc*.

SQLFreeEnv

E0 **Unallocated**	**E1** **Allocated**	**E2** ***hdbc***
(IH)	**E0**	**(S1010)**

SQLTransact

E0 **Unallocated**	**E1** **Allocated**	**E2** ***hdbc***
(IH)	**--** [1]	**--** [1]

1 The *hdbc* argument was SQL_NULL_HDBC.

All Other ODBC Functions

E0 Unallocated	E1 Allocated	E2 *hdbc*
(IH)	**(IH)**	**--**

Connection Transitions

ODBC connections have the following states:

State	Description
C0	Unallocated *henv*, unallocated *hdbc*
C1	Allocated *henv*, unallocated *hdbc*
C2	Allocated *henv*, allocated *hdbc*
C3	Connection function needs data
C4	Connected *hdbc*
C5	Connected *hdbc*, allocated *hstmt*
C6	Connected *hdbc*, transaction in progress

The following tables show how each ODBC function affects the connection state.

SQLAllocConnect

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	**C2**	**--** [1]	**C2** [1]	**C2** [1]	**C2** [1]	**C2** [1]

1 Calling **SQLAllocConnect** with a pointer to a valid *hdbc* overwrites that *hdbc*. This may be an application programming error.

SQLAllocEnv

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
C1	**--** [1]	**C1** [1]	**C1** [1]	**C1** [1]	**C1** [1]	**C1** [1]

1 Calling **SQLAllocEnv** with a pointer to a valid *henv* overwrites that *henv*. This may be an application programming error.

SQLAllocStmt

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Transaction
(IH)	**(IH)**	**(08003)**	**(08003)**	**C5**	**-- [1]**	**C5 [1]**

1 Calling **SQLAllocStmt** with a pointer to a valid *hstmt* overwrites that *hstmt*. This may be an application programming error.

SQLColumns, SQLGetTypeInfo, SQLPrimaryKeys, SQLSpecialColumns, SQLStatistics, and SQLTables

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Transaction
(IH)	**(IH)**	**(IH)**	**(IH)** **C4 [s]**	**(1H)**	**-- [1]** **C6 [2]**	**--**

1 The data source was in auto-commit mode or did not begin a transaction.
2 The data source was in manual-commit mode and began a transaction.

SQLConnect and SQLDriverConnect

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	(IH)	C4	(08002)	(08002)	(08002)	(08002)

SQLDataSources and SQLDrivers

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	--	--	--	--	--	--

SQLDisconnect

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	(IH)	(08003)	C2	C2	C2	25000

SQLDriverConnect: see SQLConnect

SQLDrivers: see SQLDataSources

SQLError

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Transaction
(IH) [1]	(IH)	--	--	--	--	--

1 This row shows transitions when *hdbc* was non-null and *hstmt* was SQL_NULL_HSTMT.

SQLExecDirect and SQLExecute

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	(IH)	(IH)	(IH)	(IH)	-- [1] C6 [2]	--

1 The data source was in auto-commit mode or did not begin a transaction.
2 The data source was in manual-commit mode and began a transaction.

SQLExecute: see SQLExecDirect

SQLFreeConnect

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	(IH)	C1	(S1010)	(S1010)	(S1010)	(S1010)

SQLFreeEnv

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	C0 [1] (S1010) [2]	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)

1 The *hdbc* was the only allocated *hdbc*.
2 There were other allocated *hdbcs*.

SQLFreeStmt

C0 No *henv*	C1 Unallo- cated	C2 Allo- cated	C3 Need Data	C4 Con- nected	C5 *hstmt*	C6 Trans- action
(IH)	(IH)	(IH)	(IH)	(IH)	-- [1] C4 [2]	-- [1] C4 [2]

1 The *fOption* argument was SQL_CLOSE, SQL_UNBIND, or SQL_RESET_PARAMS.
2 The *fOption* argument was SQL_DROP.

SQLGetConnectOption

C0 No *henv*	C1 Unallo- cated	C2 Allo- cated	C3 Need Data	C4 Con- nected	C5 *hstmt*	C6 Trans- action
(IH)	(IH)	-- [1] (08003) [2]	(S1010)	--	--	--

1 The *fOption* argument was SQL_ACCESS_MODE or SQL_AUTOCOMMIT, or a value had been set for the connection option.
2 The *fOption* argument was not SQL_ACCESS_MODE or SQL_AUTOCOMMIT, and a value had not been set for the connection option.

SQLGetFunctions

C0 No *henv*	C1 Unallo- cated	C2 Allo- cated	C3 Need Data	C4 Con- nected	C5 *hstmt*	C6 Trans- action
(IH)	(IH)	(S1010)	(S1010)	--	--	--

SQLGetInfo

C0 No *henv*	C1 Unallo- cated	C2 Allo- cated	C3 Need Data	C4 Con- nected	C5 *hstmt*	C6 Trans- action
(IH)	(IH)	-- [1] (08003) [2]	(08003)	--	--	--

1 The *fInfoType* argument was SQL_ODBC_VER.
2 The *fInfoType* argument was not SQL_ODBC_VER

SQLGetTypeInfo: see SQLColumns

SQLPrepare

C0 No *henv*	C1 Unallo- cated	C2 Allo- cated	C3 Need Data	C4 Con- nected	C5 *hstmt*	C6 Trans action
(IH)	(IH)	(IH)	(IH)	(IH)	-- [1] C6 [2]	--

1 The data source was in auto-commit mode or did not begin a transaction.
2 The data source was in manual commit mode and began a transaction.

SQLPrimaryKeys: see SQLColumns

SQLSetConnectOption

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Transaction
(IH)	(IH)	-- [1] (08003) [2]	(S1010)	-- [3] (08002) [4]	-- [3] (08002) [4]	-- [3 and 5] C5 [6] (08002) [4] S1011 [7]

1 The *fOption* argument was not SQL_TRANSLATE_DLL or SQL_TRANSLATE_OPTION.

2 The *fOption* argument was SQL_TRANSLATE_DLL or SQL_TRANSLATE_OPTION.

3 The *fOption* argument was not SQL_ODBC_CURSORS.

4 The *fOption* argument was SQL_ODBC_CURSORS.

5 If the *fOption* argument was SQL_AUTOCOMMIT, then the data source was in manual-commit mode or the *vParam* argument was SQL_AUTOCOMMIT_OFF.

6 The data source was in manual-commit mode, the *fOption* argument was SQL_AUTOCOMMIT, and the *vParam* argument was SQL_AUTOCOMMIT_ON.

7 The data source was in manual-commit mode and the *fOption* argument was SQL_TXN_ISOLATION.

SQLSpecialColumns: see SQLColumns

SQLStatistics: see SQLColumns

SQLTables: see SQLColumns

SQLTransact

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH) [1]	(IH)	(IH)	(IH)	(IH)	(IH)	(IH)
(IH) [2]	--	(08003)	(08003)	--	--	-- [e and 4] C5 [s or 5]
(IH) [3]	(IH)	(08003)	(08003)	--	--	-- [e] C5 [s]

1 This row shows transitions when *henv* was SQL_NULL_HENV and *hdbc* was SQL_NULL_HDBC.

2 This row shows transitions when *henv* was a valid environment handle and *hdbc* was SQL_NULL_HDBC.

3 This row shows transitions when *hdbc* was a valid connection handle.

4 The commit or rollback failed on the connection.

5 The function returned SQL_ERROR but the commit or rollback succeeded on the connection.

All Other ODBC Functions

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Trans-action
(IH)	(IH)	(IH)	(IH)	(IH)	--	--

Statement Transitions

ODBC statements have the following states:

State	Description
S0	Unallocated *hstmt*. (The connection state must be C4. For more information, see "Connection Transitions.")
S1	Allocated *hstmt*.
S2	Prepared statement. No result set will be created.
S3	Prepared statement. A (possibly empty) result set will be created.
S4	Statement executed and no result set was created.
S5	Statement executed and a (possibly empty) result set was created. The cursor is open and positioned before the first row of the result set.
S6	Cursor positioned with **SQLFetch**.
S7	Cursor positioned with **SQLExtendedFetch**.
S8	Function needs data. **SQLParamData** has not been called.
S9	Function needs data. **SQLPutData** has not been called.
S10	Function needs data. **SQLPutData** has been called.
S11	Still executing.
S12	Asynchronous execution canceled. In S12, an application must call the canceled function until it returns a value other than SQL_STILL_EXECUTING. The function was canceled successfully only if the function returns SQL_ERROR and SQLSTATE S1008 (Operation canceled). If it returns any other value, such as SQL_SUCCESS, the cancel operation failed and the function executed normally.

States S2 and S3 are known as the prepared states, states S5 through S7 as the cursor states, states S8 through S10 as the need data states, and states S11 and S12 as the asynchronous states. In each of these groups, the transitions are shown separately only when they are different for each state in the group; generally, the transitions for each state in each a group are the same.

The following tables show how each ODBC function affects the statement state.

SQLAllocConnect

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
-- [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]

1 Calling **SQLAllocConnect** with a pointer to a valid *hdbc* overwrites that *hdbc*. This may be an application programming error. Furthermore, this returns the connection state to C2; the connection state must be C4 before the statement state is S0.

SQLAllocEnv

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
-- [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]

1 Calling **SQLAllocEnv** with a pointer to a valid *henv* overwrites that *henv.* This may be an application programming error. Furthermore, this returns the connection state to C1; the connection state must be C4 before the statement state is S0.

SQLAllocStmt

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
S1	-- [1]	S1 [1]	S1 [1]	S1 [1]	S1 [1]	S1 [1]

1 Calling **SQLAllocStmt** with a pointer to a valid *hstmt* overwrites that *hstmt*. This may be an application programming error.

SQLBindCol

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	--	--	--	(S1010)	(S1010)

SQLBindParameter

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	--	--	--	(S1010)	(S1010)

SQLConnect, and SQLDriverConnect

S0 Unal-located	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(08002)	(08002)	(08002)	(08002)	(08002)	(08002)	(08002)

SQLCancel [1]

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	--	S1 [np] S2 [p]	S1 [np] S3 [p]	S1 [2] S2 [nr and 3] S3 [r and 3] S7 [4]	S12

1 This table does not cover cancellation of a function running synchronously on one thread when an application calls **SQLCancel** on a different thread with the same *hstmt*. In this case, the driver must note that **SQLCancel** was called and return the correct return code and SQLSTATE (if any) from the synchronous function. The statement transition when that function finishes is NS (Next State). That is, the statement transition is the same as if the function completed processing normally; the only difference is that it is possible for the function to return SQL_ERROR and SQLSTATE S1008 (Operation canceled).

2 **SQLExecDirect** returned SQL_NEED_DATA.

3 **SQLExecute** returned SQL_NEED_DATA.

4 **SQLSetPos** returned SQL_NEED_DATA.

SQLColAttributes

S0 Unallo-cated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	see below	24000	-- [s] S11 [x]	(S1010)	NS [c] (S1010) [o]

SQLColAttributes (Prepared states)

S2 **No Results**	S3 Results
24000	**--** [s] **S11** [x]

SQLColumns, SQLGetTypeInfo, SQLPrimaryKeys, SQLSpecialColumns, SQLStatistics, and SQLTables

S0 **Unallo-cated**	**S1** **Alloca-ted**	**S2 – S3** **Prepa-red**	**S4** **Execu-ted**	**S5 – S7** **Cursor**	**S8 – S10** **Need Data**	**S11 – S12** **Async**
(IH)	**S5** [s] **S11** [x]	**S1** [e] **S5** [s] **S11** [x]	**S1** [e] **S5** [s] **S11** [x]	**see below**	**(S1010)**	**NS** [c] **(S1010)** [o]

SQLColumns, SQLGetTypeInfo, SQLPrimaryKeys, SQLSpecialColumns, SQLStatistics, and SQLTables (Cursor states

)

S5 **Opened**	**S6** **SQLFetch**	**S7** **SQLExtendedFetch**
24000	**(24000)**	**(24000)**

SQLConnect

C0 No *henv*	C1 Unallo-cated	C2 Allo-cated	C3 Need Data	C4 Con-nected	C5 *hstmt*	C6 Transaction
(IH)	(IH)	C3 [d] C4 [s]	-- [d] C2 [e]	(08002)	(08002)	(08002)
			C4 [s]			

SQLDataSources and SQLDrivers

S0 Unal-located	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
--	--	--	--	--	--	--

SQLDescribeCol

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	see below	24000	-- [s] S11 [x]	(S1010)	NS [c] (S1010) [o]

SQLDescribeCol (Prepared states)

S2 No Results	S3 Results
24000	-- [s] S11 [x]

SQLDescribeParam

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	-- [s] S11 [x]	-- [s] S11 [x]	-- [s] S11 [x]	(S1010)	NS [c] (S1010) [o]

SQLDisconnect

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
-- [1]	S0 [1]	S0 [1]	S0 [1]	S0 [1]	(S1010)	(S1010)

1 Calling **SQLDisconnect** frees all *hstmts* associated with the *hdbc*. Furthermore, this returns the connection state to C2; the connection state must be C4 before the statement state is S0.

SQLDriverConnect: see SQLConnect

SQLDrivers: see SQLDataSources

SQLError

S0 Unal-located	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Exe-cuted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH) [1]	--	--	--	--	--	--

1 This row shows transitions when *hstmt* was non-null.

SQLExecDirect

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	S4 [s and nr] S5 [s and r]	S1 [e] S4 [s and nr]	S1 [e] S4 [s and nr]	see below	(S1010)	NS [c] (S1010) [o]
	S8 [d]	S5 [s and r]	S5 [s and r]			
	S11 [x]	S8 [d]	S8 [d]			
		S11 [x]	S11 [x]			

SQLExecDirect (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
24000	(24000)	(24000)

SQLExecute

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	see below	S2 [e and p] S4 [s, p, and nr]	see below	(S1010)	NS [c] (S1010) [o]
			S8 [d and p]			
			S11 [x and p]			
			(S1010) [np]			

SQLExecute (Prepared states)

S2 No Results	S3 Results
S4 [s]	S5 [s] S8 [d]
S8 [d]	S11 [x]
S11 [x]	

SQLExecute (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
24000 [p]	(24000) [p] (S1010) [np]	(24000) [p] (S1010) [np]
(S1010) [np]		

SQLExtendedFetch

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	24000	see below	(S1010)	NS [c] (S1010) [o]

SQLExtendedFetch (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
S7 [s or nf]	(S1010)	-- [s or nf] S11 [x]
S11 [x]		

SQLFetch

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepared	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	24000	see below	(S1010)	NS [c] (S1010) [o]

SQLFetch (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
S6 [s or nf]	-- [s or nf] S11 [x]	(S1010)
S11 [x]		

SQLFreeConnect

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(S1010)	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)

SQLFreeEnv

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(S1010)	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)

SQLFreeStmt

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH) [1]	--	--	S1 [np] S2 [p]	S1 [np] S3 [p]	(S1010)	(S1010)
(IH) [2]	S0	S0	S0	S0	(S1010)	(S1010)
(IH) [3]	--	--	--	--	(S1010)	(S1010)

1 This row shows transitions when *fOption* was SQL_CLOSE.
2 This row shows transitions when *fOption* was SQL_DROP.
3 This row shows transitions when *fOption* was SQL_UNBIND or SQL_RESET_PARAMS.

SQLGetConnectOption

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
--	--	--	--	--	--	--

SQLGetCursorName

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	-- [1] (S1015) [2]	-- [1] (S1015) [2]	-- [1] (S1015) [2]	--	(S1010)	(S1010)

1 A cursor name had been set by calling **SQLSetCursorName** or by creating a result set.
2 A cursor name had not been set by calling **SQLSetCursorName** or by creating a result set.

SQLGetData

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	(24000)	see below	(S1010)	NS [c] (S1010) [o]

SQLGetData (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
(24000)	-- [s or nf] S11 [x]	-- [s or nf] S11 [x]
	24000 [3]	24000 [b]
		S1109 [i]
		S1C00 [v and 1]

1 The rowset size was greater than 1 and the **SQLGetInfo** did not return the SQL_GD_BLOCK bit for the SQL_GETDATA_EXTENSIONS information type.

SQLGetFunctions

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
--	--	--	--	--	--	--

SQLGetInfo

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
--	--	--	--	--	--	--

SQLGetStmtOption

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	-- [1] (24000) [2]	-- [1] (24000) [2]	-- [1] (24000) [2]	see below	(S1010)	(S1010)

1 The statement option was not SQL_ROW_NUMBER or SQL_GET_BOOKMARK.
2 The statement option was SQL_ROW_NUMBER or SQL_GET_BOOKMARK.

SQLGetStmtOption (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
-- [1]	-- [1 or (v and 3)] 24000 [b and 3]	-- [1 or (v and (2 or 3))] 24000 [b and (2 or 3)]
(24000) [2 or 3]	S1011 [2]	S1109 [i and (2 or 3)]
	S1109 [i and 3]	

1 The *fOption* argument was not SQL_GET_BOOKMARK or SQL_ROW_NUMBER.
2 The *fOption* argument was SQL_GET_BOOKMARK.
3 The *fOption* argument was SQL_ROW_NUMBER.

SQLGetTypeInfo: see SQLColumns

SQLNumParams

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	-- [s] S11 [x]	-- [s] S11 [x]	-- [s] S11 [x]	(S1010)	NS [c] (S1010) [o]

SQLNumResultCols

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	-- [s] S11 [x]	-- [s] S11 [x]	-- [s] S11 [x]	(S1010)	NS [c] (S1010) [o]

SQLParamData

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	(S1010)	(S1010)	see below	NS [c] (S1010) [o]

SQLParamData (Need Data states)

S8 Need Data	S9 Must Put	S10 Can Put
S1 e and 1	S1010	S1 e and 1
		S2 e, nr, and 2
S2 e, nr, and 2		
		S3 e, r, and 2
S3 e, r, and 2		
		S4 s, nr, and (1 or 2)
S7 e and 3		
		S5 s, r, and (1 or 2)
S9 s		
		S7 (s or e) and 3
S11 x		
		S9 d
		S11 x

1 **SQLExecDirect** returned SQL_NEED_DATA.
2 **SQLExecute** returned SQL_NEED_DATA.
3 **SQLSetPos** returned SQL_NEED_DATA.

SQLPrepare

S0 Unallo -cated	S1 Alloca- ted	S2 – S3 Prepa- red	S4 Execu- ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	S2 s and nr S3 s and r	-- s or (e and 1) S1 e and 2	S1 e S2 s and nr	see below	(S1010)	NS c (S1010) o
	S11 x	S11 x	S3 s and r			
			S11 x			

1 The preparation fails for a reason other than validating the statement (in other words, the SQLSTATE was S1009 (Invalid argument value) or S1090 (Invalid string or buffer length)).
2 The preparation fails while validating the statement (in other words, the SQLSTATE was not S1009 (Invalid argument value) or S1090 (Invalid string or buffer length)).

SQLPrepare (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
24000	(24000)	(24000)

SQLPrimaryKeys: see SQLColumns

SQLPutData

S0 Unallo -cated	S1 Alloca- ted	S2 – S3 Prepa- red	S4 Execu- ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	(S1010)	(S1010)	see below	NS [c] (S1010) [o]

SQLPutData (Need Data states)

S8 Need Data	S9 Must Put	S10 Can Put
S1010	S1 [e and 1] S2 [e, nr, and 2]	-- [s] S1 [e and 1]
	S3 [e, r, and 2]	S2 [e, nr, and 2]
	S7 [e and 3]	S3 [e, r, and 2]
	S10 [s]	S7 [e and 3]
	S11 [x]	S11 [x]

1 **SQLExecDirect** returned SQL_NEED_DATA.
2 **SQLExecute** returned SQL_NEED_DATA.
3 **SQLSetPos** returned SQL_NEED_DATA.

SQLRowCount

S0 Unallo- cated	S1 Alloca- ted	S2 – S3 Prepa- red	S4 Execu- ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	--	--	(S1010)	(S1010)

SQLSetConnectOption

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
-- [1]	--	--	--	--	(S1010)	(S1010)

1 This row shows transitions when *fOption* was a connection option. For transitions when *fOption* was a statement option, see the statement transition table for **SQLSetStmtOption**.

SQLSetCursorName

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	--	(24000)	(24000)	(S1010)	(S1010)

SQLSetPos

S0 Unallocated	S1 Allocated	S2 – S3 Prepared	S4 Executed	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	(S1010)	(S1010)	(24000)	see below	(S1010)	NS [c] (S1010) [o]

SQLSetPos (Cursor states)

S5 Opened	S6 SQLFetch	S7 SQLExtendedFetch
(24000)	(S1010)	-- [s] S8 [d] S11 [x] 24000 [b] S1109 [i]

SQLSetScrollOptions

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	(S1010)	(S1010)	(S1010)	(S1010)	(S1010)

SQLSetStmtOption

S0 Unal-located	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
(IH)	--	-- [1] (S1011) [2]	-- [1] (24000) [2]	-- [1] (24000) [2]	(S1010) [np or 1] (S1011) [p and 2]	(S1010) [np or 1] (S1011) [p and 2]

1 The *fOption* argument was not SQL_CONCURRENCY, SQL_CURSOR_TYPE, SQL_SIMULATE_CURSOR, or SQL_USE_BOOKMARKS.
2 The *fOption* argument was SQL_CONCURRENCY, SQL_CURSOR_TYPE, SQL_SIMULATE_CURSOR, or SQL_USE_BOOKMARKS.

SQLSpecialColumns: see SQLColumns

SQLStatistics: see SQLColumns

SQLTables: see SQLColumns

SQLTransact

S0 Unallo-cated	S1 Alloca-ted	S2 – S3 Prepa-red	S4 Execu-ted	S5 – S7 Cursor	S8 – S10 Need Data	S11 – S12 Async
--	--	-- [2 or 3] S1 [1]	-- [3] S1 [np and(1 or 2)] S1 [p and 1] S2 [p and 2]	-- [3] S1 [np and(1 or 2)] S1 [p and 1] S3 [p and 2]	(S1010)	(S1010)

1 The *fType* argument is SQL_COMMIT and **SQLGetInfo** returns SQL_CB_DELETE for the SQL_CURSOR_COMMIT_BEHAVIOR information type, or the *fType* argument is SQL_ROLLBACK and **SQLGetInfo** returns SQL_CB_DELETE for the SQL_CURSOR_ROLLBACK_BEHAVIOR information type.

2 The *fType* argument is SQL_COMMIT and **SQLGetInfo** returns SQL_CB_CLOSE for the SQL_CURSOR_COMMIT_BEHAVIOR information type, or the *fType* argument is SQL_ROLLBACK and **SQLGetInfo** returns SQL_CB_CLOSE for the SQL_CURSOR_ROLLBACK_BEHAVIOR information type.

3 The *fType* argument is SQL_COMMIT and **SQLGetInfo** returns SQL_CB_PRESERVE for the SQL_CURSOR_COMMIT_BEHAVIOR information type, or the *fType* argument is SQL_ROLLBACK and **SQLGetInfo** returns SQL_CB_PRESERVE for the SQL_CURSOR_ROLLBACK_BEHAVIOR information type.

C
SQL Grammar

The following paragraphs list the recommended constructs to ensure interoperability in calls to **SQLPrepare**, **SQLExecute**, or **SQLExecDirect**. To the right of each construct is an indicator that tells whether the construct is part of the minimum grammar, the core grammar, or the extended grammar. ODBC does not prohibit the use of vendor-specific SQL grammar.

The Integrity Enhancement Facility (IEF) is included in the grammar but is optional. If drivers parse and execute SQL directly and wish to include referential integrity functionality, then we strongly recommend the SQL syntax used for this functionality conform to the grammar used here. The grammar for the IEF is taken directly from the X/Open and SQL Access Group SQL CAE specification (1992) and is a subset of the emerging ISO SQL-92 standard. Elements that are part of the IEF and are optional in the ANSI 1989 standard are presented in the following typeface and font, distinct from the rest of the grammar:

table-constraint-definition

A given driver and data source do not necessarily support all of the data types defined in this grammar. To determine which data types a driver supports, an application calls **SQLGetInfo** with the SQL_ODBC_SQL_CONFORMANCE flag. Drivers that support every core data type return 1 and drivers that support every core and every extended data type return 2. To determine whether a specific data type is supported, an application calls **SQLGetTypeInfo** with the *fSqlType* argument set to that data type.

If a driver supports data types that map to the ODBC SQL date, time, or timestamp data types, the driver must also support the extended SQL grammar for specifying date, time, or timestamp literals.

Note In **CREATE TABLE** and **ALTER TABLE** statements, applications must use the data type name returned by **SQLGetTypeInfo** in the TYPE_NAME column.

Parameter Data Types

Even though each parameter specified with **SQLBindParameter** is defined using an SQL data type, the parameters in an SQL statement have no intrinsic data type. Therefore, parameter markers can be included in an SQL statement only if their data types can be inferred from another operand in the statement. For example, in an arithmetic expression such as **? + COLUMN1**, the data type of the parameter can be inferred from the data type of the named column represented by COLUMN1. An application cannot use a parameter marker if the data type cannot be determined.

The following table describes how a data type is determined for several types of parameters.

Location of Parameter	Assumed Data Type
One operand of a binary arithmetic or comparison operator	Same as the other operand
The first operand in a **BETWEEN** clause	Same as the other operand
The second or third operand in a **BETWEEN** clause	Same as the first operand
An expression used with **IN**	Same as the first value or the result column of the subquery
A value used with **IN**	Same as the expression
A pattern value used with **LIKE**	VARCHAR
An update value used with **UPDATE**	Same as the update column

Parameter Markers

An application cannot place parameter markers in the following locations:

- In a **SELECT** list.
- As both expressions in a comparison-predicate.
- As both operands of a binary operator.
- As both the first and second operands of a **BETWEEN** operation.
- As both the first and third operands of a **BETWEEN** operation.
- As both the expression and the first value of an **IN** operation.
- As the operand of a unary + or – operation.

- As the argument of a *set-function-reference*.

For more information, see the ANSI SQL-92 specification.

If an application includes parameter markers in the SQL statement, the application must call **SQLBindParameter** to associate storage locations with parameter markers before it calls **SQLExecute** or **SQLExecDirect**. If the application calls **SQLPrepare**, the application can call **SQLBindParameter** before or after it calls **SQLPrepare**.

The application can set parameter markers in any order. The driver buffers argument descriptors and sends the current values referenced by the **SQLBindParameter** argument *rgbValue* for the associated parameter marker when the application calls **SQLExecute** or **SQLExecDirect**. It is the application's responsibility to ensure that all pointer arguments are valid at execution time.

NOTE: The keyword **USER** in the following tables represents a character string containing the *user-name* of the current user.

SQL Statements

The following SQL statements define the base ODBC SQL grammar.

Statement	Mini-mum	Core	Exten-ded	SOLID *Embedded Engne*
alter-table-statement ::= ALTER TABLE *base-table-name* { ADD *column-identifier data-type* | ADD (*column-identifier data-type* [, *column-identifier data-type*]...) } Important As a data-type in an alter-table-statement, applications must use a data type from the TYPE_NAME column of the result set returned by SQLGetTypeInfo.		•		•
alter-table-statement ::= ALTER TABLE *base-table-name* { ADD *column-identifier data-type* | ADD (*column-identifier data-type* [, *column-identifier data-type*]...) | DROP [COLUMN] *column-identifier* [CASCADE | RESTRICT] } Important As a data-type in an alter-table-statement, applications must use a data type from the TYPE_NAME column of the result set returned by SQLGetTypeInfo.			•	•
Note Objects are always dropped with drop behavior RESTRICT.				
create-index-statement ::= CREATE [UNIQUE] INDEX *index-name* ON *base-table-name* (*column-identifier* [ASC | DESC] [, *column-identifier* [ASC | DESC]]...)		•		•

create-table-statement ::= • •
  CREATE TABLE *base-table-name*
  (*column-element* [, *column-element*] ...)

column-element ::= *column-definition* |
  table-constraint-definition

column-definition ::=
  column-identifier data-type
  [DEFAULT *default-value*]
  [*column-constraint-definition*
    [*column-constraint-definition*]...]

default-value::= literal | NULL | USER

column-constraint-definition ::=
  NOT NULL | UNIQUE |
  PRIMARY KEY |
  REFERENCES *ref-table-name*
    referenced-columns |
  CHECK (*search-condition*)

table-constraint-definition ::=
  UNIQUE (*column-identifier*
    [, *column-identifier*]...) |
  PRIMARY KEY (*column-identifier*
    [, *column-identifier*]...) |
  CHECK (*search-condition*) |
  FORIEGN-KEY *referencing-columns*
  REFERENCES *ref-table-name*
    referenced-columns

Important As a data-type in a create-table-statement, applications must use a data type from the TYPE_NAME column of the result set returned by SQLGetTypeInfo.

Note Keyword DEFAULT not is supported in column-definitions in the SQL grammar of SOLID *Server.*

create-view-statement ::= • •
  CREATE VIEW *viewed-table-name*
  [(*column-identifier*
    [, *column-identifier*]...)]
  AS *query-specification*

delete-statement-positioned ::= DELETE FROM *table-name* WHERE CURRENT OF *cursor-name*		●ODBC 1.0	●ODBC C 2.0	●
delete-statement-searched ::= DELETE FROM *table-name* [WHERE *search-condition*]	●			●
drop-index-statement ::= DROP INDEX *index-name*		●		●
drop-table-statement ::= DROP TABLE *base-table-name* [CASCADE | RESTRICT]	●			●
Note Objects are always dropped with drop behavior RESTRICT.				
drop-view-statement ::= DROP VIEW *viewer-table-name* [CASCADE | RESTRICT]		●		●
Note Objects are always dropped with drop behavior RESTRICT.				
grant-statement ::= GRANT {ALL | *grant-privilege*]... } ON *table-name* TO {PUBLIC | *user-name* [, *user-name*] ...} *grant-privilege* ::= DELETE | INSERT | SELECT | UPDATE [(*column-identifier* [, *column-identifier*]...)] | REFERENCES [(*column-identifier* [, *column-identifier*]...)]		●		●
insert-statement ::= INSERT INTO *table-name* [(*column-identifier* [, *column-identifier*]...)] VALUES (*insert-value* [, *insert-value*]...)	●			●

insert-statement ::= INSERT INTO *table-name* [(*column-identifier* [, *column-identifier*]...)] { *query-specification* | VALUES (*insert-value* [, *insert-value*]...)}	•	•
ODBC-procedure-extension ::= *ODBC-std-esc-initiator* [?=] *call procedure* *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* [?=] *call procedure* *ODBC-ext-esc-terminator*	•	•
revoke-statement ::= REVOKE { ALL | *revoke-privilege* [, *revoke-privilege*]... } ON *table-name* FROM {PUBLIC | *user-name* [, *user-name*]... } [CASCADE | RESTRICT] *revoke-privilege* :: = DELETE | INSERT | SELECT | UPDATE | REFERENCES	•	•
Note. Keywords CASCADE and RESTRICT are not supported in the SQL grammar of SOLID *Server.*		
select-statement ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] [*order-by-clause*]	•	•

select-statement ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] [GROUP BY *column-name* [, *column-name*]...] [HAVING *search-condition*] [*order-by-clause*]	•		•
select-statement ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] [GROUP BY *column-name* [, *column-name*]...] [HAVING *search-condition*] [UNION [ALL] *select-statement*]... [*order-by-clause*] (In ODBC 1.0, the **UNION** clause was in the Core SQL grammar and did not support the **ALL** keyword.)		•	•
select-for-update-statement ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] FOR UPDATE OF [*column-name* [, *column-name*]...]	• ODBC 1.0	• ODBC 2.0	•
statement ::= *create-table-statement* | *delete-statement-searched* | *drop-table-statement* | *insert-stetement* | *select-statement* | *update-statement-searched*	•		•

statement ::= *alter-table-statement* | *create-index-statement* | *create-table-statement* | *create-view-statement* | *delete-statement-searched* | *drop-index-statement* | *drop-table-statement* | *drop-view-stetement* | *grant-statement* | *insert-stetement* | *revoke-statement* | *select-statement* | *update-statement-searched*	•	•
statement ::= *alter-table-statement* | *create-index-statement* | *create-table-statement* | *create-view-statement* | *delete-statement-positioned* | *delete-statement-searched* | *drop-index-statement* | *drop-table-statement* | *drop-view-stetement* | *grant-statement* | *insert-stetement* | *ODBC-procedure-statement* | *revoke-statement* | *select-statement* | *select-for-update-statement* | *statement-list* | *update-stetement-positioned* | *update-statement-searched* (In ODBC 1.0, *select-for-update-statement*, *update-statement-positioned*, and *delete-statement-positioned* were in the Core SQL grammar.)	•	•
statement-list ::= *statement* | *statement*; *statement-list*	•	

update-statement-positioned ::= UPDATE *table-name* SET *column-identifier* = {*expression* | NULL} [, *column-identifier* = {*expression* | NULL}]... WHERE CURRENT OF *cursor-name*		• ODBC 1.0	• ODBC 2.0	•
update-statement-searched ::= UPDATE *table-name* SET *column-identifier* = {*expression* | NULL} [, *column-identifier* = {*expression* | NULL}]... [WHERE *search-condition*]	•			•

Elements Used in SQL Statements

The following elements are used in the SQL statements listed previously.

Element	Mini-mum	Core	Exten-ded	SOLID *Embedded Engine*
all-function ::= {AVG | MAX | MIN | SUM} (*expression*)		•		•
approximate-numeric-literal ::= *mantissa*E*exponent*		•		•
approximate-numeric-type ::= {approximate numeric types} (For example, FLOAT, DOUBLE PRECISION, or REAL. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•		•
argument-list ::= *expression* | *expression, argument-list*	•			•
base-table-identifier ::= *user-defined-name*	•			•
base-table-name ::= *base-table-identifier*	•			•
base-table-name ::= *base-table-identifier* | *owner-name*.*base-table-identifier* | *qualifier-name qualifier-separator base-table-identifier* | *qualifier-name qualifier-separator* [*owner-name*].*base-table-identifier* (The third syntax is valid only if the data source does not support owners.)		•		•
between-predicate ::= *expression* [NOT] BETWEEN *expression* AND *expression*		•		•
binary-literal ::= {implementation defined}			•	

binary-type ::= {binary types} (For example, BINARY, VARBINARY, or LONG VARBINARY. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•	•
bit-literal ::= 0 | 1		•	
bit-type ::= {bit types} (For example, BIT. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•	
boolean-factor ::= [NOT] *boolean-primary*	•		•
boolean-primary ::= *predicate* | (*search-condition*)	•		•
boolean-term ::= *boolean-factor* [AND *boolean-term*]	•		•
character ::= {any character in the implementor's character set}	•		•
character-string-literal :: = '{*character*}...' (To include a single literal quote character (') in a *character-string-literal*, use two literal quote characters (' ').)	•		•
character-string-type ::= {character types} (The Minimum SQL conformance level requires at least one character data type. For example, CHAR, VARCHAR, or LONG VARCHAR. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)	•		•
column-alias ::= *user-defined-name*		•	•
column-identifier ::= *user-defined-name*	•		•
column-name ::= [*table-name*.]*column-identifier*	•		•

column-name ::= [{*table-name* | *correlation-name*}.]*column-identifier*		•	•
comparison-operator ::= < | > | <= | >= | = | <>	•		•
comparison-predicate ::= *expression comparison-operator expression*	•		•
comparison-predicate ::= *expression comparison-operator* {*expression* | (*sub-query*)}		•	•
correlation-name ::= *user-defined-name*		•	•
cursor-name ::= user-defined-name		•	•
data-type ::= *character-string-type*	•		
data-type ::= *character-string-type* | *exact-numeric-type* | *approximate-numeric-type*		•	
data-type ::= *character-string-type* | *exact-numeric-type* | *approximate-numeric-type* | *bit-type* | *binary-type* | *date-type* | *time-type* | *timestamp-type*			• •
date-separator ::= -		•	•
date-type ::= {date types} (For example, DATE. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•	•
date-value ::= *years-value date-separator months-value date-separator days-value*		•	•
days-value ::= *digit digit*		•	•
digit ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9	•		•

distinct-function ::= {AVG | COUNT | MAX | MIN | SUM} (DISTINCT *column-name*)		•	•
dynamic-parameter ::= ?	•		•
empty-string ::=		•	•
escape-character ::= *character*		•	•
exact-numeric-literal ::= [+|–] {*unsigned-integer*[.*unsigned-integer*] | *unsigned-integer.* | .*unsigned-integer* }		•	•
exact-numeric-type ::= {exact numeric types} (For example, DECIMAL, NUMERIC, SMALLINT, or INTEGER. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•	•
exact-numeric-type ::= {exact numeric types} (For example, DECIMAL, NUMERIC, SMALLINT, INTEGER, and BIGINT. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)		•	
exists-predicate ::= EXISTS (*sub-query*)		•	•
exponent ::= [+|–] *unsigned-integer*		•	•
expression ::= *term* | *expression* {+|–} *term*	•		•
factor ::= [+|–]*primary*	•		•
hours-value ::= *digit digit*		•	•
index-identifier ::= *user-defined-name*		•	•
index-name ::= [*index-qualifier.*]*index-identifier*		•	•
index-qualifier ::= *user-defined-name*		•	•

in-predicate ::= *expression* [NOT] IN {(*value* {, *value*}...) | (*sub-query*)}		•	•
insert-value ::= *dynamic-parameter* | *literal* | NULL | USER	•		•
keyword ::= (see list of reserved keywords)	•		•
length ::= *unsigned-integer*	•		•
letter ::= *lower-case-letter* | *upper-case-letter*	•		•
like-predicate ::= *expression* [NOT] LIKE *pattern-value*	•		•
like-predicate ::= *expression* [NOT] LIKE *pattern-value* [*ODBC-like-escape-clause*]		•	•
literal ::= *character-string-literal*	•		•
literal ::= *character-string-literal* | *numeric-literal*		•	•
literal ::= *character-string-literal* | *numeric-literal* | *bit-literal* | *binary-literal* | *ODBC-date-time-extension*		•	•
lower-case-letter ::= a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z	•		•
mantissa ::= *exact-numeric-literal*		•	•
minutes-value ::= *digit digit*		•	•
months-value ::= *digit digit*		•	•
null-predicate ::= *column-name* IS [NOT] NULL	•		•
numeric-literal ::= *exact-numeric-literal* | *approximate-numeric-literal*	•		•

ODBC-date-literal ::= *ODBC-std-esc-initiator* d '*date-value*' *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* d '*date-value*' *ODBC-ext-esc-terminator*	•	•
ODBC-date-time-extension ::= *ODBC-date-literal* | *ODBC-time-literal* | *ODBC-timestamp-literal*	•	•
ODBC-like-escape-clause ::= *ODBC-std-esc-initiator* escape '*escape-character*' *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* escape '*escape-character*' *DBC-ext-esc-terminator*	•	•
ODBC-time-literal ::= *ODBC-std-esc-initiator* t '*time-value*' *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* t '*time-value*' *ODBC-ext-esc-terminator*	•	•
ODBC-timestamp-literal ::= *ODBC-std-esc-initiator* ts '*timestamp-value*' *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* ts '*timestamp-value*' *ODBC-ext-esc-terminator*	•	•
ODBC-ext-esc-initiator ::= {	•	•
ODBC-ext-esc-terminator ::= }	•	•
ODBC-outer-join-extension ::= *ODBC-std-esc-initiator* oj *outer-join* *ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* oj *outer-join* *ODBC-ext-esc-terminator*	•	•

ODBC-scalar-function-extension ::= *ODBC-std-esc-initiator* fn *scalar-function ODBC-std-esc-terminator* | *ODBC-ext-esc-initiator* fn *scalar-function ODBC-ext-esc-terminator*			•	•
ODBC-std-esc-initiator ::= *ODBC-std-esc-prefix SQL-esc-vendor-clause*			•	•
ODBC-std-esc-prefix ::= --(*			•	•
ODBC-std-esc-terminator ::= *)--			•	•
order-by-clause ::= ORDER BY *sort-specification* [, *sort-specification*]...	•			•
outer-join ::= *table-name* [*correlation-name*] LEFT OUTER JOIN {*table-name* [*correlation-name*] | *outer-join*} ON *search-condition* (For outer joins, *search-condition* must contain only the join condition between the specified *table-names*.)			•	•
owner-name ::= *user-defined-name*		•		•
pattern-value ::= *character-string-literal* | *dynamic-parameter* (In a *character-string-literal*, the percent character (%) matches 0 or more of any character; the underscore character (_) matches 1 character.)	•			
pattern-value ::= *character-string-literal* | *dynamic-parameter* | USER (In a *character-string-literal*, the percent character (%) matches 0 or more of any character; the underscore character (_) matches 1 character.)		•		•

precision ::= *unsigned-integer*		•	•
predicate ::= *comparison-predicate* | *like-predicate* | *null-predicate*	•		
predicate ::= *between-predicate* | *comparison-predicate* | *exists-predicate* | *in-predicate* | *like-predicate* | *null-predicate* | *quantified-predicate*		•	•
primary ::= *column-name* | *dynamic-parameter* | *literal* | (*expression*)	•		
primary ::= *column-name* | *dynamic-parameter* | *literal* | *set-function-reference* | USER | (*expression*)		•	•
primary ::= *column-name* | *dynamic-parameter* | *literal* | *ODBC-scalar-function-extension* | *set-function-reference* | USER | (*expression*)		•	•
procedure ::= *procedure-name* | *procedure-name* (*procedure-parameter-list*)		•	•
procedure-identifier ::= *user-defined-name*		•	•
procedure-name ::= *procedure-identifier* | *owner-name.procedure-identifier* | *qualifier-name qualifier-separator* *procedure-identifier* | *qualifier-name qualifier-separator* [*owner-name*].*procedure-identifier* (The third syntax is valid only if the data source does not support owners.)		•	•
procedure-parameter-list ::= *procedure-parameter* | *procedure-parameter,* *procedure-parameter-list*		•	•

procedure-parameter ::= *dynamic-parameter* | *literal* | *empty-string* (If a procedure parameter is an empty string, the procedure uses the default value for that parameter.)		•	•
qualifier-name ::= *user-defined-name*	•		
qualifier-separator ::= {implementation-defined} (The qualifier separator is returned through **SQLGetInfo** with the SQL_QUALIFIER_NAME_SEPARATOR option.)	•		
quantified-predicate ::= *expression comparison-operator* {ALL | ANY} (*sub-query*)	•		•
query-specification ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] [GROUP BY *column-name*, [*column-name*]...] [HAVING *search-condition*]	•		•
ref-table-name ::= *base-table-identifier*	•		•
ref-table-name ::= *base-table-identifier* | *owner-name*.*base-table-identifier* | *qualifier-name qualifier-separator* *base-table-identifier* | *qualifier-name qualifier-separator* [*owner-name*].*base-table-identifier* (The third syntax is valid only if the data source does not support owners.)	•		•
referenced-columns ::= (*column-identifier* [, *column-identifier*]...)	•		•
referencing-columns ::= (*column-identifier* [, *column-identifier*]...)	•		•

scalar-function ::= *function-name* (*argument-list*) (The definitions for the non-terminals *function-name* and *function-name* (*argument-list*) are derived from the list of scalar functions in Appendix F, "Scalar Functions.")			•	•
scale ::= *unsigned-integer*		•		•
search-condition ::= *boolean-term* [OR *search-condition*]	•			•
seconds-fraction ::= *unsigned-integer*			•	•
seconds-value ::= *digit digit*			•	•
select-list ::= * | *select-sublist* [, *select-sublist*]...	•			•
select-sublist ::= *expression*	•			•
select-sublist ::= *expression* [[AS] *column-alias*] | {*table-name* | *correlation-name*}.*		•		•
set-function-reference ::= COUNT(*) | *distinct-function* | *all-function*		•		•
sort-specification ::= {*unsigned-integer* | *column-name* } [ASC | DESC]	•			•
SQL-esc-vendor-clause ::= VEN-DOR(Microsoft), PRODUCT(ODBC)			•	•
sub-query ::= SELECT [ALL | DISTINCT] *select-list* FROM *table-reference-list* [WHERE *search-condition*] [GROUP BY *column-name* [, *column-name*]...] [HAVING *search-condition*]		•		•
table-identifier ::= *user-defined-name*	•			•

table-name ::= *table-identifier*	•			•
table-name ::= *table-identifier* | *owner-name*.*table-identifier* | *qualifier-name qualifier-separator table-identifier* | *qualifier-name qualifier-separator* [*owner-name*].*table-identifier* (The third syntax is valid only if the data source does not support owners.)		•		•
table-reference ::= table-name	•			
table-reference ::= table-name [*correlation-name*]		•		
table-reference::= *table-name* [*correlation-name*] | *ODBC-outer-join-extension* (A **SELECT** statement can contain only one *table-reference* that is an *ODBC-outer-join-extension*.)			•	•
table-reference-list ::= *table-reference* [,*table-reference*]…		•		•
term ::= *factor* | *term* {*|/} *factor*	•			•
time-separator ::= :			•	•
time-type ::= {time types} (For example, TIME. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)			•	•
time-value ::= *hours-value time-separator minutes-value time-separator seconds-value*			•	•
timestamp-separator ::= (The blank character.)			•	•

timestamp-type ::= {timestamp types} (For example, TIMESTAMP. To determine the type name used by a data source, an application calls **SQLGetTypeInfo**.)			•	•
timestamp-value ::= *date-value timestamp-separator* *time-value*[.*seconds-fraction*]			•	•
unsigned-integer ::= {*digit*}...	•			•
upper-case-letter ::= A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z	•			•
user-defined-name ::= *letter*[*digit* | *letter*| _]...	•			•
user-name ::= user-defined-name		•		•
value ::= *literal* | USER | *dynamic-parameter*		•		•
viewed-table-identifier ::= *user-defined-name*		•		•
viewed-table-name ::= *viewed-table-identifier* | *owner-name.viewed-table-identifier* | *qualifier-name qualifier-separator* *viewed-table-identifier* | *qualifier-name qualifier-separator* [*owner-name*].*viewed-table-identifier* (The third syntax is valid only if the data source does not support owners.)		•		•
years-value ::= *digit digit digit digit*			•	•

List of Reserved Keywords

The following words are reserved for use in ODBC function calls. These words do not constrain the minimum SQL grammar; however, to ensure compatibility with drivers that support the core SQL grammar, applications should avoid using any of these keywords. The #**define** value SQL_ODBC_KEYWORDS contains a comma-separated list of these keywords.

For a complete list of reserved keywords in several SQL standards and SOLID *SQL API* see *Appendix F Reserved Words* of **SOLID *Embedded Engine* Administrator's Guide**.

ABSOLUTE	ADA
ADD	ALL
ALLOCATE	ALTER
AND	ANY
ARE	AS
ASC	ASSERTION
AT	AUTHORIZATION
AVG	BEGIN
BETWEEN	BIT
BIT_LENGTH	BY
CASCADE	CASCADED
CASE	CAST
CATALOG	CHAR
CHAR_LENGTH	CHARACTER
CHARACTER_LENGTH	CHECK
CLOSE	COALESCE
COBOL	COLLATE
COLLATION	COLUMN
COMMIT	CONNECT
CONNECTION	CONSTRAINT
CONSTRAINTS	CONTINUE

CONVERT
CORRESPONDING
COUNT
CREATE
CURRENT
CURRENT_DATE
CURRENT_TIME
CURRENT_TIMESTAMP
CURSOR
DATE
DAY
DEALLOCATE
DEC
DECIMAL
DECLARE
DEFERRABLE
DEFERRED
DELETE
DESC
DESCRIBE
DESCRIPTOR
DIAGNOSTICS
DICTIONARY
DISCONNECT
DISPLACEMENT
DISTINCT
DOMAIN
DOUBLE
DROP
ELSE
END
END-EXEC
ESCAPE
EXCEPT
EXCEPTION
EXEC
EXECUTE
EXISTS
EXTERNAL
EXTRACT
FALSE
FETCH
FIRST
FLOAT
FOR
FOREIGN
FORTRAN
FOUND
FROM
FULL
GET
GLOBAL
GO
GOTO
GRANT
GROUP
HAVING
HOUR

IDENTITY
IGNORE
IMMEDIATE
IN
INCLUDE
INDEX
INDICATOR
INITIALLY
INNER
INPUT
INSENSITIVE
INSERT
INTEGER
INTERSECT
INTERVAL
INTO
IS
ISOLATION
JOIN
KEY
LANGUAGE
LAST
LEFT
LEVEL
LIKE
LOCAL
LOWER
MATCH
MAX
MIN
MINUTE
MODULE
MONTH
MUMPS
NAMES
NATIONAL
NCHAR
NEXT
NONE
NOT
NULL
NULLIF
NUMERIC
OCTET_LENGTH
OF
OFF
ON
ONLY
OPEN
OPTION
OR
ORDER
OUTER
OUTPUT
OVERLAPS
PARTIAL
PASCAL
PLI

POSITION
PRECISION
PREPARE
PRESERVE
PRIMARY
PRIOR
PRIVILEGES
PROCEDURE
PUBLIC
RESTRICT
REVOKE
RIGHT
ROLLBACK
ROWS
SCHEMA
SCROLL
SECOND
SECTION
SELECT
SEQUENCE
SET
SIZE
SMALLINT
SOME
SQL
SQLCA
SQLCODE
SQLERROR
SQLSTATE
SQLWARNING
SUBSTRING
SUM
SYSTEM
TABLE
TEMPORARY
THEN
TIME
TIMESTAMP
TIMEZONE_HOUR
TIMEZONE_MINUTE
TO
TRANSACTION
TRANSLATE
TRANSLATION
TRUE
UNION
UNIQUE
UNKNOWN
UPDATE
UPPER
USAGE
USER
USING
VALUE
VALUES
VARCHAR
VARYING
VIEW

WHEN	WHENEVER
WHERE	WITH
WORK	YEAR

D

Data Types

Data stored on a data source has an SQL data type, which may be specific to that data source. A driver maps data source–specific SQL data types to ODBC SQL data types and driver-specific SQL data types. (A driver returns these mappings through **SQLGetTypeInfo**. It also returns the SQL data types when describing the data types of columns and parameters in **SQLColAttributes**, **SQLColumns**, **SQLDescribeCol**, **SQLDescribeParam**, **SQLProcedureColumns**, and **SQLSpecialColumns**.)

Each SQL data type corresponds to an ODBC C data type. By default, the driver assumes that the C data type of a storage location corresponds to the SQL data type of the column or parameter to which the location is bound. If the C data type of a storage location is not the *default* C data type, the application can specify the correct C data type with the *fCType* argument in **SQLBindCol**, **SQLGetData**, or **SQLBindParameter**. Before returning data from the data source, the driver converts it to the specified C data type. Before sending data to the data source, the driver converts it from the specified C data type.

This appendix discusses the following:

- ODBC SQL data types
- ODBC C data types
- Default ODBC C data types
- Transferring data in its binary form
- Precision, scale, length, and display size of SQL data types
- Converting data from SQL to C data types
- Converting data from C to SQL data types

For information about driver-specific SQL data types, see the driver's documentation.

SQL Data Types

The ODBC SQL grammar defines three sets of SQL data types, each of which is a superset of the previous set.

- **Minimum** SQL data types provide a basic level of ODBC conformance.
- **Core** SQL data types are the data types in the X/Open and SQL Access Group SQL CAE specification (1992) and are supported by most SQL data sources.
- **Extended** SQL data types are additional data types supported by some SQL data sources.

A given driver and data source do not necessarily support all of the SQL data types defined in the ODBC grammar. Furthermore, they may support additional, driver-specific SQL data types. To determine which data types a driver supports, an application calls **SQLGetTypeInfo**. For information about driver-specific SQL data types, see the driver's documentation.

Minimum SQL Data Types

The following table lists valid values of *fSqlType* for the minimum SQL data types. These values are defined in SQL.H. The table also lists the name and description of the corresponding data type from the X/Open and SQL Access Group SQL CAE specification (1992).

NOTE: The minimum SQL grammar requires that a data source support at least one character SQL data type. This table is only a guideline and shows commonly used names and limits of these data types. For a given data source, the characteristics of these data types may differ from those listed below. For information about the data types in a specific data source, see the documentation for that data source.

To determine which data types are supported by a data source and the characteristics of those data types, an application calls **SQLGetTypeInfo**.

fSqlType	SQL Data Type	Description
SQL_CHAR	CHAR(*n*)	Character string of fixed string length *n* ($1 \le n \le 254$).
SQL_VARCHAR	VARCHAR(*n*)	Variable-length character string with a maximum string length *n* ($1 \le n \le 254$).
SQL_LONGVARCHAR	LONG VARCHAR	Variable length character data. Maximum length is data source–dependent.

Core SQL Data Types

The following table lists valid values of *fSqlType* for the core SQL data types. These values are defined in SQL.H. The table also lists the name and description of the corresponding data type from the X/Open and SQL Access Group SQL CAE specification (1992). In the table, precision refers to the total number of digits and scale refers to the number of digits to the right of the decimal point.

NOTE: This table is only a guideline and shows commonly used names, ranges, and limits of core SQL data types. A given data source may support only some of the listed data types and the characteristics of the supported data types may differ from those listed below. For example, some data sources support unsigned numeric data types. For information about the data types in a specific data source, see the documentation for that data source. To determine which data types are supported by a data source and the characteristics of those data types, an application calls **SQLGetTypeInfo**.

fSqlType	SQL Data Type	Description
SQL_DECIMAL	DECIMAL(*p*,*s*)	Signed, exact, numeric value with a precision *p* and scale *s* ($1 \le p \le 15$; $0 \le s \le p$).
SQL_NUMERIC	NUMERIC(*p*,*s*)	Signed, exact, numeric value with a precision *p* and scale *s* ($1 \le p \le 15$; $0 \le s \le p$).
SQL_SMALLINT	SMALLINT	Exact numeric value with precision 5 and scale 0 (signed: $-32{,}768 \le n \le 32{,}767$, unsigned: $0 \le n \le 65{,}535$) [a].
SQL_INTEGER	INTEGER	Exact numeric value with precision 10 and scale 0 (signed: $-2^{31} \le n \le 2^{31} - 1$, unsigned: $0 \le n \le 2^{32} - 1$) [a].
SQL_REAL	REAL	Signed, approximate, numeric value with a mantissa precision 7 (zero or absolute value 10^{-38} to 10^{38}).
SQL_FLOAT	FLOAT	Signed, approximate, numeric value with a mantissa precision 15 (zero or absolute value 10^{-308} to 10^{308}).
SQL_DOUBLE	DOUBLE PRECISION	Signed, approximate, numeric value with a mantissa precision 15 (zero or absolute value 10^{-308} to 10^{308}).

a An application uses **SQLGetTypeInfo** or **SQLColAttributes** to determine if a particular data type or a particular column in a result set is unsigned.

Extended SQL Data Types

The following table lists valid values of *fSqlType* for the extended SQL data types. These values are defined in SQLEXT.H. The table also lists the name and description of the corresponding data type. In the table, precision refers to the total number of digits and scale refers to the number of digits to the right of the decimal point.

NOTE: This table is only a guideline and shows commonly used names, ranges, and limits of extended SQL data types. A given data source may support only some of the listed data types and the characteristics of the supported data types may differ from those listed below. For example, some data sources support unsigned numeric data types. For information about the data types in a specific data source, see the documentation for that data source. To determine which data types are supported by a data source and the characteristics of those data types, an application calls **SQLGetTypeInfo**.

fSqlType	Typical SQL Data Type	Description
SQL_BIT	BIT	Single bit binary data.
SQL_TINYINT	TINYINT	Exact numeric value with precision 3 and scale 0 (signed: $-128 \le n \le 127$, unsigned: $0 \le n \le 255$) a.
SQL_BIGINT	BIGINT	Exact numeric value with precision 19 (if signed) or 20 (if unsigned) and scale 0 (signed: $-2^{63} \le n \le 2^{63} - 1$, unsigned: $0 \le n \le 2^{64} - 1$) a.
SQL_BINARY	BINARY(*n*)	Binary data of fixed length *n* ($1 \le n \le 255$).
SQL_VARBINARY	VARBINARY(*n*)	Variable length binary data of maximum length *n* ($1 \le n \le 255$).
SQL_LONGVARBINARY	LONG VARBINARY	Variable length binary data. Maximum length is data source–dependent.

SQL_DATE	DATE	Date data.
SQL_TIME	TIME	Time data.
SQL_TIMESTAMP	TIMESTAMP	Date/time data.

[a] An application uses **SQLGetTypeInfo** or **SQLColAttributes** to determine if a particular data type or a particular column in a result set is unsigned.

C Data Types

Data is stored in the application in ODBC C data types. The core C data types are those that support the minimum and core SQL data types. They also support some extended SQL data types. The extended C data types are those that only support extended SQL data types. The bookmark C data type is used only to retrieve bookmark values and should not be converted to other data types.

NOTE: Unsigned C data types for integers were added to ODBC 2.0. Drivers must support the integer C data types specified in both ODBC 1.0 and ODBC 2.0; ODBC 2.0 or later applications must use the ODBC 1.0 integer C data types with ODBC 1.0 drivers and the ODBC 2.0 integer C data types with ODBC 2.0 drivers.

The C data type is specified in the **SQLBindCol**, **SQLGetData**, and **SQLBindParameter** functions with the *fCType* argument.

Core C Data Types

The following table lists valid values of *fCType* for the core C data types. These values are defined in SQL.H. The table also lists the ODBC C data type that implements each value of *fCType* and the definition of this data type from SQL.H.

fCType	ODBC C Typedef	C Type
SQL_C_CHAR	UCHAR FAR *	unsigned char FAR *
SQL_C_SSHORT	SWORD	short int
SQL_C_USHORT	UWORD	unsigned short int
SQL_C_SLONG	SDWORD	long int
SQL_C_ULONG	UDWORD	unsigned long int
SQL_C_FLOAT	SFLOAT	float
SQL_C_DOUBLE	SDOUBLE	double

NOTE: Because objects of the CString class in Microsoft C++ are signed and string arguments in ODBC functions are unsigned, applications that pass CString objects to ODBC functions without casting them will receive compiler warnings.

Extended C Data Types

The following table lists valid values of *fCType* for the extended C data types. These values are defined in SQLEXT.H. The table also lists the ODBC C data type that implements each value of *fCType* and the definition of this data type from SQLEXT.H or SQL.H.

fCType	ODBC C Typedef	C Type
SQL_C_BIT	UCHAR	unsigned char
SQL_C_STINYINT	SCHAR	signed char
SQL_C_UTINYINT	UCHAR	unsigned char
SQL_C_BINARY	UCHAR FAR *	unsigned char FAR *

SQL_C_DATE	DATE_STRUCT	struct tagDATE_STRUCT {
		SWORD year; a
		UWORD month; b
		UWORD day; c
		}

SQL_C_TIME	TIME_STRUCT	struct tagTIME_STRUCT {
		UWORD hour; d
		UWORD minute; e
		UWORD second; f
		}

SQL_C_TIMESTAMP	TIMESTAMP_STRUCT	struct
		tagTIMESTAMP_STRUCT {
		SWORD year; a
		UWORD month; b
		UWORD day; c
		UWORD hour; d
		UWORD minute; e
		UWORD second; f
		UDWORD fraction; g
		}

a The value of the year field must be in the range from 0 to 9,999. Years are measured from 0 A.D. Some data sources do not support the entire range of years.

b The value of the month field must be in the range from 1 to 12.

c The value of day field must be in the range from 1 to the number of days in the month. The number of days in the month is determined from the values of the year and month fields and is 28, 29, 30, or 31.

d The value of the hour field must be in the range from 0 to 23.

e The value of the minute field must be in the range from 0 to 59.

f The value of the second field must be in the range from 0 to 59.

g The value of the fraction field is the number of billionths of a second and ranges from 0 to 999,999,999 (1 less than 1 billion). For example, the value of the fraction field for a half-second is 500,000,000, for a thousandth of a second (one millisecond) is 1,000,000, for a millionth of a second (one microsecond) is 1,000, and for a billionth of a second (one nanosecond) is 1.

Bookmark C Data Type

Bookmarks are 32-bit values used by an application to return to a specific row; an application retrieves a bookmark either from column 0 of the result set with **SQLExtendedFetch** or **SQLGetData** or by calling **SQLGetStmtOption**. For more information, see "Using Bookmarks" in Chapter 7, "Retrieving Results."

The following table lists the value of *fCType* for the bookmark C data type, the ODBC C data type that implements the bookmark C data type, and the definition of this data type from SQL.H.

fCType	ODBC C Typedef	C Type
SQL_C_BOOKMARK	BOOKMARK	unsigned long int

ODBC 1.0 C Data Types

In ODBC 1.0, all integer C data types were signed. The following table lists values of *fCType* for the integer C data types that were valid in ODBC 1.0. To remain compatible with applications that use ODBC 1.0, all drivers must support these values of *fCType*. To remain compatible with drivers that use ODBC 1.0, ODBC 2.0 or later applications must pass these values of *fCType* to ODBC 1.0 drivers. However, ODBC 2.0 or later applications must not pass these values to ODBC 2.0 or later drivers.

fCType	ODBC C Typedef	C Type
SQL_C_TINYINT	SCHAR	signed char
SQL_C_SHORT	SWORD	short int
SQL_C_LONG	SDWORD	long int

Because the ODBC 1.0 integer C data types (SQL_C_TINYINT, SQL_C_SHORT, and SQL_C_LONG) are signed, and because the ODBC integer SQL data types can be signed or unsigned, ODBC 1.0 applications and drivers had to interpret signed integer C data as signed or unsigned.

ODBC 2.0 applications and drivers treat the ODBC 1.0 integer C data types as unsigned only when:

- The column from which data will be retrieved is unsigned, and
- The C data type of the storage location in which the data will be placed is the default C data type for that column. (For a list of default C data types, see “Default C Data Types” later in this chapter.)

In all other cases, these applications and drivers treat the ODBC 1.0 integer C data types as signed.

In other words, for any conversion except the default conversion, ODBC 2.0 drivers check the validity of the conversion based on the numeric data value. For the default conversion, the drivers simply pass the data value without attempting to validate it numerically and applications interpret the data value according to whether the column is signed. (Applications call **SQLGetTypeInfo** to determine whether a column is signed or unsigned.)

For example, the following table shows how an ODBC 2.0 driver interprets ODBC 1.0 integer C data sent to both signed and unsigned SQL_SMALLINT columns.

From C Data Type	To SQL Data Type	C Data Values	SQL Data Values
SQL_C_TINYINT	SQL_SMALLINT (signed)	–128 to 127	–128 to 127
	SQL_SMALLINT (unsigned)	< 0 0 to 127	--- [a] 0 to 127
SQL_C_SHORT (default conversion)	SQL_SMALLINT (signed)	–32,768 to 32,767	–32,768 to 32,767
	SQL_SMALLINT (unsigned)	–32,768 to –1 0 to 32,767	32,768 to 65,535 0 to 32,767
SQL_C_LONG	SQL_SMALLINT (signed)	< –32,768 –32,768 to 32,767 > 32,767	--- [a] –32,768 to 32,767 --- [a]
	SQL_SMALLINT (unsigned)	< 0 0 to 32,767 > 32,767	--- [a] 0 to 32,767 --- [a]

[a] The driver returns SQLSTATE 22003 (Numeric value out of range).

Default C Data Types

In an application specifies SQL_C_DEFAULT for the *fCType* argument in **SQLBindCol**, **SQLGetData**, or **SQLBindParameter**, the driver assumes that the C data type of the output or input buffer corresponds to the SQL data type of the column or parameter to which the buffer is bound. For each ODBC SQL data type, the following table shows the corresponding, or *default*, C data type. For information about driver-specific SQL data types, see the driver's documentation.

SQL Data Type	Default C Data Type
SQL_CHAR	SQL_C_CHAR
SQL_VARCHAR	SQL_C_CHAR
SQL_LONGVARCHAR	SQL_C_CHAR
SQL_DECIMAL	SQL_C_CHAR
SQL_NUMERIC	SQL_C_CHAR
SQL_BIT	SQL_C_BIT
SQL_TINYINT	SQL_C_STINYINT or SQL_C_UTINYINT [a]
SQL_SMALLINT	SQL_C_SSHORT or SQL_C_USHORT [a]
SQL_INTEGER	SQL_C_SLONG or SQL_C_ULONG [a]
SQL_BIGINT	SQL_C_CHAR
SQL_REAL	SQL_C_FLOAT
SQL_FLOAT	SQL_C_DOUBLE
SQL_DOUBLE	SQL_C_DOUBLE
SQL_BINARY	SQL_C_BINARY
SQL_VARBINARY	SQL_C_BINARY
SQL_LONGVARBINARY	SQL_C_BINARY
SQL_DATE	SQL_C_DATE
SQL_TIME	SQL_C_TIME
SQL_TIMESTAMP	SQL_C_TIMESTAMP

a If the driver can determine whether the column is signed or unsigned, such as when the driver is fetching data from the data source or when the data source supports only a signed type or only an unsigned type, but not both, the driver uses the corresponding signed or unsigned C data type. If the driver cannot determine whether the column is signed or unsigned, it passes the data value without attempting to validate it numerically.

NOTE: For maximum interoperability, applications should specify a C data type other than SQL_C_DEFAULT. This allows drivers that promote SQL data types (and therefore cannot always determine default C data types) to return data. It also allows drivers that cannot determine whether an integer column is signed or unsigned to correctly return data.

NOTE: ODBC 2.0 drivers use the ODBC 2.0 default C data types for both ODBC 1.0 and ODBC 2.0 integer C data.

Transferring Data in its Binary Form

Among data sources that use the same DBMS, an application can safely transfer data in the internal form used by that DBMS. For a given piece of data, the SQL data types must be the same in the source and target data sources. The C data type is SQL_C_BINARY.

When the application calls **SQLFetch**, **SQLExtendedFetch**, or **SQLGetData** to retrieve the data from the source data source, the driver retrieves the data from the data source and transfers it, without conversion, to a storage location of type SQL_C_BINARY. When the application calls **SQLExecute**, **SQLExecDirect**, or **SQLPutData** to send the data to the target data source, the driver retrieves the data from the storage location and transfers it, without conversion, to the target data source.

NOTE: Applications that transfer any data (except binary data) in this manner are not interoperable among DBMS's.

Precision, Scale, Length, and Display Size

S**QLColAttributes**, **SQLColumns**, and **SQLDescribeCol** return the precision, scale, length, and display size of a column in a table. **SQLProcedureColumns** returns the precision, scale, and length of a column in a procedure. **SQLDescribeParam** returns the precision or scale of a parameter in an SQL statement; **SQLBindParameter** sets the precision or scale of a parameter in an SQL statement. **SQLGetTypeInfo** returns the maximum precision and the minimum and maximum scales of an SQL data type on a data source.

Due to limitations in the size of the arguments these functions use, precision, length, and display size are limited to the size of an SDWORD, or 2,147,483,647.

Precision

The precision of a numeric column or parameter refers to the maximum number of digits used by the data type of the column or parameter. The precision of a nonnumeric column or parameter generally refers to either the maximum length or the defined length of the column or parameter. To determine the maximum precision allowed for a data type, an application calls **SQLGetTypeInfo**. The following table defines the precision for each ODBC SQL data type.

fSqlType	Precision
SQL_CHAR SQL_VARCHAR	The defined length of the column or parameter. For example, the precision of a column defined as CHAR(10) is 10.
SQL_LONGVARCHAR [a, b]	The maximum length of the column or parameter.
SQL_DECIMAL SQL_NUMERIC	The defined number of digits. For example, the precision of a column defined as NUMERIC(10,3) is 10.
SQL_BIT [c]	1
SQL_TINYINT [c]	3
SQL_SMALLINT [c]	5
SQL_INTEGER [c]	10
SQL_BIGINT [c]	19 (if signed) or 20 (if unsigned)
SQL_REAL [c]	7
SQL_FLOAT [c]	15
SQL_DOUBLE [c]	15

SQL_BINARY SQL_VARBINARY	The defined length of the column or parameter. For example, the precision of a column defined as BINARY(10) is 10.
SQL_LONGVARBINARY [a, b]	The maximum length of the column or parameter.
SQL_DATE [c]	10 (the number of characters in the yyyy-mm-dd format).
SQL_TIME [c]	8 (the number of characters in the hh:mm:ss format).
SQL_TIMESTAMP	The number of characters in the "yyyy-mm-dd hh:mm:ss[.f...]" format used by the TIMESTAMP data type. For example, if a timestamp does not use seconds or fractional seconds, the precision is 16 (the number of characters in the "yyyy-mm-dd hh:mm" format). If a timestamp uses thousandths of a second, the precision is 23 (the number of characters in the "yyyy-mm-dd hh:mm:ss.fff" format).

[a] For an ODBC 1.0 application calling **SQLSetParam** in an ODBC 2.0 driver, and for an ODBC 2.0 application calling **SQLBindParameter** in an ODBC 1.0 driver, when *pcbValue* is SQL_DATA_AT_EXEC, *cbColDef* must be set to the total length of the data to be sent, not the precision as defined in this table.

[b] If the driver cannot determine the column or parameter length, it returns SQL_NO_TOTAL.

[c] The *cbColDef* argument of **SQLBindParameter** is ignored for this data type.

Scale

The scale of a numeric column or parameter refers to the maximum number of digits to the right of the decimal point. For approximate floating point number columns or parameters, the scale is undefined, since the number of digits to the right of the decimal point is not fixed. (For the SQL_DECIMAL and SQL_NUMERIC data types, the maximum scale is generally the same as the maximum precision. However, some data sources impose a separate limit on the maximum scale. To determine the minimum and maximum scales allowed for a data type, an application calls **SQLGetTypeInfo**.) The following table defines the scale for each ODBC SQL data type.

fSqlType	Scale
SQL_CHAR [a] SQL_VARCHAR [a] SQL_LONGVARCHAR [a]	Not applicable.

SQL_DECIMAL SQL_NUMERIC	The defined number of digits to the right of the decimal point. For example, the scale of a column defined as NUMERIC(10,3) is 3.
SQL_BIT [a] SQL_TINYINT [a] SQL_SMALLINT [a] SQL_INTEGER [a] SQL_BIGINT [a]	0
SQL_REAL [a] SQL_FLOAT [a] SQL_DOUBLE [a]	Not applicable.
SQL_BINARY [a] SQL_VARBINARY [a] SQL_LONGVARBINARY [a]	Not applicable.
SQL_DATE [a] SQL_TIME [a]	Not applicable.
SQL_TIMESTAMP	The number of digits to the right of the decimal point in the "yyyy-mm-dd hh:mm:ss[.f...]" format. For example, if the TIMESTAMP data type uses the "yyyy-mm-dd hh:mm:ss.fff" format, the scale is 3.

[a] The *ibScale* argument of **SQLBindParameter** is ignored for this data type.

Length

The length of a column is the maximum number of bytes returned to the application when data is transferred to its default C data type. For character data, the length does not include the null termination byte. Note that the length of a column may be different than the number of bytes required to store the data on the data source. For a list of default C data types, see "*Default C Data Types"* in this appendix.

The following table defines the length for each ODBC SQL data type.

fSqlType	Length
SQL_CHAR SQL_VARCHAR	The defined length of the column. For example, the length of a column defined as CHAR(10) is 10.
SQL_LONGVARCHAR [a]	The maximum length of the column.

SQL_DECIMAL SQL_NUMERIC	The maximum number of digits plus 2. Since these data types are returned as character strings, characters are needed for the digits, a sign, and a decimal point. For example, the length of a column defined as NUMERIC(10,3) is 12.
SQL_BIT SQL_TINYINT	1 (one byte).
SQL_SMALLINT	2 (two bytes).
SQL_INTEGER	4 (four bytes).
SQL_BIGINT	20 (since this data type is returned as a character string, characters are needed for 19 digits and a sign, if signed, or 20 digits, if unsigned).
SQL_REAL	4 (four bytes).
SQL_FLOAT	8 (eight bytes).
SQL_DOUBLE	8 (eight bytes).
SQL_BINARY SQL_VARBINARY	The defined length of the column. For example, the length of a column defined as BINARY(10) is 10.
SQL_LONGVARBINARY [a]	The maximum length of the column.
SQL_DATE SQL_TIME	6 (the size of the DATE_STRUCT or TIME_STRUCT structure).
SQL_TIMESTAMP	16 (the size of the TIMESTAMP_STRUCT structure).

[a] If the driver cannot determine the column or parameter length, it returns SQL_NO_TOTAL.

Display Size

The display size of a column is the maximum number of bytes needed to display data in character form. The following table defines the display size for each ODBC SQL data type.

fSqlType	Display Size
SQL_CHAR SQL_VARCHAR	The defined length of the column. For example, the display size of a column defined as CHAR(10) is 10.

SQL_LONGVARCHAR [a]	The maximum length of the column.
SQL_DECIMAL SQL_NUMERIC	The precision of the column plus 2 (a sign, *precision* digits, and a decimal point). For example, the display size of a column defined as NUMERIC(10,3) is 12.
SQL_BIT	1 (1 digit).
SQL_TINYINT	4 if signed (a sign and 3 digits) or 3 if unsigned (3 digits).
SQL_SMALLINT	6 if signed (a sign and 5 digits) or 5 if unsigned (5 digits).
SQL_INTEGER	11 if signed (a sign and 10 digits) or 10 if unsigned (10 digits).
SQL_BIGINT	20 (a sign and 19 digits if signed or 20 digits if unsigned).
SQL_REAL	13 (a sign, 7 digits, a decimal point, the letter E, a sign, and 2 digits).
SQL_FLOAT SQL_DOUBLE	22 (a sign, 15 digits, a decimal point, the letter E, a sign, and 3 digits).
SQL_BINARY SQL_VARBINARY	The defined length of the column times 2 (each binary byte is represented by a 2 digit hexadecimal number). For example, the display size of a column defined as BINARY(10) is 20.
SQL_LONGVARBINARY [a]	The maximum length of the column times 2.
SQL_DATE	10 (a date in the format yyyy-mm-dd).
SQL_TIME	8 (a time in the format hh:mm:ss).
SQL_TIMESTAMP	19 (if the scale of the timestamp is 0) or 20 plus the scale of the timestamp (if the scale is greater than 0). This is the number of characters in the "yyyy-mm-dd hh:mm:ss[.f...]" format. For example, the display size of a column storing thousandths of a second is 23 (the number of characters in "yyyy-mm-dd hh:mm:ss.fff").

[a] If the driver cannot determine the column or parameter length, it returns SQL_NO_TOTAL.

Converting Data from SQL to C Data Types

When an application calls **SQLExtendedFetch**, **SQLFetch**, or **SQLGetData**, the driver retrieves the data from the data source. If necessary, it converts the data from the data type in which the driver retrieved it to the data type specified by the *fCType* argument in **SQLBindCol** or **SQLGetData**. Finally, it stores the data in the location pointed to by the *rgbValue* argument in **SQLBindCol** or **SQLGetData**.

NOTE: The word *convert* is used in this section in a broad sense, and includes the transfer of data, without a conversion in data type, from one storage location to another.

The following table shows the supported conversions from ODBC SQL data types to ODBC C data types. A solid circle indicates the default conversion for an SQL data type (the C data type to which the data will be converted when the value of *fCType* is SQL_C_DEFAULT). A hollow circle indicates a supported conversion.

C Data Type—SQL_C_*datatype* where *datatype* is:

SQL Data Type	CHAR	BIT	STINYINT	UTINYINT	TINYINT	SSHORT	USHORT	SHORT	SLONG	ULONG	LONG	FLOAT	DOUBLE	BINARY	DATE	TIME	TIMESTAMP
SQL_CHAR	•	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SQL_VARCHAR	•	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SQL_LONGVARCHAR	•	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SQL_DECIMAL	•	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SQL_NUMERIC	•	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SQL_BIT	o	•	o	o	o	o	o	o	o	o	o	o	o	o			
SQL_TINYINT (signed)	o	o	•	o	o	o	o	o	o	o	o	o	o	o			
SQL_TINYINT (unsigned)	o	o	o	•	o	o	o	o	o	o	o	o	o	o			
SQL_SMALLINT (signed)	o	o	o	o	o	•	o	o	o	o	o	o	o	o			
SQL_SMALLINT (unsigned)	o	o	o	o	o	o	•	o	o	o	o	o	o	o			
SQL_INTEGER (signed)	o	o	o	o	o	o	o	o	o	•	o	o	o	o			
SQL_INTEGER (unsigned)	o	o	o	o	o	o	o	o	o	o	•	o	o	o			
(SQL_BIGINT (signed and unsigned)	•	o	o	o	o	o	o	o	o	o	o	o	o	o			
SQL_REAL	o	o	o	o	o	o	o	o	o	o	o	•	o	o			
SQL_FLOAT	o	o	o	o	o	o	o	o	o	o	o	o	•	o			
SQL_DOUBLE	o	o	o	o	o	o	o	o	o	o	o	o	•	o			
SQL_BINARY	o													•			
SQL_VARBINARY	o													•			
SQL_LONGVARBINARY	o													•			
SQL_DATE	o													o	•		o
SQL_TIME	o													o		•	o
SQL_TIMESTAMP	o													o	o	o	•

• Default conversion o Supported conversion

Table Description—SQL to C

The tables in the following sections describe how the driver or data source converts data retrieved from the data source; drivers are required to support conversions to all ODBC C data types from the ODBC SQL data types that they support. For a given ODBC SQL data type, the first column of the table lists the legal input values of the *fCType* argument in **SQLBindCol** and **SQLGetData**. The second column lists the outcomes of a test, often using the *cbValueMax* argument specified in **SQLBindCol** or **SQLGetData**, which the driver performs to determine if it can convert the data. For each outcome, the third and fourth columns list the values of the *rgbValue* and *pcbValue* arguments specified in **SQLBindCol** or **SQLGetData** after the driver has attempted to convert the data. The last column lists the SQLSTATE returned for each outcome by **SQLExtendedFetch**, **SQLFetch**, or **SQLGetData**.

If the *fCType* argument in **SQLBindCol** or **SQLGetData** contains a value for an ODBC C data type not shown in the table for a given ODBC SQL data type, **SQLExtendedFetch**, **SQLFetch**, or **SQLGetData** returns SQLSTATE 07006 (Restricted data type attribute violation). If the *fCType* argument contains a value that specifies a conversion from a driver-specific SQL data type to an ODBC C data type and this conversion is not supported by the driver, **SQLExtendedFetch**, **SQLFetch**, or **SQLGetData** returns SQLSTATE S1C00 (Driver not capable).

Though it is not shown in the tables, the *pcbValue* argument contains SQL_NULL_DATA when the SQL data value is NULL. For an explanation of the use of *pcbValue* when multiple calls are made to retrieve data, see **SQLGetData**. When SQL data is converted to character C data, the character count returned in *pcbValue* does not include the null termination byte. If *rgbValue* is a null pointer, **SQLBindCol** or **SQLGetData** returns SQLSTATE S1009 (Invalid argument value).

The following terms and conventions are used in the tables:

- **Length of data** is the number of bytes of C data available to return in *rgbValue*, regardless of whether the data will be truncated before it is returned to the application. For string data, this does not include the null termination byte.
- **Display size** is the total number of bytes needed to display the data in character format.
- Words in *italics* represent function arguments or elements of the ODBC SQL grammar.

SQL to C: Character

The character ODBC SQL data types are:

SQL_CHAR
SQL_VARCHAR
SQL_LONGVARCHAR

The following table shows the ODBC C data types to which character SQL data may be converted. For an explanation of the columns and terms in the table, see the "*Table Description—SQL to C*" on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	Length of data < cbValue-Max	Data	Length of data	N/A
	Length of data ≥ cbValue-Max	Truncated data	Length of data	01004
SQL_C_STINYINT SQL_C_UTINYINT SQL_C_TINYINT [a] SQL_C_SSHORT SQL_C_USHORT SQL_C_SHORT [a] SQL_C_SLONG SQL_C_ULONG SQL_C_LONG [a]	Data converted without truncation [b]	Data	Size of the C data type	N/A
	Data converted with truncation of fractional digits [b]	Truncated data	Size of the C data type	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits [b]	Untouched	Untouched	22003
	Data is not a numeric-literal [b]	Untouched	Untouched	22005
SQL_C_FLOAT SQL_C_DOUBLE	Data is within the range of the data type to which the number is being converted [b]	Data	Size of the C data type	N/A
	Data is outside the range of the data type to which the number is being converted [b]	Untouched	Untouched	22003
	Data is not a numeric-literal [b]	Untouched	Untouched	22005

SQL_C_BIT	Data is 0 or 1 [a]	Data	1 [c]	N/A
	Data is greater than 0, less than 2, and not equal to 1 [a]	Truncated data	1 [c]	01004
	Data is less than 0 or greater than or equal to 2 [a]	Untouched	Untouched	22003
	Data is not a numeric-literal [a]	Untouched	Untouched	22005
SQL_C_BINARY	Length of data ≤ cbValueMax	Data	Length of data	N/A
	Length of data > cbValueMax	Truncated data	Length of data	01004
SQL_C_DATE	Data value is a valid date-value [b]	Data	6 [c]	N/A
	Data value is a valid timestamp-value; time portion is zero [b]	Data	6 [c]	N/A
	Data value is a valid timestamp-value; time portion is non-zero [b, d]	Truncated data	6 [c]	01004
	Data value is not a valid date-value or timestamp-value [b]	Untouched	Untouched	22008
SQL_C_TIME	Data value is a valid *time-value* [b]	Data	6 [c]	N/A
	Data value is a valid *timestamp-value*; fractional seconds portion is zero [b, e]	Data	6 [c]	N/A
	Data value is a valid *timestamp-value*; fractional seconds portion is non-zero [b, e, f]	Truncated data	6 [c]	01004
	Data value is not a valid *time-value* or *timestamp-value* [b]	Untouched	Untouched	22008

SQL_C_ TIMESTAMP	Data value is a valid *timestamp-value*; fractional seconds portion not truncated [b]	Data	16 [c]	N/A
	Data value is a valid *timestamp-value*; fractional seconds portion truncated [b]	Truncated data	16 [c]	N/A
	Data value is a valid *date-value* [b]	Data [g]	16 [c]	N/A
	Data value is a valid *time-value* [b]	Data [h]	16 [c]	N/A
	Data value is not a valid *date-value*, *time-value*, or *timestamp-value* [b]	Untouched	Untouched	22008

[a] For more information, see "ODBC 1.0 C Data Types," earlier in this appendix.

[b] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[c] This is the size of the corresponding C data type.

[d] The time portion of the *timestamp-value* is truncated.

[e] The date portion of the *timestamp-value* is ignored.

[f] The fractional seconds portion of the timestamp is truncated.

[g] The time fields of the timestamp structure are set to zero.

[h] The date fields of the timestamp structure are set to the current date.

When character SQL data is converted to numeric, date, time, or timestamp C data, leading and trailing spaces are ignored.

All drivers that support date, time, and timestamp data can convert character SQL data to date, time, or timestamp C data as specified in the previous table. Drivers may be able to convert character SQL data from other, driver-specific formats to date, time, or timestamp C data. Such conversions are not interoperable among data sources.

SQL to C: Numeric

The numeric ODBC SQL data types are:

SQL_DECIMAL	SQL_BIGINT
SQL_NUMERIC	SQL_REAL

SQL_TINYINT
SQL_SMALLINT
SQL_INTEGER
SQL_FLOAT
SQL_DOUBLE

The following table shows the ODBC C data types to which numeric SQL data may be converted. For an explanation of the columns and terms in the table, see page the "*Table Description—SQL to C"* on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	Display size < *cbValueMax*	Data	Length of data	N/A
	Number of whole (as opposed to fractional) digits < *cbValueMax*	Truncated data	Length of data	01004
	Number of whole (as opposed to fractional) digits ≥ *cbValueMax*	Untouched	Untouched	22003
SQL_C_STINYINT SQL_C_UTINYINT	Data converted without truncation [b]	Data	Size of the C data type	N/A
SQL_C_TINYINT [a] SQL_C_SSHORT SQL_C_USHORT	Data converted with truncation of fractional digits [b]	Truncated data	Size of the C data type	01004
SQL_C_SHORT [a] SQL_C_SLONG SQL_C_ULONG SQL_C_LONG [a]	Conversion of data would result in loss of whole (as opposed to fractional) digits [b]	Untouched	Untouched	22003
SQL_C_FLOAT SQL_C_DOUBLE	Data is within the range of the data type to which the number is being converted [b]	Data	Size of the C data type	N/A
	Data is outside the range of the data type to which the number is being converted [b]	Untouched	Untouched	22003

SQL_C_BIT	Data is 0 or 1 [b]	Data	1 [c]	N/A
	Data is greater than 0, less than 2, and not equal to 1 [b]	Truncated data	1 [c]	01004
	Data is less than 0 or greater than or equal to 2 [b]	Untouched	Untouched	22003
SQL_C_BINARY	Length of data ≤ *cbValueMax*	Data	Length of data	N/A
	Length of data > *cbValueMax*	Untouched	Untouched	22003

[a] For more information, see "ODBC 1.0 C Data Types," earlier in this appendix.

[b] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[c] This is the size of the corresponding C data type.

SQL to C: Bit

The bit ODBC SQL data type is:

SQL_BIT

The following table shows the ODBC C data types to which bit SQL data may be converted. For an explanation of the columns and terms in the table, see the "*Table Description—SQL to C*" on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	*cbValueMax* > 1	Data	1	N/A
	cbValueMax ≤ 1	Untouched	Untouched	22003

SQL_C_STINYINT SQL_C_UTINYINT SQL_C_TINYINT [a] SQL_C_SSHORT SQL_C_USHORT SQL_C_SHORT [a] SQL_C_SLONG SQL_C_ULONG SQL_C_LONG [a] SQL_C_FLOAT SQL_C_DOUBLE	None [b]	Data	Size of the C data type	N/A
SQL_C_BIT	None [b]	Data	1 [c]	N/A
SQL_C_BINARY	*cbValueMax* ≥ 1	Data	1	N/A
	cbValueMax < 1	Untouched	Untouched	22003

[a] For more information, see "ODBC 1.0 C Data Types," earlier in this appendix.

[b] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[c] This is the size of the corresponding C data type.

When bit SQL data is converted to character C data, the possible values are "0" and "1".

SQL to C: Binary

The binary ODBC SQL data types are:

SQL_BINARY
SQL_VARBINARY
SQL_LONGVARBINARY

The following table shows the ODBC C data types to which binary SQL data may be converted. For an explanation of the columns and terms in the table, see the "*Table Description—SQL to C*" on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	(Length of data) * 2 < *cbValueMax*	Data	Length of data	N/A
	(Length of data) * 2 ≥ *cbValueMax*	Truncated data	Length of data	01004
SQL_C_BINARY	Length of data ≤ *cbValueMax*	Data	Length of data	N/A
	Length of data > *cbValueMax*	Truncated data	Length of data	01004

When binary SQL data is converted to character C data, each byte (8 bits) of source data is represented as two ASCII characters. These characters are the ASCII character representation of the number in its hexadecimal form. For example, a binary 00000001 is converted to "01" and a binary 11111111 is converted to "FF".

The driver always converts individual bytes to pairs of hexadecimal digits and terminates the character string with a null byte. Because of this, if *cbValueMax* is even and is less than the length of the converted data, the last byte of the *rgbValue* buffer is not used. (The converted data requires an even number of bytes, the next-to-last byte is a null byte, and the last byte cannot be used.)

SQL to C: Date

The date ODBC SQL data type is:

SQL_DATE

The following table shows the ODBC C data types to which date SQL data may be converted. For an explanation of the columns and terms in the table, see the "*Table Description—SQL to C*" on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	*cbValueMax* ≥ 11	Data	10	N/A
	cbValueMax < 11	Untouched	Untouched	22003
SQL_C_BINARY	Length of data ≤ *cbValueMax*	Data	Length of data	N/A
	Length of data > *cbValueMax*	Untouched	Untouched	22003
SQL_C_DATE	None [a]	Data	6 [c]	N/A
SQL_C_TIMESTAMP	None [a]	Data [b]	16 [c]	N/A

[a] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[b] The time fields of the timestamp structure are set to zero.

[c] This is the size of the corresponding C data type.

When date SQL data is converted to character C data, the resulting string is in the "yyyy-mm-dd" format.

SQL to C: Time

The time ODBC SQL data type is:

SQL_TIME

The following table shows the ODBC C data types to which time SQL data may be converted. For an explanation of the columns and terms in the table, see the "*Table Description—SQL to C"* on page D-21.

fCType	Test	rgb-Value	pcb-Value	SQL-STATE
SQL_C_CHAR	*cbValueMax* ≥ 9	Data	8	N/A
	cbValueMax < 9	Untouched	Untouched	22003

SQL_C_BINARY	Length of data ≤ *cbValueMax*	Data	Length of data	N/A
	Length of data > *cbValueMax*	Untouched	Untouched	22003
SQL_C_TIME	None [a]	Data	6 [c]	N/A
SQL_C_TIMESTAMP	None [a]	Data [b]	16 [c]	N/A

[a] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[b] The date fields of the timestamp structure are set to the current date and the fractional seconds field of the timestamp structure is set to zero.

[c] This is the size of the corresponding C data type.

When time SQL data is converted to character C data, the resulting string is in the "hh:mm:ss" format.

SQL to C: Timestamp

The timestamp ODBC SQL data type is:

SQL_TIMESTAMP

The following table shows the ODBC C data types to which timestamp SQL data may be converted. For an explanation of the columns and terms in the table, seehe "*Table Description—SQL to C"* on page D-21.

fCType	**Test**	**rgb-Value**	**pcb-Value**	**SQL-STATE**
SQL_C_CHAR	*cbValueMax* > Display size	Data	Length of data	N/A
	20 ≤ *cbValueMax* ≤ Display size	Truncated data [b]	Length of data	01004
	cbValueMax < 20	Untouched	Untouched	22003
SQL_C_BINARY	Length of data ≤ *cbValueMax*	Data	Length of data	N/A
	Length of data > *cbValueMax*	Untouched	Untouched	22003

SQL_C_DATE	Time portion of timestamp is zero [a]	Data	6 [f]	N/A
	Time portion of timestamp is non-zero [a]	Truncated data [c]	6 [f]	01004
SQL_C_TIME	Fractional seconds portion of timestamp is zero [a]	Data [d]	6 [f]	N/A
	Fractional seconds portion of timestamp is non-zero [a]	Truncated data [d, e]	6 [f]	01004
SQL_C_TIMESTAMP	Fractional seconds portion of timestamp is not truncated [a]	Data [e]	16 [f]	N/A
	Fractional seconds portion of timestamp is truncated [a]	Truncated data [e]	16 [f]	01004

[a] The value of *cbValueMax* is ignored for this conversion. The driver assumes that the size of *rgbValue* is the size of the C data type.

[b] The fractional seconds of the timestamp are truncated.

[c] The time portion of the timestamp is truncated.

[d] The date portion of the timestamp is ignored.

[e] The fractional seconds portion of the timestamp is truncated.

[f] This is the size of the corresponding C data type.

When timestamp SQL data is converted to character C data, the resulting string is in the "yyyy-mm-dd hh:mm:ss[.f...]" format, where up to nine digits may be used for fractional seconds. (Except for the decimal point and fractional seconds, the entire format must be used, regardless of the precision of the timestamp SQL data type.)

SQL to C Data Conversion Examples

The following examples illustrate how the driver converts SQL data to C data:

SQL Data Type	SQL Data Value	C Data Type	cbValue - Max	rgbValue	SQL-STATE
SQL_CHAR	abcdef	SQL_C_CHAR	7	abcdef\0 a	N/A
SQL_CHAR	abcdef	SQL_C_CHAR	6	abcde\0 a	01004
SQL_ DECIMAL	1234.56	SQL_C_CHAR	8	1234.56\0 a	N/A
SQL_ DECIMAL	1234.56	SQL_C_CHAR	5	1234\0 a	01004
SQL_ DECIMAL	1234.56	SQL_C_CHAR	4	----	22003
SQL_ DECIMAL	1234.56	SQL_C_ FLOAT	ignored	1234.56	N/A
SQL_ DECIMAL	1234.56	SQL_C_ SSHORT	ignored	1234	01004
SQL_ DECIMAL	1234.56	SQL_C_ STINYINT	ignored	----	22003
SQL_ DOUBLE	1.2345678	SQL_C_ DOUBLE	ignored	1.2345678	N/A
SQL_ DOUBLE	1.2345678	SQL_C_ FLOAT	ignored	1.234567	N/A
SQL_ DOUBLE	1.2345678	SQL_C_ STINYINT	ignored	1	N/A
SQL_DATE	1992-12-31	SQL_C_CHAR	11	1992-12-31\0 a	N/A
SQL_DATE	1992-12-31	SQL_C_CHAR	10	-----	22003
SQL_DATE	1992-12-31	SQL_C_ TIMESTAMP	ignored	1992,12,31, 0,0,0,0 b	N/A

SQL_ TIMES-TAMP	1992-12-31 23:45:55.12	SQL_C_CHAR	23	1992-12-31 23:45:55.12\0 [a]	N/A
SQL_ TIMES-TAMP	1992-12-31 23:45:55.12	SQL_C_CHAR	22	1992-12-31 23:45:55.1\0 [a]	01004
SQL_ TIMES-TAMP	1992-12-31 23:45:55.12	SQL_C_CHAR	18	----	22003

[a] "\0" represents a null-termination byte. The driver always null-terminates SQL_C_CHAR data.

[b] The numbers in this list are the numbers stored in the fields of the TIMESTAMP_STRUCT structure.

Converting Data from C to SQL Data Types

When an application calls **SQLExecute** or **SQLExecDirect**, the driver retrieves the data for any parameters bound with **SQLBindParameter** from storage locations in the application. For data-at-execution parameters, the application sends the parameter data with **SQLPut-Data**. If necessary, the driver converts the data from the data type specified by the *fCType* argument in **SQLBindParameter** to the data type specified by the *fSqlType* argument in **SQLBindParameter**. Finally, the driver sends the data to the data source.

NOTE: The word *convert* is used in this section in a broad sense, and includes the transfer of data, without a conversion in data type, from one storage location to another.

The following table shows the supported conversions from ODBC C data types to ODBC SQL data types. A solid circle indicates the default conversion for an SQL data type (the C data type from which the data will be converted when the value of *fCType* is SQL_C_DEFAULT). A hollow circle indicates a supported conversion.

SQL Data Type —SQL_*datatype* where *datatype* is:

C Data Type	CHAR	VARCHAR	LONGVARCHAR	DECIMAL	NUMERIC	BIT	TINYINT (signed)	TINYINT (unsigned)	SMALLINT (signed)	SMALLINT (unsigned)	INTEGER (signed)	INTEGER (unsigned)	BIGINT (signed) and unsigned)	REAL	FLOAT	DOUBLE	BINARY	VARBINARY	LONGVARBINARY	DATE	TIME	TIMESTAMP
SQL_C_CHAR	•	•	•	•	•	o	o	o	o	o	o	o	•	o	o	o	o	o	o	o	o	o
SQL_C_BIT	o	o	o	o	o	•	o	o	o	o	o	o	o	o	o	o						
SQL_C_STINY INT	o	o	o	o	o	o	•	o	o	o	o	o	o	o	o	o						
SQL_C_UTINY INT	o	o	o	o	o	o	o	•	o	o	o	o	o	o	o	o						
SQL_C_TINYINT	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o						
SQL_C_SSHORT	o	o	o	o	o	o	o	o	•	o	o	o	o	o	o	o						
SQL_C_USHORT	o	o	o	o	o	o	o	o	o	•	o	o	o	o	o	o						
SQL_C_SHORT	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o						
SQL_C_SLONG	o	o	o	o	o	o	o	o	o	o	•	o	o	o	o	o						
SQL_C_ULONG	o	o	o	o	o	o	o	o	o	o	o	•	o	o	o	o						
SQL_C_LONG	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o						
SQL_C_FLOAT	o	o	o	o	o	o	o	o	o	o	o	o	o	•	o	o						
SQL_C_DOUBLE	o	o	o	o	o	o	o	o	o	o	o	o	o	o	•	•						
SQL_C_BINARY	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	•	•	•	o	o	o
SQL_C_DATE	o	o	o																	•		o
SQL_C_TIME	o	o	o																		•	o
SQL_C_ TIMESTAMP	o	o	o																	o	o	•

• Default conversion o Supported conversion

Table Description—C to SQL

The tables in the following sections describe how the driver or data source converts data sent to the data source; drivers are required to support conversions from all ODBC C data types to the ODBC SQL data types that they support. For a given ODBC C data type, the first column of the table lists the legal input values of the *fSqlType* argument in **SQLBindParameter**. The second column lists the outcomes of a test that the driver performs to determine if it can convert the data. The third column lists the SQLSTATE returned for each outcome by **SQLExecDirect**, **SQLExecute**, or **SQLPutData**. Data is sent to the data source only if SQL_SUCCESS is returned.

If the *fSqlType* argument in **SQLBindParameter** contains a value for an ODBC SQL data type that is not shown in the table for a given C data type, **SQLBindParameter** returns SQLSTATE 07006 (Restricted data type attribute violation). If the *fSqlType* argument contains a driver-specific value and the driver does not support the conversion from the specific ODBC C data type to that driver-specific SQL data type, **SQLBindParameter** returns SQLSTATE S1C00 (Driver not capable).

If the *rgbValue* and *pcbValue* arguments specified in **SQLBindParameter** are both null pointers, that function returns SQLSTATE S1009 (Invalid argument value). Though it is not shown in the tables, an application sets the value pointed to by the *pcbValue* argument of **SQLBindParameter** or the value of the *cbValue* argument to SQL_NULL_DATA to specify a NULL SQL data value. The application sets these values to SQL_NTS to specify that the value in *rgbValue* is a null-terminated string.

The following terms are used in the tables:

- **Length of data** is the number of bytes of SQL data available to send to the data source, regardless of whether the data will be truncated before it is sent to the data source. For string data, this does not include the null termination byte.
- **Column length** and **display size** are defined for each SQL data type in the section "Precision, Scale, Length, and Display Size" earlier in this chapter.
- **Number of digits** is the number of characters used to represent a number, including the minus sign, decimal point, and exponent (if needed).
- Words in *italics* represent elements of the ODBC SQL grammar.

C to SQL: Character

The character ODBC C data type is:

SQL_C_CHAR

The following table shows the ODBC SQL data types to which C character data may be converted. For an explanation of the columns and terms in the table, see *"Table Description—C to SQL"* on page D-35 .

fSqlType	Test	SQL-STATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Length of data ≤ Column length	N/A
	Length of data > Column length	01004
SQL_DECIMAL SQL_NUMERIC SQL_TINYINT SQL_SMALLINT SQL_INTEGER SQL_BIGINT	Data converted without truncation	N/A
	Data converted with truncation of fractional digits	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits	22003
	Data value is not a *numeric-literal*	22005
SQL_REAL SQL_FLOAT SQL_DOUBLE	Data is within the range of the data type to which the number is being converted	N/A
	Data is outside the range of the data type to which the number is being converted	22003
	Data value is not a *numeric-literal*	22005
SQL_BIT	Data is 0 or 1	N/A
	Data is greater than 0, less than 2, and not equal to 1	01004
	Data is less than 0 or greater than or equal to 2	22003
	Data is not a *numeric-literal*	22005
SQL_BINARY SQL_VARBINARY SQL_LONG-VARBINARY	(Length of data) / 2 ≤ Column length	N/A
	(Length of data) / 2 > Column length	01004
	Data value is not a hexadecimal value	22005
SQL_DATE	Data value is a valid *ODBC-date-literal*	N/A
	Data value is a valid *ODBC-timestamp-literal*; time portion is zero	N/A
	Data value is a valid *ODBC-timestamp-literal*; time portion is non-zero [a]	01004
	Data value is not a valid *ODBC-date-literal* or *ODBC-timestamp-literal*	22008

SQL_TIME	Data value is a valid *ODBC-time-literal*	N/A
	Data value is a valid *ODBC-timestamp-literal*; fractional seconds portion is zero [b]	N/A
	Data value is a valid *ODBC-timestamp-literal*; fractional seconds portion is non-zero [b, c]	01004
	Data value is not a valid *ODBC-time-literal* or *ODBC-timestamp-literal*	22008
SQL_TIMESTAMP	Data value is a valid *ODBC-timestamp-literal*; fractional seconds portion not truncated	N/A
	Data value is a valid *ODBC-timestamp-literal*; fractional seconds portion truncated	01004
	Data value is a valid *ODBC-date-literal* [d]	N/A
	Data value is a valid *ODBC-time-literal* [e]	N/A
	Data value is not a valid *ODBC-date-literal*, *ODBC-time-literal*,or *ODBC-timestamp-literal*	22008

[a] The time portion of the timestamp is truncated.

[b] The date portion of the timestamp is ignored.

[c] The fractional seconds portion of the timestamp is truncated.

[d] The time portion of the timestamp is set to zero.

[e] The date portion of the timestamp is set to the current date.

When character C data is converted to numeric, date, time, or timestamp SQL data, leading and trailing blanks are ignored.

When character C data is converted to binary SQL data, each two bytes of character data are converted to a single byte (8 bits) of binary data. Each two bytes of character data represent a number in hexadecimal form. For example, “01” is converted to a binary 00000001 and “FF” is converted to a binary 11111111.

The driver always converts pairs of hexadecimal digits to individual bytes and ignores the null termination byte. Because of this, if the length of the character string is odd, the last byte of the string (excluding the null termination byte, if any) is not converted.

All drivers that support date, time, and timestamp data can convert character C data to date, time, or timestamp SQL data as specified in the previous table. Drivers may be able to convert character C data from other, driver-specific formats to date, time, or timestamp SQL data. Such conversions are not interoperable among data sources.

C to SQL: Numeric

The numeric ODBC C data types are:

SQL_C_STINYINT	SQL_C_SLONG
SQL_C_UTINYINT	SQL_C_ULONG
SQL_C_TINYINT	SQL_C_LONG
SQL_C_SSHORT	SQL_C_FLOAT
SQL_C_USHORT	SQL_C_DOUBLE
SQL_C_SHORT	

For more information about the SQL_C_TINYINT, SQL_C_SHORT, and SQL_C_LONG data types, see "ODBC 1.0 C Data Types," earlier in this appendix. The following table shows the ODBC SQL data types to which numeric C data may be converted. For an explanation of the columns and terms in the table, see tsee "*Table Description—C to SQL"* on page D-35 .

fSqlType	Test	SQL-STATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Number of digits ≤ Column length	N/A
	Number of whole (as opposed to fractional) digits ≤ Column length	01004
	Number of whole (as opposed to fractional) digits > Column length	22003
SQL_DECIMAL SQL_NUMERIC SQL_TINYINT SQL_SMALLINT SQL_INTEGER SQL_BIGINT	Data converted without truncation	N/A
	Data converted with truncation of fractional digits	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits	22003
SQL_REAL SQL_FLOAT SQL_DOUBLE	Data is within the range of the data type to which the number is being converted	N/A
	Data is outside the range of the data type to which the number is being converted	22003
SQL_BIT	Data is 0 or 1	N/A
	Data is greater than 0, less than 2, and not equal to 1	01004
	Data is less than 0 or greater than or equal to 2	22003

The value pointed to by the *pcbValue* argument of **SQLBindParameter** and the value of the *cbValue* argument of **SQLPutData** are ignored when data is converted from the numeric C data types. The driver assumes that the size of *rgbValue* is the size of the numeric C data type.

C to SQL: Bit

The bit ODBC C data type is:

SQL_C_BIT

The following table shows the ODBC SQL data types to which bit C data may be converted. For an explanation of the columns and terms in the table, see "*Table Description—C to SQL*" on page D-35.

fSqlType	Test	SQLSTATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	None	N/A
SQL_DECIMAL SQL_NUMERIC SQL_TINYINT SQL_SMALLINT SQL_INTEGER SQL_BIGINT SQL_REAL SQL_FLOAT SQL_DOUBLE	None	N/A
SQL_BIT	None	N/A

The value pointed to by the *pcbValue* argument of **SQLBindParameter** and the value of the *cbValue* argument of **SQLPutData** are ignored when data is converted from the bit C data type. The driver assumes that the size of *rgbValue* is the size of the bit C data type.

C to SQL: Binary

The binary ODBC C data type is:

SQL_C_BINARY

The following table shows the ODBC SQL data types to which binary C data may be converted. For an explanation of the columns and terms in the table, see "*Table Description—C to SQL"* on page D-35.

fSqlType	Test	SQL-STATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Length of data ≤ Column length	N/A
	Length of data > Column length	01004
SQL_DECIMAL SQL_NUMERIC SQL_TINYINT SQL_SMALLINT SQL_INTEGER SQL_BIGINT SQL_REAL SQL_FLOAT SQL_DOUBLE	Length of data = SQL data length [a]	N/A
	Length of data ≠ SQL data length [a]	22003
SQL_BIT	Length of data = SQL data length [a]	N/A
	Length of data ≠ SQL data length [a]	22003
SQL_BINARY SQL_VARBINARY SQL_LONGVARBINARY	Length of data ≤ Column length	N/A
	Length of data > Column length	01004
SQL_DATE SQL_TIME SQL_TIMESTAMP	Length of data = SQL data length [a]	N/A
	Length of data ≠ SQL data length [a]	22003

[a] The SQL data length is the number of bytes needed to store the data on the data source. (This may be different than the column length, as defined earlier in this appendix.)

C to SQL: Date

The date ODBC C data type is:

SQL_C_DATE

The following table shows the ODBC SQL data types to which date C data may be converted.For an explanation of the columns and terms in the table, see see "*Table Description—C to SQL"* on page D-35.

fSqlType	Test	SQLSTATE

SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Column length ≥ 10	N/A
	Column length < 10	22003
	Data value is not a valid date	22008
SQL_DATE	Data value is a valid date	N/A
	Data value is not a valid date	22008
SQL_TIMESTAMP	Data value is a valid date [a]	N/A
	Data value is not a valid date	22008

[a] The time portion of the timestamp is set to zero.

For information about what values are valid in a SQL_C_DATE structure, see "*Extended C Data Types"* earlier in this appendix.

When date C data is converted to character SQL data, the resulting character data is in the "yyyy-mm-dd" format.

The value pointed to by the *pcbValue* argument of **SQLBindParameter** and the value of the *cbValue* argument of **SQLPutData** are ignored when data is converted from the date C data type. The driver assumes that the size of *rgbValue* is the size of the date C data type.

C to SQL: Time

The time ODBC C data type is:

SQL_C_TIME

The following table shows the ODBC SQL data types to which time C data may be converted. For an explanation of the columns and terms in the table, see see "*Table Description—C to SQL"* on page D-35 .

fSqlType	Test	SQLSTATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Column length ≥ 8	N/A
	Column length < 8	22003
	Data value is not a valid time	22008
SQL_TIME	Data value is a valid time	N/A
	Data value is not a valid time	22008
SQL_TIMESTAMP	Data value is a valid time [a]	N/A
	Data value is not a valid time	22008

a The date portion of the timestamp is set to the current date and the fractional seconds portion of the timestamp is set to zero.

For information about what values are valid in a SQL_C_TIME structure, see *"Extended C Data Types"* earlier in this appendix.

When time C data is converted to character SQL data, the resulting character data is in the "hh:mm:ss" format.

The value pointed to by the *pcbValue* argument of **SQLBindParameter** and the value of the *cbValue* argument of **SQLPutData** are ignored when data is converted from the time C data type. The driver assumes that the size of *rgbValue* is the size of the time C data type.

C to SQL: Timestamp

The timestamp ODBC C data type is:

SQL_C_TIMESTAMP

The following table shows the ODBC SQL data types to which timestamp C data may be converted. For an explanation of the columns and terms in the table, see *"Table Description—C to SQL"* on page D-35.

fSqlType	Test	SQL-STATE
SQL_CHAR SQL_VARCHAR SQL_LONGVARCHAR	Column length ≥ Display size	N/A
	19 ≤ Column length < Display size a	01004
	Column length < 19	22003
	Data value is not a valid date	22008
SQL_DATE	Time fields are zero	N/A
	Time fields are non-zero b	01004
	Data value does not contain a valid date	22008
SQL_TIME	Fractional seconds fields are zero c	N/A
	Fractional seconds fields are non-zero c, d	01004
	Data value does not contain a valid time	22008
SQL_TIMESTAMP	Fractional seconds fields are not truncated	N/A
	Fractional seconds fields are truncated d	01004
	Data value is not a valid timestamp	22008

a The fractional seconds of the timestamp are truncated.

b The time fields of the timestamp structure are truncated.

c The date fields of the timestamp structure are ignored.

d The fractional seconds fields of the timestamp structure are truncated.

For information about what values are valid in a SQL_C_TIMESTAMP structure, see "*Extended C Data Types"* earlier in this appendix.

When timestamp C data is converted to character SQL data, the resulting character data is in the "yyyy-mm-dd hh:mm:ss[.f...]" format.

The value pointed to by the *pcbValue* argument of **SQLBindParameter** and the value of the *cbValue* argument of **SQLPutData** are ignored when data is converted from the timestamp C data type. The driver assumes that the size of *rgbValue* is the size of the timestamp C data type.

C to SQL Data Conversion Examples

The following examples illustrate how the driver converts C data to SQL data:

C DataType	C Data Value	SQL Data Type	Column length	SQL Data Value	SQL-STATE
SQL_C_CHAR	abcdef\0 a	SQL_CHAR	6	abcdef	N/A
SQL_C_CHAR	abcdef\0 a	SQL_CHAR	5	abcde	01004
SQL_C_CHAR	1234.56\0 a	SQL_DECIMAL	8 b	1234.56	N/A
SQL_C_CHAR	1234.56\0 a	SQL_DECIMAL	7 b	1234.5	01004
SQL_C_CHAR	1234.56\0 a	SQL_DECIMAL	4	----	22003
SQL_C_FLOAT	1234.56	SQL_FLOAT	not applicable	1234.56	N/A
SQL_C_FLOAT	1234.56	SQL_INTEGER	not applicable	1234	01004
SQL_C_FLOAT	1234.56	SQL_TINYINT	not applicable	----	22003

SQL_C_DATE	1992,12,31 [c]	SQL_CHAR	10	1992-12-31	N/A
SQL_C_DATE	1992,12,31 [c]	SQL_CHAR	9	----	22003
SQL_C_DATE	1992,12,31 [c]	SQL_ TIMESTAMP	not applicable	1992-12-31 00:00:00.0	N/A
SQL_C_ TIMESTAMP	1992,12,31, 23,45,55, 120000000 [d]	SQL_CHAR	22	1992-12-31 23:45:55.12	N/A
SQL_C_ TIMESTAMP	1992,12,31, 23,45,55, 120000000 [d]	SQL_CHAR	21	1992-12-31 23:45:55.1	01004
SQL_C_ TIMESTAMP	1992,12,31, 23,45,55, 120000000 [d]	SQL_CHAR	18	----	22003

[a] "\0" represents a null-termination byte. The null-termination byte is required only if the length of the data is SQL_NTS.

[b] In addition to bytes for numbers, one byte is required for a sign and another byte is required for the decimal point.

[c] The numbers in this list are the numbers stored in the fields of the DATE_STRUCT structure.

[d] The numbers in this list are the numbers stored in the fields of the TIMESTAMP_STRUCT structure.

E

Comparison Between Embedded SQL and ODBC

This appendix compares ODBC and embedded SQL.

ODBC to Embedded SQL

The following table compares core ODBC functions to embedded SQL statements. This comparison is based on the X/Open and SQL Access Group SQL CAE specification (1992).

ODBC uses a parameter marker in place of a host variable, wherever a host variable would occur in embedded SQL.

The SQL language is based on the X/Open and SQL Access Group SQL CAE specification (1992).

ODBC Function	Statement	Comments
SQLAllocEnv	none	Driver Manager and driver memory allocation.
SQLAllocConnect	none	Driver Manager and driver memory allocation.
SQLConnect	CONNECT	Association management.
SQLAllocStmt	none	Driver Manager and driver memory allocation.

SQLPrepare	PREPARE	The prepared SQL string can contain any of the valid preparable functions as defined by the X/Open specification, including ALTER, CREATE, *cursor-specification*, searched DELETE, dynamic SQL positioned DELETE, DROP, GRANT, INSERT, REVOKE, searched UPDATE, or dynamic SQL positioned UPDATE.
SQLBindParameter	SET DESCRIPTOR	Dynamic SQL ALLOCATE DESCRIPTOR and dynamic SQL SET DESCRIPTOR. ALLOCATE DESCRIPTOR would normally be issued on the first call to **SQLBindParameter** for an *hstmt*. Alternatively, ALLOCATE DESCRIPTOR can be called during **SQLAllocStmt**, although this call would be unneeded by SQL statements containing no embedded parameters. The descriptor name is generated by the driver.
SQLSetCursorName	none	The specified cursor name is used in the DECLARE CURSOR statement generated by **SQLExecute** or **SQLExecDirect**.
SQLGetCursorName	none	Driver cursor name management.
SQLExecute	EXECUTE or DECLARE CURSOR and OPEN CURSOR	Dynamic SQL EXECUTE. If the SQL statement requires a cursor, then a dynamic SQL DECLARE CURSOR statement and a dynamic SQL OPEN are issued at this time.

SQLExecDirect	EXECUTE IMMEDIATE or DECLARE CURSOR and OPEN CURSOR	The ODBC function call provides for support for a *cursor specification* and statements allowed in an EXECUTE IMMEDIATE dynamic SQL statement. In the case of a *cursor specification*, the call corresponds to static SQL DECLARE CURSOR and OPEN statements.
SQLNumResultCols	GET DESCRIPTOR	COUNT form of dynamic SQL GET DESCRIPTOR.
SQLColAttributes	GET DESCRIPTOR	COUNT form of dynamic SQL GET DESCRIPTOR or VALUE form of dynamic SQL GET DESCRIPTOR with *field-name* in {NAME, TYPE, LENGTH, PRECISION, SCALE, NULLABLE}.
SQLDescribeCol	GET DESCRIPTOR	VALUE form of dynamic SQL GET DESCRIPTOR with *field-name* in {NAME, TYPE, LENGTH, PRECISION, SCALE, NULLABLE}.
SQLBindCol	none	This function establishes output buffers that correspond in usage to host variables for static SQL FETCH, and to an SQL DESCRIPTOR for dynamic SQL FETCH *cursor* USING SQL DESCRIPTOR *descriptor.*

SQLFetch	FETCH	Static or dynamic SQL FETCH. If the call is a dynamic SQL FETCH, then the VALUE form of GET DESCRIPTOR is used, with *field-name* in {DATA, INDICATOR}. DATA and INDICATOR values are placed in output buffers specified in **SQLBindCol**.
SQLRowCount	GET DIAGNOSTICS	Requested field ROW_COUNT.
SQLFreeStmt (SQL_CLOSE option)	CLOSE	Dynamic SQL CLOSE.
SQLFreeStmt (SQL_DROP option)	none	Driver Manager and driver memory deallocation.
SQLTransact	COMMIT WORK or COMMIT ROLLBACK	None.
SQLDisconnect	DISCONNECT	Association management.
SQLFreeConnect	none	Driver Manager and driver memory deallocation.
SQLFreeEnv	none	Driver Manager and driver memory deallocation.
SQLCancel	none	None.
SQLError	GET DIAGNOSTICS	GET DIAGNOSTICS retrieves information from the SQL diagnostics area that pertains to the most recently executed SQL statement. This information can be retrieved following execution and preceding the deallocation of the statement.

Embedded SQL to ODBC

The following tables list the relationship between the X/Open Embedded SQL language and corresponding ODBC functions. The section number shown in the first column of each table refers to the section of the X/Open and SQL Access Group SQL CAE specification (1992).

Declarative Statements

The following table lists declarative statements.

Section	SQL Statement	ODBC Function	Comments
4.3.1	Static SQL DECLARE CURSOR	none	Issued implicitly by the driver if a *cursor specification* is passed to **SQLExecDirect**.
4.3.2	Dynamic SQL DECLARE CURSOR	none	Cursor is generated automatically by the driver. To set a name for the cursor, use **SQLSetCursorName**. To retrieve a cursor name, use **SQLGetCursorName**.

Data Definition Statements

The following table lists data definition statements.

Section	SQL Statement	ODBC Function	Comments
5.1.2	ALTER TABLE CREATE INDEX	**SQLPrepare**, **SQLExecute**,	None.
5.1.3	CREATE TABLE	or **SQLExecDirect**	
5.1.4	CREATE VIEW		
5.1.5	DROP INDEX		
5.1.6	DROP TABLE		
5.1.7	DROP VIEW		
5.1.8	GRANT		
5.1.9	REVOKE		

Data Manipulation Statements

The following table lists data manipulation statements.

Section	SQL Statement	ODBC Function	Comments
5.2.1	CLOSE	**SQLFreeStmt** (SQL_CLOSE option)	None.
5.2.2	Positioned DELETE	**SQLExecDirect**(..., "DELETE FROM *table-name* WHERE CURRENT OF *cursor-name*")	Driver-generated *cursor-name* can be obtained by calling **SQLGetCursor-Name**.
5.2.3	Searched DELETE	**SQLExecDirect**(..., "DELETE FROM *table-name* WHERE *search-condition*")	None.

5.2.4	FETCH	**SQLFetch**	None.
5.2.5	INSERT	**SQLExecDirect** (...,"INSERT INTO *table-name* ...")	Can also be invoked by **SQLPrepare** and **SQLExecute**.
5.2.6	OPEN	none	Cursor is OPENed implicitly by **SQLExecute** or **SQLExecDirect** when a SELECT statement is specified.
5.2.7	SELECT ...INTO	none	Not supported.
5.2.8	Positioned UPDATE	**SQLExecDirect**(..., "UPDATE *table-name* SET *column-identifier* = *expression* ...WHERE CURRENT OF *cursor-name*")	Driver-generated *cursor-name* can be obtained by calling **SQLGetCursorName**.
5.2.9	Searched UPDATE	**SQLExecDirect**(..., "UPDATE *table-name* SET *column-identifier* = *expression* ...WHERE *search-condition*")	None.

Dynamic SQL Statements

The following table lists dynamic SQL statements.

Section	SQL Statement	ODBC Function	Comments
5.3 (see 5.2.1)	Dynamic SQL **CLOSE**	**SQLFreeStmt** (SQL_CLOSE option)	None.
5.3(see5.2.2)	Dynamic SQL Positioned DELETE	**SQLExecDirect**(..., "DELETE FROM *table-name* WHERE CURRENT OF *cursor-name*")	Can also be invoked by **SQLPrepare** and **SQLExecute**.

5.3(see5.2.8)	Dynamic SQL Positioned UPDATE	**SQLExecDirect**(..., "UPDATE *table-name* SET *column-identifier* = *expression* ...WHERE CURRENT OF *cursor-name*")	Can also be invoked by **SQLPrepare** and **SQLExecute**.
5.3.3	ALLOCATE DESCRIPTOR	None	Descriptor information is implicitly allocated and attached to the *hstmt* by the driver. Allocation occurs at either the first call to **SQLBindParameter** or at **SQLExecute** or **SQLExecDirect** time.
5.3.4	DEALLOCATE DESCRIPTOR	**SQLFreeStmt** (SQL_DROP option)	None.
5.3.5	DESCRIBE	none	None.
5.3.6	EXECUTE	**SQLExecute**	None.
5.3.7	EXECUTE IMMEDIATE	**SQLExecDirect**	None.
5.3.8	Dynamic SQL FETCH	**SQLFetch**	None.
5.3.9	GET DESCRIPTOR	**SQLNumResultCols** **SQLDescribeCol** **SQLColAttributes**	COUNT FORM. VALUE form with *field-name* in {NAME, TYPE, LENGTH, PRECISION, SCALE, NULLABLE}.
5.3.10	Dynamic SQL OPEN	**SQLExecute**	None.
5.3.11	PREPARE	**SQLPrepare**	None.

5.3.12	SET DESCRIPTOR	**SQLBindParameter**	**SQLBindParameter** is associated with only one *hstmt* where a descriptor is applied to any number of statements with USING SQL DESCRIPTOR.

Transaction Control Statements

The following table lists transaction control statements.

Section	SQL Statement	ODBC Function	Comments
5.4.1	COMMIT WORK	**SQLTransact** (SQL_COMMIT option)	None.
5.4.2	ROLLBACK WORK	**SQLTransact** (SQL_ROLLBACK option)	None.

Association Management Statements

The following table lists association management statements.

Section	SQL Statement	ODBC Function	Comments
5.5.1	CONNECT	**SQLConnect**	None.
5.5.2	DISCONNECT	**SQLDisconnect**	ODBC does not support DISCONNECT ALL.

5.5.3	SET CONNECTION	None	The SQL Access Group (SAG) Call Level Interface allows for multiple simultaneous connections to be established, but only one connection to be active at one time. SAG-compliant drivers track which connection is active, and automatically switch to a different connection if a different connection handle is specified. However, the active connection must be in a state that allows the connection context to be switched, in other words, there must not be a transaction in progress on the current connection. Drivers that are not SAG-compliant are not required to support this behavior. That is, drivers that are not SAG-compliant are not required to return an error if the driver and its associated data source can simultaneously support multiple active connections.

Diagnostic Statement

The following table lists the GET DIAGNOSTIC statement.

Section	SQL Statement	ODBC Function	Comments
5.6.1	GET DIAGNOSTICS	**SQLError** **SQLRowCount**	For **SQLError**, the following fields from the diagnostics area are available: RETURNED_SQLSTATE, MESSAGE_TEXT, and MESSAGE_LENGTH. For **SQLRowCount**, the ROW_COUNT field is available.

F

Scalar Functions

ODBC specifies five types of scalar functions:

- String functions
- Numeric functions
- Time and date functions
- System functions
- Data type conversion functions

The following sections list functions by function type. Descriptions include associated syntax.

String Functions

The following table lists string manipulation functions.

Character string literals used as arguments to scalar functions must be bounded by single quotes.

Arguments denoted as *string_exp* can be the name of a column, a string literal, or the result of another scalar function, where the underlying data type can be represented as SQL_CHAR, SQL_VARCHAR, or SQL_LONGVARCHAR.

Arguments denoted as *start*, *length* or *count* can be a numeric literal or the result of another scalar function, where the underlying data type can be represented as SQL_TINYINT, SQL_SMALLINT, or SQL_INTEGER.

The string functions listed here are 1-based, that is, the first character in the string is character 1.

Function	Description
ASCII(string_exp)	Returns the ASCII code value of the leftmost character of string_exp as an integer.
CHAR(code)	Returns the character that has the ASCII code value specified by code. The value of code should be between 0 and 255; otherwise, the return value is data source–dependent.
CONCAT(string_exp1, string_exp2)	Returns a character string that is the result of concatenating string_exp2 to string_exp1. If the column represented by string_exp1 or string_exp2 contained a NULL value, SOLID Server returns NULL.
INSERT(string_exp1, start, length, string_exp2)	Returns a character string where length characters have been deleted from string_exp1 beginning at start and where string_exp2 has been inserted into string_exp, beginning at start.
LCASE(string_exp)	Converts all upper case characters in string_exp to lower case.
LEFT(string_exp, count)	Returns the leftmost count of characters of string_exp.
LENGTH(string_exp)	Returns the number of characters in string_exp, excluding trailing blanks and the string termination character.

LOCATE(string_exp1, string_exp2[, start])	Returns the starting position of the first occurrence of string_exp1 within string_exp2. The search for the first occurrence of string_exp1 begins with the first character position in string_exp2 unless the optional argument, start, is specified. If start is specified, the search begins with the character position indicated by the value of start. The first character position in string_exp2 is indicated by the value 1. If string_exp1 is not found within string_exp2, the value 0 is returned.
LTRIM(string_exp)	Returns the characters of string_exp, with leading blanks removed.
REPEAT(string_exp,count)	Returns a character string composed of string_exp repeated count times.
REPLACE(string_exp1, string_exp2, string_exp3)	Replaces all occurrences of string_exp2 in string_exp1 with string_exp3.
RIGHT(string_exp, count)	Returns the rightmost count of characters of string_exp.
RTRIM(string_exp)	Returns the characters of string_exp with trailing blanks removed.
SPACE(count)	Returns a character string consisting of count spaces.
SUBSTRING(string_exp, start, length)	Returns a character string that is derived from string_exp beginning at the character position specified by start for length characters.
UCASE(string_exp)	Converts all lower case characters in string_exp to upper case.

Numeric Functions

The following table describes numeric functions that are included in the ODBC scalar function set.

Arguments denoted as *numeric_exp* can be the name of a column, the result of another scalar function, or a numeric literal, where the underlying data type could be represented as SQL_NUMERIC, SQL_DECIMAL, SQL_TINYINT, SQL_SMALLINT, SQL_INTEGER, SQL_BIGINT, SQL_FLOAT, SQL_REAL, or SQL_DOUBLE.

Arguments denoted as *float_exp* can be the name of a column, the result of another scalar function, or a numeric literal, where the underlying data type can be represented as SQL_FLOAT.

Arguments denoted as *integer_exp* can be the name of a column, the result of another scalar function, or a numeric literal, where the underlying data type can be represented as SQL_TINYINT, SQL_SMALLINT, SQL_INTEGER, or SQL_BIGINT.

Function	Description
ABS(*numeric_exp***)**	Returns the absolute value of *numeric_exp*.
ACOS(*float_exp***)**	Returns the arccosine of *float_exp* as an angle, expressed in radians.
ASIN(*float_exp***)**	Returns the arcsine of *float_exp* as an angle, expressed in radians.
ATAN(*float_exp***)**	Returns the arctangent of *float_exp* as an angle, expressed in radians.
ATAN2(*float_exp1***,** *float_exp2***)**	Returns the arctangent of the x and y coordinates, specified by *float_exp1* and *float_exp2*, respectively, as an angle, expressed in radians.
CEILING(*numeric_exp***)**	Returns the smallest integer greater than or equal to *numeric_exp*.
COS(*float_exp***)**	Returns the cosine of *float_exp,* where *float_exp* is an angle expressed in radians.
COT(*float_exp***)**	Returns the cotangent of *float_exp,* where *float_exp* is an angle expressed in radians.

DEGREES(*numeric_exp***)**	Returns the number of degrees converted from *numeric_exp* radians.
EXP(*float_exp***)**	Returns the exponential value of *float_exp*.
FLOOR(*numeric_exp***)**	Returns largest integer less than or equal to *numeric_exp*.
LOG(*float_exp***)**	Returns the natural logarithm of *float_exp*.
LOG10(*float_exp***)**	Returns the base 10 logarithm of *float_exp*.
MOD(*integer_exp1***,** *integer_exp2***)**	Returns the remainder (modulus) of *integer_exp1* divided by *integer_exp2*.
PI( )	Returns the constant value of pi as a floating point value.
POWER(*numeric_exp***,** *integer_exp***)**	Returns the value of *numeric_exp* to the power of *integer_exp*.
RADIANS(*numeric_exp***)**	Returns the number of radians converted from *numeric_exp* degrees.
ROUND(*numeric_exp***,** *integer_exp***)**	Returns *numeric_exp* rounded to *integer_exp* places right of the decimal point. If *integer_exp* is negative, *numeric_exp* is rounded to |*integer_exp*| places to the left of the decimal point.
SIGN(*numeric_exp***)**	Returns an indicator or the sign of *numeric_exp*. If *numeric_exp* is less than zero, –1 is returned. If *numeric_exp* equals zero, 0 is returned. If *numeric_exp* is greater than zero, 1 is returned.
SIN(*float_exp***)**	Returns the sine of *float_exp*, where f*loat_exp* is an angle expressed in radians.
SQRT(*float_exp***)**	Returns the square root of *float_exp*.

TAN(*float_exp***)**	Returns the tangent of *float_exp*, where *float_exp* is an angle expressed in radians.
TRUNCATE(*numeric_exp***,** *integer_exp***)**	Returns *numeric_exp* truncated to *integer_exp* places right of the decimal point. If *integer_exp* is negative, *numeric_exp* is truncated to |*integer_exp*| places to the left of the decimal point.

Time and Date Functions

The following table lists time and date functions that are included in the ODBC scalar function set.

Arguments denoted as *timestamp_exp* can be the name of a column, the result of another scalar function, or a time, date, or timestamp literal, where the underlying data type could be represented as SQL_CHAR, SQL_VARCHAR, SQL_TIME, SQL_DATE, or SQL_TIMESTAMP.

Arguments denoted as *date_exp* can be the name of a column, the result of another scalar function, or a date or timestamp literal, where the underlying data type could be represented as SQL_CHAR, SQL_VARCHAR, SQL_DATE, or SQL_TIMESTAMP.

Arguments denoted as *time_exp* can be the name of a column, the result of another scalar function, or a time or timestamp literal, where the underlying data type could be represented as SQL_CHAR, SQL_VARCHAR, SQL_TIME, or SQL_TIMESTAMP.

Values returned are represented as ODBC data types.

Function	Description
CURDATE( )	Returns the current date as a date value.
CURTIME( )	Returns the current local time as a time value.
DAYNAME(*date_exp***)**	Returns a character string containing the data source–specific name of the day (for example, Sunday, through Saturday or Sun. through Sat. for a data source that uses English, or Sonntag through Samstag for a data source that uses German) for the day portion of *date_exp*.

DAYOFMONTH(*date_exp***)**	Returns the day of the month in *date_exp* as an integer value in the range of 1–31.
DAYOFWEEK(*date_exp***)**	Returns the day to the week in *date_exp* as an integer value in the range of 1–7, where 1 represents Sunday.
DAYOFYEAR(*date_exp***)**	Returns the day of the year in *date_exp* as an integer value in the range of 1–366.
HOUR(*time_exp***)**	Returns the hour in *time_exp* as an integer value in the range of 0–23.
MINUTE(*time_exp***)**	Returns the minute in *time_exp* as an integer value in the range of 0–59.
MONTH(*date_exp***)**	Returns the month in *date_exp* as an integer value in the range of 1–12.
MONTHNAME(*date_exp***)**	Returns a character string containing the data source–specific name of the month (for example, January throughDecember or Jan. through Dec. for a data source that uses English, or Januar through Dezember for a data source that uses German) for the month portion of *date_exp*.
NOW( )	Returns current date and time as a timestamp value.
QUARTER(*date_exp***)**	Returns the quarter in *date_exp* as an integer value in the range of 1–4, where 1 represents January 1 through March 31.
SECOND(*time_exp***)**	Returns the second in *time_exp* as an integer value in the range of 0–59.

TIMESTAMPADD(*interval***,** *integer_exp***,** *timestamp_exp***)**	Returns the timestamp calculated by adding *integer_exp* intervals of type *interval* to *timestamp_exp*. Valid values of *interval* are the following keywords: SQL_TSI_FRAC_SECOND SQL_TSI_SECOND SQL_TSI_MINUTE SQL_TSI_HOUR SQL_TSI_DAY SQL_TSI_WEEK SQL_TSI_MONTH SQL_TSI_QUARTER SQL_TSI_YEAR

TIMESTAMPADD(*interval***,** *integer_exp***,** *timestamp_exp***) (continued)**

where fractional seconds are expressed in billionths of a second. For example, the following SQL statement returns the name of each employee and their one-year anniversary dates:

```
SELECT NAME,
   {fn
TIMESTAMPADD(SQL_TSI_YEAR,
   {fn CURDATE()},
    1,HIRE_DATE)} FROM
EMPLOYEES
```

If *timestamp_exp* is a time value and *interval* specifies days, weeks, months, quarters, or years, the date portion of *timestamp_exp* is set to the current date before calculating the resulting timestamp.

If *timestamp_exp* is a date value and *interval* specifies fractional seconds, seconds, minutes, or hours, the time portion of *timestamp_exp* is set to 0 before calculating the resulting timestamp.

An application determines which intervals a data source supports by calling **SQLGetInfo** with the SQL_TIMEDATE_ADD_INTERVALS option.

TIMESTAMPDIFF(*interval***,** *timestamp_exp1***,** *timestamp_exp2***)**

Returns the integer number of intervals of type *interval* by which *timestamp_exp2* is greater than *timestamp_exp1*. Valid values of *interval* are the following keywords:

SQL_TSI_FRAC_SECOND
SQL_TSI_SECOND
SQL_TSI_MINUTE
SQL_TSI_HOUR
SQL_TSI_DAY
SQL_TSI_WEEK
SQL_TSI_MONTH
SQL_TSI_QUARTER
SQL_TSI_YEAR

where fractional seconds are expressed in billionths of a second. For example, the following SQL statement returns the name of each employee and the number of years they have been employed.

```
SELECT NAME,
        {fn
TIMESTAMPDIFF(SQL_TSI_YEAR,
        {fn CURDATE()},
HIRE_DATE)}
        FROM EMPLOYEES
```

TIMESTAMPDIFF(*interval***,** *timestamp_exp1***,** *timestamp_exp2***) (continued)**	If either timestamp expression is a time value and *interval* specifies days, weeks, months, quarters, or years, the date portion of that timestamp is set to the current date before calculating the difference between the timestamps. If either timestamp expression is a date value and *interval* specifies fractional seconds, seconds, minutes, or hours, the time portion of of that timestamp is set to 0 before calculating the difference between the timestamps. An application determines which intervals a data source supports by calling **SQLGetInfo** with the SQL_TIMEDATE_DIFF_INTERVALS option.
WEEK(*date_exp***)**	Returns the week of the year in *date_exp* as an integer value in the range of 1–53.
YEAR(*date_exp***)**	Returns the year in *date_exp* as an integer value. The range is data source–dependent.

System Functions

The following table lists system functions that are included in the ODBC scalar function set.

Arguments denoted as *exp* can be the name of a column, the result of another scalar function, or a literal, where the underlying data type could be represented as SQL_NUMERIC, SQL_DECIMAL, SQL_TINYINT, SQL_SMALLINT, SQL_INTEGER, SQL_BIGINT, SQL_FLOAT, SQL_REAL, SQL_DOUBLE, SQL_DATE, SQL_TIME, or SQL_TIMESTAMP.

Arguments denoted as *value* can be a literal constant, where the underlying data type can be represented as SQL_NUMERIC, SQL_DECIMAL, SQL_TINYINT, SQL_SMALLINT, SQL_INTEGER, SQL_BIGINT, SQL_FLOAT, SQL_REAL, SQL_DOUBLE, SQL_DATE, SQL_TIME, or SQL_TIMESTAMP.

Values returned are represented as ODBC data types.

Function	Description
IFNULL(*exp***,***value***)**	If *exp* is null, *value* is returned. If *exp* is not null, *exp* is returned. The possible data type(s) of *value* must be compatible with the data type of *exp*.
USER( )	Returns the user's authorization name. (The user's authorization name is also available via **SQLGetInfo** by specifying the information type: SQL_USER_NAME or by using pseudocolumn 'USER' SQL: SELECT USER...)

Explicit Data Type Conversion

Explicit data type conversion is specified in terms of ODBC SQL data type definitions.

The ODBC syntax for the explicit data type conversion function does not restrict conversions. The validity of specific conversions of one data type to another data type will be determined by each driver-specific implementation. The driver will, as it translates the ODBC syntax into the native syntax, reject those conversions that, although legal in the ODBC syntax, are not supported by the data source. The ODBC function **SQLGetInfo** provides a way to inquire about conversions supported by the data source.

The format of the **CONVERT** function is:

CONVERT(*value_exp***,** *data_type***)**

The function returns the value specified by *value_exp* converted to the specified *data_type*, where *data_type* is one of the following keywords:

SQL_BIGINT	SQL_BINARY
SQL_BIT	SQL_CHAR
SQL_DATE	SQL_DECIMAL
SQL_DOUBLE	SQL_FLOAT
SQL_INTEGER	SQL_LONGVARBINARY

SQL_LONGVARCHAR	SQL_NUMERIC
SQL_REAL	SQL_SMALLINT
SQL_TIME	SQL_TIMESTAMP
SQL_TINYINT	SQL_VARBINARY
SQL_VARCHAR	

The ODBC syntax for the explicit data type conversion function does not support specification of conversion format. If specification of explicit formats is supported by the underlying data source, a driver must specify a default value or implement format specification.

The argument *value_exp* can be a column name, the result of another scalar function, or a numeric or string literal. For example:

{ fn CONVERT({ fn CURDATE() }, SQL_CHAR) }

converts the output of the CURDATE scalar function to a character string..

The following two examples illustrate the use of the **CONVERT** function. These examples assume the existence of a table called EMPLOYEES, with an EMPNO column of type SQL_SMALLINT and an EMPNAME column of type SQL_CHAR.

If an application specifies the following:

SELECT EMPNO FROM EMPLOYEES WHERE

--(*vendor(Microsoft),product(ODBC) fn CONVERT(EMPNO,SQL_CHAR)*)-- LIKE '1%'

or its equivalent in shorthand form:

SELECT EMPNO FROM EMPLOYEES WHERE {fn CONVERT(EMPNO,SQL_CHAR)} LIKE '1%'

SOLID ODBC driver translates the request to:

SELECT EMPNO FROM EMPLOYEES WHERE CONVERT_CHAR(EMPNO) LIKE '1%'

If an application specifies the following:

SELECT --(*vendor(Microsoft),product(ODBC) fn ABS(EMPNO)*)--, --(*vendor(Microsoft),product(ODBC) fn CONVERT(EMPNAME,SQL_SMALLINT)*)-- FROM EMPLOYEES WHERE EMPNO <> 0

or its equivalent in shorthand form:

SELECT {fn ABS(EMPNO)}, {fn CONVERT(EMPNAME,SQL_SMALLINT)} FROM EMPLOYEES WHERE EMPNO <> 0

SOLID ODBC driver translates the request to:

```
SELECT ABS(EMPNO), CONVERT_SMALLINT(EMPNAME) FROM EMPLOYEES
WHERE EMPNO <> 0
```

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Supported ODBC Functions in SOLID *Embedded Engine*

Task	Function Name	Availability when using ODBC (WinNT, Win98/95 Available)	ODBC Conformance Level
Connecting to a Data Source	SQLAllocEnv	Available	Core
	SQLAllocConnect	Available	Core
	SQLConnect	Available	Core
	SQLDriverConnect	Available	Level1
	SQLBrowseConnect	Not implemented	Level2
Obtaining Information about a Driver and Data Source	SQLDataSources	Available (Driver Manager*)	Level2
	SQLDrivers	Available (Driver Manager*)	Level2
	SQLGetInfo	Available	Level1
	SQLGetFunctions	Available	Level1
	SQLGetTypeInfo	Available	Level1
Setting and Retrieving Driver Options	SQLSetConnectOption	Available	Level1
	SQLSetStmtOption	Available	Level1
	SQLGetStmtOption	Available	Level1
Preparing SQL Requests	SQLAllocStmt	Available	Core
	SQLPrepare	Available	Core

Task	Function Name	Availability when using ODBC (WinNT, Win98/95 Available)	ODBC Conformance Level
	SQLBindParameter	Available	Level1
	SQLParamOptions	Not implemented	Level2
	SQLGetCursorName	Available	Core
	SQLSetCursorName	Available	Core
	SQLSetScrollOptions	Available (Cursor Library**)	Level2
Submitting Requests	SQLExecute	Available	Core
	SQLExecDirect	Available	Core
	SQLNativeSQL	Not implemented	Level2
	SQLDescribeParam	Available	Level2
	SQLNumParams	Available	Level2
	SQLParamData	Available	Level1
	SQLPutData	Available	Level1
Retrieving Results and Information about Results	SQLRowCount	Available	Core
	SQLNumResultCols	Available	Core
	SQLDescribeCol	Available	Core
	SQLColAttributes	Available	Core
	SQLBindCol	Available	Core
	SQLFetch	Available	Core
	SQLExtendedFetch	Available (Cursor Library**)	Level2
	SQLGetData Available	Available	Level1
	SQLSetPos	Available (Cursor Library**)	Level 2
	SQLMoreResults	Not implemented	Level 2
	SQLError	Available	Core
Obtaining Information about the Data Source's System Tables	SQLColumnPrivileges	Not implemented	Level2

Task	Function Name	Availability when using ODBC (WinNT, Win98/95 Available)	ODBC Conformance Level
	SQLColumns	Available	Level1
	SQLForeignKeys	Not implemented	Level2
	SQLPrimaryKeys	Available	Level2
	SQLProcedureColumns	Not implemented	Level2
	SQLProcedures	Not implemented	Level2
	SQLSpecialColumns	Available	Level1
	SQLStatistics	Available	Level1
	SQLTablePrivileges	Not implemented	Level2
	SQLTables	Available	Level1
Terminating a Statement	SQLFreeStmt	Available	Core
	SQLCancel	Available	Core
	SQLTransact	Available	Core
Terminating a Connection	SQLDisconnect	Available	Core
	SQLFreeConnect	Available	Core
	SQLFreeEnv	Available	Core

* Support for this function is implemented in the ODBC Driver Manager.

** Support for this function is implemented in the ODBC Cursor Library.