

# FileMaker® 8

## ODBC and JDBC Developer's Guide



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# Chapter 1

## Introduction

Welcome to the *FileMaker® ODBC and JDBC Developer's Guide*. This guide explains concepts and details to help you share FileMaker data with other applications, using ODBC (Open Database Connectivity) and JDBC (Java Database Connectivity). This guide also documents how the ODBC and JDBC client drivers, when used with FileMaker Pro and FileMaker Server Advanced, support the industry standards for ODBC, JDBC, and SQL (Structured Query Language).

You can use FileMaker Pro, FileMaker Pro Advanced, or FileMaker Server Advanced, to create and test your database solution. You can then share your FileMaker database solution as a data source with ODBC- and JDBC-compliant applications, or access other ODBC data sources using your FileMaker database solution as a client application.

### About this guide

- This document contains information to access and share data using ODBC and JDBC with FileMaker Pro 8, FileMaker Pro 8 Advanced, and FileMaker Server 8 Advanced only. For information on using ODBC and JDBC with previous versions of FileMaker Pro, download documents from [www.filemaker.com/odbc](http://www.filemaker.com/odbc).
- This guide assumes that you are familiar with the basics of using ODBC and JDBC, and constructing SQL queries. Refer to a third-party book for more information on these topics.
- For step-by-step information on FileMaker Pro features, including accessing other data sources via ODBC, refer to FileMaker Pro Help.
- FileMaker Pro documentation uses the term *web publishing* to refer to databases that users can access on the Internet or on an intranet using a web browser.
- This guide uses “FileMaker Pro” to refer to both FileMaker Pro and FileMaker Pro Advanced, unless describing specific FileMaker Pro Advanced features.
- This guide uses “FileMaker Server” to refer to FileMaker Server 8 Advanced, which supports sharing FileMaker database files with other applications using ODBC and JDBC.

**Important** You can download PDFs of FileMaker 8 documentation from [www.filemaker.com](http://www.filemaker.com). Any updates to this document are also available from [www.filemaker.com/odbc](http://www.filemaker.com/odbc).

### Using ODBC and JDBC with FileMaker

ODBC and JDBC are application programming interfaces (APIs). These APIs give client applications a common language for interacting with a variety of data sources and database services, including FileMaker Pro and FileMaker Server.

All applications that support ODBC and JDBC recognize a basic subset of SQL statements. Working with SQL, you can use other applications (like spreadsheets, word processors, and reporting tools) to view, analyze, and modify FileMaker data.

SQL is passed through the ODBC and JDBC interfaces to the FileMaker host of the data source, performing queries such as `SELECT first_name, last_name FROM customers WHERE city='Paris'` and making updates such as the creation of a new record with `INSERT INTO customers (first_name, last_name) VALUES ('Jane', 'Smith')`.

### **Using a FileMaker database file as a data source**

You can use FileMaker Server to host a FileMaker database file as a data source, sharing your data with other applications using ODBC and JDBC. FileMaker Server allows up to 50 connections and supports local access (same computer) and remote access (both for middleware such as web servers, and for remote client access from desktop productivity applications).

You can use FileMaker Pro to host a FileMaker database file as a data source, sharing your data with client applications using ODBC and JDBC. FileMaker Pro allows up to five connections and supports local access (same computer) only.

The xDBC plug-in component you need for sharing your data with other applications is automatically installed with FileMaker Server and FileMaker Pro.

To access a hosted FileMaker database file, you need to install the corresponding ODBC or JDBC client driver. The client drivers are available through a separate installation on your FileMaker CD in the folder `\xDBC`. You can also download the latest versions of the client drivers and PDFs of FileMaker 8 documentation from [www.filemaker.com/odbc](http://www.filemaker.com/odbc). If you'll be hosting a FileMaker database file using FileMaker Server, make the client drivers available to remote users.

If your FileMaker database solution uses more than one FileMaker database file, all of the database files must be on the same computer.

Client applications sometimes use different terminology for accessing a data source. Many applications have menu items with names such as `Get external data` or `SQL query`. Review the documentation or Help that comes with your application.

Chapter 4, "Supported standards," describes the SQL statements that the ODBC and JDBC client drivers support when used with FileMaker Pro and FileMaker Server. For more information on constructing SQL queries, refer to a third-party book.

**Important** If you disable ODBC/JDBC sharing after it's already been on, a data source hosted by FileMaker Server or FileMaker Pro immediately becomes unavailable. The database administrator doesn't have the capability to alert ODBC and JDBC client applications about the data source's availability (the administrator can communicate only with FileMaker database file clients). No errors are reported, and the client application should notify users that the data source is not available and transactions cannot be completed. If a client application attempts to connect to an unavailable FileMaker database file, a message explains that the connection failed. If you host your FileMaker database file on Mac OS X 10.3, restart FileMaker Pro or FileMaker Server before you re-enable ODBC/JDBC sharing (restarting is not necessary in Mac OS X 10.4).

See the *Installing FileMaker ODBC and JDBC Client Drivers* guide to install the driver files needed for accessing a FileMaker data source.



**Limitations with third-party tools**

## Microsoft Query Wizard

- In a FileMaker data source, you cannot access table or column names that use High ASCII or double-byte characters. Instead, use Microsoft Query and manually enter the characters, enclosed in double quotation marks.

## Microsoft Access

- In a FileMaker data source, you cannot access table or column names that use High ASCII or double-byte characters.
- You cannot link to a FileMaker data source; however, you can import the FileMaker data source.

**Networking requirements**

You need a TCP/IP network when using FileMaker Server 8 to host a FileMaker database file as a data source over a network. FileMaker Pro 8 supports local access (same computer) only.

**Using FileMaker Pro as a client application**

You can use FileMaker Pro as an ODBC client application, interacting with data sources on the same computer or over a network.

**Limitations with third-party tools**

## Microsoft SQL Server

- When you export decimal, float, money, or numeric data to a FileMaker database file, the auto-enter field option **Calculated value** is set in the database. The option truncates values to zero decimal places using the calculation `Truncate(fieldname;0)`. If you deselect the option in the created database and then repeat the export, the auto-enter field option remains deselected.

**Updating files from previous versions**

FileMaker Pro 8 can open files created in earlier versions of FileMaker. See the *Converting FileMaker Databases from Previous Versions* guide for information.

**Note** FileMaker Server 8 can host FileMaker Pro 8 and FileMaker Pro 7v3 databases files. FileMaker Server 8 cannot host or convert earlier versions of FileMaker Pro database files.

**If you previously shared a FileMaker database file as a data source**

If you used LDAC (Local Data Access Companion) or RDAC (Remote Data Access Companion) to share a database file in previous versions, you'll need to make two changes. First, you need to set up users to belong to an account that has the extended privilege of **Access via ODBC/JDBC** (as part of the account's privilege set). Then, you need to enable your FileMaker Server or FileMaker Pro host for ODBC/JDBC sharing (in FileMaker Pro, choose **Edit menu > Sharing > ODBC/JDBC** and turn on sharing).

See FileMaker Pro Help for details about sharing via ODBC/JDBC, and for setting up accounts and privilege sets.

**Note** In previous versions of FileMaker Server and FileMaker Pro, you needed to create only one DSN (Data Source Name) for the host application when configuring a driver for access via ODBC. The one DSN allowed you to access any of your FileMaker database files as a data source. Beginning with FileMaker Server 7 and FileMaker Pro 7, you must create a DSN for each individual FileMaker database file you want to access as a data source. If you have previously set up access through one DSN that allows tables to be spread among several FileMaker database files, you'll need to consolidate those tables into a single database file (or create several DSNs).

***If you previously used FileMaker Pro as a client to access a data source***

The drivers you configured to access the data source should still work. See [www.filemaker.com/odbc](http://www.filemaker.com/odbc) for links to third-party vendors providing updated drivers. Additionally, Windows includes client drivers, such as SQL Server driver, with the operating system.

**Important** On Mac OS, OpenLink iODBC drivers conflict with the drivers provided in earlier versions of FileMaker. If you install the OpenLink iODBC drivers, you can no longer use the Text, Oracle, or SQL Server drivers included in earlier versions of FileMaker Pro.

See FileMaker Pro Help for details about using FileMaker Pro to access other data sources via ODBC.

# Chapter 2

## Using ODBC to share FileMaker data

Use the ODBC client driver to connect to a FileMaker data source from another application. The application that uses the ODBC client driver can directly access the data in a FileMaker database file. In Windows, the FileMaker ODBC client driver is DataDirect 32-BIT Sequelink 5.4. In Mac OS, the FileMaker ODBC client driver is ivslk18.dylib.

You can also use FileMaker Pro as a client application, interacting with records from another data source via ODBC using SQL. See FileMaker Pro Help for details about accessing a data source via ODBC.

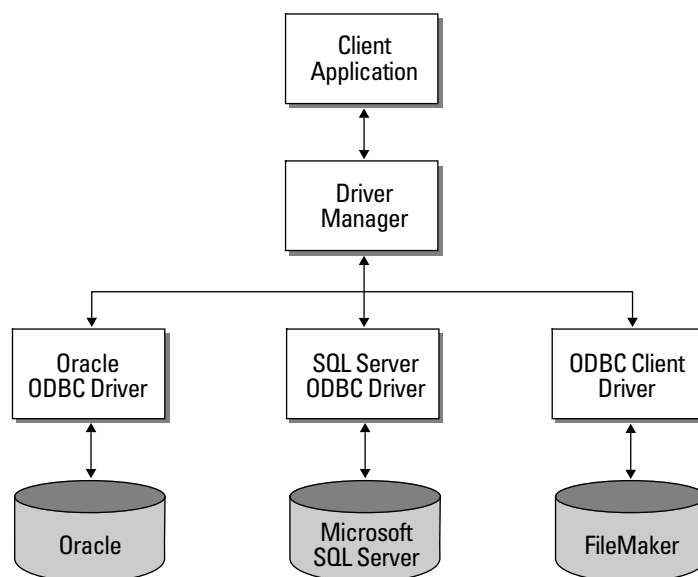
### About ODBC

ODBC is an API that enables applications to access data from many database management systems. ODBC gives client applications a common language for interacting with data sources and database services.

All applications that support ODBC recognize a common subset of statements. SQL lets you use other applications (like spreadsheets, word processors, and reporting tools) to view, analyze, and modify FileMaker data. See chapter 4, “Supported standards,” for the SQL statements, functions, and expressions that the ODBC client driver supports.

Your application can talk directly to a FileMaker database file by using the ODBC client driver. Your SQL statements are delivered to the FileMaker host of the database file and the results of those statements are sent back to you. If you use FileMaker Server to host a FileMaker database file as a data source, the database file can be located on another machine (the server machine) connected to the network, while your client application is located on your machine (the client machine). This is referred to as a client/server configuration.

ODBC components



## **Using the ODBC client driver**

You can use the ODBC client driver with any ODBC-compliant application. Sharing your FileMaker database file as a data source, you can:

- perform mail merges with Microsoft Word
- create charts with Microsoft Excel
- move FileMaker data to a DBMS like Microsoft SQL Server
- further analyze your FileMaker data with query or reporting tools to create charts, construct ad-hoc queries, and perform drill-down analysis
- create a Microsoft Visual Basic application that shares information with FileMaker Pro

To share a FileMaker database file as a data source, use FileMaker Pro to define accounts that will need access to the database file. Then, control access to the database file by assigning privilege sets to the accounts, including the extended privilege of access via ODBC/JDBC. Finally, enable the FileMaker Server or FileMaker Pro host application to share data via ODBC/JDBC.

For details, see FileMaker Pro or FileMaker Server Help.

**Important** The ODBC client driver replaces the FileMaker Pro ODBC driver released with a previous version of FileMaker. If you have previously set up access to a FileMaker data source using the older driver, you'll need to re-define access by using and configuring the new driver.

## **Accessing a FileMaker database file - overview**

From an ODBC-compliant application, you can construct SQL queries to access a FileMaker database file. The ODBC client driver must be installed on the computer generating the SQL query.

To access a FileMaker database file:

1. In FileMaker Pro, review the privilege sets you've assigned to accounts that will access the database file. Accounts that need access must use a privilege set with the extended privilege of **Access via ODBC/JDBC**.
2. Enable the FileMaker Server (via FileMaker Server Admin) or FileMaker Pro host application to share data via ODBC/JDBC.

FileMaker Server Admin (Windows): Choose **Action** menu > **Properties** > **Clients** tab, click **Enable Client Services**, then select **Allow ODBC and JDBC connections**.

FileMaker Server Admin (Mac OS): Click the **Configure** button, click the **Clients** tab, then select **Allow ODBC and JDBC connections**.

FileMaker Pro (Windows): Choose **Edit** menu > **Sharing** > **ODBC/JDBC** and set **ODBC/JDBC Sharing** to **On**.

FileMaker Pro (Mac OS): Choose **FileMaker Pro** menu > **Sharing** > **ODBC/JDBC** and set **ODBC/JDBC Sharing** to **On**.

3. Make sure the FileMaker database file you want to access is hosted and available.

If your FileMaker database solution uses more than one FileMaker database file, all of the database files must be on the same computer.

#### 4. Connect to the FileMaker data source.

Client applications sometimes use different terminology for accessing a data source via ODBC. Many applications have menu items with names such as **Get external data** or **SQL query**. Review the documentation or Help that comes with your application for details.

#### 5. Construct and execute a SQL query in the client application.

Each FileMaker database file that is open and set up for access is a separate data source (you create a DSN for each individual FileMaker database file you want to access as a data source).

Each database can have one or more tables. FileMaker fields are represented as columns. The complete field name, including any non-alphanumeric characters, displays as the column name.

**Note** In Windows, Microsoft Access can import only 32 or fewer fields at one time via ODBC from a FileMaker database file. If your database file has more than 32 fields, import them in increments of 32.

**Important** If you host your FileMaker database file on Mac OS, client drivers cannot access database names or table names that contain upper-ASCII, double-byte, or Japanese characters. If your FileMaker database file uses these characters, create a second database and use only ASCII characters for the filename and table names. In the second database, create a file reference that points to the data in your original database file. Share both files with ODBC/JDBC, but use the second database file when defining the DSN.

## ***Accessing a FileMaker database file from a Windows application***

### ***Installing the ODBC client driver (Windows)***

The ODBC client driver is available through a separate installation on the FileMaker Server Web Publishing CD and the FileMaker Pro CD in the folder \xDBC\ODBC Client Driver Installer. You can also download the latest version of the ODBC client driver and PDFs of FileMaker ODBC documentation from [www.filemaker.com/odbc](http://www.filemaker.com/odbc).

For installation instructions, see *Installing FileMaker ODBC and JDBC Client Drivers*, which is available as a PDF document on the FileMaker Pro CD in the folder \xDBC\Electronic Documentation, and in the folder \English Extras\Electronic Documentation where you installed FileMaker Server.

### ***Specifying ODBC client driver properties for a FileMaker DSN (Windows)***

Create a DSN for each individual FileMaker database file you want to access as a data source (in previous versions of FileMaker Server and FileMaker Pro, you created only one DSN for all FileMaker database files hosted by the application). The DSN identifies the FileMaker ODBC client driver, the host application (FileMaker Server or FileMaker Pro), and the FileMaker database file you're accessing as a data source.

To set up or change ODBC client driver properties:

#### 1. Open the ODBC Data Source Administrator control panel.

In the Windows Control Panel, choose **Administrative Tools > Data Sources (ODBC)**.

In Windows XP, **Administrative Tools** appear in the **Performance and Maintenance** category.

#### 2. Click the System DSN tab.

If you set up your data source as a User DSN or File DSN, click the corresponding tab.

**3. Click Add.**

If you're changing the properties of an existing data source, select the data source, click **Configure**, and skip to step 6.

**4. Choose DataDirect 32-BIT SequeLink 5.4 from the list of drivers.**

If the driver is not listed in the ODBC Data Source Administrator, look for the **(Default)** entry of the registry key `HKEY_LOCAL_MACHINE\SOFTWARE\ODBC\ODBCINST.INI\ODBC Drivers` using **Regedit** (choose **Start menu > Run > Regedit**). The Data for this entry should be **(value not set)**. If instead you see a blank string, right-click **(Default)**, choose **Delete**, and click **Yes** to confirm. This resets the entry to **(value not set)**. Uninstall and reinstall your ODBC client driver to see it in the ODBC Data Source Administrator.

**5. Click Finish.**

The DataDirect SequeLink for ODBC Setup dialog appears, with the **General** tab selected.

**6. For Data Source Name, type a name that will be meaningful to others accessing the FileMaker data source.**

An additional **Description** is optional.

Be sure **Use LDAP** is cleared. No translator **.DLLs** are included with the ODBC client driver (so clicking **Translate** will not allow you to configure an ODBC translator).

**7. For SequeLink Server Host, enter the location of your data source.**

If you're connecting to a FileMaker database file hosted by FileMaker Pro on your local machine, type `localhost` (or `127.0.0.1`).

If you're connecting to a FileMaker database file hosted by FileMaker Server over a network, type the IP address of FileMaker Server.

**8. For SequeLink Server Port, type 2399.**

**9. For Server Data Source, type the filename of the FileMaker database file you're using as a data source (don't type the filename extension).**

If you've enabled sharing via ODBC/JDBC in the FileMaker Pro or FileMaker Server host application, click the button to the right of **Server Data Source** to display the filenames of currently open FileMaker database files for you to choose from.

If your database name contains spaces, replace them with the escape characters `%20`. For example, `serverdatasource=MY%20DATABASE`.

**10. Click OK to save your data source information.**

If you're sharing another FileMaker database file, return to step 3 and set up the database file as a data source.

**11. Click OK to close the ODBC Data Source Administrator dialog box.**

**Important** When configuring a FileMaker data source, you must specify 2399 as the SequeLink Server Port.

### Verifying access via ODBC (Windows)

To verify that you've correctly configured the ODBC client driver to access the FileMaker data source:

1. Open the ODBC Data Source Administrator control panel.

In the Windows Control Panel, choose Administrative Tools > Data Sources (ODBC).

In Windows XP, Administrative Tools appear in the Performance and Maintenance category.

2. Click the System DSN tab.

If you set up your data source as a User DSN or File DSN, click the corresponding tab.

3. Choose the FileMaker data source that you previously configured.

The data source name you originally entered will appear under Name, and DataDirect 32-BIT SequeLink 5.4 will appear as the Driver.

4. Click Configure.

The DataDirect SequeLink for ODBC Setup dialog box appears.

5. Click Test Connect.

You are prompted to enter your FileMaker account name (in Database User Name) and password (in Database Password).

If the connection is OK, you'll receive the message **Connection test was successful**. If the connection fails:

- Make sure the FileMaker database file is hosted and available.
- Update or correct your connection information.
- Make sure your FileMaker account uses a privilege set with the extended privilege of Access via ODBC/JDBC.
- Verify that the FileMaker Pro or FileMaker Server host application has been set up for sharing via ODBC/JDBC.

### Accessing a FileMaker database file from a Mac OS application

If you build custom applications, use version 3.52.1 of the iODBC headers and libraries. Applications built with version 3.51 might not be able to load the client driver.

#### Installing the ODBC client driver (Mac OS)

The ODBC client driver is available through a separate installation on the FileMaker Server Web Publishing CD and the FileMaker Pro CD in the folder \xDBC\ODBC Client Driver Installer. You can also download the latest version of the ODBC client driver and PDFs of FileMaker ODBC documentation from [www.filemaker.com/odbc](http://www.filemaker.com/odbc)

To install the ODBC client driver, copy the file `SequeLink.bundle` to either your System or User library. If you don't have an /ODBC folder, create one manually:

Library	Copy SequeLink.bundle to this folder:
System	/Library/ODBC
User	/Users/<user>/Library/ODBC

For additional information, see *Installing FileMaker ODBC and JDBC Client Drivers*, which is available on the FileMaker Pro CD in the folder \xDBC\Electronic Documentation, and in the folder \English Extras\Electronic Documentation where you installed FileMaker Server.

### **Configuring the ODBC client driver (Mac OS)**

Configure the client driver using the ODBC Administrator bundled with the iODBC driver manager software recommended for your client application. If you require the OpenLink ODBC Administrator, it is bundled with the ODBC-JDBC Lite Bridge download available on the OpenLink web site.

The client driver has been tested with the following ODBC Administrators:

- OpenLink ODBC Administrator 3.52.1 (available from OpenLink Software)
- Apple ODBC Administrator 1.0.1 (available with Mac OS 10.3)

When configuring the client driver, you'll be prompted to provide a brief description and the path to the driver file:

#### **If you copied SequeLink.bundle to this library:**

#### **Use this driver path during configuration:**

/Library/ODBC	/Library/ODBC/SequeLink.bundle/Contents/MacOS/ivslk18.dylib
/Users/<user>/Library/ODBC	/Users/<user>/Library/ODBC/SequeLink.bundle/Contents/MacOS/ivslk18.dylib

The ODBC Administrator also allows you to optionally define keywords and a Setup File path, but the client driver does not need that information.

### **Specifying ODBC client driver properties for a FileMaker DSN (Mac OS)**

Create a DSN for each individual FileMaker database file you want to access as a data source (in previous versions of FileMaker Server and FileMaker Pro, you created only one DSN for all FileMaker database files hosted by the application). The DSN identifies the FileMaker ODBC driver, the location of the host application, and the FileMaker database file you're accessing as a data source.

**Important** The ODBC client driver for Mac OS does not support upper-ASCII, double-byte, or Japanese characters in database names or table names. If your FileMaker database file uses these characters, create a second database and use only ASCII characters for the filename and table names. In the second database, create a file reference that points to the data in your original database file. Share both files with ODBC/JDBC, but use the second database file when defining the DSN.



Additionally, you'll need to specify these keyword values for the DSN:

Keyword	Value
Host	If you're connecting to a FileMaker database file hosted by FileMaker Pro on your local machine, type <code>localhost</code> (or <code>127.0.0.1</code> ). If you're connecting to a FileMaker database file hosted by FileMaker Server over a network, type the IP address or hostname of FileMaker Server.
Port	Type <code>2399</code> .
ServerDataSource	Type the filename of the FileMaker database file you're using as a data source (don't type the filename extension). If your database name contains spaces, replace them with the escape characters <code>%20</code> . For example, <code>ServerDataSource=MY%20DATABASE</code> . Double-byte characters are not supported.

**Important** If you attempt to add a DSN with the ODBC Administrator and receive the message **Could not load the driver or translator setup library**, download and install the ODBC-JDBC Lite Bridge (`m615jzzz.dmg`) from OpenLink's web site. The download provides an ODBC Administrator that allows you to successfully create a DSN. See [www.filemaker.com/odbc](http://www.filemaker.com/odbc) for links to additional details.

### **Verifying access via ODBC (Mac OS)**

The OpenLink ODBC Administrator allows you to verify that you've correctly configured the ODBC client driver to access the FileMaker data source.



# Chapter 3

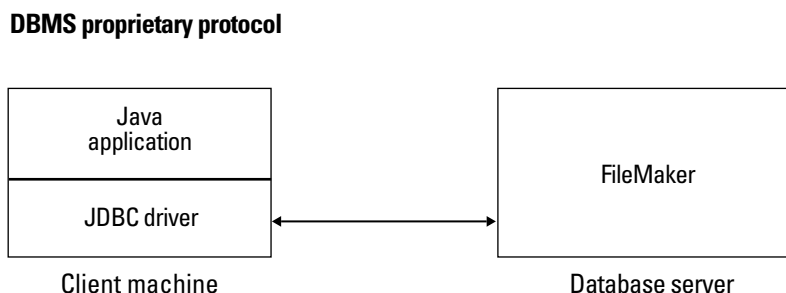
## Using JDBC to share FileMaker data

If you're a Java programmer, you can use the JDBC client driver with any Rapid Application Development (RAD) tool to visually create a Java application or applet that connects to a FileMaker data source. The Java application or applet that uses the JDBC client driver can directly access the data in a FileMaker database file.

### About JDBC

JDBC is a Java API for executing SQL statements, the standard language for accessing relational databases. JDBC is a name and not an acronym—although it is thought of as standing for “Java Database Connectivity” because it is the Java equivalent for ODBC. JDBC is a low-level interface, which means that it is used to call SQL commands directly. It is also designed to be used as a base for higher level interfaces and tools.

Your Java applet or application can talk directly to a FileMaker database file by using the JDBC client driver. Your SQL statements are delivered to the FileMaker host of the database file and the results of those statements are sent back to you. If you use FileMaker Server to host, the FileMaker database file you're using as a data source can be located on another machine (the server machine) connected to the network, while your Java applet or client application is located on your machine (the client machine). This is referred to as a client/server configuration.



### Using the JDBC client driver

You can use the JDBC client driver with a Java compiler or RAD tool to connect with your database while you build the code for your Java application or applet. After the Java application or applet has been created, the JDBC client driver must be present with the files or included within the code in order for the application or applet to communicate with the database.

To use the JDBC client driver, your Java application or applet must register the driver with the JDBC driver manager and you must specify the correct JDBC URL from within the application or applet. You need the JDBC URL to make the connection to the database.

### **Installing the JDBC client driver**

The JDBC client driver is available through a separate installation program on the FileMaker Server Web Publishing CD and the FileMaker Pro CD in the folder \xDBC\JDBC Client Driver Installer. The driver is packaged as a Java archive file (with the .jar filename extension) containing a collection of class files. You can also download the latest version of the JDBC client driver (for Windows or Mac OS) and PDFs of FileMaker JDBC documentation from [www.filemaker.com/jdbc](http://www.filemaker.com/jdbc).

For installation instructions, see *Installing FileMaker ODBC and JDBC Client Drivers*, which is available as a PDF document on the FileMaker Pro CD in the folder \xDBC\Electronic Documentation, and in the folder \English Extras\Electronic Documentation where you installed FileMaker Server.

### **About the JDBC client driver**

The JDBC client driver provides partial support for the JDBC 3.0 specification. For links to additional details, see [www.filemaker.com/jdbc](http://www.filemaker.com/jdbc). Also see the *SequeLink Developer's Reference* available at [www.datadirect.com](http://www.datadirect.com).

The JDBC client driver is designed to work with the Java Development Kit (JDK) 1.4. It is a Type 4 driver — a native protocol, pure Java driver that converts JDBC calls directly into the network protocol used by FileMaker. This type of driver offers all the advantages of Java including automatic installation (for example, downloading the JDBC driver with an applet that uses it). The driver will work with JDK 1.3 and Java 2 as long as you only use JDBC 1.2 calls in a Java 2 environment

The driver class and main entry point for the driver is named:

```
com.ddtek.jdbc.sequelink.SequeLinkDriver
```

**Important** The JDBC client driver replaces the FileMaker JDBC driver released with a previous version of FileMaker. If you have previously set up access to a FileMaker data source using the older driver, you'll need to re-define access by using and configuring the new driver.

### **Using a JDBC URL to connect to your database**

In Java, most resources are accessed through URLs (Uniform Resource Locators). A JDBC URL is used to identify the database so the JDBC client driver can recognize and establish a connection with the database.

The JDBC URL consists of three main parts separated by colons:

```
jdbc:<subprotocol>:<subname>
```

The first part in the JDBC URL is always the JDBC protocol (“jdbc”). The *subprotocol* is the driver name or the mechanism that supports multiple drivers. For the JDBC client driver, the subprotocol is `sequelink`. The *subname* is the IP address of the machine that is hosting the FileMaker data source.

### **Registering the JDBC client driver and connecting to a FileMaker data source (an example)**

Here is an example using JDBCTest that:

1. Registers the JDBC client driver with the JDBC driver manager
2. Establishes a connection with the FileMaker data source (the JDBC URL is `jdbc:sequelink://17.184.17.170:2399`)

**3. Returns error codes**

```

import java.sql.*;
class FMPJDBCTest
{
    public static void main(String[] args)
    {
        // register the JDBC client driver
        try {
            Driver d =
            (Driver)Class.forName("com.ddtek.jdbc.sequelink.SequeLinkDriver").newInstance();
        } catch(Exception e) {
            System.out.println(e);
        }
        // establish a connection to FileMaker
        Connection con;
        try {
            con =
            DriverManager.getConnection("jdbc:sequelink://17.184.17.170:2399;
            user=some user;password=some password",userName,password);
        } catch(Exception e) {
            system.out.println(e);
        }
        // get connection warnings
        SQLWarning warning = null;
        try {
            warning = con.getWarnings();
            if (warning == null) {
                System.out.println("No warnings");
                return;
            }
            while (warning != null) {
                System.out.println("Warning: "+warning);
                warning = warning.getNextWarning();
            }
        } catch (Exception e) {
            Sysem.out.println(e);
        }
    }
}

```

**Note** This example is not meant to be compiled.

**Specifying driver properties in the URL subname**

Specify the user and password driver properties in the subname of the JDBC URL. These are the properties that could be passed to the connection when calling the `DriverManager.getConnection` method via the `Properties` parameter.

- `user`: an account in the FileMaker database file that uses a privilege set with the extended privilege `Access via ODBC/JDBC`
- `password`: the password for the account in the FileMaker database file

**Basic JDBC URL connection**

Format: `jdbc:sequelink://<sequelink host IP address>:<port>`

This is the URL to connect to the FileMaker database file with no passwords. The port number will always be 2399 (you can't change the JDBC sharing to a different port).

If you are executing the JDBC URL connection on the same machine where the file is located, you can use `jdbc:sequelink://localhost:2399`

Example: `jdbc:sequelink://17.184.17.170:2399`

**JDBC URL connection with user name and password defined in the URL**

Format:

`jdbc:sequelink://<sequelink host IP address>:<port>;user=<userName>;password=<password>`

Example: `jdbc:sequelink://17.184.17.170:2399;user=phil;password=jsp`

**JDBC URL connection with the database name specified in the URL**

Format:

`jdbc:sequelink://<sequelink host IP address>:<port>;serverDataSource=<databasename>`

Example: `jdbc:sequelink://17.184.17.170:2399;serverDataSource=publications`

If your database name contains spaces, replace them with the escape characters `%20`.

Example: `jdbc:sequelink://17.184.17.170:2399;serverDataSource=MY%20DATABASE`

**JDBC URL connection with the database name, user name, and password specified in the URL**

Format 1 (using the data store user name and password): `jdbc:sequelink://<sequelink host IP address>:<port>;serverDataSource=<databasename>;DBUser=<databaseusername>;DBPassword=<databasepassword>`

Format 2 (using the host user name and password): `jdbc:sequelink://<sequelink host IP address>:<port>;serverDataSource=<databasename>;HUser=<username>;HPassword=<password>`

**Note** If your FileMaker database solution uses many FileMaker database files, create an additional database file that contains all the necessary external file references, table occurrences, and relationships for your solution. Then define this additional database file as your data source in the JDBC URL. All of the FileMaker database files must be on the same computer.

**Note** Secure Socket Layer (SSL) encryption is not supported. To create a more secure JDBC solution, set up an environment such as .ASP or .JSP, where the web server is hosting via https and communicating with the FileMaker database file behind a firewall.

## **Verifying access via JDBC**

When you install the JDBC client driver, you have the option of installing JDBCTest to help verify your connections. When installing the JDBC client driver, select **Install Developer's Tools** to get JDBCTest. See the *Installing FileMaker ODBC and JDBC Client Drivers* PDF file for information. You can download the latest PDFs of FileMaker 8 JDBC documentation from [www.filemaker.com/jdbc](http://www.filemaker.com/jdbc).

When verifying access to a FileMaker database file via JDBC, make sure:

- The FileMaker database file is hosted and available.
- Your FileMaker account uses a privilege set with the extended privilege of **Access via ODBC/JDBC** (in the FileMaker database file).
- The FileMaker Pro or FileMaker Server host application has been set up for sharing via ODBC/JDBC.
- The JDBC client driver registration and the JDBC URL are correct (the driver can be included inside the Java Application or located on the client machine).

For additional information and examples that use Java and JDBC for general data interchange or for publishing FileMaker data on the web, see [www.filemaker.com/jdbc](http://www.filemaker.com/jdbc).





# Chapter 4

## *Supported standards*

This chapter describes the SQL statements and constructs supported by the FileMaker ODBC and JDBC client drivers. Use the client drivers to access a FileMaker database solution from an ODBC- or JDBC-compliant application. The FileMaker database solution can be hosted by FileMaker Pro or FileMaker Server.

The ODBC client driver supports ODBC 3.5 Level 1 with some features of Level 2. The JDBC client driver provides partial support for the JDBC 3.0 specification; see [www.filemaker.com/jdbc](http://www.filemaker.com/jdbc) for links to additional details, and the *SequeLink Developer's Reference* available at [www.datadirect.com](http://www.datadirect.com). The ODBC and JDBC client drivers support SQL-92 entry-level conformance, with some SQL-92 intermediate features.

### ***Support for Unicode characters***

The ODBC and JDBC client drivers support the Unicode API. However, if you're creating a custom application that uses the client drivers, use ASCII for field names, table names, and filenames (in case a non-Unicode query tool or application is used).

**Note** To insert and retrieve Unicode data, use SQL\_C\_WCHAR (the SQL\_C\_BINARY data type is not supported).

### ***SQL statements and clauses***

The ODBC and JDBC client drivers provide support for the following SQL statements:

SELECT	DELETE	INSERT	UPDATE
CREATE TABLE	ALTER TABLE	CREATE INDEX	DROP INDEX

The client drivers also support FileMaker data type mapping to ODBC SQL and JDBC SQL data types. See appendix A, "Mapping FileMaker fields to ODBC data types" and appendix B, "Mapping FileMaker fields to JDBC data types" for data type conversions. For more information on constructing SQL queries, refer to a third-party book.

**Note** The ODBC and JDBC client drivers recognize only the first repetition in a repeating field. Also, the drivers do not support portals in FileMaker Pro.

### ***SELECT statement***

Use the SELECT statement to specify which columns you're requesting. Follow the SELECT statement with the column expressions (similar to field names) you want to retrieve (for example, `last_name`). Expressions can include mathematical operations or string manipulation (for example, `SALARY * 1.05`).

The SELECT statement can use a variety of clauses:

```
SELECT [DISTINCT] {* | column_expression [[AS] column_alias],...}
FROM table_name [table_alias], ...
[ WHERE expr1 rel_operator expr2 ]
[ GROUP BY {column_expression, ...} ]
[ HAVING expr1 rel_operator expr2 ]
[ UNION [ALL] (SELECT...) ]
[ ORDER BY {sort_expression [DESC | ASC]}, ... ]
[ FOR UPDATE [OF {column_expression, ...}] ]
```

Items in brackets are optional.

**Note** SELECT \* on larger databases and SELECT statements that use table aliases or literals in the projection list might not function correctly. To avoid potential confusion, avoid wildcards and specify table and column names without aliases.

column\_alias can be used to give the column a more descriptive name, or to abbreviate a longer column name. For example, to assign the alias department to the column dept:

```
SELECT dept AS department FROM emp
```

Field names can be prefixed with the table name or the table alias. For example, EMP.LAST\_NAME or E.LAST\_NAME, where E is the alias for the table EMP.

The DISTINCT operator can precede the first column expression. This operator eliminates duplicate rows from the result of a query. For example:

```
SELECT DISTINCT dept FROM emp
```

Use this SQL clause	To
FROM	Indicate which tables are used in the SELECT statement.
WHERE	Specify the conditions that records must meet to be retrieved (like a FileMaker Pro find request).
GROUP BY	Specify the names of one or more fields by which the returned values should be grouped. This clause is used to return a set of aggregate values by returning one row for each group (like a FileMaker Pro subsummary).
HAVING	Specify conditions for groups of records (for example, display only the departments that have salaries totaling more than \$200,000). This clause is only valid if you have already defined a GROUP BY clause.
UNION	Combine the results of two or more SELECT statements into a single result.
ORDER BY	Indicate how the records are sorted
FOR UPDATE	Lock the records of the database table selected by the SELECT statement

**Note** If you attempt to retrieve data from a table with no columns, the SELECT statement fails.

### Examples

The following example retrieves the names of employees who make at least 20,000:

```
SELECT last_name,first_name FROM emp WHERE salary >= 20000
```

The following example uses the ORDER BY clause to sort by both last name and first name in ascending order:

```
SELECT emp_id, last_name, first_name FROM emp ORDER BY last_name,
first_name
```

Additional examples:

Using	Sample SQL
text constant	SELECT 'CatDog' FROM Salespeople
numeric constant	SELECT 999 FROM Salespeople
date constant	SELECT DATE '2004-06-05' FROM Salespeople
time constant	SELECT TIME '02:49:03' FROM Salespeople
timestamp constant	SELECT TIMESTAMP '2004-06-05 02:49:03' FROM Salespeople
text column	SELECT Company_Name FROM Sales_Data SELECT DISTINCT Company_Name FROM Sales_Data
numeric column	SELECT Amount FROM Sales_Data SELECT DISTINCT Amount FROM Sales_Data
date column	SELECT Date_Sold FROM Sales_Data SELECT DISTINCT Date_Sold FROM Sales_Data
time column	SELECT Time_Sold FROM Sales_Data SELECT DISTINCT Time_Sold FROM Sales_Data
timestamp column	SELECT Timestamp_Sold FROM Sales_Data SELECT DISTINCT Timestamp_Sold FROM Sales_Data
BLOB <sup>a</sup> column	SELECT Company_Brochures FROM Sales_Data SELECT GETAS(Company_Logo, 'JPEG') FROM Sales_Data
Wildcard *	SELECT * FROM Salespeople SELECT DISTINCT * FROM Salespeople

a. A BLOB is a FileMaker database file container field.

### Notes from the examples

A **constant** is a single, literal value you can include in a SELECT statement, whereas a **column** is a reference to a field in the FileMaker database file (the field can contain many distinct values).

The asterisk (\*) wildcard character is shorthand for “everything”. For the example `SELECT * FROM Salespeople`, the result is all the rows in the `Salespeople` table. For the example `SELECT DISTINCT * FROM Salespeople`, the result is all the unique rows in the `Salespeople` table (no duplicates).

**Note** `SELECT *` statements on larger databases might not function correctly. To avoid potential confusion, avoid wildcards and specify table and column names (without aliases).

### Retrieving the contents of a container field: CAST() function and GetAs() function

You can retrieve binary data, file reference information, or data of a specific file type from a container field.

To retrieve binary data, use a standard SELECT statement. For example:

```
SELECT Company_Brochures FROM Sales_Data
```

If file or JPEG data exists, the SELECT statement retrieves the data in binary form; otherwise, the SELECT statement returns <null>.

To retrieve file reference information (such as the file path), use the CAST function with a SELECT statement. For example:

```
SELECT CAST(Company_Brochures AS VARCHAR(NNN)) FROM Sales_Data
```

In this example, if you:

- Inserted a file into the container field using FileMaker Pro but stored only a reference to the file, the SELECT statement retrieves the file reference information as type SQL\_VARCHAR.
- Inserted the contents of a file into the container field using FileMaker Pro, the SELECT statement retrieves the name of the file.
- Imported a file into the container field from another application, the SELECT statement displays '?' (the file displays as Untitled.dat in FileMaker Pro).

To retrieve data of a specific file type from a container field, use the GetAs function and specify the file's type. For example:

```
SELECT GetAs(Company_Logo, 'JPEG') FROM Sales_Data
```

The possible file types (case sensitive) you can retrieve from a container field in a FileMaker database file are:

File Type	Description	File Type	Description
'BMPf'	Bitmap	'PCD '	Kodak PhotoCD
'EMBO'	OLE container data	'PDF '	Portable Document Format
'EMF+'	Windows Enhanced Metafile Plus	'PICT'	Mac OS (does not have 512-byte file-based header)
'EPS '	Embedded PostScript	'PNGf'	Bitmap image format
'FILE'	Result of an Insert File command	'PNTG'	MacPaint
'FPix'	Flash (FPX)	'qtif'	QuickTime image file
'FORK'	Resource fork (Mac OS)	'.SGI'	Generic bitmap format
'GIFf'	Graphics Interchange Format	'snd '	Standard sound (Mac OS raw format)
'JPEG'	Photographic images	'TIFF'	Raster file format for digital images
'JP2 '	JPEG 2000	'TPIC'	Targa
'META'	Windows Metafile (enhanced)	'XMLO'	Layout objects
'METO'	Windows Metafile (original)	'8BPS'	PhotoShop (PSD)
'moov'	Old QuickTime format (Mac OS)		

## **DELETE statement**

Use the DELETE statement to delete records from a database table. The format of the DELETE statement is:

```
DELETE FROM table_name [ WHERE { conditions } ]
```

**Note** The WHERE clause determines which records are to be deleted. If you don't include the WHERE keyword, all records in the table are deleted (but the table is left intact).

An example of a DELETE statement on the Employee table is:

```
DELETE FROM emp WHERE emp_id = 'E10001'
```

Each DELETE statement removes every record that meets the conditions in the WHERE clause. In this case, every record having the employee ID E10001 is deleted. Because employee IDs are unique in the Employee table, only one record is deleted.

### **INSERT statement**

Use the INSERT statement to create records in a database table. You can specify either:

- A list of values to be inserted as a new record
- A SELECT statement that copies data from another table to be inserted as a set of new records

The format of the INSERT statement is:

```
INSERT INTO table_name [(column_name, ...)] VALUES (expr, ...)
```

`column_name` is an optional list of column names that provides the name and order of the columns whose values are specified in the Values clause. If you omit `column_name`, the value expressions (`expr`) must provide values for all columns defined in the table and must be in the same order that the columns are defined for the table.

`expr` is the list of expressions giving the values for the columns of the new record. Usually the expressions are constant values for the columns (but they can also be a subquery). You must enclose character string values in pairs of single quotation marks ('). To include a single quotation mark in a character string value enclosed by single quotation marks, use two single quotation marks together (for example, 'Don"t'). Date, time, and timestamp values must be enclosed in braces {}. Logical values that are characters must be enclosed in periods (for example, .T. or .F.). Subqueries must be enclosed in parentheses.

The following example inserts a list of expressions:

```
INSERT INTO emp (last_name, first_name, emp_id, salary, hire_date)
VALUES ('Smith', 'John', 'E22345', 27500, {6/5/2004})
```

Each INSERT statement adds one record to the database table. In this case a record has been added to the employee database table, EMP. Values are specified for five columns. The remaining columns in the table are assigned a blank value, meaning Null.

**Note** In container fields, you can INSERT only text.

The SELECT statement is a query that returns values for each `column_name` value specified in the column name list. Using a SELECT statement instead of a list of value expressions lets you select a set of rows from one table and insert it into another table using a single INSERT statement.

Here's an example of an INSERT statement that uses a SELECT statement:

```
INSERT INTO emp1 (first_name, last_name, emp_id, dept, salary)
SELECT first_name, last_name, emp_id, dept, salary from emp
WHERE dept = 'D050'
```

In this type of INSERT statement, the number of columns to be inserted must match the number of columns in the SELECT statement. The list of columns to be inserted must correspond to the columns in the SELECT statement just as it would to a list of value expressions in the other type of INSERT statement. For example, the first column inserted corresponds to the first column selected; the second inserted to the second, and so on.

The size and data type of these corresponding columns must be compatible. Each column in the SELECT list should have a data type that the ODBC or JDBC client driver accepts on a regular INSERT/UPDATE of the corresponding column in the INSERT list. Values are truncated when the size of the value in the SELECT list column is greater than the size of the corresponding INSERT list column.

The SELECT statement is evaluated before any values are inserted.

### **UPDATE statement**

Use the UPDATE statement to change records in a database table. The format of the UPDATE statement is:

```
UPDATE table_name SET column_name = expr, ... [ WHERE { conditions } ]
```

`column_name` is the name of a column whose value is to be changed. Several columns can be changed in one statement.

`expr` is the new value for the column. Usually the expressions are constant values for the columns (but they can also be a subquery). You must enclose character string values in pairs of single quotation marks ('). To include a single quotation mark in a character string value enclosed by single quotation marks, use two single quotation marks together (for example, 'Don"t'). Date, time, and timestamp values must be enclosed in braces {}. Logical values that are characters must be enclosed in periods (for example, .T. or .F.). Subqueries must be enclosed in parentheses.

The WHERE clause is any valid clause. It determines which records are updated.

An example of an UPDATE statement on the Employee table is:

```
UPDATE emp SET salary=32000, exempt=1 WHERE emp_id = 'E10001'
```

The UPDATE statement changes every record that meets the conditions in the WHERE clause. In this case the salary and exempt status are changed for all employees having the employee ID E10001. Because employee IDs are unique in the Employee table, only one record is updated.

Here's an example using a subquery:

```
UPDATE emp SET salary = (SELECT avg(salary) from emp) WHERE emp_id = 'E10001'
```

In this case, the salary is changed to the average salary in the company for the employee having employee ID E10001.

**Note** In container fields, you can UPDATE only with text.

### **CREATE TABLE statement**

Use the CREATE TABLE statement to create a table in a database file. The format of the CREATE TABLE statement is:

```
CREATE TABLE table_name table_element_list [NOT NULL]
```

Within the statement, you specify the name and data type of each column.

`table_name` and `table_element_list` have a 100 character limit. Defining a column to be NOT NULL automatically selects the Not Empty Validation Option for the corresponding field in the FileMaker database file. The field will be flagged as a Required Value in the Fields tab of the Define Database dialog box in FileMaker Pro.

### Examples

Using	Sample SQL
text column	CREATE TABLE T1 (C1 VARCHAR, C2 VARCHAR (50), C3 VARCHAR (1001), C4 VARCHAR (500276))
text column, NOT NULL	CREATE TABLE T1NN (C1 VARCHAR NOT NULL, C2 VARCHAR (50) NOT NULL, C3 VARCHAR (1001) NOT NULL, C4 VARCHAR (500276) NOT NULL)
numeric column	CREATE TABLE T2 (C1 DECIMAL, C2 DECIMAL (10,0), C3 DECIMAL (7539,2), C4 DECIMAL (497925,301))
date column	CREATE TABLE T3 (C1 DATE, C2 DATE, C3 DATE, C4 DATE)
time column	CREATE TABLE T4 (C1 TIME, C2 TIME, C3 TIME, C4 TIME)
timestamp column	CREATE TABLE T5 (C1 TIMESTAMP, C2 TIMESTAMP, C3 TIMESTAMP, C4 TIMESTAMP)
BLOB column	CREATE TABLE T6 (C1 BLOB, C2 BLOB, C3 BLOB, C4 BLOB)

### **ALTER TABLE statement**

Use the ALTER TABLE statement to change the structure of an existing table in a database file. You can modify only one column in each statement. The formats of the ALTER TABLE statement are:

```
ALTER TABLE table_name ADD [COLUMN] column_definition
```

```
ALTER TABLE table_name DROP [COLUMN] unqualified_column_name
```

You must know the table's structure and how you want to modify it before using the ALTER TABLE statement.

### Examples

To	Sample SQL
add columns	ALTER TABLE Salespeople ADD C1 VARCHAR
remove columns	ALTER TABLE Salespeople DROP C1

### **CREATE INDEX statement**

Use the CREATE INDEX statement to speed searches in your database file. The format of the CREATE INDEX statement is:

```
CREATE INDEX [ index_name ] [ON] table_name.column_name
```

CREATE INDEX is supported for a single column (multi-column indexes are not supported). Indexes are not allowed on columns that correspond to container field types, summary fields, fields that have the global storage option, or unstored calculation fields in a FileMaker database file.

Creating an index for a text column automatically selects the Storage Option of Minimal in Indexing for the corresponding field in the FileMaker database file. Creating an index for a non-text column (or a column formatted as Japanese text) automatically selects the Storage Option of All in Indexing for the corresponding field in the FileMaker database file.

Creating an index for any column automatically selects the Storage Option of **Automatically create indexes as needed in Indexing** for the corresponding field in the FileMaker database file.

### Example

```
CREATE INDEX myIndex ON Salespeople.Salesperson_ID
```

### **DROP INDEX statement**

Use the DROP INDEX statement to remove an index from a database file. The format of the DROP INDEX statement is:

```
DROP INDEX [ON] table_name.column_name
```

Remove an index when your database file is too large, or you don't often use a field in queries.

If your queries are experiencing poor performance, and you're working with an extremely large FileMaker database file with many indexed text fields, consider dropping the indexes from some fields. Also consider dropping the indexes from fields that you rarely use in SELECT statements.

Dropping an index for any column automatically selects the Storage Option of **None** and clears **Automatically create indexes as needed in Indexing** for the corresponding field in the FileMaker database file.

The PREVENT INDEX CREATION attribute is not supported.

### Example

```
DROP INDEX ON Salespeople.Salesperson_ID
```

### **FROM clause**

The FROM clause indicates the tables that will be used in the SELECT statement. The format is:

```
FROM table_names [table_alias]
```

`table_names` can be one or more simple table names in the current working directory or complete pathnames.

`table_alias` can be used to give the table a more descriptive name, or to abbreviate a longer table name.

Field names can be prefixed with the table name or the table alias. For example, given the table specification FROM `employee E`, you can refer to the `LAST_NAME` field as `E.LAST_NAME`. Table aliases must be used if the SELECT statement joins a table to itself. For example:

```
SELECT * FROM employee E, employee F WHERE E.manager_id = F.employee_id
```

The equal sign (=) includes only matching rows in the results.

If you are joining more than one table, and you want to discard all rows that don't have corresponding rows in both source tables, you can use INNER JOIN. For example:

```
SELECT *
FROM Salespeople INNER JOIN Sales_Data
ON Salespeople.Salesperson_ID = Sales_Data.Salesperson_ID
```

**Note** OUTER JOIN is not currently supported.



### **WHERE clause**

The WHERE clause specifies the conditions that records must meet to be retrieved. The WHERE clause contains conditions in the form:

```
WHERE expr1 rel_operator expr2
```

`expr1` and `expr2` can be field names, constant values, or expressions.

`rel_operator` is the relational operator that links the two expressions. For example, the following SELECT statement retrieves the names of employees who make \$20,000 or more.

```
SELECT last_name, first_name FROM emp WHERE salary >= 20000
```

**Note** If you use fully qualified names in the SELECT (projection) list, you must also use fully qualified names in the related WHERE clause.

### **GROUP BY clause**

The GROUP BY clause specifies the names of one or more fields by which the returned values should be grouped. This clause is used to return a set of aggregate values. It has the following format:

```
GROUP BY column_expressions
```

`column_expressions` must match the column expression used in the SELECT clause. A column expression can be one or more field names of the database table separated by commas, or one or more expressions separated by commas.

The following example sums the salaries in each department.

```
SELECT dept_id, sum(salary) FROM emp GROUP BY dept_id
```

This statement returns one row for each distinct department ID. Each row contains the department ID and the sum of the salaries of the employees in the department.

### **HAVING clause**

The HAVING clause enables you to specify conditions for groups of records (for example, display only the departments that have salaries totaling more than \$200,000). This clause is valid only if you have already defined a GROUP BY clause. It has the following format:

```
HAVING expr1 rel_operator expr2
```

`expr1` and `expr2` can be field names, constant values, or expressions. These expressions do not have to match a column expression in the SELECT clause.

`rel_operator` is the relational operator that links the two expressions. The following example returns only the departments whose sums of salaries are greater than \$200,000:

```
SELECT dept_id, sum(salary) FROM emp
GROUP BY dept_id HAVING sum(salary) > 200000
```

### **UNION operator**

The UNION operator combines the results of two or more SELECT statements into a single result. The single result is all of the returned records from the SELECT statements. By default, duplicate records are not returned. To return duplicate records, use the ALL keyword (UNION ALL). The format is:

```
SELECT statement UNION [ALL] SELECT statement
```

When using the UNION operator, the select lists for each SELECT statement must have the same number of column expressions, with the same data types, and must be specified in the same order. For example:

```
SELECT last_name, salary, hire_date FROM emp UNION SELECT name, pay,
birth_date FROM person
```

This example has the same number of column expressions, and each column expression, in order, has the same data type.

The following example is not valid because the data types of the column expressions are different (SALARY from EMP has a different data type than LAST\_NAME from RAISES). This example has the same number of column expressions in each SELECT statement, but the expressions are not in the same order by data type.

```
SELECT last_name, salary FROM emp UNION SELECT salary, last_name FROM
raises
```

### **ORDER BY clause**

The ORDER BY clause indicates how the records are to be sorted. The format is:

```
ORDER BY {sort_expression [DESC | ASC]}, ...
```

sort\_expression can be field names, expressions, or the positional number of the column expression to use. The default is to perform an ascending (ASC) sort.

For example, to sort by last\_name then by first\_name, you could use either of the following SELECT statements:

```
SELECT emp_id, last_name, first_name FROM emp ORDER BY last_name,
first_name
```

or

```
SELECT emp_id, last_name, first_name FROM emp ORDER BY 2,3
```

In the second example, last\_name is the second column expression following SELECT, so ORDER BY 2 sorts by last\_name.

### **FOR UPDATE clause**

The FOR UPDATE clause locks the records of the database table selected by the SELECT statement. The format is:

```
FOR UPDATE [OF column_expressions]
```

column\_expressions is a list of field names in the database table that you intend to update, separated by a comma. column\_expressions is optional.

The following example returns all records in the employee database that have a SALARY field value of more than \$20,000. When each record is fetched, it is locked. If the record is updated or deleted, the lock is held until you commit the change. Otherwise, the lock is released when you fetch the next record.

```
SELECT * FROM emp WHERE salary > 20000 FOR UPDATE OF last_name, first_name,
salary
```

## SQL aggregate functions

Aggregate functions return a single value from a set of records. You can use an aggregate function as part of a SELECT statement, with a field name (for example, `AVG(SALARY)`), or in combination with a column expression (for example, `AVG(SALARY * 1.07)`).

You can precede the column expression with the `DISTINCT` operator to eliminate duplicate values. For example:

```
COUNT (DISTINCT last_name)
```

In this example, only unique last name values are counted.

**Important** Use uppercase letters for SQL function names (some are case sensitive).

Aggregate function	Returns
SUM	The total of the values in a numeric field expression. For example, <code>SUM(SALARY)</code> returns the sum of all salary field values.
AVG	The average of the values in a numeric field expression. For example, <code>AVG(SALARY)</code> returns the average of all salary field values.
COUNT	The number of values in any field expression. For example, <code>COUNT(NAME)</code> returns the number of name values. When using <code>COUNT</code> with a field name, <code>COUNT</code> returns the number of non-null field values. A special example is <code>COUNT(*)</code> , which returns the number of records in the set, including records with null values.
MAX	The maximum value in any field expression. For example, <code>MAX(SALARY)</code> returns the maximum salary field value.
MIN	The minimum value in any field expression. For example, <code>MIN(SALARY)</code> returns the minimum salary field value.

### Examples

```
SELECT SUM (Sales_Data.Amount) AS agg FROM Sales_Data
SELECT AVG (Sales_Data.Amount) AS agg FROM Sales_Data
SELECT COUNT (Sales_Data.Amount) AS agg FROM Sales_Data
SELECT MAX (Sales_Data.Amount) AS agg FROM Sales_Data WHERE
Sales_Data.Amount < 3000
SELECT MIN (Sales_Data.Amount) AS agg FROM Sales_Data WHERE
Sales_Data.Amount < 3000
```

## SQL expressions

Use expressions in `WHERE`, `HAVING`, and `ORDER BY` clauses of `SELECT` statements to form detailed and sophisticated database queries. Valid expression elements are:

Field names	Numeric operators	Relational operators
Constants and literals	Character operators	Logical operators
Exponential notation	Date operators	Functions

## Field names

The most common expression is a simple field name, such as `calc` or `Sales_Data.Invoice_ID`.

## Constants and literals

Constants are values that do not change. For example, in the expression `PRICE * 1.05`, the value `1.05` is a constant. Or you might assign a value of `30` to the constant `Number_Of_Days_In_June`.

A literal is another kind of constant; but instead of having an assigned value, the literal itself is the value, such as `'Paris'` or `'14:35:10'`. A literal is a “what you see is what you get” constant.

You must enclose character constants (such as literals) in pairs of single quotation marks (`'`). To include a single quotation mark in a character constant enclosed by single quotation marks, use two single quotation marks together (for example, `'Don"t'`).

You must enclose date, time, and timestamp constants in braces (`{}`), for example, `{D '2005-06-05'}`, `{14:35:10}`, and `{TS '2005-06-05 14:35:10'}`. The one exception: SQL-92 syntax requires ISO date and time formats with no brackets:

- `DATE 'YYYY-MM-DD'`
- `TIME 'HH:MM:SS'`
- `TIMESTAMP 'YYYY-MM-DD HH:MM:SS'`

Constant	Acceptable syntax (examples)
Text	<code>'Paris'</code>
Number	<code>1.05</code>
Date	<code>DATE '2005-06-05'</code> <code>{ D '2005-06-05' }</code> <code>{ 06/05/2005 }</code> <code>{ 06/05/05 }</code>
Time	<code>TIME '14:35:10'</code> <code>{ T '14:35:10' }</code> <code>{ 14:35:10 }</code>
Timestamp	<code>TIMESTAMP '2005-06-05 14:35:10'</code> <code>{ TS '2005-06-05 14:35:10' }</code> <code>{ 06/05/2005 14:35:10 }</code> <code>{ 2005-06-05 14:35:10 }</code> <code>{ 06/05/05 14:35:10 }</code> Make sure <b>Strict data type: 4-Digit Year Date</b> is not selected as a validation option in the FileMaker database file for a field using this 2-digit year syntax.

When entering date and time values, match the format of the database file locale. For example, if the database was created on an Italian language system, use Italian date and time formats.

Logical values that are characters must be enclosed in periods. The logical constants are `.T.` and `1` for True and `.F.` and `0` for False. For portability, use `1` and `0`.

### Exponential/scientific notation

You can include exponential notation.

#### Example

```
SELECT column1, 3.4E+7 FROM table1 WHERE calc < 3.4E-6 * column2
```

### Numeric operators

You can include the following operators in number expressions: +, -, \*, /, and ^ or \*\* (exponentiation).

You can precede numeric expressions with a unary plus (+) or minus (-).

### Character operators

You can concatenate characters.

#### Examples

In the following examples, last\_name is 'JONES ' and first\_name is 'ROBERT ':

Operator	Concatenation	Example	Result
+	Keep trailing blank characters	first_name + last_name	'ROBERT JONES '
-	Move trailing blank characters to the end	first_name - last_name	'ROBERTJONES '

### Date operators

You can modify dates.

#### Examples

In the following examples, hire\_date is {01/30/2004}

Operator	Effect on date	Example	Result
+	Add a number of days to a date	hire_date + 5	{02/04/2004}
-	Find the number of days between two dates, or subtract a number of days from a date	hire_date - {01/01/2004} hire_date - 10	29 {01/20/2004}

Additional examples:

```
SELECT Date_Sold, Date_Sold + 30 AS agg FROM Sales_Data
```

```
SELECT Date_Sold, Date_Sold - 30 AS agg FROM Sales_Data
```

## Relational operators

Operator	Meaning
=	Equal
<>	Not equal
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
LIKE	Matching a pattern
NOT LIKE	Not matching a pattern
IS NULL	Equal to Null
IS NOT NULL	Not equal to Null
BETWEEN	Range of values between a lower and upper bound
IN	A member of a set of specified values or a member of a subquery
NOT IN	Not a member of a set of specified values or a member of a subquery
EXISTS	'True' if a subquery returned at least one record
ANY	Compares a value to each value returned by a subquery (operator must be preceded by =, <>, >, >=, <, or <=); =Any is equivalent to In
ALL	Compares a value to each value returned by a subquery (operator must be preceded by =, <>, >, >=, <, or <=)

### Examples

```

SELECT Sales_Data.Invoice_ID FROM Sales_Data
WHERE Sales_Data.Salesperson_ID = 'SP-1'

SELECT Sales_Data.Amount FROM Sales_Data WHERE Sales_Data.Invoice_ID <> 125

SELECT Sales_Data.Amount FROM Sales_Data WHERE Sales_Data.Amount > 3000

SELECT Sales_Data.Time_Sold FROM Sales_Data
WHERE Sales_Data.Time_Sold < '12:00:00'

SELECT Sales_Data.Company_Name FROM Sales_Data
WHERE Sales_Data.Company_Name LIKE '%University'

SELECT Sales_Data.Company_Name FROM Sales_Data
WHERE Sales_Data.Company_Name NOT LIKE '%University'

SELECT Sales_Data.Amount FROM Sales_Data WHERE Sales_Data.Amount IS NULL

SELECT Sales_Data.Amount FROM Sales_Data WHERE Sales_Data.Amount IS NOT
NULL

SELECT Sales_Data.Invoice_ID FROM Sales_Data
WHERE Sales_Data.Invoice_ID BETWEEN 1 AND 10

SELECT COUNT(Sales_Data.Invoice_ID) AS agg
FROM Sales_Data WHERE Sales_Data.INVOICE_ID IN (50,250,100)

```

```

SELECT COUNT(Sales_Data.Invoice_ID) AS agg
FROM Sales_Data WHERE Sales_Data.INVOICE_ID NOT IN (50,250,100)

SELECT COUNT(Sales_Data.Invoice_ID) AS agg FROM Sales_Data
WHERE Sales_Data.INVOICE_ID NOT IN (SELECT Sales_Data.Invoice_ID
FROM Sales_Data WHERE Sales_Data.Salesperson_ID = 'SP-4')

SELECT *
FROM Sales_Data WHERE EXISTS (SELECT Sales_Data.Amount
FROM Sales_Data WHERE Sales_Data.Salesperson_ID IS NOT NULL)

SELECT *
FROM Sales_Data WHERE Sales_Data.Amount = ANY (SELECT Sales_Data.Amount
FROM Sales_Data WHERE Sales_Data.Salesperson_ID = 'SP-1')

SELECT *
FROM Sales_Data WHERE Sales_Data.Amount = ALL (SELECT Sales_Data.Amount
FROM Sales_Data WHERE Sales_Data.Salesperson_ID IS NULL)

```

### Logical operators

You can combine two or more conditions. The conditions must be related by AND or OR, such as:

```
salary = 40000 AND exempt = 1
```

The logical NOT operator is used to reverse the meaning, such as:

```
NOT (salary = 40000 AND exempt = 1)
```

### Examples

```

SELECT * FROM Sales_Data WHERE Sales_Data.Company_Name
NOT LIKE '%University' AND Sales_Data.Amount > 3000

SELECT * FROM Sales_Data WHERE (Sales_Data.Company_Name
LIKE '%University' OR Sales_Data.Amount > 3000)
AND Sales_Data.Salesperson_ID = 'SP-1'

```

### Functions

The ODBC and JDBC client drivers support many functions you can use in expressions. Some of the functions return characters strings, some return numbers, and some return dates.

**Important** Use uppercase letters for SQL function names (some are case sensitive).

#### Functions that return character strings

	Description	Example
CHR	Converts an ASCII code to a one-character string	CHR(67) returns C
RTRIM	Removes trailing blanks from a string	RTRIM('ABC ') returns ABC
TRIM	Removes trailing blanks from a string	TRIM('ABC ') returns ABC
LTRIM	Removes leading blanks from a string	LTRIM(' ABC') returns ABC
UPPER	Changes each letter of a string to uppercase	UPPER('Allen') returns ALLEN
LOWER	Changes each letter of a string to lowercase	LOWER('Allen') returns allen

**Functions that return character strings**

Function	Description	Example
LEFT	Returns leftmost characters of a string	LEFT('Mattson',3) returns Mat
RIGHT	Returns rightmost characters of a string	RIGHT('Mattson',4) returns tson
SUBSTR	Returns a substring of a string, with parameters of the string, the first character to extract, and the number of characters to extract (optional)	SUBSTR('Conrad',2,3) returns onr SUBSTR('Conrad',2) returns onrad
SPACE	Generates a string of blanks	SPACE(5) returns ' '
STRVAL	Converts a value of any type to a character string	STRVAL('Woltman') returns Woltman STRVAL(5 * 3) returns 15 STRVAL(4 = 5) returns 'False' STRVAL({12/25/2004}) returns 12/25/2004
TIME	Returns the time of day as a string	At 9:49 PM, TIME() returns 21:49:00
USERNAME	Returns the login ID specified at connect time	

**Examples**

```

SELECT CHR(67) + SPACE(1) + CHR(70) FROM Salespeople
SELECT RTRIM(' ' + Salespeople.Salesperson_ID) AS agg FROM Salespeople
SELECT TRIM(SPACE(1) + Salespeople.Salesperson_ID) AS agg FROM Salespeople
SELECT LTRIM(' ' + Salespeople.Salesperson_ID) AS agg FROM Salespeople
SELECT UPPER(Salespeople.Salesperson) AS agg FROM Salespeople
SELECT LOWER(Salespeople.Salesperson) AS agg FROM Salespeople
SELECT LEFT(Salespeople.Salesperson, 5) AS agg FROM Salespeople
SELECT RIGHT(Salespeople.Salesperson, 7) AS agg FROM Salespeople
SELECT SUBSTR(Salespeople.Salesperson_ID, 2, 2) +
SUBSTR(Salespeople.Salesperson_ID, 4, 2) AS agg FROM Salespeople
SELECT SUBSTR(Salespeople.Salesperson_ID, 2) +
SUBSTR(Salespeople.Salesperson_ID, 4) AS agg FROM Salespeople
SELECT SPACE(2) + Salespeople.Salesperson_ID AS Salesperson_ID FROM
Salespeople
SELECT STRVAL('60506') AS agg FROM Sales_Data WHERE Sales_Data.Invoice_ID
= 1
SELECT TIME() AS agg FROM Sales_Data WHERE Sales_Data.Invoice_ID = 1
SELECT USERNAME() AS agg FROM Sales_Data WHERE Sales_Data.Invoice_ID = 1

```

**Functions that return numbers**

Function	Description	Example
MOD	Divides two numbers and returns the remainder of the division	MOD(10,3) returns 1
LEN	Returns the length of a string	LEN('ABC') returns 3



Functions that return numbers	Description	Example
MONTH	Returns the month part of a date	MONTH({01/30/2004}) returns 1
DAY	Returns the day part of a date	DAY({01/30/2004}) returns 30
YEAR	Returns the year part of a date	YEAR({01/30/2004}) returns 2004
MAX	Returns the larger of two numbers	MAX(66,89) returns 89
DAYOFWEEK	Returns the day of week (1-7) of a date expression	DAYOFWEEK({05/01/2004}) returns 7
MIN	Returns the smaller of two numbers	MIN(66,89) returns 66
POW	Raises a number to a power	POW(7,2) returns 49
INT	Returns the integer part of a number	INT(6.4321) returns 6
X	Returns the decimal equivalent of a hexadecimal number	X'b9' returns 185
B	Returns the decimal equivalent of a binary number	B'1001' returns 9
ROUND	Rounds a number	ROUND(123.456,0) returns 123 ROUND(123.456,2) returns 123.46 ROUND(123.456,-2) returns 100
NUMVAL	Converts a character string to a number; if the character string is not a valid number, returns 0	NUMVAL('123') returns 123
VAL	Converts a character string to a number; if the character string is not a valid number, returns 0	VAL('123') returns 123

Functions that return dates	Description	Example
DATE	Returns today's date	If today is 11/21/2005, DATE() returns {2005-11-21}
DATEVAL	Converts a character string to a date	DATEVAL('01/30/2006') returns {2006-01-30}

### Operator precedence

As expressions become more complex, the order in which the expressions are evaluated becomes important. This table shows the order in which the operators are evaluated. The operators in the first line are evaluated first, and so on. Operators in the same line are evaluated left to right in the expression.

Precedence	Operator
1	Unary '-', Unary '+'
2	^, **
3	*, /
4	+, -
5	=, <>, <, <=, >, >=, Like, Not Like, Is Null, Is Not Null, Between, In, Exists, Any, All

Precedence	Operator
6	Not
7	AND
8	OR

The following example shows the importance of precedence:

```
WHERE salary > 40000 OR hire_date > {01/30/2004} AND dept = 'D101'
```

Because AND is evaluated first, this query retrieves employees in department D101 hired after January 30, 2004, as well as every employee making more than \$40,000, no matter what department or hire date.

To force the clause to be evaluated in a different order, use parentheses to enclose the conditions to be evaluated first. For example:

```
WHERE (salary > 40000 OR hire_date > {01/30/1989}) AND dept = 'D101'
```

retrieves employees in department D101 that either make more than \$40,000 or were hired after January 30, 2004.

## ***ODBC Catalog functions***

The ODBC client driver supports the following Catalog functions:

- SQLTables - catalog information is stored and reported as single part names (table name only).
- SQLColumns
- SQLColumnPrivileges
- SQLDescribeCol
- SQLGetTypeInfo

## ***JDBC Meta Data functions***

The JDBC client driver supports the following Meta Data functions:

- getColumnns
- getColumnPrivileges
- getMetaData
- getTypeInfo
- getTables
- getTableTypes

For JDBC, query Meta Data with the `dmd.getFunction` command in Java.

# Appendix A

## Mapping FileMaker fields to ODBC data types

This table illustrates how FileMaker field types map to the standard ODBC data types.

FileMaker field type	Converts to ODBC data type	About the data type
text	SQL_VARCHAR	The maximum column length of text is 1 million characters, unless you specify a smaller Maximum number of characters for the text field in FileMaker. FileMaker returns empty strings as NULL.
number	SQL_DOUBLE	The FileMaker number field type can contain positive or negative values as small as $10^{-308}$ , and as large as $10^{+308}$ , with up to 15 significant digits.
date	SQL_DATE	
time	SQL_TIME	The FileMaker time field type can contain the time of day or a time interval. A time interval will be returned as a time of day, unless it is less than 0 or greater than 24 hours (both return a value of 0).
timestamp	SQL_TIMESTAMP	
container (BLOB)	SQL_LONGVARBINARY	You can retrieve binary data, file reference information, or data of a specific file type from a container field. Within a SELECT statement, use the CAST function to retrieve file reference information, and use the GetAs function to retrieve data of a specific file type.
calculation		The result is mapped to the corresponding ODBC data type.

String length is optional in table declarations. All strings will be stored and retrieved in Unicode.

### Notes

- You can SELECT up to 170 fields at one time from a FileMaker database file; you can UPDATE up to 100 fields at one time.
- FileMaker supports repeating fields (array data types), but ODBC does not. FileMaker exports repetitions to tab-delimited or comma-delimited files and separates each repetition with a group separator (Unicode decimal value 29). Text columns separated with the group separator will be concatenated. All other data types will return only the first repetition.



# Appendix B

## *Mapping FileMaker fields to JDBC data types*

The JDBC client driver uses the following mappings when converting FileMaker data types to JDBC SQL types. (For information about these types, see the JDK 1.4 documentation web pages at [www.javasoft.com](http://www.javasoft.com).)

<b>FileMaker field type</b>	<b>Converts to JDBC SQL type</b>
text	java.sql.Types.VARCHAR
number	java.sql.Types.DOUBLE
date	java.sql.Types.DATE
time	java.sql.Types.TIME
timestamp	java.sql.Types.TIMESTAMP
container	java.sql.Types.BLOB
calculation	specified by the data type of the calculation's result

The JDBC client driver converts the FileMaker calculation data type to the JDBC SQL type matching the calculation's result. For example, the JDBC client driver converts a FileMaker calculation that results in a timestamp data type to `java.sql.Types.TIMESTAMP`.



# Appendix C

## ***ODBC and JDBC error messages***

Here are the basic formats of error messages you receive when working with FileMaker and ODBC/JDBC. For a listing of error numbers and explanations, see [www.datadirect.com](http://www.datadirect.com).

For more information about working with errors in FileMaker, see the Get(LastError) or Get(LastODBCError) functions described in FileMaker Pro Help.

### ***ODBC error messages***

Error messages can come from:

- ODBC driver errors
- ODBC Driver Manager errors
- SequeLink Client errors
- SequeLink Server errors
- the data source or database management system

### ***ODBC driver error messages***

An error reported by the SequeLink ODBC driver has the following format:

[DataDirect] [ODBC SequeLink driver] message

For example:

[DataDirect] [ODBC SequeLink driver] Invalid precision specified

If you get this type of error, check the last ODBC call your application made for possible problems or contact your ODBC application vendor.

### ***ODBC Driver Manager error messages***

An error reported by the ODBC Driver Manager has the following format:

[Microsoft] [ODBC Driver Manager] message

For example:

[Microsoft] [ODBC Driver Manager] Function sequence error

If you get this type of error, check to see that you have the proper ODBC support files and drivers.

### ***SequeLink Client error messages***

An error reported by the SequeLink ODBC Client has the following format:

[DataDirect] [ODBC SequeLink driver] [SequeLink Client] message

For example:

[DataDirect] [ODBC SequeLink driver] [SequeLink Client] The specified transliteration module is not found

**SequeLink Server error messages**

An error reported by the SequeLink Server has the following format:

[DataDirect] [ODBC SequeLink driver] [SequeLink Server] message

For example:

[DataDirect] [ODBC SequeLink driver] [SequeLink Server] Only SELECT statements are allowed in this read-only connection.

**Data source error messages**

An error that occurs in the data source includes the data source name, in the following format:

[DataDirect] [ODBC SequeLink driver] [data\_source] message

For example, you might get the following message from your FileMaker data source:

[DataDirect] [ODBC SequeLink driver] [FileMaker] Invalid Username/Password

If you get this type of error, you did something incorrectly with the database system. Check your FileMaker documentation for more information or consult your database administrator.

Consecutive messages for errors in different columns can sometimes display an incorrect column name.

**JDBC error messages**

The SequeLink for JDBC driver reports errors to the calling application by returning SQLExceptions. Error messages can come from:

- JDBC driver errors
- SequeLink Server errors
- the data source or database management system

**JDBC driver error messages**

An error reported by the JDBC driver has the following format:

[DataDirect] [SequeLink JDBC Driver] message

For example:

[DataDirect] [SequeLink JDBC Driver] Timeout expired

If you get this type of error, check the last JDBC call your application made for possible problems or contact your JDBC application vendor.

**SequeLink Server error messages**

An error reported by SequeLink Server has the following format:

[DataDirect] [SequeLink JDBC Driver] [SequeLink] message

If no SequeLink Server errors exist, you see:

[DataDirect] [JDBC SequeLink driver] [SequeLink]



**Data source error messages**

An error that occurs in the data source includes the data source name, in the following format:

[DataDirect] [Sequelink JDBC Driver] [data\_source] message

For example, you might get the following message from your FileMaker data source:

[DataDirect] [Sequelink JDBC Driver] [FileMaker] Invalid Username/Password

If you get this type of error, you did something incorrectly with the database system. Check your FileMaker documentation for more information or consult your database administrator.



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