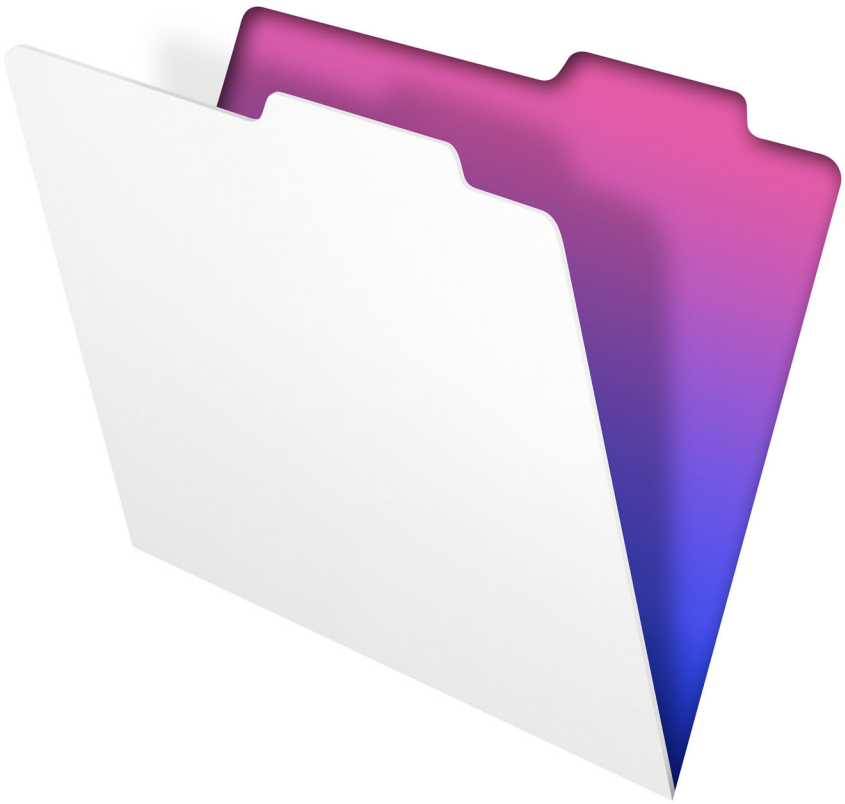
FileMaker® 12

ODBC and JDBC Guide



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Contents

Chapter 1
Introduction

This guide describes how you can use FileMaker® software as an ODBC client application and as a data source for ODBC and JDBC applications.

The following table gives an overview of how to use ODBC and JDBC with FileMaker software.

What do you want to do?	How do you do it?	Product	See
▪ Use FileMaker software as an ODBC client application. ▪ Access ODBC data stored in an external SQL data source.	1. Interactively via the relationships graph 2. One-time, static via ODBC import or **File** menu > **Open**. Also, the Import Records script step, the Execute SQL script step, and the ExecuteSQL function	▪ FileMaker Pro ▪ FileMaker Pro Advanced ▪ FileMaker Server ▪ FileMaker Server Advanced	▪ This guide, chapter 2. ▪ FileMaker Pro Help
▪ Use a FileMaker database as a data source. ▪ Share FileMaker Pro data with a third-party ODBC client application.	1. SQL queries 2. ODBC and JDBC	▪ FileMaker Pro ▪ FileMaker Pro Advanced ▪ FileMaker Server Advanced only	This guide, chapters 3 to 8.

About this guide

- For information on using ODBC and JDBC with previous versions of FileMaker Pro, see http://www.filemaker.com/documentation.
- 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.
- This guide uses “FileMaker Pro” to refer to both FileMaker Pro and FileMaker Pro Advanced, unless describing specific FileMaker Pro Advanced features.

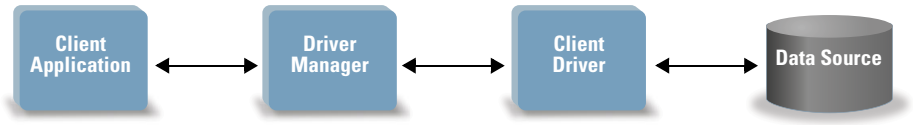
Note You can download PDFs of FileMaker documentation from http://www.filemaker.com/documentation. Any updates to this document are also available from the website.

About ODBC and JDBC

ODBC and JDBC are application programming interfaces (APIs). ODBC is an API for applications written in the C language, and JDBC is a similar API for the Java language. 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 Advanced.

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

Using ODBC or JDBC APIs, a *client application* communicates with a *driver manager* that identifies the *client driver* to communicate with a *data source*.



FileMaker software can act either as a client application or as a data source.

Using FileMaker software as an ODBC client application

As an ODBC client application, FileMaker software can access data in external SQL data sources. FileMaker software connects to the external SQL data source using the client driver for the ODBC data source, and either imports ODBC data or works with ODBC tables in the relationships graph.

Importing ODBC data

You can import ODBC data in either of these ways:

- from the File menu, by specifying an ODBC data source and entering SQL statements in the FileMaker Pro SQL Query builder dialog box
- by creating a FileMaker script that uses the Import Records script step, the Execute SQL script step, or the ExecuteSQL function

For either of these methods, you enter the SQL statements yourself, so you need to know the supported SQL statements and their syntax for your ODBC data source. Because you write the SQL statements yourself, you can import ODBC data from any ODBC data source.

Adding ODBC tables to the relationships graph

When you add an ODBC table to the relationships graph, you can connect to and work with data in external SQL data sources in much the same way that you work with data in the current, active FileMaker database file. For example, you can:

- create tables in the relationships graph for ODBC data sources
- add supplemental fields to ODBC tables to perform unstored calculations or to summarize data in the ODBC tables
- add, change, and delete external data interactively
- create relationships between fields in FileMaker tables and fields (also called “columns”) in ODBC tables

Because FileMaker Pro generates the SQL statements used to communicate with an ODBC table that has been added to the relationships graph, you are limited to the specific Oracle, SQL Server, and MySQL data sources that FileMaker Pro supports in the relationships graph.

Note You cannot modify the schema of external ODBC data sources using FileMaker Pro.

Chapter 2, “Accessing external SQL data sources,” describes how to use FileMaker software as an ODBC client application.

Using a FileMaker database as a data source

As a data source, FileMaker data is shared with ODBC- and JDBC-compliant applications. The application connects to the FileMaker data source using the FileMaker client driver, constructs and executes the SQL queries using ODBC or JDBC, and processes the data retrieved from the FileMaker database solution.

Accessing a hosted FileMaker Pro database

With either FileMaker Server Advanced or FileMaker Pro, you can host a FileMaker database file as a data source, sharing your data with other applications using ODBC and JDBC. The following table describes what each FileMaker product allows.

This FileMaker product	Allows
FileMaker Server Advanced	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).
FileMaker Pro	Up to nine connections and supports local access (same computer) only.

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

The ODBC and JDBC plug-in components you need for sharing your data with other applications are installed with FileMaker Server Advanced and FileMaker Pro.

To access a hosted FileMaker database file, you need to install the corresponding ODBC or JDBC client driver. Install the client driver on the machine where the third-party application is installed.

This guide documents how the ODBC and JDBC client drivers, when used with FileMaker Pro and FileMaker Server Advanced, support the industry standards for ODBC (Open Database Connectivity), JDBC (Java Database Connectivity), and SQL (Structured Query Language).

- Chapter 3, “Installing FileMaker ODBC client drivers,” explains how to install the driver files needed for accessing a FileMaker data source using ODBC.
- Chapter 4, “Using ODBC to share FileMaker data,” describes how to use the FileMaker ODBC client driver to connect to a FileMaker data source from another application.
- Chapter 5, “Installing FileMaker JDBC client drivers,” explains how to install the driver files needed for accessing a FileMaker data source using JDBC.
- Chapter 6, “Using JDBC to share FileMaker data,” describes how to use the FileMaker JDBC client driver with a Java application or applet that connects to a FileMaker data source.
- Chapter 7, “Supported standards,” describes the SQL statements that the ODBC and JDBC client drivers support when used with FileMaker Pro and FileMaker Server Advanced.

Important If you disable ODBC/JDBC sharing after it has already been on, a data source hosted by FileMaker Server Advanced 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.

Limitations with third-party tools

Microsoft Access: When using Microsoft Access to view data in a FileMaker data source, do not use data from a summary field. The summary field's data should not be edited in Microsoft Access, and the data value that is displayed in Microsoft Access may not be accurate.

Networking requirements

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

Updating files from previous versions

Installing current drivers

If you installed a driver from prior versions of FileMaker Pro or FileMaker Server Advanced, you must install the driver for version 12.

The driver for FileMaker version 12 is not compatible with earlier versions of FileMaker Pro or FileMaker Server Advanced.

For more information on installing drivers, see chapter 3, "Installing FileMaker ODBC client drivers" and chapter 5, "Installing FileMaker JDBC client drivers."

Note You have to create a Data Source Name (DSN) for each 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).

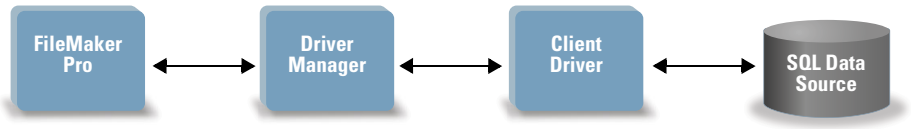
Chapter 2
Accessing external SQL data sources

As an ODBC client application, FileMaker software can access data in external SQL data sources. FileMaker software connects to the external SQL data source using the client driver for the ODBC data source, and either imports ODBC data or works with ODBC tables in the relationships graph.

Whether you are importing ODBC data or working with ODBC tables in the relationships graph, you must configure a driver for the ODBC data source you're using. For example, to access records from an Oracle database, you configure an Oracle client driver.

Importing ODBC data

When you import ODBC data, you need an ODBC client driver for the external SQL data source configured on the client machine.



After configuring an ODBC client driver, you can interact with records, import records into an existing FileMaker Pro database file, or create a new FileMaker Pro database file from an ODBC data source (such as Oracle or Microsoft Access databases).

First, you access the data source you want to import from. Then you construct a query for the records you want to import from the data source. Finally, if you're importing data into an existing file, you map fields from your data source to fields in your FileMaker Pro database file.

You can access your ODBC data source through the File menu, with the Import Records script step, with the Execute SQL script step, or with the ExecuteSQL function.

To import ODBC data, follow this general process:

- Install and configure specific ODBC drivers for the external data sources you want to access.
- On the computer that hosts the current FileMaker Pro file, define a system Data Source Name (DSN) for each ODBC data source you want to access.
- Determine any additional considerations for the ODBC data sources you want to access (for example, whether users are prompted for a user name and password).

- In FileMaker Pro, do one of the following:
  - To import into an existing FileMaker Pro file, choose **File** menu **> Import Records > ODBC Data Source**.
  - To create a FileMaker Pro file from the data source records, choose **File** menu **> Open**. In the Open dialog box, choose **ODBC Data Source** for **Files of type** (Windows) or **Show** (Mac OS).

  Choose your data source, enter the user name and password (if any), and click **OK** to open the FileMaker Pro SQL Query builder dialog box.

  Using the FileMaker Pro SQL Query builder dialog box, you can construct a query. Select the table from which you want to import, and then select specific columns you want to use in your SQL query. Use the WHERE tab to construct search criteria and the ORDER BY tab to specify a sort order.

  You can also type an SQL statement directly into the SQL Query builder dialog box.

  You can execute the query immediately, or you can use the Import Records script step, the Execute SQL script step, or the ExecuteSQL function to execute a query as part of a FileMaker script.

Note ODBC import, the Execute SQL script step, and external SQL data sources are not supported in runtime solutions created with FileMaker Pro Advanced.

See FileMaker Pro Help for more information on importing data, using the SQL Query builder dialog box, and creating FileMaker scripts.

Executing SQL to interact with data sources via ODBC

In addition to importing data into a FileMaker Pro database file via ODBC, you can also interact with data sources using SQL statements through the Execute SQL script step and the ExecuteSQL function. You can use any SQL statement supported by the data source, such as `INSERT`, `UPDATE`, and `DELETE`.

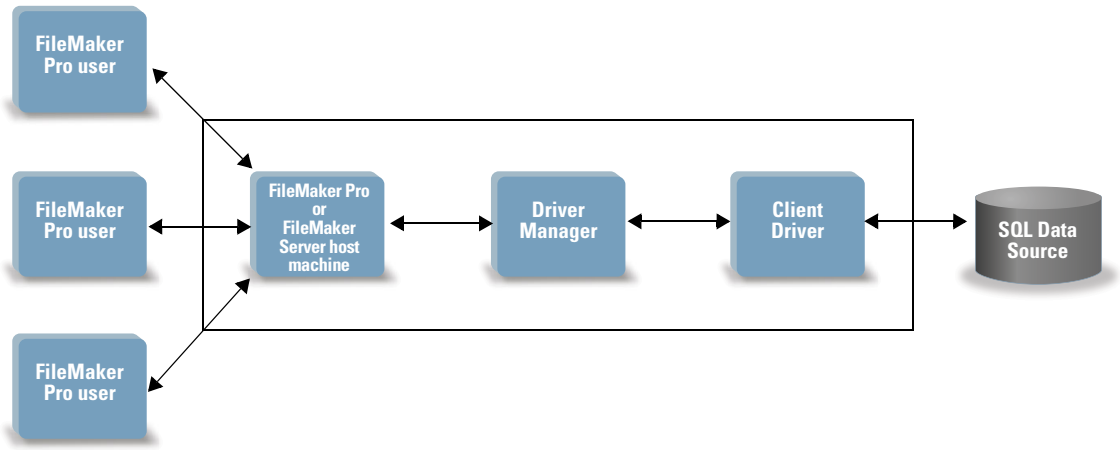
You can also use SQL statements that go beyond simply importing data into a FileMaker Pro database file. For example, you could execute SQL statements that add records to a database table in SQL Server, using information from a FileMaker Pro database file.

See FileMaker Pro Help for more information on creating FileMaker scripts that use the Execute SQL script step and the ExecuteSQL function.

Working with ODBC tables in the relationships graph

When you add an ODBC table to the relationships graph, you can connect to and work with data in external SQL data sources in much the same way that you work with data in the current, active FileMaker database file.

When you use FileMaker Pro or FileMaker Server as the host for a solution that includes ODBC tables in the relationships graph, you configure the ODBC client driver for the external SQL data source on the host machine.



Data sources supported in FileMaker 12

As an ODBC client application, FileMaker supports the following external SQL data sources as ODBC tables in the relationships graph:

- Oracle 10*g*
- Oracle 11*g*
- SQL Server 2005
- SQL Server 2008
- MySQL 5.1 Community Edition (free)

For information on supported client drivers, see http://www.filemaker.com/support/technologies.

Adding ODBC tables to the relationships graph

To set up a FileMaker Pro database to access data in supported ODBC data sources:

- Install and configure specific ODBC drivers for the external data sources you want to access.
- On the computer that hosts the current FileMaker Pro file, define a system Data Source Name (DSN) for each ODBC data source you want to access.
- Determine any additional considerations for ODBC data sources you want to access (for example, whether users are prompted for a user name and password).
- Add one or more tables from the ODBC data source to the relationships graph in the current FileMaker Pro file.
- Add fields to layouts in the FileMaker Pro file to display external data.
- Optionally, add supplemental fields to external tables and layouts to display calculation and summary results based on data stored in external ODBC data sources.

See FileMaker Pro Help for detailed steps and additional information on configuring an ODBC client driver, connecting to ODBC data sources, editing ODBC data sources, and setting up an ODBC table in the relationships graph.

Chapter 3
Installing FileMaker ODBC client drivers

These instructions help you install the ODBC client driver needed to access FileMaker as a data source from third-party and custom applications via ODBC (Open Database Connectivity). The ODBC client driver is available through a separate installation on your FileMaker installation disk or electronic download in the xDBC folder.

The latest versions of the client drivers are also available in the FileMaker Knowledge Base: http://help.filemaker.com/

Additional information about client drivers is available from this URL: http://www.filemaker.com/support/technologies

If you'll be hosting a FileMaker database file using FileMaker Server Advanced, make the client drivers available to remote users.

After installing the client driver you need, you can configure the driver to access a FileMaker data source and construct SQL (Structured Query Language) queries to interact with the data.

Hardware and software requirements

To install and use the ODBC client drivers, you need the following minimum equipment and software:

ODBC client driver requirements (Windows)

- Pentium III 700MHz or higher
- 256 MB RAM minimum, 2 GB RAM recommended, for Windows XP; 1 GB RAM minimum for Windows Vista, Windows 7, and Windows Server 2008 R2
- Microsoft Data Access Components (MDAC) 2.8 SP1; Windows MDAC 6.0 for Vista. The MDAC component is usually installed with Windows on the supported Windows platforms.

ODBC client driver requirements (Mac OS)

- Mac OS computer with an Intel processor
- 1 GB RAM minimum; 2 GB RAM recommended
- Mac OS X version 10.6 (the software may also work with later versions certified by FileMaker)

Networking requirements

If you'll be accessing a FileMaker data source hosted on another computer, you'll need network access via TCP/IP.

ODBC client driver architecture overview

FileMaker provides 32- and 64-bit client drivers for both Windows and Mac OS, to support 32- and 64-bit ODBC applications.

FileMaker Pro always uses a 32-bit xDBC Listener. FileMaker Server Advanced uses a 32-bit xDBC Listener on a 32-bit operating system, and a 64-bit xDBC Listener on a 64-bit operating system. But both the 32- and 64-bit xDBC Listeners can communicate with the 32- and 64-bit client drivers.

You must install the client driver that matches your ODBC application. If your ODBC application is a 32-bit application, then install the 32-bit client driver. If your ODBC application is a 64-bit application, then install the 64-bit client driver.

ODBC client driver installation (Windows)

Windows 32-bit and 64-bit client drivers are installed as separate libraries. On a 32-bit Windows operating system, you can install the 32-bit client driver only. On a 64-bit Windows operating system, both the 32-bit and 64-bit client drivers can be installed.

To install the ODBC client driver:

1. Do one of the following:
   - If you received your software electronically, double-click the installation icon (.exe file).
   - If you have an installation disk, insert the disk into the drive.
2. In the FileMaker Pro or FileMaker Server window, double-click the xDBC folder.
3. In the xDBC folder, double-click the ODBC Client Driver Installer folder.
4. In the ODBC Client Driver Installer folder, double-click the installer file for the driver you want to install.
   - To install the 32-bit client driver (fmodbc32.dll), use the 32-bit installer file: **FMODBC_Installer_Win32.msi**
   - To install the 64-bit client driver (fmodbc64.dll), use the 64-bit installer file: **FMODBC_Installer_Win64.msi**

   The FileMaker ODBC Driver Setup Wizard opens.
5. Install the ODBC client driver by following the on-screen instructions.
6. When the installation is complete, click **Close**.

   By default, the ODBC client driver will be installed in this folder:
   - On a 32-bit Windows operating system, the 32-bit client driver (fmodbc32.dll) is installed in this folder: **c:\windows\system32**
   - On a 64-bit Windows operating system, the 32-bit client driver (fmodbc32.dll) is installed in this folder: **c:\windows\SysWoW64**
   - On a 64-bit Windows operating system, the 64-bit client driver (fmodbc64.dll) is installed in this folder: **c:\windows\system32**

   The ODBC client driver, **FileMaker ODBC**, is now available for you to configure for accessing a FileMaker data source.

Configuring client drivers (Windows)

Before using an ODBC client application to access a FileMaker data source, you must configure a client driver for the data source. Configuration settings identify the client driver you're using, the location of the data source, and details on how you intend to connect.

Important When using a FileMaker client driver, you must reserve 2399 as the port.

Opening the ODBC administrator (Windows)

To configure the 32-bit client driver, you must use the 32-bit ODBC administrator. To configure the 64-bit client driver, you must use the 64-bit ODBC administrator.

To open the 32-bit ODBC administrator on a 32-bit Windows operating system:

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

- In Windows XP, Administrative Tools appear in the **Performance and Maintenance** category.
- In Windows Vista and Windows 7, Administrative Tools appear in the **System and Security** category.

The 32-bit ODBC Data Source Administrator opens.

To open the 32-bit ODBC client driver on a 64-bit Windows operating system:

1. Open the **SysWoW64** folder on your system. (By default, the **SysWoW64** folder is at **c:\windows\SysWoW64**.)
2. Double-click the **odbcad32.exe** file.

The 32-bit ODBC Data Source Administrator opens.

To open the 64-bit ODBC client driver on a 64-bit Windows operating system:

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

- In Windows XP, Administrative Tools appear in the **Performance and Maintenance** category.
- In Windows Vista and Windows 7, Administrative Tools appear in the **System and Security** category.

The 64-bit ODBC Data Source Administrator opens.

Configuring the DSN (Windows)

To configure the ODBC client driver:

1. In the ODBC Data Source Administrator, select the **System DSN** or **User DSN** tab
2. Click **Add**.

   The Create New Data Source dialog box opens.
3. Select **FileMaker ODBC**, and click **Finish**.

   The FileMaker DSN Configuration dialog box opens.

4. Click **Next**.

5. For **Name**, enter a name that will be meaningful to others accessing the FileMaker data source. For **Description**, enter an optional description of the FileMaker data source. Click **Next**.

6. For **Host**:
   - If you're connecting to a database file hosted by FileMaker Pro on your local machine, enter **localhost** or the IP address **127.0.0.1**.
   - If you're connecting to a database file hosted by FileMaker Server Advanced over a network, enter the IP address of the FileMaker Server.

   If you have enabled sharing via ODBC/JDBC in the host application, you can select **Connect to host to obtain the names of available databases**. Click **Next**.

   Otherwise, click **Finish** to save your data source information.

7. For **Database**, select a database from the list of available databases, or type the filename of the FileMaker database file you're using as a data source.

   Note For database files hosted by FileMaker Server Advanced, the list of databases may be filtered based on the **File Display Filter** setting. See FileMaker Server Help for information.

   If you need special handling of non-English text, click **Advanced Language**. The Advanced Language Options dialog box opens.
   - To auto-detect language settings, select the **Auto-detect language settings for application** option.
   - To specify the language setting, clear the **Auto-detect language settings for application** option and select the system setting you want to use.

   Select the **Describe text fields as long varchar** option to correct issues with long field values, such as fields that do not have a maximum length specified getting used for Microsoft Word Mail Merge import, or field values in PHP applications that are longer than 255 characters. If you do not use this option for field values longer than 255 characters, then your application may retrieve an empty string (Windows) or only 255 characters (Mac OS).

   If you want to create a log file for long-running queries, select the **Save long-running queries to a log file** option, and enter the name for the log file.

   Click **Finish** to save your data source information.

8. Review the information about your FileMaker DSN.
   - Click **Test** to verify that you have correctly configured the ODBC client driver to access the FileMaker data source. If you receive an error message, you can correct the connection information. You may also need to check that the FileMaker database file is hosted and available, that the FileMaker account specified uses a privilege set with the extended privilege Access via ODBC/JDBC, and that host application (FileMaker Pro or FileMaker Server Advanced) has been set up for sharing via ODBC/JDBC.
   - Click **Done** to save your data source information.

ODBC client driver installation (Mac OS)

Mac OS 32-bit and 64-bit client drivers are installed as a single bundle (**FileMaker ODBC.bundle**) in the **/Library/ODBC** folder. The ODBC client application loads the correct driver automatically.

To install the ODBC client driver:

1. Do one of the following:
   - If you received your software electronically, double-click the disk image icon (.dmg file).
   - If you have an installation disk, insert the disk into the drive.
2. In the FileMaker Pro or FileMaker Server window, double-click the xDBC folder.
3. In the xDBC folder, double-click the ODBC Client Driver Installer folder.
4. In the ODBC Client Driver Installer folder, double-click **FileMaker ODBC.mpkg**.

   The FileMaker ODBC Driver Installer opens.
5. Install the ODBC client driver by following the on-screen instructions.
6. When the installation is complete, click **Close**.

   The ODBC client driver will be installed in this folder: **/Library/ODBC**

   Note You cannot change the installation folder for the ODBC client driver.

   The ODBC client driver, **FileMaker ODBC**, is now available for you to configure for accessing a FileMaker data source.

Configuring client drivers (Mac OS)

Before using an ODBC client application to access a FileMaker data source, you must configure a client driver for the data source. Configuration settings identify the client driver you're using, the location of the data source, and details on how you intend to connect.

These instructions assume you have installed the ODBC Manager from Actual Technologies, available at http://www.odbcmanager.net, which is a freeware product not supported by FileMaker.

You may also use Apple's ODBC Administrator Tool for Mac OS X. For Mac OS X version 10.6, ODBC Administrator is available at http://support.apple.com/downloads/ODBC_Administrator_Tool_for_Mac_OS_X.

Because there is only one installed bundle for both 32- and 64-bit client drivers, you can use the same ODBC administrator for both 32- and 64-bit ODBC applications. The FileMaker DSN that you configure can be used for both 32- and 64-bit ODBC applications.

Important When using a FileMaker client driver, you must reserve 2399 as the port.

To configure the ODBC client driver:

1. Launch the ODBC Manager utility. (The ODBC Manager is installed in the Utilities folder in the Applications folder.)
2. Select the **System DSN** or **User DSN** tab, and click **Add**.

   The Choose a driver dialog box opens.

3. Select **FileMaker ODBC**, and click **OK**.

   The FileMaker DSN Configuration dialog box opens.

4. Click **Continue**.

5. For **Name**, enter a name that will be meaningful to others accessing the FileMaker data source. For **Description**, enter an optional description of the FileMaker data source. Click **Continue**.

6. For **Host**:

   - If you're connecting to a database file hosted by FileMaker Pro on your local machine, enter **localhost** or the IP address **127.0.0.1**.
   - If you're connecting to a database file hosted by FileMaker Server Advanced over a network, enter the IP address of the FileMaker Server.

   If you have enabled sharing via ODBC/JDBC in the host application, you can select **Connect to host to obtain the names of available databases**. Click **Continue**.

   Otherwise, click **Finish** to save your data source information.

7. For **Database**, select a database from the list of available databases, or type the filename of the FileMaker database file you're using as a data source.

   Note For database files hosted by FileMaker Server Advanced, the list of databases may be filtered based on the **File Display Filter** setting. See FileMaker Server Help for information.

   If you need special handling of non-English text, click **Advanced Language**. The Advanced Language Options dialog box opens.

   - To auto-detect language settings, select the **Auto-detect language settings for application** option.
   - To specify the language setting, clear the **Auto-detect language settings for application** option and select the system setting you want to use.

   Select the **Describe text fields as long varchar** option to correct issues with long field values, such as fields that do not have a maximum length specified getting used for Microsoft Word Mail Merge import, or field values in PHP applications that are longer than 255 characters.

   If you want to create a log file for long-running queries, select the **Save long-running queries to a log file** option, and enter the name for the log file.

   Click **Finish** to save your data source information.

8. Review the information about your FileMaker DSN.

   - Click **Test** to verify that you have correctly configured the ODBC client driver to access the FileMaker data source. If you receive an error message, you can correct the connection information. You may also need to check that the FileMaker database file is hosted and available, that the FileMaker account specified uses a privilege set with the extended privilege Access via ODBC/JDBC, and that host application (FileMaker Pro or FileMaker Server Advanced) has been set up for sharing via ODBC/JDBC.
   - Click **Done** to save your data source information.

Where to go from here

After you install and configure a client driver, you can construct and execute SQL queries to access a 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.

For more information on using FileMaker as an ODBC data source, see chapter 4, “Using ODBC to share FileMaker data.”

Chapter 4
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.

The FileMaker ODBC client driver is **FileMaker ODBC**.

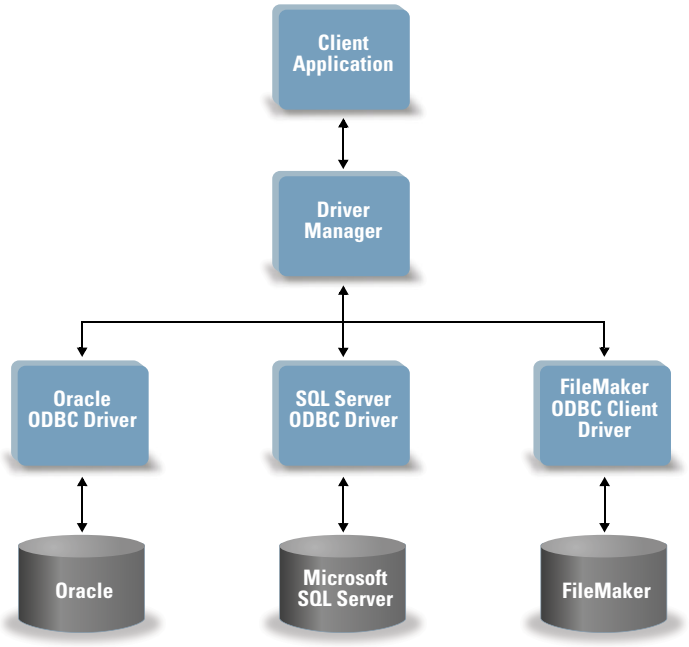
Note You can also use FileMaker Pro as an ODBC client application, interacting with records from another data source via ODBC using SQL. See chapter 2, “Accessing external SQL data sources,” for details about accessing an external SQL data source via ODBC.

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 basic subset of SQL (Structured Query Language) statements. SQL lets you use other applications (such as spreadsheets, word processors, and reporting tools) to view, analyze, and modify FileMaker data. See chapter 7, “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 Advanced 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.



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 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 Advanced or FileMaker Pro host application to share data via ODBC/JDBC. For details, see FileMaker Pro or FileMaker Server Help.

Important Prior versions of the FileMaker ODBC client driver are not compatible with FileMaker version 12. To connect to a FileMaker version 12 database file, you need to install and configure the new ODBC client driver.

Note To confirm that the FileMaker xDBC Listener is currently running, you can use the Activity Monitor on Mac OS or the Task Manager on Windows to check the status of the FileMaker xDBC Listener process. When the process is started, it is named fmxdbc_listener, and events are logged by that name. The FileMaker xDBC Listener process is separate from the FileMaker Server process.

Overview of accessing a FileMaker database file

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 Advanced (via FileMaker Server Admin Console) or FileMaker Pro host application to share data via ODBC/JDBC.

   FileMaker Server Admin Console: Click **ODBC/JDBC** then select **Enable ODBC/JDBC**.

   FileMaker Pro: Choose **File** 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.

5. Construct and execute an 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 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.

Accessing a FileMaker database file from a Windows application

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

Create a DSN for each FileMaker database file you want to access as a data source. The DSN identifies the FileMaker ODBC client driver, the location of the FileMaker host application, and the FileMaker database file you're accessing as a data source.

To configure a new ODBC client driver, see "Configuring client drivers (Windows)" on page 15.

Changing an existing ODBC client driver (Windows)

To change an existing ODBC client driver, open the correct version of the ODBC administrator. To configure the 32-bit client driver, you must use the 32-bit ODBC administrator. To configure the 64-bit client driver, you must use the 64-bit ODBC administrator.

To open the 32-bit ODBC administrator on a 32-bit Windows operating system:

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

- In Windows XP, Administrative Tools appear in the **Performance and Maintenance** category.
- In Windows Vista and Windows 7, Administrative Tools appear in the **System and Security** category.

The 32-bit ODBC Data Source Administrator opens.

To open the 32-bit ODBC client driver on a 64-bit Windows operating system:

1. Open the **SysWoW64** folder on your system. (By default, the **SysWoW64** folder is at **c:\windows\SysWoW64**.)
2. Double-click the **odbcad32.exe** file.

The 32-bit ODBC Data Source Administrator opens.

To open the 64-bit ODBC client driver on a 64-bit Windows operating system:

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

- In Windows XP, Administrative Tools appear in the **Performance and Maintenance** category.
- In Windows Vista and Windows 7, Administrative Tools appear in the **System and Security** category.

The 64-bit ODBC Data Source Administrator opens.

To change the existing ODBC client driver:

1. In the ODBC Data Source Administrator, select the **System DSN** or **User DSN** tab (select the tab used when you previously configured).
2. Choose the FileMaker data source that you previously configured.

   The data source name you originally entered appears under **Name**, and **FileMaker ODBC** appears as the **Driver**.
3. Click **Configure**.

   The FileMaker DSN Configuration dialog box appears.
4. For **Name**, enter a name that will be meaningful to others accessing the FileMaker data source. For **Description**, enter an optional description of the FileMaker data source. Click **Next**.
5. For **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 `127.0.0.1` (or `localhost`).

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

   If you've enabled sharing via ODBC/JDBC in the host application, select **Connect to host to obtain the names of available databases.**
6. For **Database**, select a database from the list of available databases, or type the filename of the FileMaker database file you're using as a data source.

   Note For database files hosted by FileMaker Server Advanced, the list of databases may be filtered based on the **File Display Filter** setting. See FileMaker Server Help for information.

   If you need special handling of non-English text, click **Advanced Language**. The Advanced Language Options dialog box opens.

   - To auto-detect language settings, select the **Auto-detect language settings for application** option.
   - To specify the language setting, clear the **Auto-detect language settings for application** option and select the system setting you want to use.

   Select the **Describe text fields as long varchar** option to correct issues with long field values, such as fields that do not have a maximum length specified getting used for Microsoft Word Mail Merge import, or field values in PHP applications that are longer than 255 characters.

   If you want to create a log file for long-running queries, select the **Save long-running queries to a log file** option, and enter the name for the log file.
7. Click **Finish** to save your data source information.
8. Click **Done** to close the FileMaker DSN Configuration dialog box.

Verifying access via ODBC (Windows)

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

1. In the Windows Control Panel, open **Administrative Tools > Data Sources (ODBC)**.
   - In Windows XP, Administrative Tools appear in the **Performance and Maintenance** category.
   - In Windows Vista and Windows 7, Administrative Tools appear in the **System and Security** category.

   The ODBC Data Source Administrator opens.
2. Select the **System DSN** or **User DSN** tab (select the tab used when you previously configured).
3. Choose the FileMaker data source that you previously configured.

   The data source name you originally entered appears under **Name**, and **FileMaker ODBC** appears as the **Driver**.
4. Click **Configure**.

   The FileMaker DSN Configuration dialog box appears.
5. Click **Next** until you reach the **Conclusion** page.
6. Click **Test**.

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

If the connection is OK, you receive the message **Test completed successfully**.

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

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

Create a DSN for each FileMaker database file you want to access as a data source. The DSN identifies the FileMaker ODBC client driver, the location of the FileMaker host application, and the FileMaker database file you're accessing as a data source.

To configure a new ODBC client driver, see "Configuring client drivers (Mac OS)" on page 17.

Changing an existing ODBC client driver (Mac OS)

These instructions assume you have installed the ODBC Manager from Actual Technologies, available at http://www.odbcmanager.net, which is a freeware product not supported by FileMaker.

You may also use Apple's ODBC Administrator Tool for Mac OS X. For Mac OS X version 10.6, ODBC Administrator is available at http://support.apple.com/downloads/ODBC_Administrator_Tool_for_Mac_OS_X.

Because there is only one installed bundle for both 32- and 64-bit client drivers, you can use the same ODBC administrator for both 32- and 64-bit ODBC applications. The FileMaker DSN that you configure can be used for both 32- and 64-bit ODBC applications.

To change an existing ODBC client driver:

1. Launch the ODBC Manager utility. (The ODBC Manager is installed in the Utilities folder in the Applications folder.)
2. Click the **System DSN** or **User DSN** tab.
3. Choose the FileMaker data source that you previously configured.

   The data source name you originally entered appears under **Name**, and **FileMaker ODBC** appears as the **Driver**.
4. Click **Configure**.

   The FileMaker DSN Configuration dialog box opens.
5. Click **Continue**.
6. For **Name**, type a name that will be meaningful to others accessing the FileMaker data source.

   An additional **Description** is optional.
7. For **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 `127.0.0.1` (or `localhost`).

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

   If you've enabled sharing via ODBC/JDBC in the host application, select **Connect to host to obtain the names of available databases.**
8. For **Database**, select a database from the list of available databases, or type the filename of the FileMaker database file you're using as a data source.

   Note For database files hosted by FileMaker Server Advanced, the list of databases may be filtered based on the **File Display Filter** setting. See FileMaker Server Help for information.

   If you need special handling of non-English text, click **Advanced Language**. The Advanced Language Options dialog box opens.

   - To auto-detect language settings, select the **Auto-detect language settings for application** option.
   - To specify the language setting, clear the **Auto-detect language settings for application** option and select the system setting you want to use.

Select the **Describe text fields as long varchar** option to correct issues with long field values, such as fields that do not have a maximum length specified getting used for Microsoft Word Mail Merge import, or field values in PHP applications that are longer than 255 characters.

If you want to create a log file for long-running queries, select the **Save long-running queries to a log file** option, and enter the name for the log file.

9. Click **Finish** to save your data source information.
10. Click **Done** to close the FileMaker DSN Configuration dialog box.

Verifying access via ODBC (Mac OS)

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

1. Launch the ODBC Manager utility. (The ODBC Manager is located in the Utilities folder in the Applications folder.)
2. Select the **System DSN** or **User DSN** tab (select the tab used when you previously configured).
3. Choose the FileMaker data source that you previously configured.

   The data source name you originally entered appears under **Name**, and **FileMaker ODBC** appears as the **Driver**.
4. Click **Configure**.

   The FileMaker DSN Configuration dialog box opens.
5. Click **Continue** until you recheck the **Conclusion** page.
6. Click **Test**.

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

If the connection is OK, you receive the message **Test completed successfully**.

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.

Chapter 5
Installing FileMaker JDBC client drivers

These instructions help you install the client driver needed to access FileMaker as a data source from third-party and custom applications via JDBC (Java Database Connectivity). The client driver is available on your FileMaker DVD or electronic download in the xDBC folder. The latest versions of the client drivers are also available from http://www.filemaker.com/support/technologies

If you'll be hosting a FileMaker database file using FileMaker Server Advanced, make the client drivers available to remote users.

After installing the client driver you need, you can configure the driver to access a FileMaker data source and construct SQL (Structured Query Language) queries to interact with the data.

The JDBC client driver is the driver portions of the FileMaker software that allow third-party applications or custom applications to access FileMaker files as JDBC data sources.

Software requirements

To install and use the JDBC client drivers, you need JDK 1.4 or later.

To find which version of Java you're running, open a command window (Windows) or Terminal window (Mac OS) and type `java -version`.

Networking requirements

If you'll be accessing a FileMaker data source hosted on another computer, you'll need network access via TCP/IP.

JDBC client driver installation

You must have write access to the folder where you're installing the JDBC client driver.

To install the JDBC client driver:

1. Do one of the following:

- Windows: If you received your software electronically, double-click the installation icon (.exe file).
- Mac OS: If you received your software electronically, double-click the disk image icon (.dmg file).
- If you have an installation disk, insert the disk into the drive.

2. In the FileMaker Pro or FileMaker Server window, double-click the xDBC folder.

3. In the xDBC folder, double-click the JDBC Client Driver Installer folder.

4. Copy the `fmjdbc.jar` file to the appropriate folder for your operating system:

- Windows: Copy the `fmjdbc.jar` file to the folder that includes your Java executable file (java.exe) or to another folder location included in the ClassPath of your Java application.
- Mac OS: Copy the `fmjdbc.jar` file to the /Library/Java/Extensions folder or to another folder location included in the ClassPath of your Java application.

The JDBC client driver is now available for you to use to access a FileMaker data source.

Using the JDBC client driver

Your Java application or applet must register the JDBC client driver with the JDBC driver manager, and you must specify the correct JDBC URL from within the application or applet.

Important You must reserve the port 2399 for the FileMaker JDBC client driver. The port number is always 2399. You can't change the JDBC sharing to a different port.

For more information on using the JDBC client driver, see chapter 6, "Using JDBC to share FileMaker data."

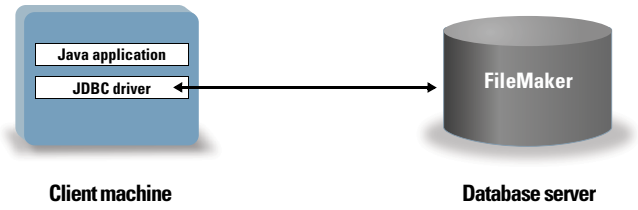
Chapter 6
Using JDBC to share FileMaker data

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.

About the JDBC client driver

The JDBC client driver provides partial support for the JDBC 3.0 specification. The following features are not supported by FileMaker:

- Savepoint support
- Retrieval of auto-generated keys
- Passing parameters to a callable statement object by name
- Holdable cursor support

- Retrieving and updating the object referenced by a Ref object
- Updating of columns containing CLOB, ARRAY and REF data types
- Boolean data type
- DATALINK data type
- Transform groups and type mapping
- Relationship between the JDBC SPI and the Connector architecture

For additional details, see http://www.filemaker.com/support/technologies.

The JDBC client driver has been tested against the Java Development Kit (JDK) 1.5 (Mac OS) and 1.6 (Windows). 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 class and main entry point for the driver is named:

com.filemaker.jdbc.Driver

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.

Note To confirm that the FileMaker xDBC Listener is currently running, you can use the Activity Monitor on Mac OS or the Task Manager on Windows to check the status of the FileMaker xDBC Listener process. When the process is started, it is named fmxdbc_listener, and events are logged by that name. The FileMaker xDBC Listener process is separate from the FileMaker Server process.

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 `filemaker`. 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 a snippet of a JDBC client application 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:filemaker://192.168.1.1/database**

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.filemaker.jdbc.Driver").newInstance();
        } catch(Exception e) {
            System.out.println(e);
        }
        // establish a connection to FileMaker
        Connection con;
        try {
            con =
            DriverManager.getConnection("jdbc:filemaker://192.168.1.1/mydataba
            se","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);
        }
    }
}þ
```

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

JDBC URL connection with the database name specified in the URL

Format:

jdbc:filemaker://<filemaker host IP address>/<databasename>

Example:

jdbc:filemaker://192.168.1.1/publications

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

Format:

jdbc:filemaker://<filemaker host IP address>/<databasename>?user=<databaseusername>&password=<databasepassword>

Example:

jdbc:filemaker://192.168.1.1/customers?user=Collections&password=admin

Note Because of the use of the ampersand character (&) in this syntax, you cannot use an ampersand character in the user name or the password.

Invalid user name example:

jdbc:filemaker://localhost/sales_db?user=ad&min&password=admin

Invalid password example:

jdbc:filemaker://localhost/sales_db?user=admin1&password=ad&min

Solutions with multiple FileMaker database files

If your FileMaker database solution uses many FileMaker database files, create an additional database file that contains all the necessary external data source 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.

Verifying access via 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**.

- The FileMaker Pro or FileMaker Server Advanced host application has been set up for sharing via ODBC/JDBC.

  To share a FileMaker database file as a data source, use FileMaker Pro to define accounts that 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 Advanced or FileMaker Pro host application to share data via ODBC/JDBC. For details, see FileMaker Pro Help.
- 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 on using JDBC to share FileMaker data, see http://www.filemaker.com/support/technologies.

Chapter 7
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 either FileMaker Pro or FileMaker Server Advanced.

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 http://www.filemaker.com/support/technologies for more information. 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`.

SQL statements

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

- SELECT (see below)
- DELETE (page 41)
- INSERT (page 41)
- UPDATE (page 42)
- CREATE TABLE (page 43)
- ALTER TABLE (page 44)
- CREATE INDEX (page 45)
- DROP INDEX (page 45)

The client drivers also support FileMaker data type mapping to ODBC SQL and JDBC SQL data types. See "Mapping FileMaker fields to ODBC data types" on page 58 and "Mapping FileMaker fields to JDBC data types" on page 58 for data type conversions. For more information on constructing SQL queries, refer to a third-party book.

Note The ODBC and JDBC client drivers do not support FileMaker portals.

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.

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
```

SQL clauses

The ODBC and JDBC client drivers provide support for the following SQL clauses.

Use this SQL clause	To
FROM (page 35)	Indicate which tables are used in the SELECT statement.
WHERE (page 36)	Specify the conditions that records must meet to be retrieved (like a FileMaker Pro find request).
GROUP BY (page 37)	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 (page 37)	Specify conditions for groups of records (for example, display only the departments that have salaries totaling more than $200,000).
UNION (page 37)	Combine the results of two or more SELECT statements into a single result.
ORDER BY (page 38)	Indicate how the records are sorted
FOR UPDATE (page 38)	To perform Positioned Updates or Positioned Deletes via SQL cursors

Note If you attempt to retrieve data from a table with no columns, the SELECT statement returns nothing.

FROM clause

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

```
FROM table_name [table_alias] [, table_name [table_alias]]
```

table_name is the name of a table in the current database.

table_alias can be used to give the table a more descriptive name, to abbreviate a longer table name, or to include the same table in the query more than once (for example, in self-joins).

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
```

If you are joining two tables, but you don't want to discard rows of the first table (the "left" table), you can use `LEFT JOIN`.

```
SELECT *
   FROM Salespeople LEFT JOIN Sales Data
   ON Salespeople.Salesperson ID = Sales Data.DepartmentID
```

Every row from the "Salespeople" table will appear in the joined table.

If you are joining two tables, but you don't want to discard rows of the second table (the "right" table), you can use `RIGHT JOIN`.

```
SELECT *
   FROM Salespeople RIGHT JOIN Sales Data
   ON Salespeople.Salesperson ID = Sales Data.DepartmentID
```

Every row from the "Sales Data" table will appear in the joined table.

Notes

- `LEFT JOIN` is supported, but the grammar `LEFT OUTER JOIN` is not currently supported.
- `RIGHT JOIN` is supported, but the grammar `RIGHT OUTER JOIN` is not currently supported.
- `FULL 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
```

The `WHERE` clause can also use expressions such as these:

```
WHERE expr1 IS NULL
WHERE NOT expr2
```

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 columns
```

`columns` 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.

Example

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). 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.

Example

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 records for Positioned Updates or Positioned Deletes via SQL cursors. 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, and is ignored.

Example

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
```

Additional examples:

Using	Sample SQL
text constant	`SELECT 'CatDog' FROM Salespeople`
numeric constant	`SELECT 999 FROM Salespeople`
date constant	`SELECT DATE '2012-06-05' FROM Salespeople`
time constant	`SELECT TIME '02:49:03' FROM Salespeople`
timestamp constant	`SELECT TIMESTAMP '2012-06-05 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[a] 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 `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 columns in the `Salespeople` table. For the example `SELECT DISTINCT * FROM Salespeople`, the result is all the unique rows in the `Salespeople` table (no duplicates).

- FileMaker does not store data for empty strings, so the following queries always return no records:

```
SELECT * FROM test WHERE c =''
SELECT * FROM test WHERE c <>''
```

- If you use `SELECT` with binary data, you must use the `GetAs()` function to specify the stream to return. See the following section “Retrieving the contents of a container field: CAST() function and GetAs() function,” for more information.

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 from a container field, such as the file path to a file, picture, or Quicktime movie, 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 from a container field, use the `GetAs()` function and specify the file's type depending on how the data was inserted into the container field in FileMaker Pro.

- If the data was inserted using the **Insert** > **File** command, specify `'FILE'` in the `GetAs()` function. For example:

  ```
  SELECT GetAs(Company_Brochures, 'FILE') FROM Sales_Data
  ```

- If the data was inserted using the **Insert** > **Sound** command (Standard sound — Mac OS raw format), specify `'snd'` in the `GetAs()` function. For example:

  ```
  SELECT GetAs(Company_Meeting, 'snd ') FROM Company_Newsletter
  ```

- If the data was inserted using the **Insert** > **Object** command (OLE container data), specify `'EMBO'` in the `GetAs()` function. For example:

  ```
  SELECT GetAs(Company_Results, 'EMBO') FROM Annual_Report
  ```

- If the data was inserted using the **Insert** > **Picture** command, drag and drop, or paste from the clipboard, specify one of the file types listed in the following table. For example:

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

File type	Description	File type	Description
`'EMF+'`	Windows Enhanced Metafile Plus	`'PDF '`	Portable Document Format
`'EPS '`	Embedded PostScript	`'PICT'`	Mac OS (does not have 512-byte file-based header)
`'FPix'`	Flash (FPX)	`'PNGf'`	Bitmap image format
`'FORK'`	Resource fork (Mac OS)	`'PNTG'`	MacPaint
`'GIFf'`	Graphics Interchange Format	`'qtif'`	QuickTime image file
`'JPEG'`	Photographic images	`'.SGI'`	Generic bitmap format
`'JP2 '`	JPEG 2000	`'TIFF'`	Raster file format for digital images
`'META'`	Windows Metafile (enhanced)	`'TPIC'`	Targa
`'METO'`	Windows Metafile (original)	`'XMLO'`	Layout objects
`'moov'`	Old QuickTime format (Mac OS)	`'8BPS'`	PhotoShop (PSD)

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).

Example

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, ...)
[, 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. column_name may also specify a field repetition, for example lastDates[4].

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').

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, {d '2008/06/05'})
```

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 text only, unless you prepare a parameterized statement and stream the data from your application. To use binary data, you must specify the type in a PutAs() function: PutAs(col, 'type'), where the type value is a type as described in "Retrieving the contents of a container field: CAST() function and GetAs() function" on page 39.

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').

Subqueries must be enclosed in parentheses.

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

Examples

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` with text only, unless you prepare a parameterized statement and stream the data from your application. To use binary data, you must specify the type in a `PutAs()` function: `PutAs(col, 'type')`, where the type value is a type as described in “Retrieving the contents of a container field: CAST() function and GetAs() function” on page 39.

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 [, table_element_list...] )
```

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

- `table_name` is the name of the table. `table_name` has a 100 character limit. A table with the same name must not already be defined.
- The format for `table_element_list` is:

  ```
  field_name field_type [DEFAULT expr][UNIQUE][NOT NULL] [EXTERNAL
  relative_path_string [SECURE | OPEN calc_path_string]]
  ```

  - `field_name` is the name of the field. No field in the same table may have the same name. You specify a field repetition by using a number in square brackets. For example: `lastDates[4]`.
  - `field_type` may be any of the following: `NUMERIC`, `DECIMAL`, `INT`, `DATE`, `TIME`, `TIMESTAMP`, `VARCHAR`, `CHARACTER VARYING`, `BLOB`, `VARBINARY`, `LONGVARBINARY`, or `BINARY VARYING`. For `NUMERIC` and `DECIMAL`, you can specify the precision and scale. For example: `DECIMAL(10,0)`. For `TIME` and `TIMESTAMP`, you can specify the precision. For example: `TIMESTAMP(6)`. For `VARCHAR` and `CHARACTER VARYING`, you can specify the length of the string. For example: `VARCHAR(255)`.
  - The `DEFAULT` keyword allows you to set a default value for a column. For `expr`, you may use a constant value or expression. Allowable expressions are `USER`, `USERNAME`, `CURRENT_USER`, `CURRENT_DATE`, `CURDATE`, `CURRENT_TIME`, `CURTIME`, `CURRENT_TIMESTAMP`, and `CURTIMESTAMP`.
  - Defining a column to be `UNIQUE` automatically selects the **Unique** Validation Option for the corresponding field in the FileMaker database file.
  - 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 is flagged as a **Required Value** in the **Fields** tab of the Manage Database dialog box in FileMaker Pro.
  - To define a column as a container field, use `BLOB`, `VARBINARY`, or `BINARY VARYING` for the `field_type`.
  - To define a column as a container field that stores data externally, use the `EXTERNAL` keyword. The `relative_path_string` defines the folder where the data is stored externally, relative to the location of the FileMaker database. This path must be specified as the base directory in the FileMaker Pro Manage Containers dialog box. You must specify either `SECURE` for secure storage or `OPEN` for open storage. If you are using open storage, the `calc_path_string` is the folder inside the `relative_path_string` folder where container objects are to be stored. `calc_path_string` can be a FileMaker calculation.

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)`
column for container field	`CREATE TABLE T6 (C1 BLOB, C2 BLOB, C3 BLOB, C4 BLOB)`
column for external storage container field	`CREATE TABLE T7 (C1 BLOB EXTERNAL 'Files/MyDatabase' SECURE)` `CREATE TABLE T8 (C1 BLOB EXTERNAL 'Files/MyDatabase' OPEN 'Objects')`

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
ALTER TABLE table_name ALTER [COLUMN] column_definition SET DEFAULT expr
ALTER TABLE table_name ALTER [COLUMN] column_definition DROP DEFAULT
```

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`
set the default value for a column	`ALTER TABLE Salespeople ALTER Company SET DEFAULT 'FileMaker'`
remove the default value for a column	`ALTER TABLE Salespeople ALTER Company DROP DEFAULT`

Note `SET DEFAULT` and `DROP DEFAULT` do not affect existing rows in the table, but change the default value for rows that are subsequently added to the table.

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 ON table_name.column_name
CREATE INDEX 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.

FileMaker automatically creates indexes as needed. Using `CREATE INDEX` causes the index to be built immediately rather than on demand.

Example

```
CREATE INDEX 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
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
```

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.

Examples

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

```
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
- Constants
- Exponential notation
- Numeric operators
- Character operators
- Date operators
- Relational operators
- Logical operators
- Functions

Field names

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

Constants

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`.

You must enclose character constants 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'`).

FileMaker accepts the ODBC/JDBC format date, time, and timestamp constants in braces ({}), for example:

- `{D '2012-06-05'}`
- `{T '14:35:10'}`
- `{TS '2012-06-05 14:35:10'}`

FileMaker allows the type specifier (`D`, `T`, `TS`) to be in upper case or lower case. You may use any number of spaces after the type specifier, or even omit the space.

FileMaker also accepts SQL-92 syntax ISO date and time formats with no braces:

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

Constant	Acceptable syntax (examples)
Text	`'Paris'`
Number	`1.05`

Date	`DATE '2012-06-05'`
	`{ D '2012-06-05' }`
	`{06/05/2012}`
	`{06/05/12}`
	Note: The 2-digit year syntax is not supported for the ODBC/JDBC format or the SQL-92 format.

Time	`TIME '14:35:10'`
	`{ T '14:35:10' }`
	`{14:35:10}`

Timestamp	`TIMESTAMP '2012-06-05 14:35:10'`
	`{ TS '2012-06-05 14:35:10'}`
	`{06/05/2012 14:35:10}`
	`{06/05/12 14:35:10}`
	Make sure **Strict data type: 4-Digit Year Date** is not selected as a validation option in the FileMaker database file for a field using this 2-digit year syntax.
	Note: The 2-digit year syntax is not supported for the ODBC/JDBC format or the SQL-92 format.

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.

Exponential/scientific notation

Numbers can be expressed using scientific 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 `{D '2008-30-01'}`.

Operator	Effect on date	Example	Result
+	Add a number of days to a date	hire_date + 5	`{D '2008-02-04'}`
-	Find the number of days between two dates, or subtract a number of days from a date	hire_date - {D '2008-01-01'} hire_date - 10	`29` `{D '2008-01-20'}`

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

FileMaker SQL supports many functions you can use in expressions. Some of the functions return characters strings, some return numbers, and some return dates.

Functions that return character strings

Functions that return character strings	Description	Example
CHR	Converts an ASCII code to a one-character string	CHR(67) returns **C**
CURRENT_USER	Returns the login ID specified at connect time	
DAYNAME	Returns the name of the day that corresponds to a specified date.	
RTRIM	Removes trailing blanks from a string	RTRIM(' ABC ') returns ' ABC'
TRIM	Removes leading and 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'
LEFT	Returns leftmost characters of a string	LEFT('Mattson',3) returns 'Mat'
MONTHNAME	Returns the names of the calendar month.	
RIGHT	Returns rightmost characters of a string	RIGHT('Mattson',4) returns 'tson'
SUBSTR SUBSTRING	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({D '2008-12-25'}) returns '2008-12-25'
TIME TIMEVAL	Returns the time of day as a string	At 9:49 PM, TIME() returns **21:49:00**
USERNAME USER	Returns the login ID specified at connect time	

Note The TIME() function is deprecated. Use the SQL standard CURRENT_TIME instead.

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 = 1
```

Functions that return numbers

Functions that return numbers	Description	Example
ABS	Returns the absolute value of the numeric expression	
ATAN	Returns the arc tangent of the argument as an angle expressed in radians	
ATAN2	Returns the arc tangent of x and y coordinates as an angle expressed in radians	
B	Returns the decimal equivalent of a binary number	`B'1001'` returns **9**
CEIL CEILING	Returns the smallest integer value that is greater than or equal to the argument	
DEG DEGREES	Returns the number of degrees of the argument, which is an angle expressed in radians	
DAY	Returns the day part of a date	`DAY({d '2012/01/30'})` returns **30**
DAYOFWEEK	Returns the day of week (1-7) of a date expression	`DAYOFWEEK({d '2004/05/01'})` returns **7**
MOD	Divides two numbers and returns the remainder of the division	`MOD(10,3)` returns **1**
EXP	Returns a value that is the base of the natural logarithm (e) raised to a power specified by the argument	
FLOOR	Returns the largest integer value that is less than or equal to the argument	
HOUR	Returns the hour part of a value.	
INT	Returns the integer part of a number	`INT(6.4321)` returns **6**
LEN LENGTH	Returns the length of a string	`LEN('ABC')` returns **3**
MONTH	Returns the month part of a date	`MONTH({d '2012/01/30'})` returns **1**

Functions that return numbers	Description	Example
LN LOG	Returns the natural logarithm of the argument	
MAX	Returns the larger of two numbers	MAX(66,89) returns **89**
MIN	Returns the smaller of two numbers	MIN(66,89) returns **66**
MINUTE	Returns the minute part of a value	
NUMVAL	Converts a character string to a number; if the character string is not a valid number, returns 0	NUMVAL('123') returns **123**
PI	Returns the constant value of the mathematical constant pi	
RADIANS	Returns the number of radians for an argument that is expressed in degrees	
ROUND	Rounds a number	ROUND(123.456,0) returns **123** ROUND(123.456,2) returns **123.46** ROUND(123.456,-2) returns **100**
SECOND	Returns the seconds part of a value	
SIGN	An indicator of the sign of the argument: -1 for negative, 0 for 0, and 1 for positive.	
SIN	Returns the sine of the argument	
SQRT	Returns the square root of the argument	
TAN	Returns the tangent of the argument	
VAL	Converts a character string to a number; if the character string is not a valid number, returns 0	VAL('123') returns **123**
X	Returns the decimal equivalent of a hexadecimal number	X'b9' returns **185**
YEAR	Returns the year part of a date	YEAR({d '2012/01/30'}) returns **2012**

Functions that return dates

Functions that return dates	Description	Example
CURDATE CURRENT_DATE	Returns today's date	
CURTIME CURRENT_TIME	Returns the current time	
CURTIMESTAMP CURRENT_TIMESTAMP TIMESTAMPVAL	Returns the current timestamp value	
DATE TODAY	Returns today's date	If today is 11/21/2012, DATE() returns **2012-11-21**
DATEVAL	Converts a character string to a date	DATEVAL({01/30/2012}) returns **2012-01-30**

Note The DATE() function is deprecated. Use the SQL standard CURRENT_DATE instead.

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
6	Not
7	AND
8	OR

The following example shows the importance of precedence:

```
WHERE salary > 40000 OR hire_date > {d '2008/01/30'} AND dept = 'D101'
```

Because AND is evaluated first, this query retrieves employees in department D101 hired after January 30, 2008, 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 > {d '2008/01/30'}) AND dept = 'D101'
```

retrieves employees in department D101 that either make more than $40,000 or were hired after January 30, 2008.

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:

- getColumns
- getColumnPrivileges
- getMetaData
- getTypeInfo

- getTables
- getTableTypes

Reserved SQL keywords

This section lists reserved keywords that should not be used as names for columns, tables, aliases, or other user-defined objects. If you are getting syntax errors, these errors may be due to using one of these reserved words. If you want to use one of these keywords, you need to use quotation marks to prevent the word from being treated as a keyword.

For example, the following `CREATE TABLE` statement shows how to use the `DEC` keyword as a data element name.

create table t ("dec" numeric)

ABSOLUTE	CATALOG	CURSOR
ACTION	CHAR	CURTIME
ADD	CHARACTER	CURTIMESTAMP
ALL	CHARACTER_LENGTH	DATE
ALLOCATE	CHAR_LENGTH	DATEVAL
ALTER	CHECK	DAY
AND	CHR	DAYNAME
ANY	CLOSE	DAYOFWEEK
ARE	COALESCE	DEALLOCATE
AS	COLLATE	DEC
ASC	COLLATION	DECIMAL
ASSERTION	COLUMN COMMIT	DECLARE
AT	CONNECT	DEFAULT
AUTHORIZATION	CONNECTION	DEFERRABLE
AVG	CONSTRAINT	DEFERRED
BEGIN	CONSTRAINTS	DELETE
BETWEEN	CONTINUE	DESC
BINARY	CONVERT	DESCRIBE
BIT	CORRESPONDING	DESCRIPTOR
BIT_LENGTH	COUNT	DIAGNOSTICS
BLOB	CREATE	DISCONNECT
BOOLEAN	CROSS	DISTINCT
BOTH	CURDATE	DOMAIN
BY	CURRENT	DOUBLE
CASCADE	CURRENT_DATE	DROP
CASCADED	CURRENT_TIME	ELSE
CASE	CURRENT_TIMESTAMP	END
CAST	CURRENT_USER	END_EXEC

ESCAPE
EVERY
EXCEPT
EXCEPTION
EXEC
EXECUTE
EXISTS
EXTERNAL
EXTRACT
FALSE
FETCH
FIRST
FLOAT
FOR
FOREIGN
FOUND
FROM
FULL
GET
GLOBAL
GO
GOTO
GRANT
GROUP
HAVING
HOUR
IDENTITY
IMMEDIATE
IN
INDEX
INDICATOR
INITIALLY
INNER
INPUT
INSENSITIVE
NSERT
INT
INTEGER
INTERSECT
INTERVAL
INTO
IS
ISOLATION
JOIN
KEY
LANGUAGE
LAST
LEADING
LEFT
LENGTH
LEVEL
LIKE
LOCAL
LONGVARBINARY
LOWER
LTRIM
MATCH
MAX
MIN
MINUTE
MODULE
MONTH
MONTHNAME
NAMES
NATIONAL
NATURAL
NCHAR
NEXT
NO
NOT
NULL
NULLIF
NUMERIC
NUMVAL
OCTET_LENGTH
OF
ON
ONLY
OPEN
OPTION
OR
ORDER
OUTER
OUTPUT
OVERLAPS
PAD
PART
PARTIAL
POSITION
PRECISION
PREPARE
PRESERVE
PRIMARY
PRIOR
PRIVILEGES
PROCEDURE
PUBLIC
READ
REAL
REFERENCES
RELATIVE
RESTRICT
REVOKE
RIGHT
ROLLBACK
ROUND
ROWID
ROWS
RTRIM
SCHEMA
SCROLL
SECOND
SECTION
SELECT
SESSION
SESSION_USER
SET

SIZE
SMALLINT
SOME
SPACE
SQL
SQLCODE
SQLERROR
SQLSTATE
STRVAL
SUBSTRING
SUM
SYSTEM_USER
TABLE
TEMPORARY
THEN
TIME
TIMESTAMP
TIMESTAMPVAL
TIMEVAL
TIMEZONE_HOUR
TIMEZONE_MINUTE
TO
TODAY
TRAILING
TRANSACTION
TRANSLATE
TRANSLATION
TRIM
TRUE
UNION
UNIQUE
UNKNOWN
UPDATE
UPPER
USAGE
USER
USERNAME
USING
USAGE
USER
USERNAME
USING
VALUE
VALUES
VARBINARY
VARCHAR
VARYING
VIEW
WHEN
WHENEVER
WHERE
WITH
WORK
WRITE
YEAR
ZONE

Chapter 8
Reference Information

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 negatives 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 is 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 are stored and retrieved in Unicode.

Note FileMaker repeating fields are supported like arrays. Examples:

```
INSERT INTO mytable(repField[3]) VALUES ('this is rep 3')
SELECT repField[1], repField[2] FROM mytable
```

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 1.5 documentation web pages at http://www.javasoft.com.)

FileMaker field type	Converts to JDBC SQL type
text	`java.sql.Types.VARCHAR`
number	`java.sql.Types.DOUBLE`
date	`java.sql.Types.DATE`
time	`java.sql.Types.TIME`

FileMaker field type	Converts to JDBC SQL type
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**.

Data types in 64-bit applications

In the 32-bit version of the ODBC API, some functions used parameters that could pass integer values or pointer values, depending on context. But in 64-bit Windows operating systems, integers and pointers are not the same size. The 64-bit version of the ODBC API uses abstract data types that are not defined as a specific size.

Applications that use 32-bit values may crash when they are ported to a 64-bit operating system. Applications that use abstract data types work correctly on both 32- and 64-bit operating systems.

ODBC and JDBC error messages

Here are the basic formats of error messages you receive when working with FileMaker and ODBC/JDBC.

ODBC error messages

Error messages can come from:

- ODBC driver errors
- FileMaker and FileMaker xDBC Listener errors

FileMaker ODBC error messages

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

[FileMaker] [FileMaker ODBC] message

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

[FileMaker] [FileMaker ODBC] 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 FileMaker JDBC driver reports errors to the calling application by returning SQLExceptions. Error messages can come from:

- JDBC driver errors
- FileMaker and FileMaker xDBC Listener errors

FileMaker JDBC error messages

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

[FileMaker] [FileMaker JDBC] message

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

[FileMaker] [FileMaker JDBC] Invalid Username/Password

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