



# Simba JDBC Driver with SQL Connector for Google BigQuery

## Installation and Configuration Guide

Simba Technologies Inc.

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**Contact Us**

Simba Technologies Inc.  
938 West 8th Avenue  
Vancouver, BC Canada  
V5Z 1E5

Tel: +1 (604) 633-0008

Fax: +1 (604) 633-0004

[www.simba.com](http://www.simba.com)

## About This Guide

### Purpose

The *Simba JDBC Driver with SQL Connector for Google BigQuery Installation and Configuration Guide* explains how to install and configure the Simba JDBC Driver with SQL Connector for Google BigQuery on all supported platforms. The guide also provides details related to features of the driver.

### Audience

The guide is intended for end users of the Simba JDBC Driver for Google BigQuery.

### Knowledge Prerequisites

To use the Simba JDBC Driver for Google BigQuery, the following knowledge is helpful:

- Familiarity with the platform on which you are using the Simba JDBC Driver for Google BigQuery
- Ability to use the data store to which the Simba JDBC Driver for Google BigQuery is connecting
- An understanding of the role of JDBC technologies in connecting to a data store
- Experience creating and configuring JDBC connections
- Exposure to SQL

### Document Conventions

*Italics* are used when referring to book and document titles.

**Bold** is used in procedures for graphical user interface elements that a user clicks and text that a user types.

Monospace font indicates commands, source code or contents of text files.

#### Note:

A text box with a pencil icon indicates a short note appended to a paragraph.

**! Important:**

A text box with an exclamation mark indicates an important comment related to the preceding paragraph.

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## About the Simba JDBC Driver for Google BigQuery

The Simba JDBC Driver for Google BigQuery enables Business Intelligence (BI), analytics, and reporting on data that is stored in BigQuery. The driver complies with the JDBC 4.1 and 4.2 data standards.

JDBC is one of the most established and widely supported APIs for connecting to and working with databases. At the heart of the technology is the JDBC driver, which connects an application to the database. For more information about JDBC, see *Data Access Standards Glossary*: <http://www.simba.com/resources/data-access-standards-library>.

This guide is suitable for users who want to access data residing within BigQuery from their desktop environment. Application developers might also find the information helpful. Refer to your application for details on connecting via JDBC.

## System Requirements

Each machine where you use the Simba JDBC Driver for Google BigQuery must have Java Runtime Environment (JRE) installed. The version of JRE that must be installed depends on the version of the JDBC API you are using with the driver. The following table lists the required version of JRE for each provided version of the JDBC API.

JDBC API Version	JRE Version
4.1	7.0 or later
4.2	8.0 or later



## Simba JDBC Driver for Google BigQuery Files

The Simba JDBC Driver for Google BigQuery is delivered in the following two ZIP archives, where *[Version]* is the version number of the driver:

- `BigQueryJDBC41_[Version].zip`
- `BigQueryJDBC42_[Version].zip`

Each archive contains the driver supporting the JDBC API version indicated in the archive name, as well as release notes and third party license information.

## Installing and Using the Simba JDBC Driver for Google BigQuery

To install the Simba JDBC Driver for Google BigQuery on your machine, extract the files from the appropriate ZIP archive to the directory of your choice.

### ! Important:

If you received a license file through email, then you must copy the file into the same directory as the `BigQueryJDBC41_[Version].jar` file or the `BigQueryJDBC42_[Version].jar` file before you can use the Simba JDBC Driver for Google BigQuery.

To access a BigQuery data store using the Simba JDBC Driver for Google BigQuery, you need to configure the following:

- The list of driver library files (see [Referencing the JDBC Driver Libraries](#) on page 10)
- The Driver or DataSource class (see [Registering the Driver Class](#) on page 11)
- The connection URL for the driver (see [Building the Connection URL](#) on page 12)

## Referencing the JDBC Driver Libraries

Before you use the Simba JDBC Driver for Google BigQuery, the JDBC application or Java code that you are using to connect to the data store must be able to access the driver JAR files. In the application or code, specify all the JAR files that you extracted from the appropriate ZIP archive.

### Using the Driver in a JDBC Application

Most JDBC applications provide a set of configuration options for adding a list of driver library files. Use the provided options to include all the JAR files from the ZIP archive as part of the driver configuration in the application. For more information, see the documentation for your JDBC application.

### Using the Driver in Java Code

You must include all the driver library files in the class path. This is the path that the Java Runtime Environment searches for classes and other resource files. For more information, see "Setting the Class Path" in the Java SE Documentation:

- For Windows:  
<http://docs.oracle.com/javase/7/docs/technotes/tools/windows/classpath.html>
- For Linux and Solaris:  
<http://docs.oracle.com/javase/7/docs/technotes/tools/solaris/classpath.html>

## Registering the Driver Class

Before connecting to the data store, you must register the appropriate class for your application.

The following is a list of the classes used to connect the Simba JDBC Driver for Google BigQuery to BigQuery data stores. The `Driver` classes extend `java.sql.Driver`, and the `DataSource` classes extend `javax.sql.DataSource` and `javax.sql.ConnectionPoolDataSource`.

To support JDBC 4.1, classes with the following fully-qualified class names (FQCNs) are available:

- `com.simba.googlebigquery.jdbc41.Driver`
- `com.simba.googlebigquery.jdbc41.DataSource`

To support JDBC 4.2, classes with the following FQCNs are available:

- `com.simba.googlebigquery.jdbc42.Driver`
- `com.simba.googlebigquery.jdbc42.DataSource`

The following sample code shows how to use the `DriverManager` to establish a connection for JDBC 4:

```
private static Connection connectViaDM() throws Exception
{
    Connection connection = null;
    connection = DriverManager.getConnection(CONNECTION_URL);
    return connection;
}
```

The following sample code shows how to use the `DataSource` class to establish a connection:

```
private static Connection connectViaDS() throws Exception
{
    Connection connection = null;
    DataSource ds = new
        com.simba.googlebigquery.jdbc41.DataSource();
}
```

```
ds.setURL(CONNECTION_URL);  
connection = ds.getConnection();  
return connection;  
}
```

## Building the Connection URL

Use the connection URL to supply connection information to the data store that you are accessing. The following is the format of the connection URL for the Simba JDBC Driver for Google BigQuery:

```
jdbc:bigquery://[Host]:[Port];ProjectId=[Project];OAuthType=  
[AuthValue];[Property1]=[Value1];[Property2]=[Value2];...
```

The variables are defined as follows:

- *[Host]* is the DNS or IP address of the server.
- *[Port]* is the number of the TCP port to connect to. Specifying the port number is optional if you are connecting to port 443.
- *[Project]* is the name of your BigQuery project.
- *[AuthValue]* corresponds to the type of authentication used by the driver:
  - 1: The driver uses user-based OAuth authentication. For more information on building a connection URL for user-based authentication, see [Using a Google User Account](#) on page 13.
  - 0: The driver uses service-based OAuth authentication. For more information on building a connection URL for service-based authentication, see [Using a Google Service Account](#) on page 14.
- *[Property1..N]* and *[Value1..N]* are additional connection properties supported by the driver. For a list of the properties available in the driver, see [Driver Configuration Options](#) on page 22.

### ! Important:

- Properties are case-sensitive.
- Do not duplicate properties in the connection URL.

## Configuring Authentication

The Simba JDBC Driver for Google BigQuery uses the OAuth 2.0 protocol for authentication and authorization. It authenticates your connection through Google OAuth APIs. You can configure the driver to provide your credentials and authenticate the connection to the database using one of the following methods:

- [Using a Google User Account](#) on page 13
- [Using a Google Service Account](#) on page 14

### Using a Google User Account

You can configure the driver to authenticate the connection with a Google user account.

You must provide your Google user account credentials to connect to the server. For more information about authenticating through OAuth 2.0 with a Google user account, see "Using OAuth 2.0 to Access Google APIs" in the Google Developers documentation: <https://developers.google.com/identity/protocols/OAuth2>.

#### To configure user account authentication:

1. Connect to the server using a connection URL written in the following format:

```
jdbc:bigquery://[Host]:[Port];ProjectId=[Project];OAuthType=1;
```

The variables are defined as follows:

- *[Host]* is the DNS or IP address of the server.
- *[Port]* is the number of the TCP port to connect to. Specifying the port number is optional if you are connecting to port 443.
- *[Project]* is the name of your BigQuery project.

For example:

```
jdbc:bigquery://https://www.googleapis.com/bigquery/v2:443;ProjectId=MyBigQueryProject;OAuthType=1;
```

The driver returns a connection URL, and requests an access token.

2. In a web browser, navigate to the connection URL, and provide your Google account name and password for authentication.

The browser returns an access token.

3. In the driver, type or paste the access token and press Enter.

For more information about connection URL syntax, see [Building the Connection URL](#) on page 12.

## Using a Google Service Account

You can configure the driver to authenticate the connection with a Google service account. The service account can handle the authentication process so that no user input is required.

You must provide a Google service account email address and the full path to a private key file for the service account. You can download the private key file from the Google API console web page. For more information about OAuth authentication using a service account, see "Using OAuth 2.0 for Server to Server Applications" in the Google Developers documentation:

<https://developers.google.com/identity/protocols/OAuth2ServiceAccount>.

You provide this information to the driver in the connection URL. For more information about the syntax of the connection URL, see [Building the Connection URL](#) on page 12.

### To configure service account authentication:

1. Set the `OAuthType` property to 0.
2. Set the `ProjectID` property to the name of your BigQuery project.
3. Set the `OAuthServiceAcctEmail` property to your Google service account email address.
4. Set the `OAuthPvtKeyPath` property to the full path to the key file that is used to authenticate the service account email address. This parameter supports both `.p12` or `.json` formatted keys.

For example:

```
jdbc:bigquery://https://www.googleapis.com/bigquery/v2:443;ProjectId=MyBigQueryProject;OAuthType=0;OAuthServiceAcctEmail==bqtest1@data-driver-testing.iam.gserviceaccount.com;OAuthPvtKeyPath=C:\SecureFiles\ServiceKeyFile.p12;
```

## Configuring Logging

To help troubleshoot issues, you can enable logging in the driver.

**! Important:**

Only enable logging long enough to capture an issue. Logging decreases performance and can consume a large quantity of disk space.

In the connection URL, set the `LogLevel` key to enable logging at the desired level of detail. The following table lists the logging levels provided by the Simba JDBC Driver for Google BigQuery, in order from least verbose to most verbose.

LogLevel Value	Description
0	Disable all logging.
1	Log severe error events that lead the driver to abort.
2	Log error events that might allow the driver to continue running.
3	Log events that might result in an error if action is not taken.
4	Log general information that describes the progress of the driver.
5	Log detailed information that is useful for debugging the driver.
6	Log all driver activity.

**To enable logging:**

1. Set the `LogLevel` property to the desired level of information to include in log files.
2. Set the `LogPath` property to the full path to the folder where you want to save log files. To make sure that the connection URL is compatible with all JDBC applications, escape the backslashes (\) in your file paths by typing another backslash.

For example, the following connection URL enables logging level 3 and saves the log files in the `C:\temp` folder:

```
jdbc:bigquery://localhost;LogLevel=3;LogPath=C:\\temp
```

3. To make sure that the new settings take effect, restart your JDBC application and reconnect to the server.

The Simba JDBC Driver for Google BigQuery produces the following log files in the location specified in the `LogPath` property:

- A `BigQuery_connection_[Number].log` file for each connection made to the database, where `[Number]` is a number that identifies each log file. This file logs driver activity that is specific to the connection.

If the `LogPath` value is invalid, then the driver sends the logged information to the standard output stream (`System.out`).

#### To disable logging:

1. Remove the `LogLevel` and `LogPath` properties from the connection URL.
2. To make sure that the new settings take effect, restart your JDBC application and reconnect to the server.



## Features

More information is provided on the following features of the Simba JDBC Driver for Google BigQuery:

- [SQL Connector](#) on page 17
- [Data Types](#) on page 17
- [Nested and Repeated Records](#) on page 18
- [Arrays](#) on page 19
- [Security and Authentication](#) on page 19
- [Catalog and Schema Support](#) on page 20
- [Large Result Set Support](#) on page 20
- [Write-Back](#) on page 21
- [Positional Parameters](#) on page 21

## SQL Connector

The SQL Connector feature of the driver allows applications to execute standard SQL queries or legacy BigQuery SQL queries against the database.

The driver does not support query prefixes, and instead determines which dialect to use based on the `QueryDialect` connection setting. By default, `QueryDialect` is set to `SQL` so that the driver executes queries using standard SQL syntax. For more information, see [QueryDialect](#) on page 27.

## Data Types

The Simba JDBC Driver for Google BigQuery supports many common data formats, converting between BigQuery, SQL, and Java data types.

The following table lists the supported data type mappings.

BigQuery Type	SQL Type	Java Type
BOOL	SQL_BOOLEAN	BOOLEAN
BYTES	SQL_VARBINARY	BYTE[]
DATE	SQL_DATE	DATE

BigQuery Type	SQL Type	Java Type
DATETIME	SQL_VARCHAR	STRING
FLOAT64	SQL_DOUBLE	DOUBLE
INT64	SQL_BIGINT	BIGINTEGER
STRING	SQL_VARCHAR	STRING
TIME	SQL_TIME	TIME
TIMESTAMP	SQL_TIMESTAMP	TIMESTAMP

## Nested and Repeated Records

The Simba JDBC Driver for Google BigQuery fully supports nested and repeated records.

The Standard SQL syntax represents the sub-components of record data as nested sub-types. In the example below, `city` and `years` belong to the base record type of `address`.

If the record column is specified in a query projection list, the driver returns the base record as a text representation of the JSON record object, and no flattening occurs. The dot operator (.) is used to select sub-components. For example, to select from `city`, the column name `address.city` should be used.

```
{
  "address": [
    {
      "city": "Vancouver",
      "years": 5
    }
  ],
  "name": "Google"
}
```

In Legacy SQL, sub-components of record types are implicitly flattened and are represented as individual attributes. In the example below, the sub-components of `city` and `years` of the record `address` are represented as individual columns of `address_city` and `address_years`.

```
{
  "address_city": "Vancouver",
  "address_years": "5",
  "name": "Google"
}
```

## Arrays

The Simba JDBC Driver for Google BigQuery fully supports array data types. The driver returns the base array type as a text representation of the JSON array object.

For example, the SQL statement `SELECT [1,2,3]` returns the following JSON:

```
{
  "v": [
    {
      "v": "1 ",
    },
    {
      "v": "2 ",
    },
    {
      "v": "3 "
    }
  ]
}
```

## Security and Authentication

To protect data from unauthorized access, BigQuery data stores require all connections to be authenticated using the OAuth 2.0 protocol. The Simba JDBC Driver for Google BigQuery provides mechanisms that allow you to complete an OAuth 2.0 authentication flow using a personal Google account or a Google service account.

When you connect to BigQuery, the driver automatically initiates an OAuth 2.0 authentication flow. The driver retrieves an access token based on the credentials specified in the connection URL, and then uses the token to authenticate the connection to the database.

You can authenticate your connection with a personal Google account. When you initiate a connection through the driver, you must authenticate the connection at the URL provided by the driver. For detailed instructions, see [Using a Google User Account](#) on page 13.

If you have a Google developer account, you can assign a service account to the driver. You must provide a private key file to authenticate this service account. The driver then handles authentication on behalf of the service account, so that an individual user account is not directly involved. For detailed instructions, see [Using a Google Service Account](#) on page 14

For more information about OAuth 2.0, see "Using OAuth 2.0 to Access Google APIs" in the Google Developers documentation:

<https://developers.google.com/identity/protocols/OAuth2>. For information about configuring a service account, see "Using OAuth 2.0 for Server to Server Applications" in the Google Developers documentation:

<https://developers.google.com/identity/protocols/OAuth2ServiceAccount>.

## Catalog and Schema Support

The Simba JDBC Driver for Google BigQuery supports both catalogs and schemas to make it easy for the driver to work with various JDBC applications. Projects are mapped to catalogs, and table datasets are mapped to schemas. For more information, see [Catalog \(Project\)](#) on page 22.

## Large Result Set Support

The Simba JDBC Driver for Google BigQuery supports the `AllowLargeResults` option in BigQuery job configurations, enabling result sets greater than 128MB (compressed).

To store large query results, the driver creates temporary tables in BigQuery under the table and dataset ID specified using the `LargeResultTable` and `LargeResultDataset` options. These temporary tables exist for a limited time before they are deleted.

Large result sets are always supported if Standard SQL is used. If Legacy SQL is used, large result sets are only supported if the `AllowLargeResults` key is set to 1.

For more information about large result sets and the limitations of enabling this option, see the following sections in the BigQuery documentation:

- "Queries" in *Quota Policy*: <https://developers.google.com/bigquery/quota-policy>.
- "Returning large query results" in *Query Data*: <https://developers.google.com/bigquery/querying-data>.

## Write-Back

The Simba JDBC Driver for Google BigQuery supports Data Manipulation Language (DML) statements such as INSERT, UPDATE, and DELETE.

For example, the following INSERT statement is supported:

```
INSERT INTO MyTable (Col1, Col2) VALUES ("Key", "Value");"
```

## Positional Parameters

A parameterized query contains placeholders that are used for parameters. The values of those parameters are supplied at execution time.

The Simba JDBC Driver for Google BigQuery supports SQL positional parameters. Parameters are specified in queries with a question mark (?).

For example, the following parameterized query is supported:

```
SELECT * FROM MyTable WHERE Col1=?"
```

## Driver Configuration Options

Driver Configuration Options lists and describes the properties that you can use to configure the behavior of the Simba JDBC Driver for Google BigQuery.

You can set configuration properties using the connection URL. For more information, see [Building the Connection URL](#) on page 12.



### Note:

Property names and values are case-sensitive.

## AllowLargeResults

Default Value	Data Type	Required
0	Integer	No

## Description

This option specifies the driver's response to query results greater than 128MB.

- 1: The driver allows query results that are larger than 128MB in size.
- 0: The driver returns an error when query results are larger than 128MB in size.

### ! Important:

This option can only be disabled if Legacy SQL is enabled. If the `QueryDialect` key is set to `BIG_QUERY`, this option is always considered to be enabled. For more information about Legacy SQL, see [QueryDialect](#) on page 27.

## Catalog (Project)

Key Name	Default Value	Required
Catalog	None	Yes

## Description

The name of your BigQuery project. This project is the default project that the Simba JDBC Driver for Google BigQuery queries against, and is also the project that is billed for queries that are run using the DSN.

Simba JDBC Driver for Google BigQuery supports multiple catalogs, which are equivalent to projects in Google BigQuery terms.

For queries, tables in the projection list must be fully qualified, in the format of ``catalog.schema.table``. If the catalog is not specified, the driver will assume the projectId specified by the “projectId” connection option.

For catalog functions, in order to retrieve information from the desired catalog, the JDBC **Connection.setCatalog(myCatalog)** method must be called with **myCatalog** set to the desired catalog.

## LargeResultDataset

Default Value	Data Type	Required
None	String	Yes, if <code>AllowLargeResults=1</code>

## Description

The destination dataset for queries that are executed because the `AllowLargeResults` key is enabled. For more information, see [AllowLargeResults](#) on page 22.

## LargeResultTable

Default Value	Data Type	Required
None	String	Yes, if <code>AllowLargeResults=1</code>

## Description

The destination table for queries that are executed because the `AllowLargeResults` key is enabled. For more information, see [AllowLargeResults](#) on page 22.

## LogLevel

Default Value	Data Type	Required
0	Integer	No

### Description

Use this property to enable or disable logging in the driver and to specify the amount of detail included in log files.

**! Important:**

Only enable logging long enough to capture an issue. Logging decreases performance and can consume a large quantity of disk space.

Set the property to one of the following numbers:

- 0: Disable all logging.
- 1: Enable logging on the FATAL level, which logs very severe error events that will lead the driver to abort.
- 2: Enable logging on the ERROR level, which logs error events that might still allow the driver to continue running.
- 3: Enable logging on the WARNING level, which logs events that might result in an error if action is not taken.
- 4: Enable logging on the INFO level, which logs general information that describes the progress of the driver.
- 5: Enable logging on the DEBUG level, which logs detailed information that is useful for debugging the driver.
- 6: Enable logging on the TRACE level, which logs all driver activity.

When logging is enabled, the driver produces the following log files in the location specified in the `LogPath` property:

- A `BigQuery_connection_[Number].log` file for each connection made to the database, where `[Number]` is a number that distinguishes each log file from the others. This file logs driver activity that is specific to the connection.

If the `LogPath` value is invalid, then the driver sends the logged information to the standard output stream (`System.out`).



## LogPath

Default Value	Data Type	Required
The current working directory	String	No

### Description

The full path to the folder where the driver saves log files when logging is enabled.

## MaxResults

Default Value	Data Type	Required
0	Integer	No

### Description

The maximum number of results that are displayed per page.

The default value of 0 allows an unlimited number of results to be displayed per page.

## OAuthPvtKeyPath

Default Value	Data Type	Required
None	String	Yes, if OAuthUserAuth=0

### Description

The full path to the .p12 or .json key file that is used to authenticate the service account email address if you are using service authentication. For more information, see [Using a Google Service Account](#) on page 14.

## OAuthServiceAcctEmail

Default Value	Data Type	Required
None	String	Yes, if OAuthUserAuth=0

### Description

The service account email ID that is used for authentication if you are using service authentication. For more information, see [Using a Google Service Account](#) on page 14.

## OAuthType

Default Value	Data Type	Required
1	Integer	No

### Description

This option specifies whether the driver uses OAuth user authentication or OAuth service authentication.

- 1: The driver uses user-based OAuth authentication (see [Using a Google User Account](#) on page 13).
- 0: The driver uses service-based OAuth authentication (see [Using a Google Service Account](#) on page 14).

## ProjectId

Default Value	Data Type	Required
None	String	Yes

### Description

The name of your BigQuery project. This project is the default project that the Simba JDBC Driver for Google BigQuery queries against, and also the project that is billed for queries that are run using the DSN.

## QueryDialect

Default Value	Data Type	Required
SQL	Enumerated	No

### Description

This option specifies whether the driver executes queries using standard SQL syntax or the legacy BigQuery SQL syntax.

- `SQL`: The driver uses standard SQL.
- `BIG_QUERY`: The driver uses legacy SQL.

## Timeout

Default Value	Data Type	Required
10	Integer	No

### Description

The length of time, in seconds, that the driver waits for a query to retrieve the results of an executed job.

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