

# **An SQL engine for YottaDB and other M-like databases**

## **mgsq**

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# 1 Introduction

**mgsq1** is an Open Source SQL engine developed primarily for the **YottaDB** database. It will also work with the GT.M database and other M-like databases.

SQL access is provided via the following routes:

- Embedded SQL statements in M code.
- REST.
- ODBC.

Note that the **mgsq1** project is very much 'work in progress'. Use cautiously!

## 2 Pre-requisites

The **YottaDB** database (or similar M database):

`https://yottadb.com/`

## 3 Installing mgsq1

### 3.1 YottaDB

The instructions given here assume a standard 'out of the box' installation of **YottaDB** deployed in the following location:

`/usr/local/lib/yottadb/r122`

The primary default location for routines:

`/root/.yottadb/r1.22_x86_64/r`

Copy all the routines (i.e. all files with an 'm' extension) held in the GitHub **/yottadb** directory to:

`/root/.yottadb/r1.22_x86_64/r`

Change directory to the following location and start a **YottaDB** command shell:

`cd /usr/local/lib/yottadb/r122`

```
./ydb
```

Link all the **mgsq1** routines and check the installation:

```
do ylink^%mgsq1

do ^%mgsq1

MGSQ1 by M/Gateway Developments Ltd.
Version: 1.0; Revision 6 (7 June 2019) %mgsq1
```

Note that the version of **mgsq1** is successfully displayed.

## 3.2 Other M systems

Log in to the Manager UCI and, using the %RI utility (or similar) load the **mgsq1** routines held in **/m/mgsq1.ro**. Change to your development UCI and check the installation:

```
do ^%mgsq1

MGSQ1 by M/Gateway Developments Ltd.
Version: 1.0; Revision 6 (7 June 2019) %mgsq1
```

## 4 Creating tables

Tables defined in **mgsq1** map directly to M global variables for their physical storage. The standard SQL '*create table*' constructs are used to create **mgsq1** tables, but with a number of extensions to define the precise mapping to physical storage.

As an example, consider a simple table defining a hospital patient keyed by a unique patient number (**num**):

```
create table patient (
  num int not null,
  name varchar(255),
  address varchar(255) separate,
  phone_no varchar(32),
  constraint pk_patient primary key (num))
/!* global=mgpat, delimiter=# */
```

Data is stored in the column order implied in the '*create*' statement. Note the definition of the physical global name and a data-string delimiter as a comment line. By default, column fields are stored as a data string separated by the delimiter character defined here. For cases where fields may themselves contain the delimiter character, it is possible to configure the table so that such fields are stored separately outside the data string. Note the '*separate*' keyword defined against the address field.

Now consider the following *'insert'* statement:

```
insert into patient (num, name, address, phone_no)
values(100001,
      'John Smith',
      'Apartment #3, Some Street, London',
      '1234 567890');
```

When executed, this will result in the following physical storage:

```
^mgpat(100001)="John Smith##1234 567890"
^mgpat(100001,2)="Apartment #3, Some Street, London"
```

## 5 Executing SQL statements from the YottaDB/M command line

Before executing SQL statements do familiarise yourself with the M system resources (i.e. globals) used by **mgsql**. Refer to the *Resources used by mgsql* section.

The general form for executing SQL statements from within M code (or from the M command line) is as follows:

```
set status=$$exec^%mgsql(<schema>,<sql statement>,.%zi,.%zo)
```

Where:

- %zi is an M array representing data that needs to be input to the script.
- %zo is an M array representing parameters controlling output from the script.

The top level routine **%mgsql** (physical file **\_mgsql.m**) contains a number of sample SQL scripts. These work to a simple database representing hospital patients and their associated admissions. View the embedded scripts in this routine.

Create the test schema:

```
do create^%mgsql
```

Insert a few test records:

```
do insert^%mgsql
```

Run the various SQL retrieval scripts:

```
do sel1^%mgsql
```

A number of SQL scripts are available at line labels sel1 to sel8.

## 6 Setting up the network service

So far we have covered the basics of executing SQL statements from M code. In order to execute SQL queries over REST or ODBC the **mgsq**l installation must be accessible over the network. The service described here will concurrently support access to **mgsq**l via REST and ODBC. The default TCP server port for **mgsq**l is **7041**. If you wish to use an alternative port then modify the following instructions accordingly.

### 6.1 YottaDB

Network connectivity to **YottaDB** is managed via the **xinetd** service. First create the following launch script (called **mgsq**l\_ydb here):

```
/usr/local/lib/yottadb/r122/mgsq_l_ydb
```

Content:

```
#!/bin/bash
cd /usr/local/lib/yottadb/r122
export ydb_dir=/root/.yottadb
export ydb_dist=/usr/local/lib/yottadb/r122
export
ydb_routines="/root/.yottadb/r1.22_x86_64/o* (/root/.yottadb/r1.22_x86_6
4/r /root/.yottadb/r) /usr/local/lib/yottadb/r122/libyottadbutil.so"
export ydb_gblidir="/root/.yottadb/r1.22_x86_64/g/yottadb.gld"
$ydb_dist/ydb -r xinetd^%mgsq_l
```

Create the **xinetd** script (called **mgsq**l\_xinetd here):

```
/etc/xinetd.d/mgsq_l_xinetd
```

Content:

```
service mgsq_l_xinetd
{
    disable          = no
    type             = UNLISTED
    port             = 7041
    socket_type      = stream
    wait             = no
    user             = root
    server            = /usr/local/lib/yottadb/r122/mgsq_l_ydb
}
```

- Note: sample copies of **mgsq**l\_xinetd and **mgsq**l\_ydb are included in the /unix directory.

Edit the services file:

```
/etc/services
```

Add the following line to this file:

```
mysql_xinetd          7041/tcp          # MYSQL
```

Finally restart the **xinetd** service:

```
/etc/init.d/xinetd restart
```

## 6.2 Other M systems

Start the M-hosted concurrent TCP service in the Manager UCI:

```
do start^%mysql(0)
```

To use a server TCP port other than 7041, specify it in the start-up command (as opposed to using zero to indicate the default port of 7041).

## 7 Access to mysql using REST

Now that the network service has been configured and deployed it is possible to execute SQL scripts via REST calls. Results are returned formatted as JSON.

For example, using the **curl** utility from the UNIX command line:

```
curl -d "select * from patient" -H "Content-Type: text/sql"
http://localhost:7041/mg.sql/execute
```

Assuming that the simple test database described previously has been created the above request will generate the following output:

```
{ "sqlcode": 0, "sqlstate": "00000", "error": "", "result":
[{"num": "1", "name": "Chris Munt", "address": "Banstead"}, {"num":
"2", "name": "Rob Tweed", "address": "Redhill"}, {"num": "3", "name": "John
Smith", "address": "London"}, {"num": "4", "name": "Jane Doe", "address":
"Oxford"}]}
```

Simple invocation from a browser (Hint: Firefox does a good job of rendering JSON):

```
http://127.0.0.1:7041/mssql/mg.sql?sql=select * from patient
```

Alternatively, enter an SQL statement in the form generated by:

```
http://127.0.0.1:7041/mgsq1/mg.sql
```

In a live environment a production-grade web server should be used. For example, using the Apache server the **mod\_proxy** module can be used to *front* the **mgsq1** service.

## 8 Access to mgsq1 using ODBC

The ODBC driver is in the **/odbc** directory. Pre-built drivers for 32 and 64-bit Windows are in the **/odbc/x86** and **/odbc/x64** directories respectively. To install both drivers copy the contents of **/odbc/x86** to:

```
C:\Program Files (x86)\mgsq1\
```

And copy the contents of **/odbc/x64** to:

```
C:\Program Files\mgsq1\
```

You will have to create the **/mgsq1** sub-directory if it doesn't already exist. To register both drivers, using Windows Explorer, double click on each of the following Registry files:

```
C:\Program Files (x86)\mgsq1\mgodbc32.reg  
C:\Program Files\mgsq1\mgodbc64.reg
```

You can now configure an ODBC Data Source using the Windows Administrative tools for ODBC Data sources (accessed via the Windows Control Panel:

```
Control Panel\System and Security\Administrative Tools\ODBC Data  
Sources
```

Under the **System DSN** tab. select **Add...** and choose one of the **mgsq1** drivers as appropriate:

```
MGSQ1 ODBC x86  
MGSQ1 ODBC x64
```

Complete the **mgodbc** configuration dialogue box and save:

- **Name:** Your Data Source Name (DSN).
- **Description:** An optional description.
- **Server:** IP Address of your M server.
- **TCP Port:** TCP Port (the default is 7041).
- **Directory or UCI:** M UCI (leave blank for YottaDB).

- **Event Log File:** Log file (including full path).
- **Event Log Level:** Log level (a comma separated list of log directives).

Log Level Directives:

- **e:** Log Errors.
- **ft:** Log ODBC function call trace.
- **nt:** Log all network buffers sent and received.

Example:

The screenshot shows a Windows-style dialog box titled "MGSQLE ODBC Data Source Setup". It contains a "Data Source" section with the following fields and values:

Field	Value
Name	YottaDB
Description	YottaDB
Server	192.168.1.83
TCP Port	7041
Directory or UCI	
Event Log File	C:\odbc\odbc.log
Event Log Level	ft,nt

At the bottom of the dialog are three buttons: "About", "Save", and "Cancel".

The data source created can now be used in Windows applications.

## 8.1 Building the ODBC Driver from source

The **mgsqle** ODBC driver (mgodbc.dll) is written in C and you will need *Microsoft Visual Studio* to build it from source. The *Visual Studio Community Edition* is available for download from Microsoft free of charge.

The Visual Studio project for building the ODBC driver is in the `/odbc` directory (**mgodbc.vcxproj**). This project can be loaded in to, and built from, the Visual Studio GUI toolset. Alternatively, you can build the project from the Developer Command Shell:



Building the 32-bit driver:

```
msbuild mgodbc.vcxproj /p:configuration=release /p:platform=Win32
```

Building the 64-bit driver:

```
msbuild mgodbc.vcxproj /p:configuration=release /p:platform=x64
```

## 9 Resources used by mssql

**mssql** will write to the following globals

- ^mssqlid: The catalogue or schema.
- ^mssqls: The spool file for SQL output.
- ^mssqlx: The cache of compiled queries.
- ^mglog: The event Log.
- ^mgtmp: A temporary file used by the SQL compiler.
- ^mgtemp: A temporary sort file used when executing SQL queries.
- mssql will generate M Routines prefixed by 'x'.

## 10 License

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