# COMPACT, RUGGED, IP67 TELEMATICS DEVICE

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## Revision History

| Rev | Date | Description |
|-----|------|-------------|
| 1.0 | 23 July 2015 | Initial document creation |
| 1.1 | <span style="color:red">Not yet released</span> | Updated Multi-APN section |

# 1   TECHNICAL SPECIFICATIONS

For detailed technical specifications, please see the G60 Datasheet, available on the Digital Matter website. The datasheet also contains the product variants and product codes for ordering.

## 2 PRECAUTIONS

### 2.1 IP67 Rating

The G60 is an IP67 rated device. It is important to ensure that the device is correctly assembled in order to achieve the rating. Failure to do so may result in water ingress and damage to the product.

Please ensure:

- The enclosure is not damaged before installation

- Seals supplied with the product are correctly placed

- Only screws supplied with the product are used

- The guidelines for closing and sealing the product are followed

- The device is only opened in a clean, dry environment

### 2.2 Static damage

The G60 may be damaged by electrostatic discharge if not handled correctly. Ensure adequate anti-static precautions are taken.

Take special care not to touch the ceramic GPS antenna as static can damage the sensitive GPS circuitry.

### 2.3 Battery precautions

The G60 uses a Li-Po battery. If these batteries are not cared for correctly, their performance will degrade and they can be hazardous.

For a complete guide to battery care, see the Digital Matter Battery Notice.

Store batteries at room temperature.

Maintain stored battery levels at 60% (about 3.8V) for maximum life.

Stored batteries should be checked and recharged every 6 months.

## 3   INSTALLATION

### 3.1   SIM Installation

*The G60 may be damaged by electrostatic discharge if not handled correctly.  Ensure adequate static precautions are taken like wearing an anti-static wrist guard. Avoid touching the antennae and any of the electronic components on the PCB. Take special care not to touch the ceramic GPS antenna as static can damage the sensitive GPS circuitry.*

The SIM holder is located on the top side of the main PCB.

Unplug the battery and remove any external power connections.

Slide the locking mechanism on the SIM holder to the "unlock" position, and lift the hinged portion of the SIM holder.

Insert the SIM into the holder with the keyed corner orientated away from the hinge and the SIM contacts orientated down to the PCB.

Close the SIM holder, and slide the locking mechanism to the "lock" positon.

### 3.2   Housing Assembly

Ensure that the main PCB is secured to the housing with the 4 small PCB screws and that the SIM is inserted as above.

Plug in the battery. The red LED on the board will begin flashing.

The seal should be the latest Digital Matter clear silicon seal to ensure the IP rating of the housing.

Ensure that the seal is in the base and lying flat, and that there is not dust or dirt on the seal.

Locate the battery on the main PCB against the GPS board and on top of the SIM holder

Ensure the battery cable will not be pinched by the lid.

Place the lid onto the base. The battery locating tab in the lid should sit against the battery.

Insert the 4 x 20mm housing screws. Note that G52S screws look similar but are 25mm in length. DO NOT use G52S screws as they will crack the plastic housing when tightened.

Hand tighten the screws to a uniform tightness.

Ensure that the cable gland is tightened around the cable.

Please make sure that you take extra precautions to ensure that the device has been sealed adequately when it will be installed in environments where it is exposed to the weather or water or liquid spraying. The Digital Matter manufacturer's warranty does not cover damage due to water ingress as the final installation is not performed by Digital Matter.

### 3.3   Connect On Power-On

When the G60 is powered on it will always attempt to get a GPS fix and connect to the server. You can use OEM server to check that the device is connecting and has sent through a GPS fix before installing the device.

### 3.4   OEM Server

Checklist:

Connector: ensure the connector is setup to forward data to the correct software platform. For Telematics Guru the connector is "TCP_TG_Live_Flexi".

Ensure the device has been added and setup on Telematics Guru or whichever software platform you are forwarding the data to.

## 3.5   Device Installation

There are a few considerations for the final mounting position of the G60.

The G60 has been engineered to have the best possible GPS reception. It will work from inside engine bays, body panels, under dashboards and other places where other GPS devices simply fail to operate reliably. Although the G60 will work in these locations it is always advisable to install the G60 where it is able to get signals from the GPS satellites, with the optimum position being a location with a clear 180 degree view of the sky.

The housing has mounting holes for screws, bolts or cable ties.

# 4  OEM SERVER

The G60 connects to Digital Matter's device management software called OEM Server. The server is hosted by Digital Matter on the Internet. In special cases, the server can be licensed to 3rd parties.

## 4.1  Data Connectors

The OEM Server provides Data Connectors that forward data records on to the software platform of your choice, including Digital Matter's own Telematics Guru and GPS Log Book platforms.

## 4.2  Device Administration

All Digital Matter devices are fully managed Over-The-Air (OTA) via the OEM Server web interface. The OEM Server seamlessly manages:

- Device firmware – firmware updates can be done remotely.

- Network (administrator) parameters relating to critical communications

- System parameters, including GPS parameters, IO configuration, logging options and general device behaviour settings

- GPS AssistNow Offline aiding data files

- Remote debugging of devices, including being able to trace data, view detailed debug message logs, and view a live trace of the server debug messages

- Remote disconnect and reboot of devices

- Geo-fence syncing with the devices – this allows the device to do advanced in-cab alerting and monitoring such as geo-fence arrival and departure, speed limit alerting, dangerous intersection warnings, turn on warning lights inside a geo-fence, and disable communications inside intrinsically safe zones such as gas plants. This is in development on the G60.

- Provides a command and message queueing platform to the devices and is incorporated into the remote management and debugging applications

## 4.3  Data Connectors

Using the OEM Server's Data Connectors the G60 can be used with a number of software platforms including Digital Matter's Telematics Guru vehicle and asset management platform.

New platforms can be added in two ways:

- The software platform implements the DM protocols and a data connector is setup to forward the data to the platform. The two options for DM Protocols are raw data over TCP, and JSON data over HTTP. Please contact DM for more information.

- DM can create a custom data connector to deliver the data in your platforms format and transport mechanism. Please contact DM for more information.

# 5  GENERAL FIRMWARE FEATURES

## 5.1  Auto-APN

Auto-APN allows the G60 to analyse the SIM card and select the correct APN details from a list that is pre-loaded in the device's firmware. This means that the G60 can be shipped world-wide without requiring specialist setup for SIMs.

The G60 queries the Mobile Country Code (MCC) and Mobile Network Code (MNC) from the SIM, using the IMSI. It tries to find a matching MCC and MNC entries in the table in the firmware. There are multiple scenarios:

No matching entry: device will use the "internet" APN with no username and password.

Single matching entry: device will use the details in the table.

Multiple matching entries: the device will try the first entry. If it works, it will continue to use those details. If it doesn't work, it will move to the next matching entry.

Note that the IMSI is fixed on the SIM. If the SIM roams onto another network, the IMSI does not change and the Auto-APN details will be for that of the home network. For roaming, see the section of Multi-APN.

The device uses the Auto-APN feature if the admin parameter APN list is blank. See the OEM guide for more information.

The Auto-APN table in FW 1/2.51 is shown below. If a network is not listed, please contact DM to enquire about adding it to the table.

Also note that networks using "internet" will not be listed (e.g. Vodacom in South Africa).

## 5.2  Multi-APN

The G60 can be configured to roam across multiple networks and to automatically use the different APN details for the roaming networks.

Note that this is different to Auto-APN. Auto-APN uses the SIM's IMSI, which is fixed, even when roaming. The multi-APN feature checks which network the SIM has registered on and checks the Admin Parameter list for a matching MCC MNC value.

The multi-APN feature is used if the admin parameter APN list contains at least one entry. In this case, the following process is followed:

1. The APN list in admin parameters is not blank, so the device knows not to use the Auto-APN feature.

2. On each connection, the modem is allowed to register on an automatically selected (SIM appropriate) network.

3. The MCC and MNC of the current network is queried.

4. The APN list in admin parameters is scanned for the first matching entry, or the wildcard character ('*').

5. If no entries match, the default APN 'internet' is used.

## 5.3  Admin Parameters

Admin parameters are a block of parameters separate to system parameters. They contain the APN and server settings. They are settable by SMS (see the SMS Configuration section)

and over the air via the OEM interface. A view of the OEM interface's dialog box is shown below. These settings are the defaults and will use the Auto-APN feature.

| Edit Admin Parameters | | ⊠ |
|---|---|---|
| DeprecatedParameters | 0x000000000000000000000 | Deprecated Parameters used only by obsolete FW. Defaulted to point to OEM. |
| APN1_MCCMNC | | APN 1 MCC + MNC, null terminated |
| APN1_APN | | APN 1 + ',' + username + ',' + password + null terminator |
| APN2_MCCMNC | | APN 2 MCC + MNC, null terminated |
| APN2_APN | | APN 2 + ',' + username + ',' + password + null terminator |
| APN3_MCCMNC | | APN 3 MCC + MNC, null terminated |
| APN3_APN | | APN 3 + ',' + username + ',' + password + null terminator |
| APN4_MCCMNC | | APN 4 MCC + MNC, null terminated |
| APN4_APN | | APN 4 + ',' + username + ',' + password + null terminator |
| APN5_MCCMNC | | APN 5 MCC + MNC, null terminated |
| APN5_APN | | APN 5 + ',' + username + ',' + password + null terminator |
| APN6_MCCMNC | | APN 6 MCC + MNC, null terminated |
| APN6_APN | | APN 6 + ',' + username + ',' + password + null terminator |
| ServerURL1 | s0.oemserver.com | Server URL 1 - A null terminated ASCII server URL or ASCII IP address |
| ServerPort1 | 8962 | Server Port 1 - TCP port number on server to connect to |
| | Update  Cancel | |

*APNX_MCCMNC:* To use Auto-APN, leave blank. To use Multi-APN, fill in the MCC and MNC that match the APN details. For example, for Vodacom SA, use 65501. Simple concatenate the MCC and MNC. Remember that for Multi-APN, the device looks as the network that the modem is registered on, rather than the MCC MNC from the IMSI. There are 6 possible entries, where *X* is 1-6

*APNX_APN:* The APN details for the MCC MNC combination. These are comma separated in this format <APN Name>,<APN Username>,<APN Password>. There should be no spaces. Username and password can be omitted. For example `internet,user,pass` or `m2m.` There are 6 possible entries, where *X* is 1-6

*ServerURL1:* the URL or IP of the server to connect to. By default, s0.oemserver.com

*ServerPort1:* the Port of the server to connect to. By default for the G60, 8962.

## 5.4   AssistNow Offline

The G60 will track successfully where other devices just give up. This technology allows the GPS to predict which satellites are in orbit above it and to dramatically reduce the time-to-first-fix of the GPS, and the overall performance of the GPS, especially in 'urban canyon' or forested environments.

This information that is passed to the GPS module is commonly referred to as "Aiding Data". The OEM server provides the G60 with aiding data that is valid for two weeks. This is automatically updated and included in the OEM Server service.

## 5.5   Input setup

Most DM hardware inputs will have a generic setup block in the device's system parameters. This allows a number of common setup configurations for digital inputs. This section describes this setup block and how it is used on the OEM Server.

Note: Not all inputs have the complete set of functionality described here. For example, the Ignition input on the G60 is permanently pulled down by the hardware. The pull up/down setting has no effect.

What follows is an example of a fully configurable digital input. It happens to be the ignition input on the G60, but the properties may be used on other inputs (input 1, tamper).

| | | |
|---|---|---|
| Ignition IO Function | 1 | GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1 |
| Ignition Flags Pull Up Down | 1 | GenericIOPinMode_t (GPIO_NO_PUPD = 0, GPIO_PULLUP = 1, GPIO_PULLDOWN = 2, GPIO_RESERVED = 3) |
| Ignition Flags Active High | 0 | Active High 0 = false, 1 = true |
| Ignition Flags Log On Active | 1 | log a record on active (we always notify) - see fLogOnInactive later in struct |
| Ignition Flags Upload On Active | 0 | Request immediate upload on change to active |
| Ignition Flags Upload On In Active | 0 | Request immediate upload on change to inactive |
| Ignition Flags Emergency Uploads | 0 | Request emergency uploads |
| Ignition Flags Log On Inactive | 1 | log a record on change to inactive |
| Ignition Digital | 0 | Which DI ignition maps into. 0 for wired ignition in GPS FW. 0 for rain gauge status in SMP FW. 0xFF for NULL. |
| Ignition Config1 | 120 | Ignition debounce [milliseconds] |

IO Function: sets the function for the input. Generally, 0 means disabled. Set to 1 for Digital Input.

Pull Up Down: this sets the input's internal pull up/down. The three options are: no pull up (float), pull up, and pull down. Note that this may depend on the hardware of the input. For example, input 1 on the G60 is permanently pulled down by the hardware, so this setting has no effect.

Active High: if 1 (true), the input will be considered on when the voltage is high. For example, if using a rain gauge that will pull to ground when active, it makes sense to set active high to 0 (false). This results in the digital input being active (on) when the rain gauge pulls it to ground.

Log on active: if 1 (true), notify and log a record when the input changes to active. If 0 (false), the input will be notified, but no record will be logged. See log on inactive below.

Upload on active: if 1 (true), request an upload when the input changes to active. If 0 (false), an upload will not be requested on change to active.

Upload on inactive: if 1 (true), request an upload when the input changes to inactive. If 0 (false), an upload will not be requested on change to inactive.

Emergency upload: if 1 (true), request an emergency upload when the input changes to active or inactive. If 0 (false), an emergency upload will not be requested. An emergency upload is used in situations where it is critical that the server is notified. The upload attempt will not timeout. The device will try to upload the data until it is successful. Use this with a panic button for example.

Log on inactive: if 1 (true), notify and log a record when the input changes to inactive. If 0 (false), the input will be notified, but no record will be logged.

Digital: this is the mapping of the physical input to the logical digital input. For example, the ignition line can be mapped to logical input 3 if required.

Config1: this is a configuration field and the effect depends on the IO Function. If set to Digital Input, this is the debounce period of the input in milliseconds.

(Not shown above) Analog: this is the mapping of the physical input to the logical analogue. For example, a pulse counter on input 1 could be mapped to analogue 6.

## 5.6 LED Behaviour

The LED is a useful tool for understanding what the device is doing. The LED is located on the PCB and is only visible with the housing open.

| Behaviour | Meaning |
|---|---|
| From off, switches on briefly, and switches off again | Likely to mean the device is power up, checking the battery level, and shutting down because it is too low.<br><br>Connect to external power. |
| Slow flash (10ms ever 2sec) | Running |
| Fast flash (10ms ever 0.5sec) | Connected to the server. Once the modem makes a successful connection to the server, the LED will flash fast. |
| Solid | Sending a record. While waiting for a commit response, the LED will stay on. |
| Very fast flash for 2 sec, followed by slow flash. | Firmware update. If the device receives new firmware, it will bootload to update itself. While updating, the LED will flash very fast. Once finished, it will start up normally and resume the slow flash. |

# 6   DEVICE BEHAVIOUR

The G60 device behaviour is determined by the firmware that is running on the device.

All firmware can be updated over-the-air (OTA) from the OEM Server.

## 6.1   Firmware version

The GPS tracking firmware major version is 1.

The format for version numbering is XX.YY, where XX is the major version and YY is the minor version.

## 6.2   Trips

The GPS tracking firmware is designed to provide asset tracking in a variety of environments. There are 2 high level modes for this:

Trip based tracking: trips are started and stopped using either movement or the ignition wire. Trips are tracked with periodic GPS points.

The operational parameters are configurable in each mode.

Movement based trips use the accelerometer to wake the device up on movement. The GPS is then used to determine if the movement meets the trip start criteria, which is a distance threshold. It is important to note that the accelerometer is simply used to wake the device up. The GPS is used to decide on the trip status.

## 6.3   System Parameters

The behaviour of the firmware can be adjusted with system parameters.  See the section on OEM Server functionality to see how to adjust system parameters. This section describes the parameters and what they do.

## 7   OEM SERVER

Ensure the Device Type is set to G60 to view your devices.

G60-UM

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**Revision 1.0 - 4 December 2017**

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## 8   SMS CONFIGURATION

SMS commands can be sent to the device. SMS's will be received when the GSM modem is powered up. The GSM module checks for SMS's after the socket connection is complete. When the device is in its low power "sleep" mode the GSM modem is off. Cycle the external power to initiate a wakeup and server connection attempt.

### 8.1   Format

The SMS text must start with a "#*" (without the quotes).

The SMS text command takes the following generic form of a command followed by a variable list of comma separated parameters:

```
#*[<reply#>],<command>,…
```

***The [<reply#>] is not yet supported by the firmware***, but may be in future. Leave blank as per the examples below. In future, if specified then the device will send an acknowledgement SMS to the number. Specify "*" to reply to the number that the SMS came from.

String values are **not** contained in quotation marks.

Fields in [] are optional.

### 8.2   APN

```
#*[<reply#>],APN[,<apn name>[,<user name>,<password>]]
```

If the APN details are omitted then the APN will be erased and the device will use auto-APN.

Examples:

```
#*,APN,telstra.internet
```

```
#*,APN,custom.APN,user1,pwd1
```

```
#*,APN
```

### 8.3   Server

```
#*[<reply#>],SERVER[,<server URL>,<port number>]
```

If <server URL>,<port number> are omitted then the default OEM Server details will be used.

Examples:

```
#*,SERVER,s0.oemserver.com,8962
```

### 8.4   Reset

```
#*[<reply#>],RESET
```

Examples:

```
#*,RESET
```

## 9 FLEXIBLE RECORDS

For a complete description of the flexible record format that is sent up by the G60, see the *DMT Data Fields* document. This section gives some insight into the records for the G60 specifically.

### 9.1 Analogue Mappings

The G60 has 4 dedicated system analogue mappings. These will not be change and should not be reassigned. Analogue 6 and up may be re-assigned.

| Analogue Number | Mapping | Unit |
|:---:|---|---|
| 1 | Internal battery voltage | mV |
| 2 | External voltage | mV ÷ 10 (E.g. 1200 mean 12,000mV or 12V) |
| 3 | Internal temperature | °C x 100 (E.g. 2400 mean 24°C) |
| 4 | GSM signal strength | dBm (0-31 with 31 being full strength) |
|  |  |  |

The internal temperature is measured using a sensor on the main PCB.

The GSM signal strength is captured when the modem is on and registered on the network, just before initiating a connection.

# 10 TROUBLESHOOTING

## 10.1 Not Connecting

If a device is not connecting, it is usually SIM or power related.

SIM card:

Installed correctly – orientation? See the installation section.

No SIM PIN? Either use no SIM PIN, or the device's SIM PIN.

Has credit/airtime?

Device has SIM's APN? Either Auto-APN or do you need to SMS it?

Connect External Power.

## 10.2 Force a Connection

You can force the G60 to connect to the server by cycling the external power connection. This causes an "External Power Change" record to be logged and uploaded to the server.

You can also force a connection by resetting the unit. Disconnect the battery and external power in order to do a full reset of the device.

## 10.3 SMS Config Issues

Consider the following:

Is the SMS format correct?

Are the details in the SMS correct? The SMS may be being read, but if it the contents are incorrect, it will not connect.

Is the sender getting a delivery report? This would confirm that the modem is being switched on and the SMS is being delivered.

## 11 MAINTENANCE

### 11.1 Battery Maintenance

The life of Lithium based batteries depends on a number of factors including the number of charge / discharge cycles and the temperatures at which they operate.

Under normal conditions Digital Matter expects the lifespan of a G60 battery to be 3 years. As they age the batteries tend to not be as effective at holding their charge.

Leaving batteries in a discharged state for a long period of time is also not advisable. For further information please read the battery storage guidelines in the *Digital Matter Battery Notice.*

### 11.2 Seal Maintenance

The G60 seal is a slightly cloudy silicon material. Seals should also be replaced every 3 years to ensure reliable performance.

If possible, coincide this with battery replacement.

Contact Digital Matter to obtain extra seals.