

## SOLAR POWERED GPS TRACKER



For the latest version of this document, pricing and other product information please visit [www.digitalmatter.com/support](http://www.digitalmatter.com/support)

## 1. TABLE OF CONTENTS

Click on the contents to jump to that location in the document:

<b>1. TABLE OF CONTENTS</b>	<b>2</b>
<b>2. INTRODUCTION</b>	<b>5</b>
2.1 BACKGROUND	5
2.2 TECHNICAL SPECIFICATIONS	5
<b>3. PRECAUTIONS</b>	<b>6</b>
3.1 IP67 RATING	6
3.2 STATIC DAMAGE	6
3.3 BATTERY PRECAUTIONS	6
<b>4. DIGITAL MATTER ECOSYSTEM</b>	<b>7</b>
4.1 OEM SERVER	7
4.2 SOFTWARE PLATFORM FRONT ENDS	7
<b>5. INSTALLATION</b>	<b>8</b>
5.1 SIM INSTALLATION	8
5.2 HOUSING ASSEMBLY	8
5.3 OEM SERVER	9
5.4 DEVICE INSTALLATION	9
<b>6. MAINTENANCE</b>	<b>10</b>
6.1 BATTERY MAINTENANCE	10
6.2 SOLAR PANEL MAINTENANCE AND CLOUDING	10
6.3 SEAL MAINTENANCE	10
<b>7. HARNESSING</b>	<b>11</b>
<b>8. GENERAL FIRMWARE FEATURES</b>	<b>12</b>
8.1 AUTO-APN	12
8.2 MULTI-APN	14
8.3 ADMIN PARAMETERS	15
8.4 ASSISTNOW OFFLINE	15
8.5 POWER BANDS	16
8.6 BOOTLOADER DEEP POWER DOWN BELOW 3.5V	16
8.7 BATTERY PROTECTION	16
8.8 INPUT SETUP	16
8.9 LED BEHAVIOUR	18
<b>9. AGRICULTURAL TELEMATICS FIRMWARE</b>	<b>19</b>
9.1 FIRMWARE VERSION	19
9.2 GENERAL OPERATION DESCRIPTION	19
9.3 SYSTEM PARAMETER DEFAULTS	19
9.4 UNDERSTANDING SYSTEM PARAMETERS	19
<b>10. GPS TRACKING FIRMWARE</b>	<b>26</b>
10.1 FIRMWARE VERSION	26
10.2 GENERAL OPERATION DESCRIPTION	26
10.3 SYSTEM PARAMETER DEFAULTS	26
10.4 UNDERSTANDING SYSTEM PARAMETERS	26
10.5 ACCIDENT DETECTION	32
10.6 PERIODIC ONLY SETUP	32
<b>11. OEM SERVER</b>	<b>33</b>
<b>12. ENERGY USAGE</b>	<b>34</b>

12.1	BATTERY CAPACITY	34
12.2	CHARGE RATE	34
12.3	ENERGY COST OF COMMON OPERATIONS	34
<b>13.</b>	<b>SMS CONFIGURATION</b>	<b>35</b>
13.1	FIRMWARE VERSION NOTE	35
13.2	FORMAT	35
13.3	APN	35
13.4	SERVER	35
13.5	RESET	36
<b>14.</b>	<b>FLEXIBLE RECORDS</b>	<b>37</b>
14.1	GPS FIELD TIME	37
14.2	ANALOGUE MAPPINGS	37
14.3	SDI-12 RECORD INTERPRETATION	37
<b>15.</b>	<b>TROUBLESHOOTING</b>	<b>39</b>
15.1	NOT CONNECTING	39
15.2	NO UPDATE	39
15.3	FORCE A CONNECTION	39
15.4	BATTERY GOING FLAT	39
15.5	SMS CONFIG ISSUES	40
15.6	POOR TRIP START PERFORMANCE	40
15.7	SDI-12 ISSUES	41

## Revision History

Rev	Date	Description
1.0	23 Jul. 15	Initial document creation
1.1	9 Dec 15	Updated Multi-APN section

## 2. INTRODUCTION

---

The G52 Solar's rugged housing and built in solar panel allows the device to monitor and track assets in harsh and remote environments, without the need for an external power source. This compact 2G or 3G (NextG) GPS tracking device provides telemetry using the power of the sun.

This user manual provides information commonly needed when evaluating, installing, supporting and maintaining the G52S. The manual will be updated as more functionality becomes available and as the support knowledge base grows. Please check the website for newer versions.

### 2.1 Background

---

The G52S is designed and manufactured by Digital Matter in South Africa and Australia. The firmware on the device is written and maintained by Digital Matter.

### 2.2 Technical Specifications

---

For detailed technical specifications, please see the G52S Datasheet, available on the Digital Matter website. The datasheet also contains the product variants and product codes for ordering.

### 3. PRECAUTIONS

---

#### 3.1 IP67 Rating

---

The G52 Solar device is an IP67 rated device. It is important to ensure that the device is correctly assembled to achieve the IP rating. Failure to do so may result 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 ever opened in a clean, dry environment.

#### 3.2 Static damage

---

The G52S may be damaged by electrostatic discharge if not handled correctly. Ensure adequate static precautions are taken.

Take special care not to touch the ceramic GPS antenna.

#### 3.3 Battery precautions

---

The G52S 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.
- Check and recharge batteries ever 4-6 months.

## 4. DIGITAL MATTER ECOSYSTEM

---

The G52S forms part of a larger Digital Matter Ecosystem. The key parts of this are the OEM Server and Software Platform Front Ends.

### 4.1 OEM Server

---

The G52S connects to the OEM Server. The server is hosted by DM. In special cases, the server can be licensed to 3<sup>rd</sup> parties.

#### 4.1.1 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.

#### 4.1.2 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 G52S.
- Provides a command and message queueing platform to the devices and is incorporated into the remote management and debugging applications

### 4.2 Software Platform Front Ends

---

Using the OEM Server's Data Connectors the G52S can be used with a number of Software Platforms.

Current integrations include: Telematics Guru (DM), Key Telematics, and a number of other high profile platforms.

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. INSTALLATION

### 5.1 SIM Installation

- The SIM holder is under the GPS board.
- When handling the PCB, be careful not to touch the GPS antenna.
- Unplug the battery and the solar panel.
- Remove the screws holding the PCB to the housing.
- Tilt the GPS end of the PCB out of the housing.
- Insert the SIM into the holder.
- The SIM should be inserted with the keyed corner orientated outwards and the SIM contacts orientated down to the main board.



Figure 1 SIM partially inserted with keyed corner orientated outwards. Be sure to push the SIM in completely.



Figure 2: SIM inserted completely

### 5.2 Housing Assembly

- Secure the main PCB to the housing using the 4 small PCB screws.
- Plug in the battery.
- Plug in the solar panel.
- The seal should be the latest DM Clear Silicon Seal to ensure the IP Rating.
- Ensure that the seal is in the base and lying flat.
- Locate the battery on the main PCB against the GPS board.



---

## 5. Installation

- 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 large housing screws. The screws should be 25 mm in length. Note that G60 screws look similar but are 20 mm in length – these will not work.
- Hand tighten the screws to a uniform tightness.
- Ensure the Weipu connector cap is screwed on tightly.

---

### 5.3 OEM Server

Check the device is connecting before placing the device in the field. Refer to the document on OEM Server Setup.

Devices will either be pre-configured on OEM (firmware, system parameters, admin parameters, connector), or the distributor will need to set them up. The setup is important for the device to perform correctly.

Some general guidelines for setup:

- Firmware major versions: 1 for Agriculture. 2 for GPS Tracking.
- System parameters: the default settings are a good place to start.
- Admin parameter: the default settings are a good place to start.
- Connector: ensure the connector is setup to forward data to the correct front end. Ensure the front end is setup to receive the data.

---

### 5.4 Device Installation

There are a few considerations for the final mounting position of the G52S:

- Maximise direct sunlight. The device needs direct sunlight to charge. Ambient light will not charge the device. See the trouble shooting guide in section 15 for a discussion.
- Minimise the chance of the panel being covered by dust or other substances.
- Magnets can be attached to the housing and the device can be magnetically attached to assets.
- The housing has mounting holes for screws, bolts or cable ties.

## 6. MAINTENANCE

---

### 6.1 Battery Maintenance

---

DM expects to get 3 years of use from a battery in the field. This does not refer to the charge of the battery, but how long it should last if it is receiving regular energy input (solar or external power). Note that the warranty may not extend to 3 years. The life of the battery will depend on the conditions in which it operates.

Also take note of the battery storage guidelines in the *Digital Matter Battery Notice*.

### 6.2 Solar Panel Maintenance and Clouding

---

Keep the panel clean and dust free for best performance.

Panels may cloud in some circumstances. Experience in the field and testing of returned panels show that the panels still work as normal and no significant performance degradation is seen.

### 6.3 Seal Maintenance

---

The G52S seal has seen a number of evolutions. The latest seal is a clear silicon material. Older black plastic or blue sponge cord seals will not perform as reliably. Replacing older seals that are not the latest type is recommended.

Seals should also be replaced every 3 years to ensure reliable performance. If possible, coincide this with battery replacement.

Contact DM to obtain extra seals.

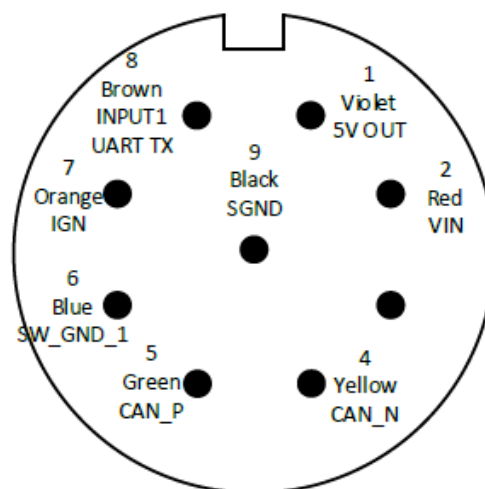
## 7. HARNESSING

The G52S has an IP67 rated connector that exposes functionality to the outside world. There are 8 wires available. The harness comes in 3m and 6m length variations. Contact DM for ordering information.

The harness wiring description is shown below. If there is a specific use in the different FW, the relevant column may provide additional information.

Wire Colour	General Function	Agriculture FW specific use	GPS Tracking FW specific use
Black	Ground	SDI-12 & Rain gauge ground	
Brown	Input 1	SDI-12 signal	General digital input (pulled down internally)
Red	External Power		
Orange	Ignition	Rain gauge signal	Ignition
Yellow	CAN –ve		
Green	CAN +ve		
Blue	Switched ground 1		
Violet	5V output	SDI-12 power	

The Weipu connector pin-out is below:



## 8. GENERAL FIRMWARE FEATURES

The G52S hardware supports two different modes of operation: Agricultural Telematics and GPS Tracking. The hardware is the same, but the mode can be changed by switching between the major versions of firmware. This section describes features that are common to both versions of firmware

### 8.1 Auto-APN

Auto-APN allows the G52S 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 G52S can be shipped world-wide without requiring specialist setup for SIMs.

The G52S 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).

Country	Network	APN Name	APN Username	APN Password
Angola	Unitel	internet.unitel.co.ao		
Australia	KORE (Optus SIM)	od1.korem2m.com	kore	kore123
Australia	Optus	connect		
Australia	TELSTRA	telstra.internet		
Australia	TELSTRA M2M	telstra.m2m		
Bahrain	Batelco	internet.batelco.com		
Botswana	Mascom	internet.mascom		

## 8. General Firmware Features

Chile	Entel 73001	bam.entelpcs.cl	entelpcs	entelpcs
Chile	Entel 73010	bam.entelpcs.cl	entelpcs	entelpcs
Chile	Movistar	web.tmovil.cl	web	web
Egypt	Mobinil	mobinilweb		
France	SFR	websfr		
Kenya	Airtel	ke.celtel.com		
Kenya	Safaricom	safaricom	saf	data
Kuwait	Wataniya	action.wataniya.com		
Luxemburg	orange.lu			
Mauritius	Emtel	web		
Mozambique	mCel	isp.mcel.mz		
Namibia	MTC contract	internet		
Namibia	MTC prepaid	ppsinternet	ppsuser	ppsuser
Netherlands	Vodafone	public4.m2minternet.com		
Nigeria	Etisalat	etisalat		
Nigeria	Glo	glosecure	gprs	gprs
Nigeria	Glo Halogen	halogen		
Nigeria	internet.ng.airtel.com			
Nigeria	MTN	web.gprs.mtnnigeria.net	web	web

## 8. General Firmware Features

Oman	Oman Mobile	taif	taif	taif
Portugal	Vodafone	internet.vodafone.pt		
SA	internet APN	internet		
SA	MTN Geotab APN	geotab.co.za		
Swaziland	Swazi MTN	mymtn.co.sz		
Sweden	Tele2 (global m2m provider)	m2m.tele2.com		
UAE	etisalat.ae			
UAE/Dubai	Emirates ITC - DU	du		
UK	eseye (global m2m provider)	eseye.com	user	pass
US	AT&T Cingular	wap.cingular	WAP@CINGULAR GPRS.COM	CINGULAR1
Zimbabwe	Econet	econet.net		

## 8.2 Multi-APN

The G52S 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 (\*).

## 8. General Firmware Features

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

## 8.3 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	<input type="text" value="0x000000000000000000000000"/>	Deprecated Parameters used only by obsolete FW. Defaulted to point to OEM.
APN1_MCCMNC	<input type="text"/>	APN 1 MCC + MNC, null terminated
APN1_APN	<input type="text"/>	APN 1 + ',' + username + ',' + password + null terminator
APN2_MCCMNC	<input type="text"/>	APN 2 MCC + MNC, null terminated
APN2_APN	<input type="text"/>	APN 2 + ',' + username + ',' + password + null terminator
APN3_MCCMNC	<input type="text"/>	APN 3 MCC + MNC, null terminated
APN3_APN	<input type="text"/>	APN 3 + ',' + username + ',' + password + null terminator
APN4_MCCMNC	<input type="text"/>	APN 4 MCC + MNC, null terminated
APN4_APN	<input type="text"/>	APN 4 + ',' + username + ',' + password + null terminator
APN5_MCCMNC	<input type="text"/>	APN 5 MCC + MNC, null terminated
APN5_APN	<input type="text"/>	APN 5 + ',' + username + ',' + password + null terminator
APN6_MCCMNC	<input type="text"/>	APN 6 MCC + MNC, null terminated
APN6_APN	<input type="text"/>	APN 6 + ',' + username + ',' + password + null terminator
ServerURL1	<input type="text" value="s0.oemserver.com"/>	Server URL 1 - A null terminated ASCII server URL or ASCII IP address
ServerPort1	<input type="text" value="8962"/>	Server Port 1 - TCP port number on server to connect to
		<input type="button" value="Update"/> <input type="button" value="Cancel"/>

**Deprecated Parameters:** Ignore these. They are a placeholder for older versions of FW.

**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 G52S, 8962.

## 8.4 AssistNow Offline

The G52S 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-

## 8. General Firmware Features

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 G52S with aiding data that is valid for two weeks. This is automatically updated and included in the OEM Server service.

### 8.5 Power bands

The G52S must work in power constrained environment. The firmware has built in power bands to adjust the behaviour according to how much power is available. The battery capacity is divided into thirds. Different behaviour can be assigned to each third. This provides a flexible setup that maximises the usefulness under different power conditions.

The relationship between battery voltage and capacity is not linear. The table below shows how the battery capacity is divided into thirds. The detail of what is customisable in each band is described in the specific agriculture/GPS firmware sections.

Battery voltage	Battery Capacity
3.5 – 3.7 V	0 – 33%
3.7 – 3.85 V	33 – 66%
3.85 – 4.1V	66 – 100%

### 8.6 Bootloader Deep Power Down Below 3.5V

If the battery voltage drops below 3.5V, the device will go into deep power down. This puts the device into a very low power state and allows the input power from the solar panel to be maximised. The bootloader will do a low power wake up every hour to check the battery. If it is above 3.5V, it will do a full power up and operate normally. If below 3.5V, it will go back into deep power down.

### 8.7 Battery Protection

The Li-Po battery is sensitive to overcharging and charging out of the temperature specification. The G52S firmware protects the battery to ensure longevity and performance. The device uses a shunt strategy to divert energy away from the battery when the battery should not be charged.

The shunting of power away from the battery is done by turning on the GPS and leaving the processor on.

The device checks for shunting conditions before it sleeps. It will shunt in the following situations:

Battery level is above 4.1V **AND** the solar panel voltage is above the battery voltage

Temperature is below 0°C or above +60°C **AND** the solar panel voltage is above the battery voltage

### 8.8 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.



## 8. General Firmware Features

Note: Not all inputs have the complete set of functionality described here. For example, input 1 on the G52S 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 G52S, but the properties may be used on other inputs (input 1, tamper).

Ignition IO Function	<input type="text" value="1"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1
Ignition Flags Pull Up Down	<input type="text" value="1"/>	GenericIOPinMode_t (GPIO_NO_PUPD = 0, GPIO_PULLUP = 1, GPIO_PULLDOWN = 2, GPIO_RESERVED = 3)
Ignition Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true
Ignition Flags Log On Active	<input type="text" value="1"/>	log a record on active (we always notify) - see fLogOnInactive later in struct
Ignition Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active
Ignition Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive
Ignition Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads
Ignition Flags Log On Inactive	<input type="text" value="1"/>	log a record on change to inactive
Ignition Digital	<input type="text" value="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	<input type="text" value="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 G52S 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.

## 8. General Firmware Features

### 8.9 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. Check the battery level is above 3.5 V.
Slow flash (10ms ever 2sec)	Running. Depending on the FW, could be getting an SDI-12 measurement, a GPS fix, or powering up the modem.
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.

## 9. AGRICULTURAL TELEMATICS FIRMWARE

### 9.1 Firmware version

The agricultural telematics 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. Currently, the latest Agriculture version is 1.51. This is likely to be updated in due course with new functionality and bug fixes.

### 9.2 General Operation Description

The agricultural firmware is designed to provide telemetry from sensors in remote, unpowered locations. The following is possible:

- Communication with up to 10 SDI-12 sensors with different addresses.
- Schedule SDI-12 sensor queries at configurable times. Different schedules can be set for the three power bands.
- Schedule GPS position updates at configurable times. Different schedules can be set for the three power bands.
- Schedule GSM uploads at configurable times. Different schedules can be set for the three power bands.
- Record device specific data before each upload. This records internal battery level, external voltage, GSM signal strength, internal temperature, and solar panel voltage.
- Using the AgriCAN peripheral\*, take a temperature reading with each SDI-12 sensor query and take a photograph at configurable times.

\* Contact DM about the AgriCAN peripheral.

### 9.3 System Parameter Defaults

The following table briefly describes the default settings in the three power bands:

Battery level	GPS fix period	Upload period	SDI-12 reading & AgriCAN Temp reading period	Cameras Enabled
0-33% (3.5-3.7 V)	12 hr	6 hr	1 hr	No
33-66% (3.7-3.85 V)	12 hr	1 hr	15 min	Yes
66-100% (3.85-4.1V)	12 hr	1 hr	15 min	Yes

### 9.4 Understanding System Parameters

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

The values shown in the subsequent sections are the default parameters.

## 9. Agricultural Telematics Firmware

## 9.4.1 Logging and Upload Settings

Edit System Parameters						
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings	Debug
SD I12 Gps Period	<input type="text" value="12"/>	Period between GPS fixes [hours]				
Periodic Log13	<input type="text" value="60"/>	Log period for 1\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)				
Periodic Log23	<input type="text" value="15"/>	Log period for 2\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)				
Periodic Log33	<input type="text" value="15"/>	Log period for 3\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)				
Periodic Upload13	<input type="text" value="360"/>	Upload period for 1\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)				
Periodic Upload23	<input type="text" value="60"/>	Upload period for 2\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)				
Periodic Upload33	<input type="text" value="60"/>	Upload period for 3\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)				

This tab controls the logging and upload periods.

GPS Period is the number of hours between getting a GPS fix.

Periodic Log values are the number of minutes between taking SDI-12 readings. There is one value per power band. 13 refers to the bottom third, 23 to the middle third and 33 to the top third.

Periodic Upload values are the number of minutes between uploading the data. This is also split per power band. A heartbeat record will be logged before each upload. This will contain analogues 1-5, GPS data and digital inputs.

## 9.4.2 SDI-12 settings

Edit System Parameters				
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings
SD I12 Power Up Delay	<input type="text" value="1"/>	Delay between probe power up and communication [seconds]		
SD I12 Address0	<input type="text" value="0x30"/>	SDI12 Address 0. Note '0' is 0x30. Disabled is 0x00.		
SD I12 Measure Mask0	<input type="text" value="0x03"/>	Bit mask for measurements to report for Address 0.		
SD I12 Address1	<input type="text" value="0x00"/>	SDI12 Address 1. Note '1' is 0x31. Disabled is 0x00.		
SD I12 Measure Mask1	<input type="text" value="0x00"/>	Bit mask for measurements to report for Address 1.		
SD I12 Address2	<input type="text" value="0x00"/>	SDI12 Address 2. Note '2' is 0x32. Disabled is 0x00.		
SD I12 Measure Mask2	<input type="text" value="0x00"/>	Bit mask for measurements to report for Address 2.		

Power up delay is how long the 5V output should be on for before measurements start. 1 second is the default. Some probes require more time to power up.

SDI-12 Address: the ASCII address of each probe. There is an address field for each probe. Up to 10 probes with unique addresses are supported. The address needs to be entered as an ASCII value. Address zero is '0' which is 0x30 in ASCII. To make this simpler, refer to the table below.

## 9. Agricultural Telematics Firmware

Simply entering 0 or 1 will not work. 0 will be considered a null entry and it will not be queried. If 0 is encountered while traversing the list from the first probe to the tenth probe, querying will stop.

Address	Enter into field
'0'	0x30
'1'	0x31
'2'	0x32
'3'	0x33
'4'	0x34
'5'	0x35
'6'	0x36
'7'	0x37
'8'	0x38
'9'	0x39

## 9.4.3 Ignition Settings

In the agricultural firmware context, the ignition line is used as an input. There is no concept of a trip. Commonly the input is connected to a tipping rain gauge. The rain gauge may have different configurations and the ignition input can be setup accordingly.

Edit System Parameters							
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings	Debug Settings	Acceler
Ignition IO Function	<input type="text" value="1"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1					
Ignition Flags Pull Up Down	<input type="text" value="1"/>	GenericIOPinMode_t (GPIO_NO_PUPD = 0, GPIO_PULLUP = 1, GPIO_PULLDOWN = 2, GPIO_RESERVED = 3)					
Ignition Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true					
Ignition Flags Log On Active	<input type="text" value="1"/>	log a record on active (we always notify) - see fLogOnInactive later in struct					
Ignition Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active					
Ignition Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive					
Ignition Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads					
Ignition Flags Log On Inactive	<input type="text" value="1"/>	log a record on change to inactive					
Ignition Digital	<input type="text" value="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	<input type="text" value="120"/>	Ignition debounce [milliseconds]					

To setup a commonly used rain gauge configuration:

Rain gauge is tipping type: IO Function = Digital Input (1); Pull Up/Down = Pull Up (1); Active High = false (0); Log On Active = true (1); Log on Inactive = false (0); Upload on Active = false (0); Upload on Inactive = false (0); Emergency Uploads = false (0); Digital Mapping = 0; Config 1 (debounce) = 120 ms;

Rain gauge is see saw type: IO Function = Digital Input (1); Pull Up/Down = Pull Up (1); Active High = false (0); Log On Active = true (1); Log on Inactive = true (1); Upload on Active

## 9. Agricultural Telematics Firmware

= false (0); Upload on Inactive = false (0); Emergency Uploads = false (0); Digital Mapping = 0; Config 1 (debounce) = 120 ms;

## 9.4.4 Tamper Settings

A tamper wire may be configured. By default it is not used (settings below). See the Generic IO description to set it up.

The settings shown here have the tamper input deactivated:

Edit System Parameters					
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings
Tamper IO Function	<input type="text" value="0"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1			
Tamper Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true			
Tamper Flags Log On Active	<input type="text" value="0"/>	log a record on active (we always notify) - see fLogOnInactive later in struct			
Tamper Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active			
Tamper Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive			
Tamper Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads			
Tamper Flags Log On Inactive	<input type="text" value="0"/>	log a record on change to inactive			
Tamper Digital	<input type="text" value="0"/>	Which DI to map tamper alert into.			
Tamper Config1	<input type="text" value="0"/>	Debounce for tamper alert [milliseconds]			

To setup a tamper wire, change the settings to: IO Function = Digital Input (1); Pull up/down setting not available; Active High = true (1); Log on Active = true (1); Log on Inactive = false (0); Upload on Active = true (1); Upload on Inactive = false (0); **Emergency Uploads = true (1)**; Digital Mapping = 1; Config 1 (debounce) = 1000 ms.

## 9.4.5 AgriCAN Settings

If the AgriCAN peripheral is attached, it may provide the following functionality:

- 1 or 2 Cameras setup to take photos at 8 different times.
- Temperature sensor.

Edit System Parameters				
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings
Camera Hour0 Hour	<input type="text" value="0"/>	Camera Hour 0 UTC		
Camera Hour0 Camera0 Active	<input type="text" value="0"/>	For hour 0: Camera 0 active = 1, Camera 0 inactive = 0		
Camera Hour0 Camera1 Active	<input type="text" value="0"/>	For hour 0: Camera 1 active = 1, Camera 1 inactive = 0		
Camera Hour1 Hour	<input type="text" value="0"/>	Camera Hour 1 UTC		
Camera Hour1 Camera0 Active	<input type="text" value="0"/>	For hour 1: Camera 0 active = 1, Camera 0 inactive = 0		
Camera Hour1 Camera1 Active	<input type="text" value="0"/>	For hour 1: Camera 1 active = 1, Camera 1 inactive = 0		

The time for a photo is setup using a "camera hour". There are 8 configurable hours. For example, setting Camera Hour0 Hour to 12, will setup a photo at 12 UTC time.

For each hour, camera 1 or 2 can be enabled or disabled. For example setting Camera Hour0 Camera0 Active to 0 (false) and Camera Hour0 Camera0 Active to 1 (true) will disable camera 0 and enable camera 1 for the photo at Hour 0.

## 9. Agricultural Telematics Firmware

To disable all photos, set all camera active flags to 0 (false).

Further down you will find:

Camera0 Image Quality	<input type="text" value="60"/>	Camera 0 image quality: 0 = lowest quality, highest compression; 100 = highest quality, lowest compression
Camera0 Image Res	<input type="text" value="3"/>	Camera 0 image res: 1 = 160 x 128; 2 = 320 x 240; 3 = 640 x 480; 4 = 1280 x 1024
Camera1 Image Quality	<input type="text" value="60"/>	Camera 1 image quality: 0 = lowest quality, highest compression; 100 = highest quality, lowest compression
Camera1 Image Res	<input type="text" value="3"/>	Camera 1 image res: 1 = 160 x 128; 2 = 320 x 240; 3 = 640 x 480; 4 = 1280 x 1024
Temp0 Sensor Type	<input type="text" value="0"/>	Type of sensor connected to AgriCan
Temp0 Analog Mapping	<input type="text" value="0xFF"/>	Analogue mapping for AgriCan temperature sensor reading

This block of parameters setups the photo settings:

Quality: this is a percentage 0-100 describing the JPEG compression ratio. 100 is highest quality, lowest compression and largest size.

Image Res: there are 4 settings for the camera photo resolution.

The final two parameters setup the temperature reading using the AgriCAN temperature sensors:

Sensor Type: this relates to the type and address of the temperature sensor. See the DM Temperature Sensor Description document. The sensors are generally marked with coloured heat shrink. As a rule of thumb:

- Blue: sensor type 0
- Red: sensor type 1
- Blue and white: sensor type 5
- Blue and red: sensor type 7

### 9.4.6 GPS Settings

A number of GPS settings can be adjusted. This is seldom useful for the Agriculture FW. See the description in the GPS tracking section. These settings can be adjusted and will have an effect, but it is seldom required and the defaults work well.

Edit System Parameters					
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings
Gps Req PDOP	<input type="text" value="5.0"/>	Minimum PDOP required for a valid fix			
Gps Req Pos Acc	<input type="text" value="50"/>	Minimum GPS position accuracy required for a valid fix [metres]			
Gps Req Speed Acc	<input type="text" value="10"/>	Minimum GPS speed accuracy required for a valid fix [kmph]			
Gps Flags Fix Req	<input type="text" value="1"/>	GPS 3D fix required?			
Gps Static Hold Threshold	<input type="text" value="6"/>	GPS Static Hold Threshold [kmph]			
Gps Fix Count	<input type="text" value="5"/>	Number of valid fixes before logging			

### 9.4.7 Debug Settings

In addition to telemetry data, devices can log debug information. Each firmware module can be given a debug log level. The default is "critical only". See the section on OEM for a description of how to set the level for each module.

## 9. Agricultural Telematics Firmware

It is not recommended to adjust the debug settings from the system parameter view. Rather use the Device Operations->Set Debug Expiry process.

Edit System Parameters	
Logging and Upload Settings	SDI12 Settings
Debug Log Level1	0xFF
Debug Log Level2	0xFF
Debug Log Level3	0xFF
Debug Log Level4	0xFF
Debug Log Level5	0xFF
Debug Log Level6	0xFF
Debug Log Level7	0xFF
Debug Log Level8	0xFF

## 9.4.8 Accelerometer Settings

The accelerometer is generally not used in the agriculture FW. The defaults shown below have the accelerometer disabled.

A “bump test” can be setup to aid installation. If setup, the installer can “bump” the device to trigger a test process. This does the following.

- Wake the device from sleep.
- Do an SDI-12 query of any probes setup in system parameters.
- Get a GPS fix.
- Log a heartbeat
- Log a record with an “accident” log reason. This allows the front end system to detect a bump test and take special action if required. For example, SMS the installer with results of the SDI-12 query, GPS fix, battery levels, etc.
- Upload the data
- Go to sleep and continue with normal operation.

To enable this bump test, change *Operation Flags Enable Accel Irq* to 1 (true). Set *Accel Wake Up No Movement Limit* to 1. This limits the number of bump tests between normal operational wakeups. For example, if the device is being moved, it will only allow 1 bump test between each normal operation wakeup. Also, under the general tab (next section), ensure *Use Powerdown* is set to 1 (true).

Edit System Parameters							
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings	Debug Settings	Accelerometer Settings
Operation Flags Enable Accel Irq	0	Arm the accel interrupt to wakeup when in power down - immediate wakeup.					
Accel Wake Up No Movement Limit	7	Disable accelerometer wakeups after this many wakeups with no trip start.					

## 9.4.9 General Settings

Many of the settings in the general tab will not need to be adjusted. Some that are of interest for the Agriculture FW:



## 9. Agricultural Telematics Firmware

**Use Power Down:** if set to 1 (true), sleep in the power down state, rather than deep power down. This allows the device to react to input changes and accelerometer wakeups. This is important for use with a tipping rain gauge on the ignition wire or the bump test.

**Shunt Outside 0-60 deg:** if set to 1 (true), shunt any power from the solar panel when the internal device temperature is outside the battery charging range (below 0 and above 60). It is up to the distributor to decide how to set this up, but it is recommended to set this to true.

**Wakeup Period Min:** the maximum amount of time (in minutes) that the device will sleep before checking the battery level and shunting requirements. By default this is 60 min. If the battery is above 4.0V, the device will wake up every 10 min to check the shunting requirements.

Edit System Parameters								
Logging and Upload Settings	SDI12 Settings	Ignition/Trip Settings	IO/Tamper Settings	AgriCan Settings	GPS Settings	Debug Settings	Accelerometer Settings	General
Upload Batch Size	<input type="text" value="40"/>	Max number of records in a batch before a commit request is sent.						
Vext Good DI	<input type="text" value="0xFF"/>	Which DI the 'Vext Good' maps into. 0xFF for NULL						
Vext Good Log On Active	<input type="text" value="1"/>	Log a record on active (we always notify) - see fLogOnInactive later in struct						
Vext Good Upload On Active	<input type="text" value="1"/>	Request immediate upload on change to active						
Vext Good Upload On In Active	<input type="text" value="1"/>	Request immediate upload on change to inactive						
Vext Good Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads						
Vext Good Log On Inactive	<input type="text" value="1"/>	Log a record on change to inactive						
Vbat Good DI	<input type="text" value="0xFF"/>	Which DI the 'Vbat Good' maps into. 0xFF for NULL						
Vbat Good Log On Active	<input type="text" value="1"/>	Log a record on active (we always notify) - see fLogOnInactive later in struct						
Vbat Good Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active						
Vbat Good Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive						
Vbat Good Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads						
Vbat Good Log On Inactive	<input type="text" value="1"/>	Log a record on change to inactive						
Operation Flags Periodic Only	<input type="text" value="0"/>	Only use periodic time for logging - no trip logging.						
Operation Flags Use Power Down	<input type="text" value="1"/>	Don't use deep power down - needed if using IOs.						
Operation Flags Avoid Gps Wander	<input type="text" value="1"/>	If GPS position within movement threshold then log using last GPS data to avoid 'birds nest' wander.						
Operation Flags Shunt At Low Threshold	<input type="text" value="0"/>	If true (1), shunt threshold = 4.1V. If false (0), shunt threshold = 4.2V below 45 degrees C and 4.1V above 45 degrees C.						
Operation Flags Shunt Outside 0-60deg	<input type="text" value="0"/>	If true (1), shunt when on charge and outside 0-60 degree C temp spec. If false (0), allow charging outside 0-60 degrees C.						
Wakeup Period Min	<input type="text" value="60"/>	How often in minutes unit will wakeup to check shunt status.						

## 10. GPS TRACKING FIRMWARE

### 10.1 Firmware version

The GPS tracking firmware major version is 2.

The format for version numbering is XX.YY, where XX is the major version and YY is the minor version. Currently, the latest GPS tracking version is 2.51. This is likely to be updated in due course with new functionality and bug fixes.

### 10.2 General Operation Description

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.
- Periodic only GPS points: GPS positions are logged at configurable intervals. This is periodic only, with no concept of trips.

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.

### 10.3 System Parameter Defaults

The following table briefly describes the default settings in the three power bands. The default mode is **trip based tracking**, not periodic only tracking:

	In trip		Out of trip	
Battery level	GPS log period	Upload period	GPS log period	Upload period
0-33% (3.5-3.7 V)	5 min	60 min	6 hrs	24 hrs
33-66% (3.7-3.85 V)	1 min	15 min	3 hrs	12 hrs
66-100% (3.85-4.1 V)	30 sec	15 min	1 hrs	12 hrs

### 10.4 Understanding System Parameters

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

The values shown in the subsequent sections are the default parameters.

## 10. GPS Tracking Firmware

## 10.4.1 Logging and Upload Settings

The logging and upload rates are configurable in each power band. Setup the out of trip logging and upload period. Also setup the in-trip logging and upload period.

Edit System Parameters					
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings	GPS Settings	Debug Settings	Accelerometer Settings
Periodic Log13	<input type="text" value="360"/>	Log period for 1\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)			
Periodic Log23	<input type="text" value="180"/>	Log period for 2\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)			
Periodic Log33	<input type="text" value="60"/>	Log period for 3\3 battery [minutes]. (SMP FW = measurement period; GPS FW = out of trip GPS period)			
Periodic Upload13	<input type="text" value="1440"/>	Upload period for 1\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)			
Periodic Upload23	<input type="text" value="720"/>	Upload period for 2\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)			
Periodic Upload33	<input type="text" value="720"/>	Upload period for 3\3 battery [minutes]. (SMP FW = upload period; GPS FW = out of trip upload period)			
In Trip Log13	<input type="text" value="300"/>	In trip log period for 1\3 battery [seconds]			
In Trip Log23	<input type="text" value="60"/>	In trip log period for 2\3 battery [seconds]			
In Trip Log33	<input type="text" value="30"/>	In trip log period for 3\3 battery [seconds]			
In Trip Upload13	<input type="text" value="3600"/>	In trip upload period for 1\3 battery [seconds]			
In Trip Upload23	<input type="text" value="900"/>	In trip upload period for 2\3 battery [seconds]			
In Trip Upload33	<input type="text" value="900"/>	In trip upload period for 3\3 battery [seconds]			

**Periodic Log X3:** when out of trip, how often to obtain a GPS fix and log a heartbeat record. Measured in minutes. X = 1 (13) means lowest third of the battery capacity (default 360 min or 6 hours), X = 2 (23) means middle third of the battery capacity (default 180 min or 3 hours), X = 3 (33) means the top third of the battery capacity (default 60 min or 1 hour).

**Periodic Upload X3:** when out of trip, how often to connect to the server and upload any records. Measured in minutes. X = 1 (13) means lowest third of the battery capacity (default 1440 min or 24 hours), X = 2 (23) means middle third of the battery capacity (default 720 min or 12 hours), X = 3 (33) means the top third of the battery capacity (default 720 min or 12 hours).

**In Trip Log X3:** when in trip, how often to obtain a GPS fix and log a time elapsed record. Measured in seconds. X = 1 (13) means lowest third of the battery capacity (default 300 sec or 5 min), X = 2 (23) means middle third of the battery capacity (default 60 sec), X = 3 (33) means the top third of the battery capacity (default 30 sec).

**In Trip Upload X3:** when in trip, how often to connect and upload any records. Measured in seconds. X = 1 (13) means lowest third of the battery capacity (default 3600 sec or 1 hour), X = 2 (23) means middle third of the battery capacity (default 900 sec or 15 min), X = 3 (33) means the top third of the battery capacity (default 900 sec or 15 min).

## 10.4.2 Ignition/Trip Settings

This parameter block configures ignition line and the trip start/stop settings.

Trips can be start and stopped using:

- Ignition wire and/or
- Movement and/or
- Run Detect.

There is a generic IO input block for the ignition wire (see section 8.8).

## 10. GPS Tracking Firmware

There are a number of parameters for the movement based trip tracking

Run detect is a scheme that uses the external voltage level to determine the in-trip status. This is based on the assumption that the battery voltage of a vehicle will rise when the engine is running and the battery is being charged by the alternator.

Edit System Parameters		
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings
Ignition IO Function	<input type="text" value="1"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1
Ignition Flags Pull Up Down	<input type="text" value="1"/>	GenericIOPinMode_t (GPIO_NO_PUPD = 0, GPIO_PULLUP = 1, GPIO_PULLDOWN = 2, GPIO_RESERVED = 3)
Ignition Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true
Ignition Flags Log On Active	<input type="text" value="1"/>	log a record on active (we always notify) - see fLogOnInactive later in struct
Ignition Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active
Ignition Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive
Ignition Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads
Ignition Flags Log On Inactive	<input type="text" value="1"/>	log a record on change to inactive
Ignition Digital	<input type="text" value="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	<input type="text" value="1000"/>	Ignition debounce [milliseconds]
Trip Status DI	<input type="text" value="0"/>	Which DI the trip status maps into. 0xFF for NULL, 0 for emulated IGN
Movement Threshold	<input type="text" value="250"/>	Movement threshold - used to stop and start movement trips [metres]
Movement Count	<input type="text" value="5"/>	Number of GPS counts exceeding threshold
Trip End Time	<input type="text" value="5"/>	Amount of time of non-movement to determine trip end [minutes]
Assumed Movement Start Point Range	<input type="text" value="10"/>	Threshold within which to use assumed start point [kilometres]. 0 = disable
Trip Status Log Trip Start	<input type="text" value="1"/>	Log a trip start record?
Trip Status Log Trip End	<input type="text" value="1"/>	Log a trip end record?
Trip Status Upload On Trip Start	<input type="text" value="1"/>	Upload on trip start?
Trip Status Upload On Trip End	<input type="text" value="1"/>	Upload on trip end?
Run Detect Hi	<input type="text" value="0.00"/>	Start a run detect trip if external voltage is above this threshold [V]. 0 = disabled
Run Detect Lo	<input type="text" value="0.00"/>	End a run detect trip if external voltage is below this threshold [V]
Run Detect DI	<input type="text" value="0xFF"/>	Map run detect status to this digital input.

Ignition generic IO block: see section 8.8 for a details description. Set ignition digital = 0 to allow the ignition line to start and stop trips.

**Trip Status DI:** map the trip status to this digital input. Set to 0 to enable movement based (emulated) ignition tracking.

**Movement threshold:** start a movement trip if the device moves this many metres from its resting point. The lower this is, the higher the chance of false trip starts with GPS wander. The default is 250m. Using a value less than 100m is not recommended.

**Movement count:** wait for this many valid GPS points beyond the start threshold before starting a trip. This reduces the number of false trip starts.

**Trip end time:** the amount of time, in minutes, that the device should be stationary before ending a movement based trip.

**Assumed Movement Start Point Range:** if a movement trip start is detected, log an assumed start point if the device is still within this radius of the start point. If within the assumed start point range, the trip start will be logged at the rest position, and a distance travelled point will

## 10. GPS Tracking Firmware

be logged at the point when the device crossed the threshold. If not within this assumed start point range, the trip start is logged at the point where the device decided it was in trip.

*Log Trip Start:* if 1 (true), log the trip start. If 0 (false), do not log the trip start.

*Log Trip End:* if 1 (true), log the trip end. If 0 (false), do not log the trip end.

*Upload Trip Start:* if 1 (true), upload when a trip starts. If 0 (false), do not upload the trip start and wait for the in trip periodic upload.

*Upload Trip End:* if 1 (true), upload when a trip ends. If 0 (false), do not upload the trip end and wait for the out of trip periodic upload or the next upload event (new trip start, ext. power change, etc.)

*Run Detect Hi:* External voltage threshold for transitioning from off to on.

*Run Detect Lo:* External voltage threshold for transitioning from on to off. Use the different between the Hi and Lo thresholds to provide some hysteresis.

*Run Detect DI:* Which digital input to map the run detect status to. To start and stop trips, map to DI = 0 (ignition). Otherwise, mapping to an input other than 0 will simply reflect on/off, but not start and stop trips.

## 10.4.3 IO/Tamper Settings

In GPS tracking mode, input 1 is free to be used as a general digital input. By default it is disabled. Note that it is permanently pulled down by the hardware.

The tamper wire is also available, but by default is not used.

Edit System Parameters		
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings
Input1 IO Function	<input type="text" value="0"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1
Input1 Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true
Input1 Flags Log On Active	<input type="text" value="0"/>	log a record on active (we always notify) - see flogOnInactive later in struct
Input1 Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active
Input1 Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive
Input1 Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads
Input1 Flags Log On Inactive	<input type="text" value="0"/>	log a record on change to inactive
Input1 Digital	<input type="text" value="0"/>	
Input1 Config1	<input type="text" value="0"/>	
Tamper IO Function	<input type="text" value="0"/>	GPIO_NONE = 0, GPIO_DIGITAL_INPUT = 1
Tamper Flags Active High	<input type="text" value="0"/>	Active High 0 = false, 1 = true
Tamper Flags Log On Active	<input type="text" value="0"/>	log a record on active (we always notify) - see flogOnInactive later in struct
Tamper Flags Upload On Active	<input type="text" value="0"/>	Request immediate upload on change to active
Tamper Flags Upload On In Active	<input type="text" value="0"/>	Request immediate upload on change to inactive
Tamper Flags Emergency Uploads	<input type="text" value="0"/>	Request emergency uploads
Tamper Flags Log On Inactive	<input type="text" value="0"/>	log a record on change to inactive
Tamper Digital	<input type="text" value="0"/>	Which DI to map tamper alert into.
Tamper Config1	<input type="text" value="0"/>	Debounce for tamper alert [milliseconds]

## 10. GPS Tracking Firmware

See the Generic IO description for information on how to setup Input 1.

To setup a tamper wire, change the settings to: IO Function = Digital Input (1); Pull up/down setting not available; Active High = true (1); Log on active = true (1); Log on Inactive = false (0); Upload on Active = true (1); Upload on Inactive = false (0); **Emergency Uploads = true (1)**; Digital Mapping = 1; Config 1 (debounce) = 1000 ms.

## 10.4.4 GPS Settings

This block of parameters seldom needs changing, but there may be circumstances that require it.

Edit System Parameters		
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings
Gps Req PDOP	<input type="text" value="5.0"/>	Minimum PDOP required for a valid fix
Gps Req Pos Acc	<input type="text" value="50"/>	Minimum GPS position accuracy required for a valid fix [metres]
Gps Req Speed Acc	<input type="text" value="10"/>	Minimum GPS speed accuracy required for a valid fix [kmph]
Gps Flags Fix Req	<input type="text" value="1"/>	GPS 3D fix required?
Gps Static Hold Threshold	<input type="text" value="6"/>	GPS Static Hold Threshold [kmph]
Gps Fix Count	<input type="text" value="5"/>	Number of valid fixes before logging

**GPS Req PDOP:** maximum PDOP value to be accepted as a valid fix. By default, any PDOP greater than 5.0 will not be accepted. Lower PDOP values indicate better fixes.

**GPS Req Pos Acc:** the maximum positional accuracy to be accepted as a valid fix. Measured in metres. By default positional accuracies better than 50m are required.

**GPS Req Speed Acc:** the maximum speed accuracy to be accepted as a valid fix. Measured in km/h. By default speed accuracies better than 10km/h are required.

**GPS Flags Fix Req:** if 1 (true) a 3D fix must be obtained. If 0 (false), a 2D fix will be considered.

**GPS Static Hold Threshold:** the static hold threshold for the GPS in km/h. Speeds below this will be set to 0 km/h and the GPS will remain stationary. By default this is 6 km/h. Reduce this if tracking very slow moving assets.

**GPS Fix Count:** The number of fixes to obtain before considering the fix valid. This improves the quality of the fix and reduces the number of false trip starts.

## 10.4.5 Debug Settings

See the Debug Settings section in the agriculture firmware section.

## 10.4.6 Accelerometer Settings

The accelerometer is important for waking the device up when detecting movement based trips.

There are circumstances in a battery powered device where constantly being woken by the accelerometer and checking the GPS for movement drains the battery. The way to preserve the battery in this case is to count the number of wakeups with no GPS movement. If the count exceeds a configurable threshold, disable the accelerometer and sleep for a configurable period. On wakeup, check the GPS for movement. If the accelerometer has

## 10. GPS Tracking Firmware

fired in the meantime, keep ignoring it and go back to sleep. If it has not fired, reset the count and wakeup on accelerations again. The default values are 7 wake ups and sleep for 3 min.

Consider the example of a G52S on a boat, with the default setup. If the boat is rocking constantly, it will keep waking the device up to check the GPS. If the device wakes up 7 times with no GPS movement, it will disable the accelerometer and sleep for 3 min. It will wake up after 3 min and check the GPS for movement. If there is no movement, it will check if the accelerometer fired while it was asleep for 3 min. If it did fire, it will disable it again and sleep for a further 3 min. If it did not fire, it will enable the accelerometer again and sleep until it is woken by the accelerometer or a normal periodic wake up.

Edit System Parameters						
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings	GPS Settings	Debug Settings	Accelerometer Settings	General
Operation Flags Enable Accel Irq	<input type="text" value="1"/>	Arm the accel interrupt to wakeup when in power down - immediate wakeup.				
Accel Wake Up No Movement Limit	<input type="text" value="7"/>	Disable accelerometer wakeups after this many wakeups with no trip start.				
Accel Wake Up No Movement Sleep Period	<input type="text" value="180"/>	Wake up delay after disabling the accelerometer due to excessive wakeups [seconds]				
Accel Threshold	<input type="text" value="1"/>	Accel threshold for wakeup [0.063g] (7 bits = 8g)				
Accel Count	<input type="text" value="0"/>	Number of accel counts exceeding threshold, time depends on ODR, typically 20ms				
Accel Accident Threshold	<input type="text" value="100"/>	Threshold for an accident [100 G <sup>2</sup> ]				
Accel Accident Count	<input type="text" value="4"/>	Count of acceleration exceeding threshold for an accident.				

**Enable Accel Irq:** if 1 (true), allow the device to be woken from sleep by the accelerometer. If 0 (false), the accelerometer wake ups are ignored.

**Accel Wake Up No Movement Limit:** as discussed above, this is the count of wakeups with no GPS movement that will lead to the accelerometer wakeup being disabled. By default, this is 7.

**Accel Wake Up No Movement Sleep Period:** as discussed above, this is period that the device will sleep for after disabling the accelerometer wakeups. By default, this is 180 sec, or 3 min.

**Accel Threshold:** this is the threshold (in units of 0.063g) that will wake the G52S up. Set to 1 by default for most sensitive.

**Accel Count:** this is the number of samples which must exceed the *Accel Threshold* to wake the device up. Set to 0 by default for most sensitive.

**Accel Accident Threshold:** This is the threshold for accident logging. Units are in 100 G<sup>2</sup>. The default of 100 is 3.2G.

**Accel Accident Count:** this is the number of samples which must exceed the *Accel Accident Threshold* to log an accident. At 20 ms per sample, the default of 4 is 80 ms.

#### 10.4.7 General Settings

Many of the settings in the general tab will not need to be adjusted. Some that are of interest for the GPS Tracking FW:

**Use Periodic Only:** if set to 1 (true), do not do any trip based tracking. Instead, only record and upload periodically.

**Use Power Down:** if set to 1 (true), sleep in the power down state, rather than deep power down. This allows the device to react to input changes and accelerometer wakeups. This is important for use with the accelerometer or ignition wire. If used in periodic only mode, the device can go into deep power down.



## 10. GPS Tracking Firmware

**Shunt Outside 0-60 deg:** if set to 1 (true), shunt any power from the solar panel when the internal device temperature is outside the battery charging range (below 0 and above 60). It is up to the distributor to decide how to set this up, but it is recommended to set this to true.

**Wakeup Period Min:** the maximum amount of time (in minutes) that the device will sleep before checking the battery level and shunting requirements. By default this is 60 min. If the battery is above 4.0V, the device will wake up every 10 min to check the shunting requirements.

Edit System Parameters						
Logging and Upload Settings	Ignition/Trip Settings	IO/Tamper Settings	GPS Settings	Debug Settings	Accelerometer Settings	General
Upload Batch Size	40					Max number of records in a batch before a commit request is sent.
Vext Good DI	0xFF					Which DI the 'Vext Good' maps into. 0xFF for NULL
Vext Good Log On Active	1					Log a record on active (we always notify) - see fLogOnInactive later in struct
Vext Good Upload On Active	1					Request immediate upload on change to active
Vext Good Upload On In Active	1					Request immediate upload on change to inactive
Vext Good Emergency Uploads	0					Request emergency uploads
Vext Good Log On Inactive	1					Log a record on change to inactive
Vbat Good DI	0xFF					Which DI the 'Vbat Good' maps into. 0xFF for NULL
Vbat Good Log On Active	1					Log a record on active (we always notify) - see fLogOnInactive later in struct
Vbat Good Upload On Active	0					Request immediate upload on change to active
Vbat Good Upload On In Active	0					Request immediate upload on change to inactive
Vbat Good Emergency Uploads	0					Request emergency uploads
Vbat Good Log On Inactive	1					Log a record on change to inactive
Operation Flags Periodic Only	0					Only use periodic time for logging - no trip logging.
Operation Flags Use Power Down	1					Don't use deep power down - needed if using IOs.
Operation Flags Avoid Gps Wander	1					If GPS position within movement threshold then log using last GPS data to avoid 'birds nest' wander.
Operation Flags Shunt At Low Threshold	1					If true (1), shunt threshold = 4.1V. If false (0), shunt threshold = 4.2V below 45 degrees C and 4.1V above 45 degrees C.
Operation Flags Shunt Outside 0-60deg	1					If true (1), shunt when on charge and outside 0-60 degree C temp spec. If false (0), allow charging outside 0-60 degrees C.
Wakeup Period Min	60					How often in minutes unit will wakeup to check shunt status.

### 10.5 Accident Detection

Accident detection uses the accelerometer to monitor for an acceleration above a configurable threshold for a configurable time.

If detected, the device will log a record with the accident log reason. Software platforms should alert based on this log reason.

The thresholds are explained in the accelerometer system parameter section above. The defaults are 3.2 G for 4 counts (80 ms).

### 10.6 Periodic Only Setup

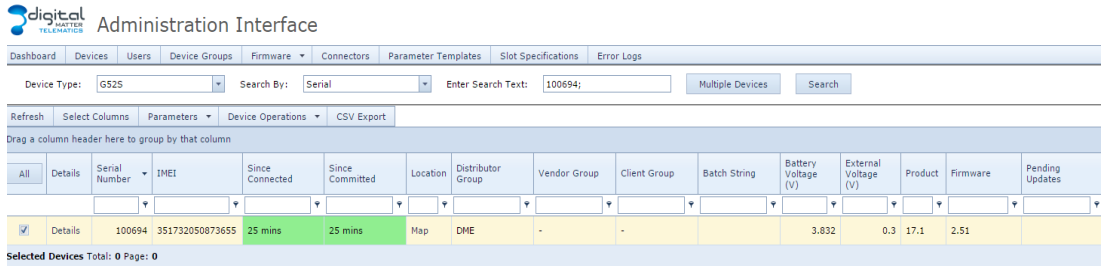
To setup a device in periodic only mode, see the general system parameters section above. This will ignore the in trip upload and GPS fix periods. It will use the out of trip upload and GPS fix periods.

In this setup, it may be worth putting the device into deep power down between fixes if it does not need to respond to inputs. This will extend the battery life. Do this with the flag in the general system parameters section.



## 11. OEM SERVER

The OEM Server is covered in a separate document. Contact DM for assistance.



The screenshot shows the 'Administration Interface' for Digital Matter. The 'Device Type' is set to 'G52S'. The search criteria are 'Serial' with the text '100694'. The table below shows a list of devices with columns for details, serial number, IMEI, since connected, since committed, location, distributor group, vendor group, client group, batch string, battery voltage, external voltage, product, firmware, and pending updates. The first device shown has a serial number of 100694, IMEI 351732050873655, and is connected for 25 minutes.

All	Details	Serial Number	IMEI	Since Connected	Since Committed	Location	Distributor Group	Vendor Group	Client Group	Batch String	Battery Voltage (V)	External Voltage (V)	Product	Firmware	Pending Updates
<input checked="" type="checkbox"/>	Details	100694	351732050873655	25 mins	25 mins	Map	DME	-	-		3.832	0.3	17.1	2.51	

Selected Devices Total: 0 Page: 0

There are some G52S specific notes to consider:

- Ensure the Device Type is set to G52S to view your devices.
- Note the difference between the firmware versions. They will all appear in one drop down menu. Select the correct type: Agricultural vs GPS Tracking
- Default parameters are available as parameter sets. The names are:
- Agricultural FW: "SMP: Defaults"
- GPS Tracking FW: "GPS : Defaults"
- Devices may not connect for extended periods depending on their parameter settings. This may be to conserve power. The defaults for GPS Tracking FW when idle are 12 or 24 hours depending on the battery level.

## 12. ENERGY USAGE

The question of energy usage is important for predicting how the G52S will perform. The performance predictions can be made from test data and verified with field experience. The following section gives an indication of what can be expected.

### 12.1 Battery Capacity

The G52S battery is 800mAh in size. It is a 3.7 V Li-Po battery.

### 12.2 Charge Rate

The solar panel will charge the battery at a peak current of 50mA in direct sun. This gives a charge rate of 1/16C.

Note that the charge rate is severely reduced by indirect sun and sun passing through glass such as a windscreen. Mounting positions should be carefully chosen.

### 12.3 Energy Cost of Common Operations

The following table gives measured current readings for common G52S operations. These should be considered indicative only, as there are many factors that will adjust these results.

Using numbers like this, it is possible to build an “energy budget” to understand what is possible with the 800mAh available. And how much sun would be needed to sustain certain behaviour.

Note that network conditions and network technology affect power consumption. Measurements suggest that power consumption of the different network technologies are, in order of most efficient to least: 2G modem on 2G network, 3G modem on 3G network, 3G modem on 2G network. Generally, 3G devices are expected to use marginally more power than 2G.

Operation	Current	Average Time	Energy cost
Deep power down	50 uA	-	50uA/hour
Power down	500-1500 uA	-	500-1500 uA/hour
GPS Acquiring (cold start to fix) (rare)	70 mA	34 sec	0.66 mAh per cold start
GPS Acquiring (warm start to fix) (common)	64 mA	5 sec	0.088 mAh per warm start
Modem session (off, register, connect, upload, disconnect, off) (RSSI = 28)	74 mA	65 sec	1.33 mAh per connection
SDI-12 query (15 sensor probe, 5 sec power on delay)	33 mA	14 sec	0.13 mAh per query

## 13. 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.

### 13.1 Firmware Version Note

---

The descriptions below will work with firmware newer than 1.20 or 2.20. Older firmware may require a different SMS format. Contact DM to setup a device on old firmware by SMS.

### 13.2 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.

### 13.3 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
```

### 13.4 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
```

### 13.5 Reset

---

#\* [<reply#>], RESET

Examples:

#\*, RESET

## 14. FLEXIBLE RECORDS

For a complete description of the flexible record format that is sent up by the G52S, see the *DMT Data Fields* document. This section gives some insight into the records for the G52S specifically.

### 14.1 GPS Field Time

Note that the time inside the GPS field is the time of the GPS fix. It is not the time that the record was logged. For example, the fix may have been obtained at 8am, and the input change event may occur at 9am. The time of the greater record will be 9am. The time of the fix will be 8am.

### 14.2 Analogue Mappings

The G52S has 5 dedicated system analogue mappings. These will not be change and should not be reassigned. Analogue 6 and up may be re-assigned. For example, An6 may be used for the AgriCAN temperature sensor reading.

Analogue Number	Mapping	Unit
1	Internal battery voltage	mV
2	External voltage	mV x 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)
5	Solar voltage (if applicable)	mV

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. This may only be logged and reflected the next time an analogue field is logged, which may be on the next wakeup.

### 14.3 SDI-12 Record Interpretation

SDI-12 query results will be logged in two parts:

- SDI-12 device identification: this will contain the device address (single char) and an identification string (typically 30 ASCII chars)
- SDI-12 measurements: this will be a measurement type value (single byte), followed by a number of measurements (INT32 values)

The measurement type when used with a soil moisture probes is typically:

1. Normalised soil moisture readings. These may read empty if the probe is uncalibrated.
2. Temperature
3. Raw readings. Specific to some probes. Unit is kHz. Expected range 40-70 MHz

---

**14. Flexible Records**

A typical view of a reading captured on the OEM server would look like this:

```
SDI12Sensordata. DeviceAddress: 48, DeviceId: 13OEMFAKE1SMP000105S4294967295  
Measurements: Type:0, Count: 3, Values: 99339 100000 100000. Measurements: Type:1, Count:  
3, Values: 10125 10312 10437. Measurements: Type:2, Count: 3, Values: 48827 48728 49072.
```

Probe meta data such as depth and geometry are not captured in the records. These should be captured at installation time through a separate process.

As a useful note, probe wiring is commonly: brown for 5V; blue for data; green/yellow for ground.

## 15. TROUBLESHOOTING

---

### 15.1 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?

Internal battery:

Is it plugged in?

Voltage? Measure the battery voltage with a multi-meter. Is it more than 3.5 V? 3.8-4.1 V upwards is ideal.

On reset, does the LED flash? Be sure to reset by disconnecting the solar panel, external power and the internal battery. See the LED flash meanings in the general FW section.

If this doesn't work, contact DM for assistance.

### 15.2 No Update

---

If the device has not reported when it should have, consider the following:

The device is designed to work on a battery, so retries are limited. If there is a network glitch or the device is out of coverage, it will only try to upload for 3 minutes. If it times out, it will go to sleep and only retry on the next scheduled upload. This may be on the heartbeat (up to 12 or 24 hours) or on the start of the next trip.

### 15.3 Force a Connection

---

There is no way to initiate a connection remotely because when the device sleeps, it switches off its modem. You will need to wait for the next scheduled connection – either a heartbeat, trip start, or IO change.

You can trigger an upload by changing the external power level. The device will detect this if it is not in deep power down, log a record and upload it.

Finally, you can force a connection by resetting the unit. Disconnect the battery and solar panel and reconnect.

### 15.4 Battery Going Flat

---

If the energy use of the G52S' configuration is too aggressive and the solar panel is unable to provide enough charge, the battery will run down and eventually go flat. Consider a few issues:

- Configuration is too aggressive: too many GPS fixes and GSM sessions are using more power than the battery can provide. Reduce the number of fixes and GSM sessions.

---

## 15. TroubleSHOOTING

- Not enough sun: perhaps the device is not getting enough sun. The panel must be in direct sunlight. The angle of the panel to the sun is important too – a perpendicular angle of incidence is ideal.

Measurements suggest that passing light through a windscreen reduces the power output of the panel to 25% that of direct sunlight.

- Constant waking up: if the device is set to wake using the accelerometer and then to check the GPS for movement, it is possible that some kind of vibration or movement is waking the device up too much. The large number of GPS fixes is draining the battery. See section 10.4.6 about disabling the accelerometer wakeup for after a certain number of false wakeups. Try a different combination of wakeup count and sleep period, for example 2 false wakeups, and 2 min of sleep.
- Temperature: is the device out of its temperature range and preventing itself from charging to preserve the battery. Disabling the temperature dependant shunting is an option, but not recommended.

---

### 15.5 SMS Config Issues

Consider the following:

- Is the SMS format correct?  
Remember FW older than 1/2.20 uses a different format. You will need to SMS it with the new format after it gets firmware newer than 1/2.20. Contact DM for help.
- Are the details in the SMS correct? The SMS may be being read, but if it the contents are incorrect, it will not connect.
- Reset the device to get it to turn its modem on and off. Is the LED coming on? Is there sufficient charge in the battery? It must be above 3.5V and ideally above 3.8V.
- The SMS is read from the modem just before it is switched off. So to check that it worked, another connection may need to be triggered. Reset the device again to trigger another connection.
- Is the sender getting a delivery report? This would confirm that the modem is being switched on and the SMS is being delivered.

---

### 15.6 Poor Trip Start Performance

In some cases, trip starts may be far beyond the trip start threshold (default 250m). This may be because the device has disabled its accelerometer due to excessive wakeups, and is sleeping for the configured period. Upon waking, it is checking the GPS and realising it is in a trip. This may be further away than the start threshold, resulting in poor trip start reproduction.

As an example, consider a device on a car. If the driver disturbs the car initially by opening the boot, the G52S will wake up to get a fix. It may get the fix in 5 sec. It will see that it hasn't moved and sleep. The driver may continue to start to drive and the device will continue to wake up and check the GPS position. By default, if it wakes up 7 times (5 sec x 7 = 35 sec) without crossing the 250m threshold, it will sleep for 3 min. The vehicle may easily cover 500m in 3 min, resulting in a poor trip start.

To improve this, adjust the excessive wakeup count and sleep period. Try a combination of 2 wakeups and 60 seconds for example.



## 15.7 SDI-12 Issues

The OEM server is an important tool for debugging installations. The G52S will always record critical errors. Problems encountered with SDI-12 sensors are logged as critical errors. They should be uploaded and viewable in Device Details -> Logs.

### 15.7.1 Common Errors

Common errors and how they can be interpreted:

Error	Meaning
Boost regulator BAD	The 5V output is not able to sustain the 5V output. Usually this is because there is a short on the cable.
Error in response identifying SDI12 sensor at address X	Usually means no probe is attached. The device is unable to communicate with the probe. Test probe and cable.
Error in command identifying SDI12 sensor at address X	SDI-12 protocol error. Contact DM as something is not behaving according to the SDI-12 specification. In the past, this has been either a slow probe or an overly long ID string.
Error in SDI12 measure response. Address=X measure=Y	SDI-12 protocol error. Contact DM. In the past, this has been due to a slow probe.

### 15.7.2 SDI-12 voltage

The G52S was originally designed to work with 5V SDI-12 devices. 3.3V device may work, but performance was unpredictable. A modification was made in October 2014 to improve the sensitivity to 3.3V SDI-12. This should improve reliability with 3.3V devices. Contact DM if you would like further information.