(Q)be©

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1.2	15/11/2018	STE Industries address updated. Document versioning added. 2.1.12: added note on GSM test.
1.1	22/09/2017	Second edition of the document – added 902-928MHz band and 3G module features
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1 OVERVIEW

The (Q)Be© STATION is a "driving through" gate based on the patented micro.SP© technology. It enables a fast monitoring of TPMS Micro.SP© sensors installed in tires.

Data from sensors is collected by the 2 receivers, each one fitted into a tower, while truck vehicles do not need to stop (dynamic monitoring) passing through the dedicated gate area, and it is later delivered to the database for the relevant analysis of pressure, temperature and battery status.

The (Q)Be© standard installation consists of 1 Master tower and 1 Slave tower and adopts a multiple wireless communication platform that enables the system to collect in "real time" data coming through the Micro.SP© wireless sensors installed in tire stems or truck extensors (PM1712©, BST1712-XT valve extensors or OEM valves); the Master tower also features a 3G device to communicate with the remote central data collector.

It is also possible to expand the installation by adding 2 extra Slave towers like in previous (Q)Be© product version, for example in case performance requirements are particularly critical.

The installation includes a vehicle sensor in all towers to wake each receiver autonomously when vehicles pass by, and to turn off operation when vehicles are not in the operative range: the activity of sensors monitoring is activated only during the drive-through operation, for an enhanced energy efficiency of the system.

The Master tower, through a wireless communication system ((Q)Be© data exchange network) based on standard 902-928MHz ISM frequency band as specified in FCC part 15.249, is set to poll the slave and the collected data coming through the (Q)Be© is filtered and delivered over the air via GPRS/3G to the central IT platform database where data is monitored and analyzed.

The mother board has also the function to perform a first logical data filter going through sensor ID and time of collection.

The (Q)Be© architecture adopts a plug 'n play approach and the installation is as simple as possible to reduce time to set the system into operation. Harnesses and required tools for fitting (Q)Be© towers are very simple and user friendly.

The system is engineered to operate with battery cells: the adopted (primary) battery cells, that are installed in each tower, guarantee 1 year of continuous operation with an average of 200 vehicles passing through each day; in following releases an optional solar panel may be adopted for an extended system autonomy (in this case, proper rechargeable batteries shall be chosen).

The (Q)Be© station includes all the necessary hardware, interfaces, connectors and cables that are needed for a correct installation.

In order to collect a reliable amount of data readings, vehicles are required to pass through the monitoring area at very low speed (<5km/h) or better, if possible, stop for 5-10 seconds after passing the gate. Optimum vehicle detection occurs if towers are installed at ≤ 5m distance from each other.

1.1 Features

The (Q)Be© has the following features:

- Micro.SP© sensors to provide TPMS monitoring
- Wireless communication between master and slave towers
- Vehicle sensor to activate the system only when needed
- Powered by battery cells (with optional solar panel to be investigated in later releases)

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1.2 Understanding the user guide

The User Guide is subdivided into the following sections:

Overview: Provides a general introduction for using the product, the type of technology used, and recommended practices for using it.

Installation: Provides a detailed step by step instruction for a correct set up of the system: please refer to this section for details on getting the unit up and running. This section included all the necessary steps for the unit to be active and ready to work.

Specifications and additional information: List of definitions and acronyms; list of functional, electrical and technical specifications.

1.3 System Contents

(Q)Be© v4 station system consists of the following items:

- Nr. 1 (Q)Be© Master unit, including:
  - 3G communication module
  - TPMS receiver
  - (Q)Be© data exchange network – 902-928 MHz ISM band
  - Vehicle sensor for proximity activation
- Nr. 1(Q)Be© Slave unit, including:
  - TPMS receiver
  - (Q)Be© data exchange network – 902-928 MHz ISM band
  - Vehicle sensor for proximity activation

Up to 2 extra Slave units can be added to the system if required, for a maximum total of 1 Master and 3 Slave.

1.4 Understanding functions

In the following sections, all functions of (Q)Be© station are listed and described in detail, in order to understand the operating principles of the system.

1.4.1 Micro.SP© technology

Direct TPMS systems utilizing traditional standard ASK or FSK modulation have several limitations, the most important being the high energy consumption required by these systems to transmit with acceptable efficiency. In battery-powered devices, this means that either batteries need to be frequently replaced, or energy consumption must be lowered, thus decreasing system performance.

Micro.SP© technology, patented by STE, is based on short RF pulses transmitted with Pulse Position Modulation (PPM) technique, which guarantees high RF peak power, as required for radio link reliability, but with a very low average power (Power Density) and consequently

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low current absorption (in the order of 200 µA) during the transmission period. This allows the use of very small primary batteries and also the possibility to employ autonomous energy sources (Energy Scavengers).

Benefits of Micro.SP© technology are:

- High reliability
- Excellent RF performances
- Low power consumption
- Low cost

1.4.2 Activation via vehicle sensor

The operative way to monitor data incoming from the extensors devices, illustrated in Figure 1, consists of the following steps:

1. When a vehicle passes through the gate, the vehicle sensors activate Master and Slave towers autonomously; the SPR micro.SP© receivers interfaces wake up and, through the antennas integrated into the towers, system is ready to collect data.
2. While the vehicle drives through the gate, the receivers collect the data packets sent from the micro.SP© based TPMS devices located on each tire.
3. All data is captured when the vehicle moves along the 2 towers: (Q)Be© master, by means of the 902-928MHz (Q)Be© data exchange network, polls the (Q)Be© slave and collects captured data.

The “drive through” concept guarantees a smooth operation and service is performed in the quickest way so that, when the vehicle passes by the towers, all data is safely recorded and ready to be filtered and delivered to the central server by the 3G module on the (Q)Be© master tower.

Due to the fact that the system is activated only by the vehicle sensor and stays in idle state otherwise, a very good system energy budget is guaranteed.

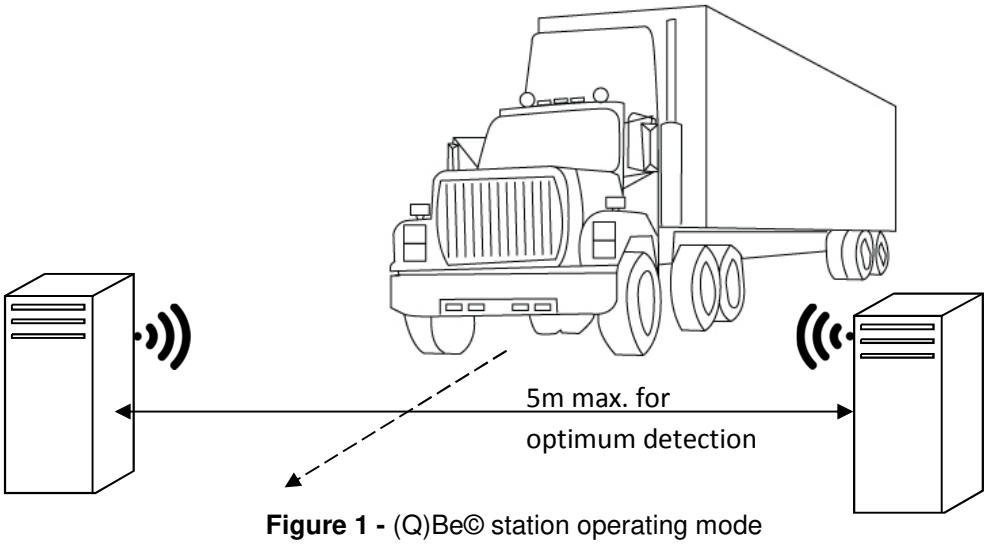

Figure 1 - (Q)Be© station operating mode

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1.4.3 Wireless sensor monitoring

Wireless sensor system is based on Micro.SP© technology.

Whenever a vehicle passes through the gate, Data from TPMS sensors is transmitted continuously from valves, located into each tire of the vehicle, to receivers located into (Q)Be© station master and slave towers. Transmitted data includes tire pressure, temperature and battery voltage.

1.4.4 GPRS/3G communication

Master tower is programmed to gather the TPMS data packets received by the two towers and send them through the 3G module to the central database station, where data is processed and analyzed.

1.4.5 PC configuration and system requirements

- Operating system: Windows 7, 8 or 10
- VCP (Virtual COM Port) driver for FT230X chip. Please refer to section 2.2 for driver download and installation.

1.5 Physical Description

The following sections describe the physical characteristics of (Q)Be© station.

1.5.1 (Q)Be© Mother Board

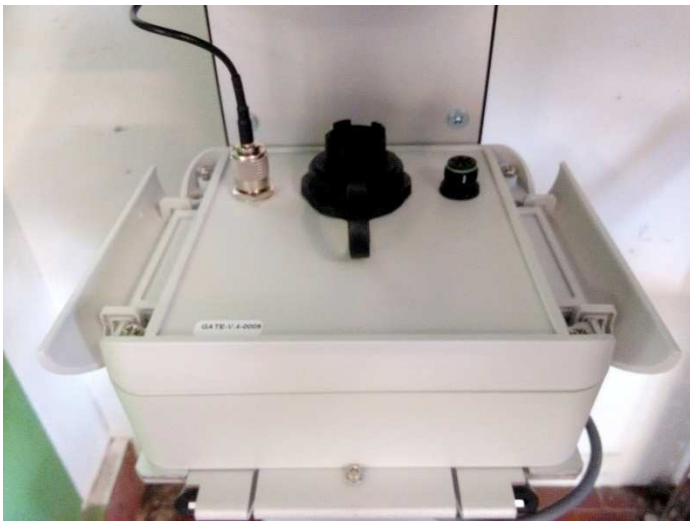

Figure 2 - (Q)be© mother board (master) box

The (Q)Be© mother board is encased in a waterproof plastic box IP66 compliant plastic case to guarantee protection from water, dust and moisture.

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The following connectors are provided:

- 1 USB connector for (Q)Be© system configuration (only for Master tower)
- 1 BNC for 434 MHz (Q)Be© TPMS antenna (both Master and Slave)
- 1 power supply connector to connect the Mother Board to the battery (both Master and Slave)

The plastic case is mounted inside the tower on the upper rack of the metal bracket.

To facilitate maintenance and replacement, it is designed such as all the wirings and connectors are easily accessible.

1.5.2 Metal Bracket

The Metal bracket consists of 3 racks.

Top rack is provided with holes to mount and hold in place 434MHz TPMS receiver antenna.

Mid rack with holes to mount and hold in place (Q)Be© mother boards.

Bottom rack houses battery pack.

The metal brackets are painted in black.

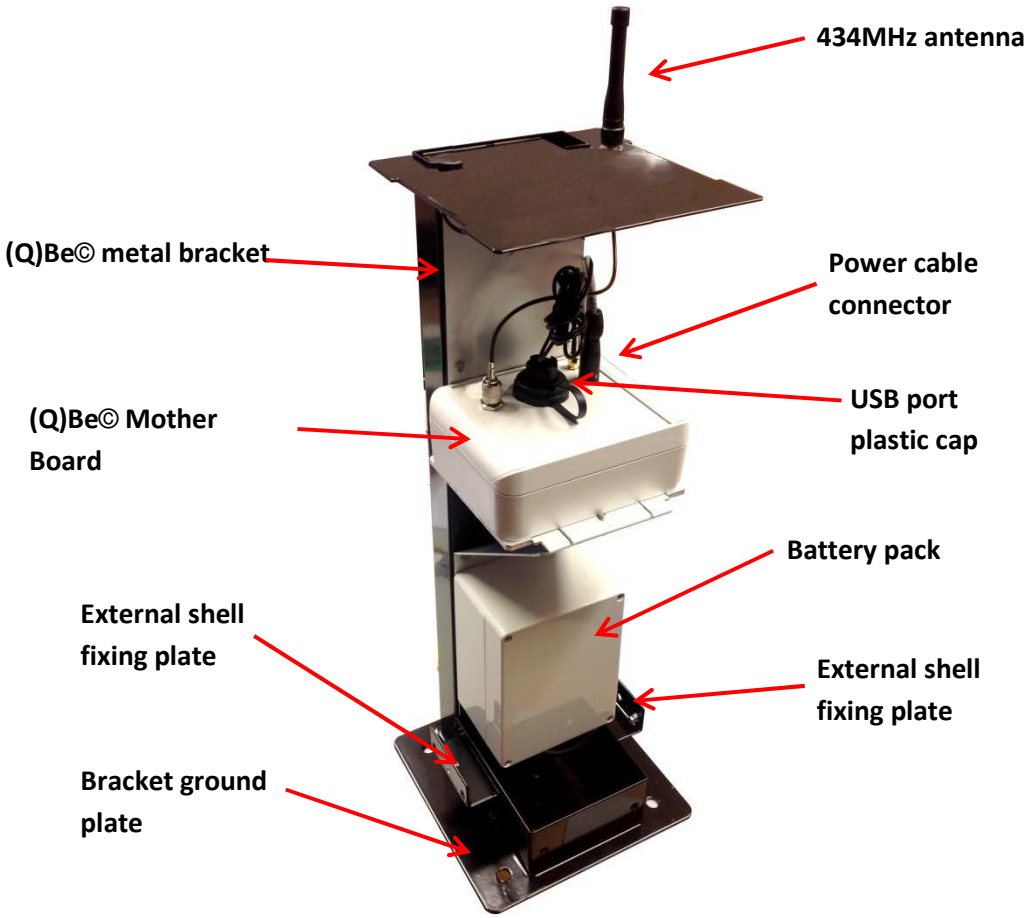

Figure 3 - (Q)Be© metal bracket with installed components

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1.5.3 External shell

The plastic external protection is a light weight robust construction consisting in a modular number of lower sections and one top section: parts are solidly coupled with mechanics designed by STE.

The plastic PVC shell is anchored to the internal metal bracket by means of three bolts (two on the right side, one on the left side) placed in the lower section of the shell.

The shell is UV resistant and it is robust enough to guarantee protection from external agents.

Figure 4 - (Q)Be© with external shell. Left side of (Q)Be© tower is shown.

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2 INSTALLATION

The product consists of two towers. Check that each tower has the following content:

- Metal Bracket nr.1
- Plastic cover nr.1
- Battery pack nr.1
- (Q)Be© mother board nr.1
- (Q)Be© TPMS antenna nr.1
- Shells fixing bolts nr.3
- Bracket plate dowels and screws nr.4
- USB type B cable nr.1 (master tower only)

Note: the product does not include data network SIM card, it has to be provided by the customer.

The following tools (not included in product content) are needed for the installation:

- Square head screwdriver (Ø5mm, max length 12cm)
- Hexagonal spanners (Ø16mm, Ø8mm)
- Drill to pierce holes in concrete or tarmac, Ø8mm
- Hammer to fit bracket plate dowels and screws

2.1 System setup

Follow carefully the next sections for detailed setup instructions.

2.1.1 (Q)Be© system placement and installation

For best system efficiency, it is recommended that master and slave towers are placed as shown in the figure below, with front sides facing each other.

i	**Note**: Towers shall be first powered on and configured correctly, as explained in next sections, before fixing them to the ground.

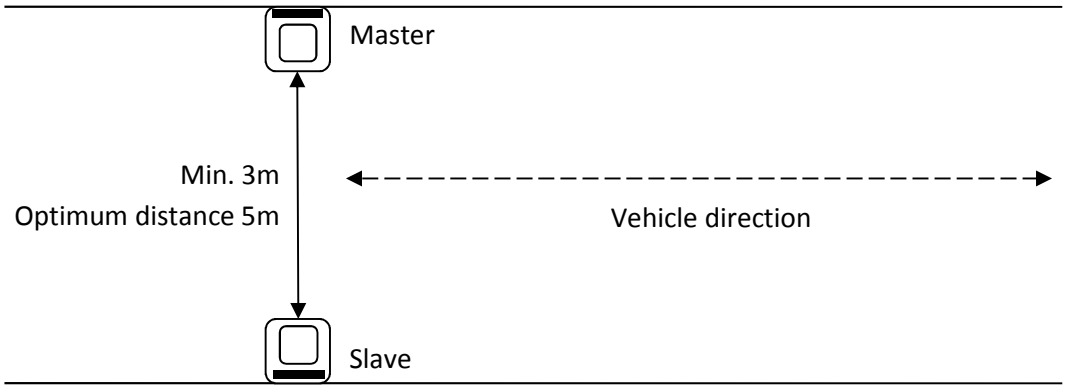

Figure 5 - (Q)be© station system placement instructions

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2.1.2 Removing (Q)Be© plastic cover

(Q)Be© towers are delivered with plastic cover already mounted. In order to install the product, plastic cover must be removed following the steps below:

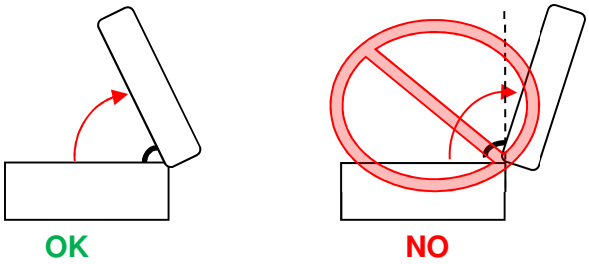
- Unscrew the three hexagonal screws located on the sides of the tower (2 on the right side, 1 on the left side)
- Lift the plastic cover carefully

⚠	**Caution**: When lifting the plastic cover, do not damage the antenna located on the upper rack of (Q)Be© metal bracket.

Figure 6 – Lifting (Q)Be© plastic cover

2.1.3 (Q)be mother board setup

1. Open the lateral apertures of the plastic box
2. Unscrew the four screws
3. Lift the upper side of the box

⚠	**Warning**: Lift the upper side carefully and do not exceed the opening angle of 90° to avoid damaging cables and connectors. 

The main controls and functional blocks of (Q)be Master unit mother board are highlighted in the picture below. Slave unit is equipped with the same circuit board but the blocks required only on Master (3G, CPU, SIM card holder) are not mounted.

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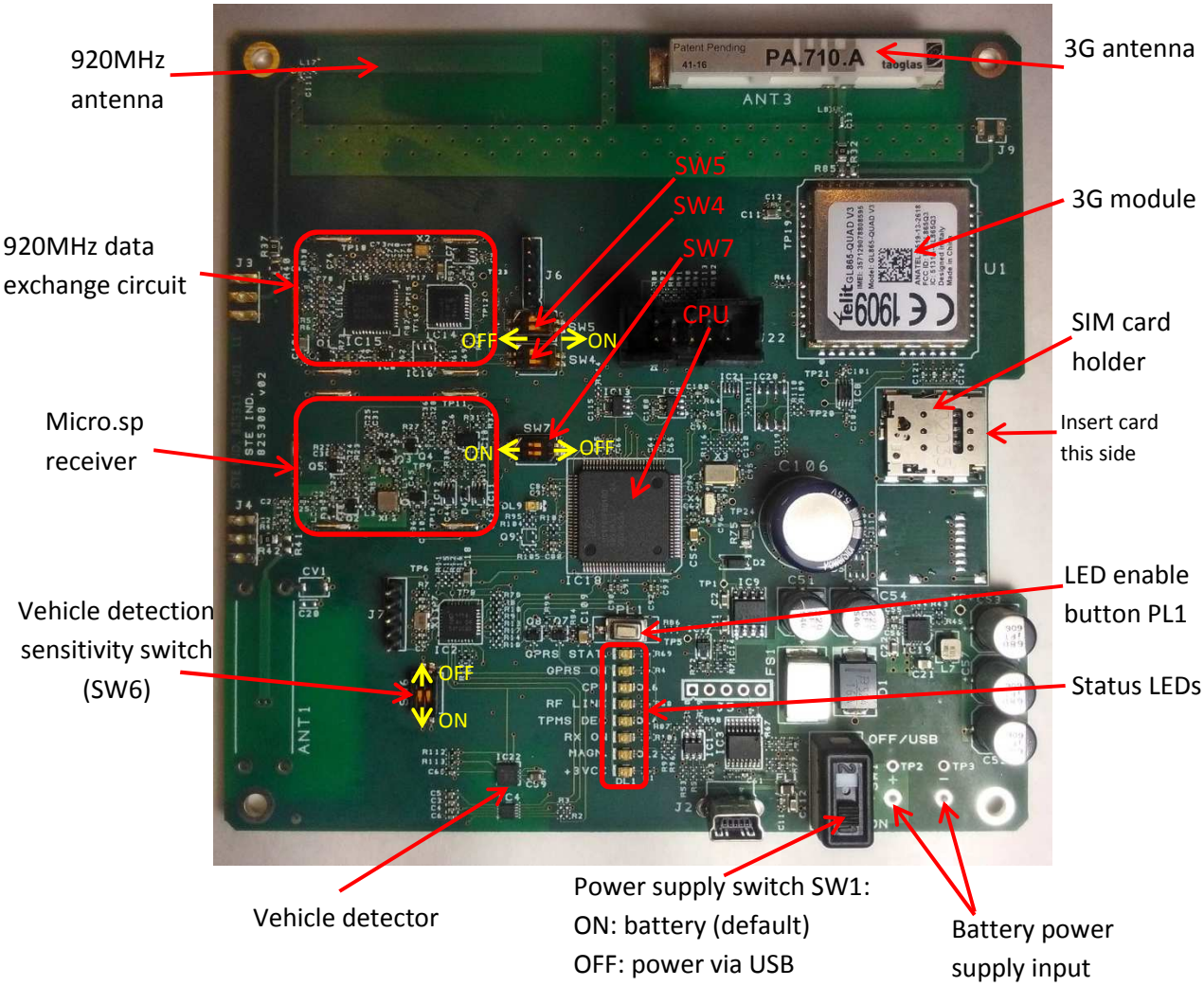

Figure 7 – (Q)Be© mother board

The functions of each status LED are explained in the table below.

LEDs are disabled in normal operating mode in order to save power thus increasing battery lifetime. By pressing PL1 button (see picture above for PL1 position) they can be enabled for some minutes: this feature is required to monitor the system during initial setup or troubleshooting.

LED ID	Function	Description
DL1	3VCC	ON when main power supply is applied.
DL2	MAGN	Long blink (1 sec) when a vehicle is detected.
DL3	RX ON	ON when Micro.sp receiver is powered up. Activated by vehicle detection.
DL4	TPMS DEC	Short blink each time a valid TPMS sensor is received.
DL5	RF LINK	ON when the device is ready for Master-Slave data transfer. During this phase it turns rapidly OFF (and then ON again) each time a data packet is exchanged between Master and Slave.
DL6	CPU	ON when CPU is active (Master only)
DL7	GPRS ON	ON when 3G module is powered up (Master only)
DL8	GPRS STAT	3G status and alarms LED (Master only – currently not used)

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2.1.4 Detection sensitivity

Vehicle detection sensitivity is controlled by setting DIP switch SW6 on both Master and Slave towers before powering up the system. Please refer to Figure 7 for SW6 location. You will need a small pointed tool to operate the switches.

Switch 1	Switch 2	Sensitivity
Off	Off	Highest
Off	On	High (default option)
On	Off	Medium
On	On	Low

Note that it is possible to set levels differently on Master and Slave in order to optimize vehicle detection in any installation.

Also note that, when changing sensitivity levels, the system must be restarted before the new settings can be taken into account. Disconnect power cable (see 2.1.7 for details) after setting DIP switches and wait a few seconds until reconnecting it.

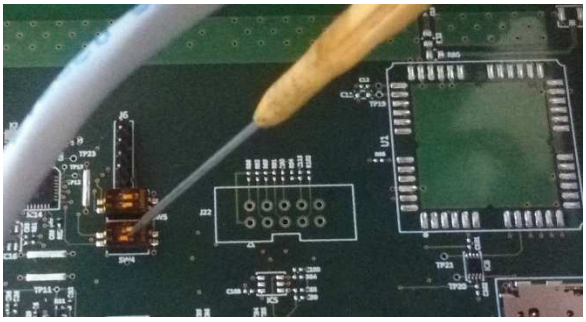

Figure 8 – Setting DIP switches

2.1.5 System configuration DIP switches

Slave address is determined by DIP switch SW4 and identifies the role of a tower in (Q)be Gate System as explained in the table below. Please refer to Figure 7 for SW4 location. Default configuration includes only Master and Slave 1: the other two Slave units are optional. This DIP switch is programmed in factory and should never be changed.

Switch 1	Switch 2	Identifier
On	On	Master
On	Off	Slave 1
Off	On	Slave 2
Off	Off	Slave 3

Installation address is determined by DIP switch SW5 and defines the address that Master and Slave units use to communicate between each other. Data polling only occurs when Master and Slave(s) have the same installation address. This feature can be used in the particular case when multiple Gate systems need to be equipped in the same area, in order to prevent those systems from interfering with each other. Please refer to Figure 7 for SW5 location.

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Switch 1	Switch 2	Installation
On	On	Address 0 (default)
On	Off	Address 1
Off	On	Address 2
Off	Off	Address 3

DIP switch SW7 is equipped only on Master unit and defines the number of Slave units present in the system. At present only the default configuration (one Slave) has been tested and released.

Switch 1	Switch 2	Configuration
On	On	No slave units, Master only
On	Off	One slave unit (default)
Off	On	Two slave units
Off	Off	Three slave units

2.1.6 SIM card installation (only on Master tower)

Note: SIM card is not included in (Q)Be© product content, it must be provided by the customer.

SIM card shall be installed in the mother board of (Q)Be© master tower. A Nano SIM card is required.

To install the SIM card, remove the SIM card tray from the holder, then place the card on the tray and slide it towards the holder (as shown in the figure below) until it is inserted completely. You may need a small tool (e.g. pincers) to help pushing the card inside.

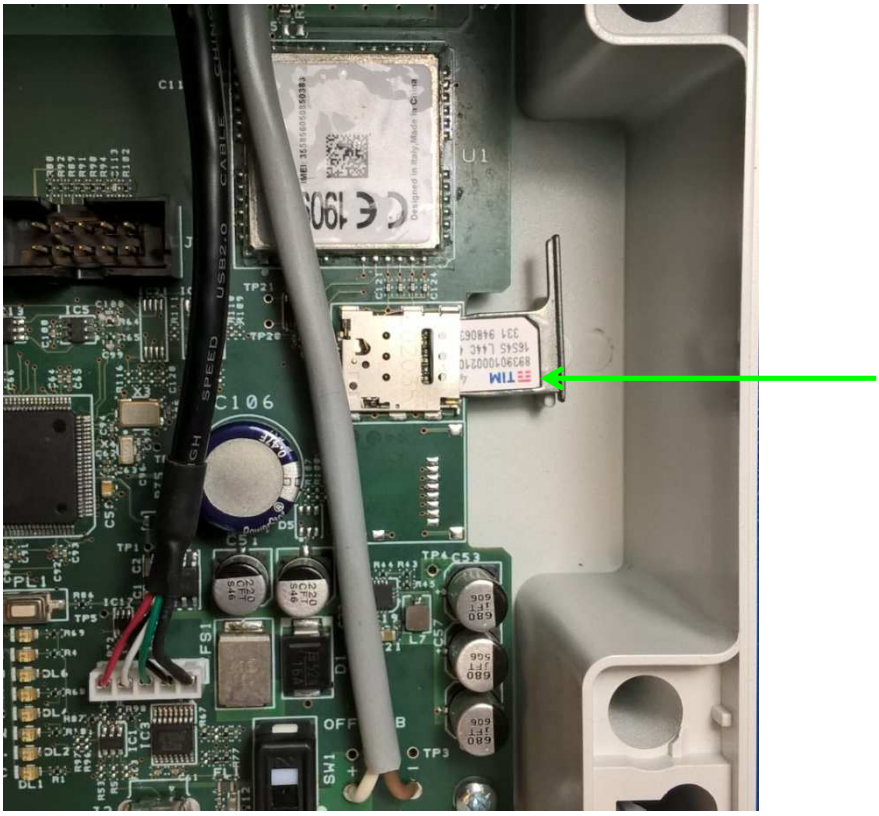

Figure 9 – SIM card insertion

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2.1.7 Connecting power supply

⚠	**Warning**: Do not open the battery box. Do not remove the battery box from the metal bracket.

⚠	**CAUTION:** risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.

Align the power cable to the appropriate direction and carefully connect it to the mother board (see figure below).

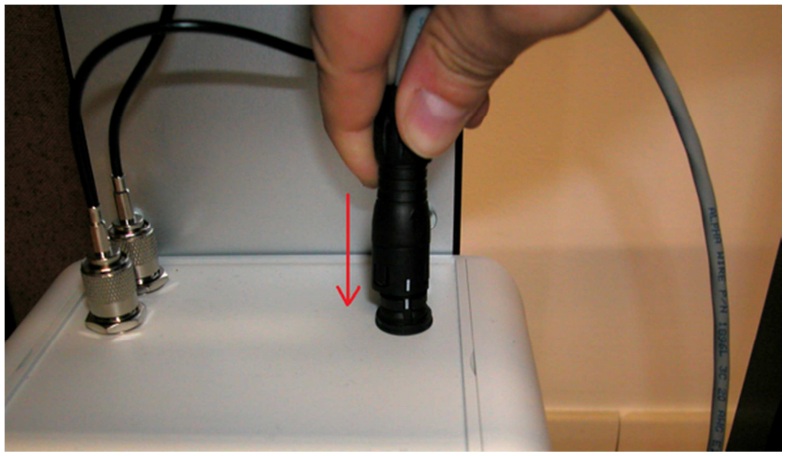

Figure 10 – Power cable connection

Make sure that SW1 is in ON position. Open the plastic box, press PL1 button (it is located near Status LEDs) and check that DL1 is on.

2.1.8 Software setup

In order to configure (Q)Be© station, VCP (Virtual COM Port) driver for FT230X chip, if not already installed, must be downloaded from FTDI website and installed on your PC.

The latest version of VCP driver setup executable can be downloaded at the following link:

- http://www.ftdichip.com/Drivers/CDM/CDM20828_Setup.exe

Installation instructions depend on your computer's operative system. Please download the appropriate instruction manual from the following link and follow the installation steps indicated in the manual.

- http://www.ftdichip.com/Support/Documents/InstallGuides.htm

2.1.9 System Configuration

After FTDI driver has been installed successfully, please follow the next steps to configure (Q)Be© system:

1. Unscrew by hand the USB port plastic cap of (Q)Be© master tower.
2. Connect the USB cable from any free USB port of the PC to (Q)Be© master tower USB Type B connector.
3. Open "Gate Interface" Windows application.

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4. Select the correct COM port.
5. From pull-down menu, select the “Connect” button. If the connection is successful, the output message “Connected to COMx” (where x is the COM port number) shall be printed on the upper side of the window.
6. Configure Gate Interface parameters by selecting the “Settings” tab (see Figure 11).
   a. Read currently stored entries by clicking the “Read Parameters” button.
   b. If any parameter needs to be modified, type the new value in the corresponding box, following the rules indicated in the table below, then click Write. Make sure that the system replies with an “OK” in the corresponding box of the Result column, otherwise check and retry.

Parameter	Description	Note
Gate ID	Gate name or identifier	1)
PIN SIM	SIM card pin number (min 4 digits)	
APN SIM	Access point name (max 50 chars)	
User SIM	APN user name (max 10 chars)	2)
Password SIM	APN user password (max 10 chars)	2)
GSM/UMTS Band	GSM: Select from the pull-down menu one of the options depending on your location. Default option for this product version is 3 (“USA”). UMTS: This feature is currently not active as it is not supported by UL865 module.	
TPMS Filter	Select from the pull-down menu On (multiple readings of the same TPMS ID will be ignored, only the first is stored) or Off (store every subsequent reading of any TPMS ID). Default option is On.	
Battery Type	Select the option “Battery” from the pull-down menu. “Solar” is not implemented in this product release.	
Over Pressure Limit	Insert the desired value in Bar using the comma (,) as decimal separator	
Under Pressure Limit	Insert the desired value in Bar using the comma (,) as decimal separator	
GSM transmission rate	Insert the desired rate in hours. Default value is 12. Min=1	
GSM lifetime rate	Insert the desired rate in hours. Default value is 12. Min=1	
EMS URL/IP Address	Server address (max 50 chars)	
EMS TCP Port	TCP server port. Port number = 443 for TLS use.	
EMS Token	Max 125 chars	
Json Host Header	Max 40 chars	
Json POST Header	Max 65 chars	

Notes:
1) This parameter is read only.
2) In case username and password are not required, leave both parameters blank and click both Write buttons to store the data.

7. After all parameters have been written, click the “Confirm Data” button. If all values are correct, the result “OK” shall be printed next to the “Confirm Data” button. Otherwise the system replies with “ERROR”: please check each parameter and retry step 6.

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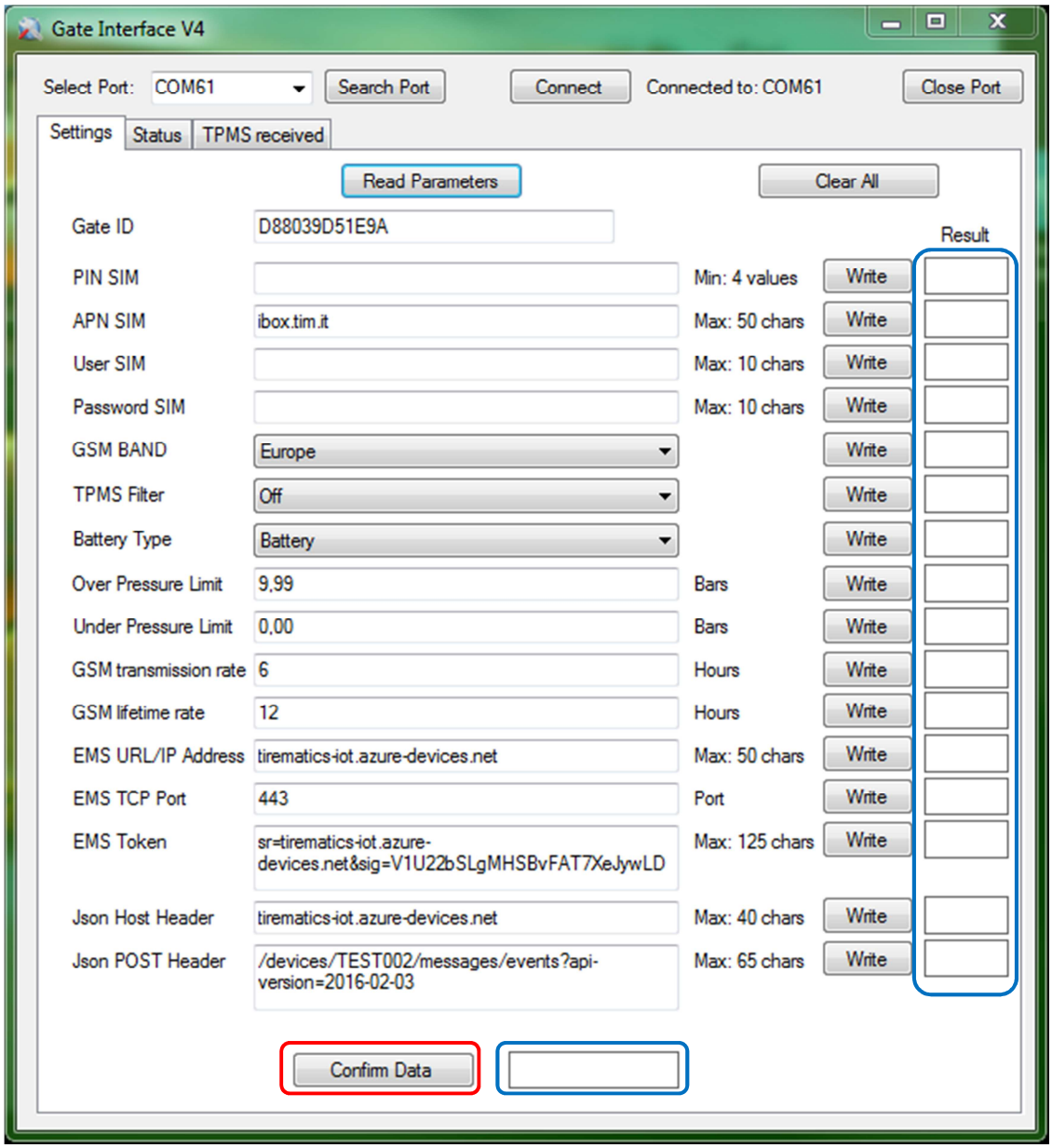

Figure 11 – Gate Interface settings

2.1.10 Vehicle detection test

Scope of this test is to determine the optimum sensitivity thresholds for Master and Slave for any location.

A vehicle with TPMS sensors equipped on its tires is required for this test.

1. Open the box containing Master circuit board and press PL1 button in order to activate Status LEDs. Repeat this procedure on Slave unit. Wait until both DL3 and DL5 turn off.

2. Transit with the vehicle in the area between the two towers and check that:
   a. When the vehicle approaches the Gate, LED DL2 is turned ON both on Master and Slave for about one second.
   b. Immediately after DL2 activation, DL3 is turned ON both on Master and Slave.

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c. Monitor DL4 on both Master and Slave: it will blink shortly each time a valid TPMS sensor is received.
d. If at least one TPMS sensor has been received by Master unit, after 15 sec DL5 is turned ON. Master unit then starts polling Slave for TPMS data exchange. On Slave unit, DL5 is turned ON as soon as a TPMS sensor has been received. Wait other 15 sec then repeat step 2 a number of times in order to have reliable statistics.

If DL2 is not turned on in most of the transits, raise the sensitivity by selecting the desired value on SW6 dip switch (refer to section 2.1.4 for detailed procedure), then restart the system and try again.

If DL2 turns on spontaneously quite often even if there is no vehicle transit and no metallic objects pass close to the detector, then its sensitivity may be too high: decrease it by selecting the desired value on SW6 dip switch (refer to section 2.1.4 for detailed procedure), then restart the system and try again.

3. On Gate Interface V4, select “TPMS Received” tab and click “Read Data”. Every received TPMS sensor is displayed in the window below. Check that a consistent number of sensors has been received and finally click “Stop test” to end this activity.

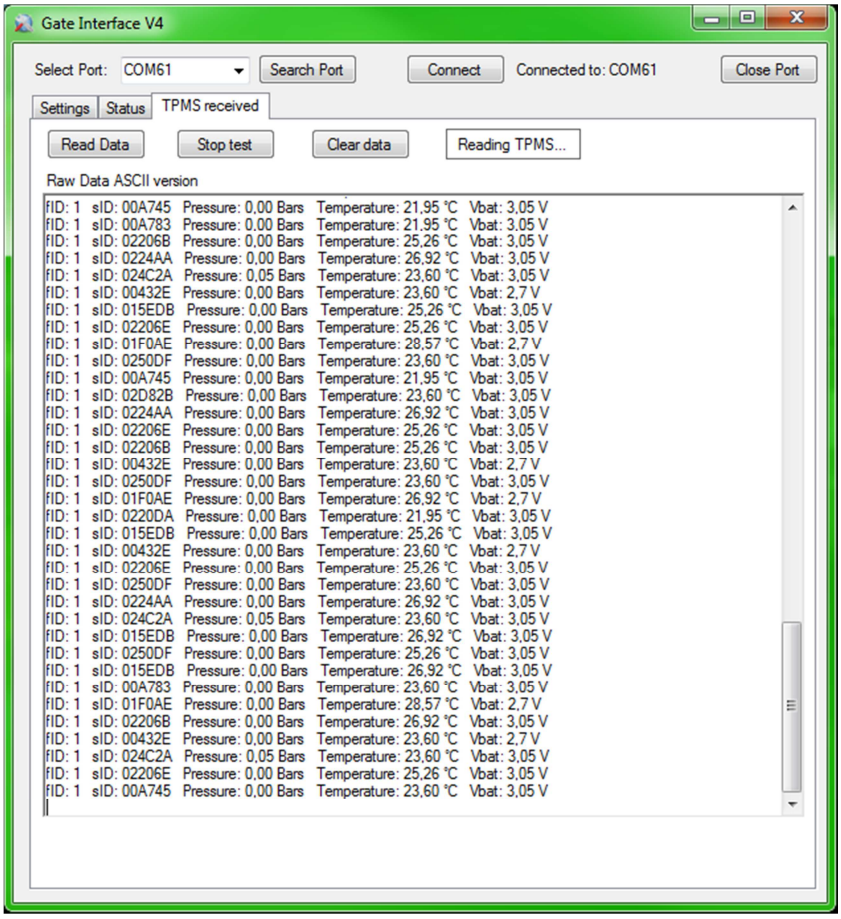

Figure 12 – TPMS received

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2.1.11 Testing towers

To start the test, click the “Test Towers” button on Gate Interface V4, as shown in the figure below.

After a short time, output parameters of each tower (Battery voltage, quantity of TPMS sensors received, Tower link quality and Temperature) are shown on the Gate Interface window and test is stopped automatically.

Check that:

- Measured battery voltage is greater or equal to nominal voltage (6V) both on Master and Slave Tower
- The number of TPMS received corresponds to the statistics shown in the “Vehicle detection test” section
- Temperature reading is consistent both on Master and Slave Tower

Link quality is the ratio between Master polling attempts and successfully read replies from Slave. It may be significantly lower than 100% e.g. if towers have not been activated in the same time frame, thus it is not a measure of system performance.

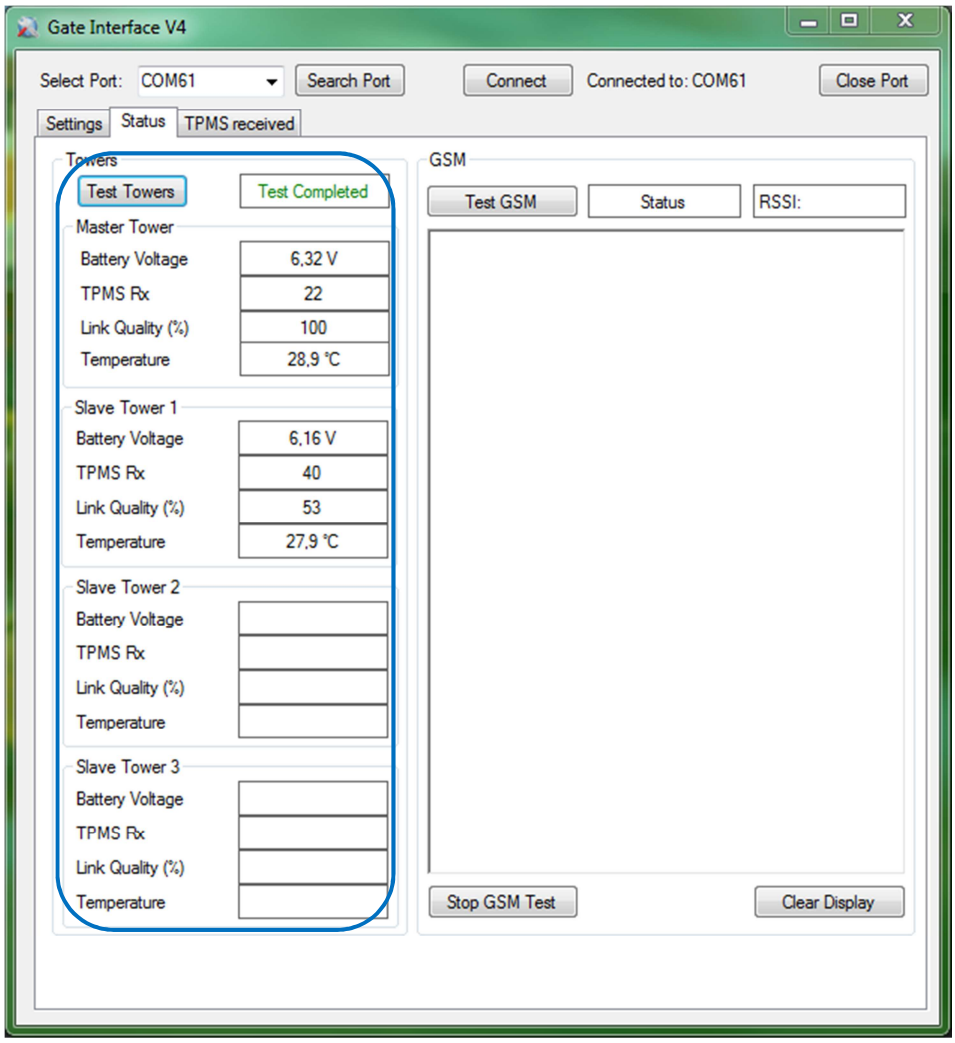

Figure 13 – Tower test results

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2.1.12 GSM Test

Note: this test applies to both GSM and 3G modules.

Before starting the test, it is recommended to download and install Device Explorer to monitor data sent to the server. It can be downloaded from https://github.com/Azure/azure-iot-sdk-csharp/releases/.

1. Open Device Explorer, select Configuration tab and copy the following string into the "IoT Hub Connection String" window:

   HostName=tirematics-iot.azure-devices.net;SharedAccessKeyName=iothubowner;SharedAccessKey=Z6ip+HnDiugv0C2it5OsxJDS55rJ0cUPCmuK18e5Xjw=

   Click the Update button and check that the program responds by opening the "Setting updated successfully" popup window.

   Select Data tab and choose the same Device ID written in the Json POST Header entry (see section 2.1.8). Default Device ID is FL001_G01. You may select another Device ID, provided that you first update the corresponding entry in the Json POST Header as explained in 2.1.8. Also EMS Token can be modified, if required.

2. On Gate Interface V4, to start GSM test click the "Test GSM" button, as shown in Figure 14. System status will change to "Testing GSM" and results are printed on the screen below.

   GSM test may take several minutes. During this time, if communication with Bridgestone server is successful, you should see data transfer on the Event Hub Data window as shown in Figure 15.

   If it is successful, the result "GSM: OK" is printed (see Figure 16). Click "Stop GSM Test" button to end this test procedure.

   (optional) After a successful GSM test click again on the "Test Towers" button as explained in section 2.1.11. The numbers of TPMS received by Master and Slave towers "TPMS RX" should be either 0 or lower than the previous readings, meaning that TPMS data has been successfully transferred to the remote server.

   In case of any error, the test is interrupted and the message "GSM: ERROR" is printed (see Figure 17). Click "Stop GSM Test" button to end this test procedure and retry after troubleshooting.

Possible causes of error are listed in the table below.

Error case	Error description / possible cause
Power ON GSM	Power supply failure or HW failure.
Serial Communication with GSM device	HW failure.
Verbose Mode Activation	GSM/3G failure.
Choice Band Plan GSM network	Wrong GSM/3G band selection.
Connection to the GSM network	GSM/3G network may be temporarily unavailable.
APN settings	Check APN settings in section 2.1.8 and enter

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	the correct parameter.
Socket configuration	Wrong username or password. Check settings in section 2.1.8.
Activation socket	Either network is temporarily unavailable or connection is refused by the carrier.
Opening socket	Bridgestone server temporarily refuses the connection.
Data transfer to Bridgestone Servers....	Connection to Bridgestone servers has been interrupted during data transfer.

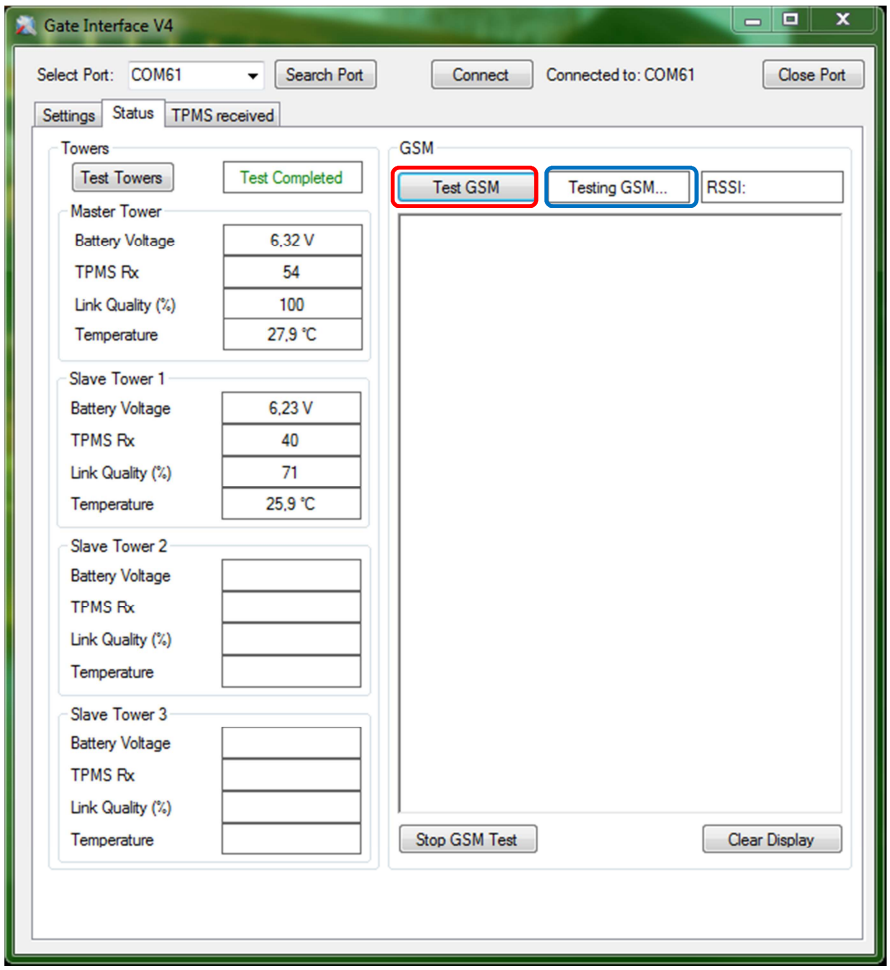

Figure 14 – GSM Test start

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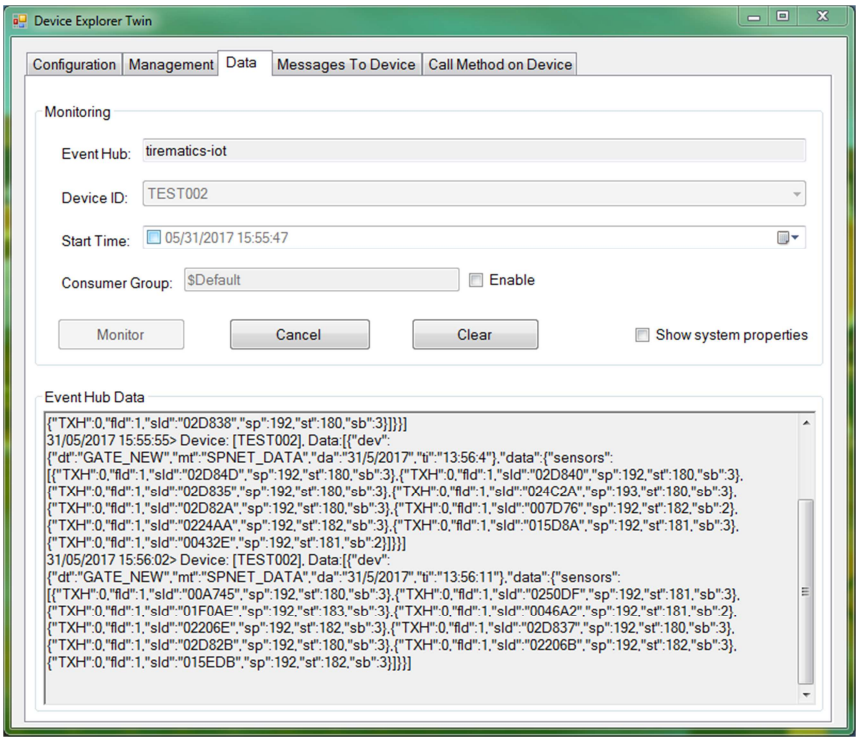

Figure 15 – GSM data sent to Bridgestone server

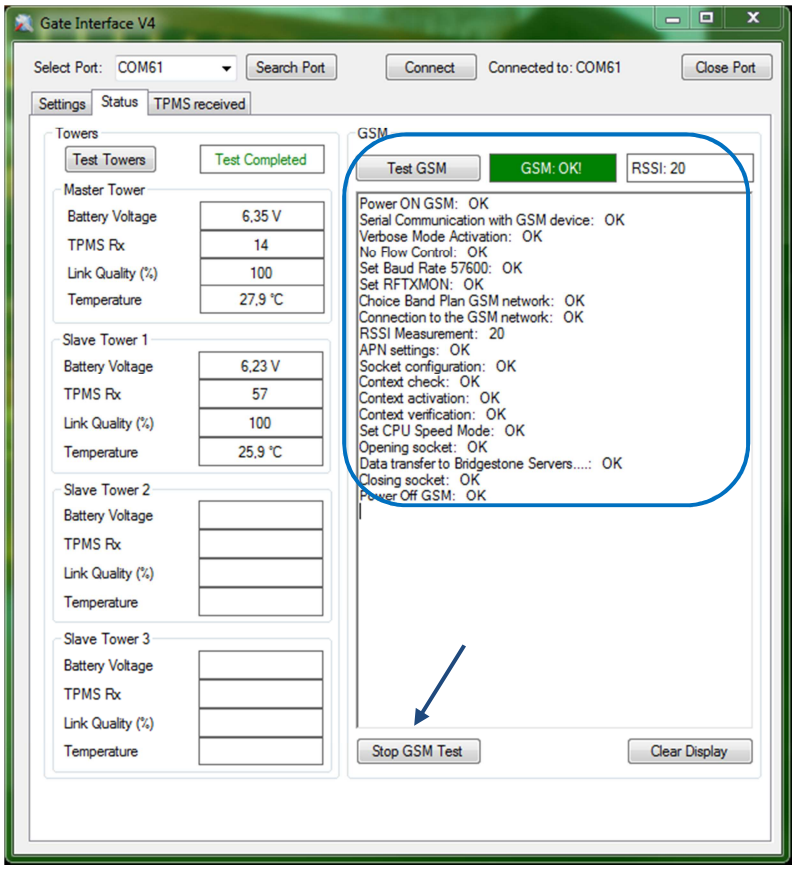

Figure 16 – GSM Test passed

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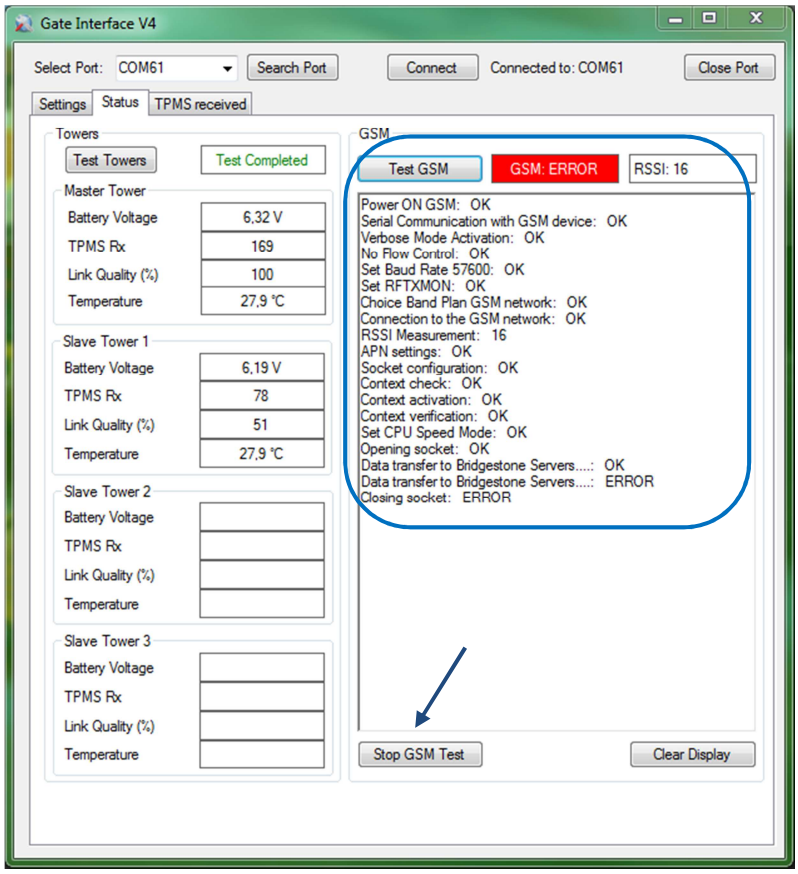

Figure 17 – GSM Test failed

2.1.13 Fixing Tower bracket

After the system has been configured and tested, please follow the steps below:

1. Close the mother board box carefully, avoiding to crush cables
2. Screw the four screws
3. Close the lateral apertures of the plastic box
4. Fasten (Q)Be© towers to the ground with four fixing bolts (included in the installation content). Use a hexagonal spanner of the appropriate diameter and fix firmly the towers to the concrete floor.

2.1.14 Re-installing (Q)Be© plastic cover

To complete the installation, re-install (Q)Be© plastic cover on top of the metal bracket.

⚠	**Caution**: When placing the plastic cover on top of (Q)Be© metal bracket, do not damage the antennas located on the upper rack.

Insert the plastic cover carefully and in the right direction (so that there shall be two holes on the right side and one on the left side), then screw the hexagonal screws. Do not overtighten, otherwise the plastic cover may break.

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3 SPECIFICATIONS AND ADDITIONAL INFORMATION

3.1 Glossary

ASK	Amplitude-Shift Keying
ETSI	European Telecommunications Standards Institute
FSK	Frequency-Shift Keying
GPRS	General Packet Radio Service
ISM	Industrial, Scientific and Medical radio band
PPM	Pulse Position Modulation
RF	Radio Frequency
TPMS	Tire Pressure Monitoring System
TPS	Tire Pressure Sensor

3.2 Electrical and Functional Specifications

Parameter	**Minimum**	**Typical**	**Maximum**
Supply Voltage	4V DC	6V DC	11V DC
Current Absorption			2A @3.6V (peak pulse during GSM/3G transmission)
Frequency of TPMS receiver		434.4 MHz	
Frequency of Network for collecting data between Master and Slave		922.4 MHz	
Radiated Power (dBµV/m at 3m)		85	
Frequency of GSM Module		850/900/1800/1900 MHz	
Frequency of 3G Module		850/900/1900/2100 MHz	
Operating temperature	-20°C		+55°C
Expected battery life at average temperature considering 200 trucks passing through per day		1 year	

3.3 Mother Board Plastic Enclosure Technical Specifications

Fire classification	Flame Retardant (UL 94 V-0)
Protection Class	IP 66

3.4 Plastic External Shell Of Towers: Technical Specifications

Color	white
Material	PP GF30
Mechanical dimensions	200 x 200 x 650 mm
Note: Mechanical dimensions may be subject to variations.	

3.5 Battery pack: Technical Specifications

Model	Duracell PC1300 Size D 1.5V (12pcs)
Nominal voltage	6V (4 x 1.5V)
Capacity	3x15000 mAh
Operating temperature range	-20°C to +55°C

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4 Compliance Information

4.1 FCC Interference Statement (Part 15.105 (b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

4.2 FCC Part 15 Clause 15.21

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

4.3 FCC Part 15.19(a)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference
(2) This device must accept any interference received, including interference that may cause undesired operation.

4.4 ISED RSS-Gen Notice

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1) l'appareil ne doit pas produire de brouillage;
2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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4.5 RF Exposure Guidance Statement

In order to comply with FCC/ISED Canada RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

Afin de se conformer aux exigences d'exposition RF FCC / ISED Canada, cet appareil doit être installé pour fournir au moins 20 cm de séparation du corps humain en tout temps.

Annex 1 – BST1712 TPMS Sensor activation/deactivation procedure

Note: pressure values are meant to be relative.

The TPMS sensor, when programmed, has the following behavior:

1. After power-up, the device transmits 3 times in sequence; after that, the sensor does not transmit anymore and it only samples pressure value, every 5 seconds. This mode is called "zero-bar".

2. The procedure of step 1 is performed until the ambient pressure exceeds 5,5 bar.

3. As soon as the device measures a pressure higher than 5,5 bar, called threshold pressure, the device starts to measure all the values (pressure, temperature and battery voltage) and transmits the message 3 times in sequence; it then activates a decrementing timer of 300 seconds.

4. At the end of the three transmissions, the device enters in semi-operative mode and it starts transmitting every 5 seconds while the timer is still working, until the ambient pressure is higher than 5,5bar.

5. If, during the time when the timer is active, the pressure drops below threshold pressure, the device goes to the mode "zero-bar": it transmits three messages in sequence and goes back to step 2.

6. On the other hand, if the device reads a pressure higher than 5,5 bar for a timer longer than 300 seconds, the timer stops and the device enters permanently standard operative mode and it measure and transmits messages every 5 seconds without stopping.

7. If the measured pressure drop below 0,5 bar the device continues to work as per step 6.

8. If the measured pressure goes higher than 5,5 bars, the device enters in mode as per step 3.

9. If the device has to be turned off, starting from step 7, it is only necessary to keep the pressure higher than 5,5 bar for at least 5 to 10 seconds and then drop the pressure down to a value lower than 0,5 bar and keep that for a time longer than 5 to 10 seconds. Then the device will send three messages in sequence and will pass to "zero-bar" mode.

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