



## DISCO-B5-MAGNET

### Hardware manual



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#### Version history:

*This table provides a summary of the document revisions.*

Version	Author	Changes	Modified
1.0.1	F. Beqiri	- Added configuration settings for the light/dark sensor - see chapter <a href="#">6.2</a> . - Added "Hint:" - An annual replacement of the O'ring rubber recommended. - Added chapter <a href="#">7.1.1</a> - <a href="#">Procedure for greasing the O-ring</a> .	04/10/2012
1.0.0	F. Beqiri	- Initial version.	19/10/2011

## Cautions

Information furnished herein by FALCOM is believed to be accurate and reliable. However, no responsibility is assumed for its use. Please, read carefully the safety precautions.

If you have any technical questions regarding this document or the product described in it, please contact your vendor.

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No patent liability is assumed with respect to the use of the information contained herein.

## Note

Specifications and information given in this document are subject to change by FALCOM without notice.

# 1 INTRODUCTION

This product manual is only addressed to qualified personnel which are well skilled in electronical/electrical installation and not addressed to private consumers/end users. The installation, implementing or setting into operation of the product can only be performed by qualified personnel.

The status of the product described in the data sheet may have changed since publication of the data sheet and therefore information in this data sheet on product status may be outdated. The latest information of the product is available on the download area of the FALCOM website.

## 1.1 General

DISCO-B5-MAGNET is a free configurable smart tracking device which can be fully adapted to different user needs. Using a Quad-Band GSM/GPRS technology for two way worldwide communication, the latest GPS technology for positioning, a high-capacity Lithium-Ion rechargeable battery, and housed in a weatherproof plastic case, the device is suitable for a wide range of mixed outdoor applications in the AVL, fleet management, asset tracking, vehicle security and recovery and transit sectors. The device has a protection class IP69K, which allows mounting of the device permanently on the roof of the vehicles, including buses, trucks, trains, vessels and other assets. The unit is magnetically mounted to your vehicle's roof, and its rubberised feet keep it from scratching your paint. The DISCO-B5-MAGNET contains a truck detection and an anti-tamper detection system. The truck detection automatically informs the user when the device has been mounted or removed from the asset. The anti-tamper detection automatically informs the user when the device case has been opened or closed.

DISCO-B5-MAGNET can be adapted to existing tracking solutions and can be easily configured to gather or exchange relevant information with servers or users directly. An often used example is sending the status reports or alarm messages directly to the users via SMS and/or to the tracking servers via TCP/UDP/HTTP/SMTP. Drivers logbook and data logging functionalities are combined in the history feature. Geofencing can be used to report violations of predefined routes or areas (for example if a car enters or leaves a specific area or deviate a specific route). All of these features are perfectly integrated in a device concept which significantly reduces time-to-market and provides low cost tracking and security solutions.

*DISCO-B5-MAGNET* is a device that can be configured and integrated onto any asset platform, including:

- Trailers,
- Trucks,
- Delivery vans,
- Rail cars,
- as well as other industrial monitoring installations.

and it can be used in a variety of applications, including:

- Online tracking,
- Fleet management / Monitoring / Territory management,
- Security / emergency services,
- Personalized drivers logbook,
- Route verification / Trip management / Distance calculations,
- Theft protection,

- Truck detection / Anti-tamper detection system,
- Toll collection / Pay as you drive.

## 1.2 Circuit concept

DISCO-B5-MAGNET architecture consists of the following major components (*a block diagram is available below*):

### ❖ HARDWARE ARCHITECTURE:

- High-performance Quad-Band GSM/GPRS core
- high sensitive GPS core
- ARM7TDMI Processor controlling all functions of the system
- Anti-tempering detection
- Magnetic mounting
- Internal Lithium-Ion battery pack (5 x 2250 mAh)
- Internal GSM and GPS antennas

### ❖ ADDITIONAL OPTIONS TO DISCO-B5-MAGNET

- 3D motion sensor

### ❖ PHYSICAL INTERFACES:

- Inside SIM card holder for 1,8/3 V SIM cards
- 8pin connector

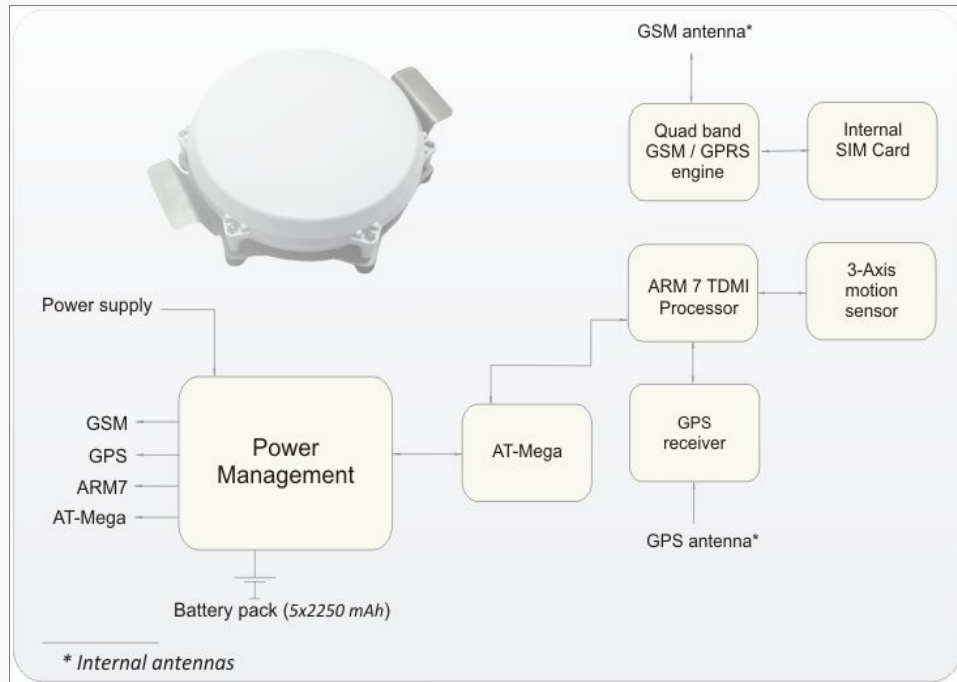


Figure 1: DISCO-B5-MAGNET block diagram

### 1.3 Related documents

Some other PDF documents such as FCC approval, application notes, Certificate of Conformity R&TTE etc. are also available on the Web at: <http://www.falcom.de/> in the published download area.

In addition to this document, the following files comprise the full set of FALCOM *DISCO-B5-MAGNET* product manuals:

NR	PDF file name	Description
[1]	SteppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf	Contains the description of the internal firmware and the supported Configuration Command Set for the FALCOM STEPPIII, FOX/-LT/-IP and BOLERO-LT.
[2]	AppNotes_Transform_history_data.pdf	Contains information of how to transform history data that is being transmitted from a FALCOM AVL device via TCP connection.
[3]	AppNote_Remote_update.pdf	Contains information of how to upgrade FALCOM AVL devices to a new firmware revision remotely via TCP (server based application).
[4]	STEPPIII_FOX_BOLERO_LT_Software_Update.pdf	Contains information how to upgrade a FALCOM AVL device to a new firmware version locally via serial port.
[5]	AppNotesRemoteUpdateWithWorkbench.pdf	Contains information how to upgrade a FALCOM AVL devices to a new firmware version remotely via TCP.

*These PDF files are viewable and printable from Adobe Reader. If you do not have the Adobe Reader installed, you can download it from <http://www.adobe.com>.*

## 2 SECURITY

**IMPORTANT FOR THE EFFICIENT AND SAFE OPERATION OF YOUR GSM-MODEM, READ THIS INFORMATION BEFORE USE!**

Your cellular engine *DISCO-B5-MAGNET* is one of the most exciting and innovative electronic products ever developed. With it you can stay in contact with your office, your home, emergency services and others, wherever service is provided.

This chapter contains important information for the safe and reliable use of the *DISCO-B5-MAGNET* device. Please read this chapter carefully before starting to use the cellular engine *DISCO-B5-MAGNET*.

### 2.1 General information

Your *DISCO-B5-MAGNET* device utilizes the GSM/GPS standard for cellular technology. GSM is a newer radio frequency („RF“) technology than the current FM technology that has been used for radio communications for decades. The GSM standard has been established for use in the European community and elsewhere. Your *DISCO-B5-MAGNET* is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your modem, the cellular system handling your calls controls both the radio frequency and the power level of your cellular modem.

SIM cards are needed for the use of the acquired devices, which are not included in the scope of delivery of the device. The SIM cards can be acquired e.g. by specific providers. Additional costs can result from the use of the SIM cards which are to be borne by the purchaser (client) of the devices. The seller does not cover the extra costs for the use of the devices. The seller gives no recommendation for the use of specific SIM cards and is not liable for the fact that the devices are usable with all available SIM cards. The seller is also not liable for any other costs that are needed for the application of the customer in connection with this device.

### 2.2 Exposure to RF energy

There has been some public concern about possible health effects when using GSM modems. Although research on health effects from RF energy has focused for many years on the current RF technology, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product is fit for use.

If you are concerned about exposure to RF energy, there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular modem efficiently by following the guidelines below.

### 2.3 Driving

Check the laws and regulations on the use of cellular devices in the area where you drive. Always obey them. Also, when using your *DISCO-B5-MAGNET* while driving, please pay full attention to driving, pull off the road and park before making or answering a call if driving conditions so require. When applications are prepared for mobile use, they should fulfil road-safety instructions of the current law!



## 2.4 Electronic devices

Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However, RF energy may affect some malfunctioning or improperly shielded electronic equipment.

## 2.5 Vehicle electronic equipment

Check your vehicle manufacturer's representative to determine if any on board electronic equipment is adequately shielded from RF energy.

## 2.6 Medical electronic equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc.) to determine if they are adequately shielded from external RF energy. Turn your *DISCO-B5-MAGNET* device OFF in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

## 2.7 Aircraft

Turn your *DISCO-B5-MAGNET* OFF before boarding any aircraft. Use it on the ground only with crew permission. Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you to have permission from a crew-member to use your modem while the plane is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem whilst airborne.

## 2.8 Children

Do not allow children to play with your *DISCO-B5-MAGNET* device. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem or make calls that increase your modem bills.

## 2.9 Blasting areas

To avoid interfering with blasting operations, turn your device OFF when in a "*blasting area*" or in areas posted: „*turn off two-way radio*". Construction crew often uses remote control RF devices to set off explosives.

## 2.10 Potentially explosive atmospheres

Turn your *DISCO-B5-MAGNET* device **OFF** when in any area with a potentially explosive atmosphere. It is rare, but your modems or their accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust or metal powders. Do not transport or store flammable gas, liquid or explosives, in the compartment of your vehicle, which contains your modem or accessories.

Before using your modem in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

### 3 SAFETY STANDARDS

Your GSM/GPRS/GPS device complies with all applicable RF safety standards.

*DISCO-B5-MAGNET* meets the safety standards for RF receivers and the standards and recommendations for the protection of public exposure to RF electromagnetic energy established by government bodies and professional organizations, such as directives of the European Community, Directorate General V in matters of radio frequency electromagnetic energy.

## 4 TECHNICAL DATA

### 4.1 Product features

#### ✚ Supply voltage range:

- Operating power supply voltage range of +10.8 V to +32.0 VDC.
- Internal Lithium-Ion rechargeable battery pack (5 x 2250 mAh)

#### ✚ Power saving:

- 6 different energy-saving modes - programmable with PFAL commands. Refer to the chapter 5.1.3, "Power saving" for a brief overview.

#### ✚ Operating temperature range:

- -20°C to + 60°C (see chapter 4.1.2 for more details).

#### ✚ Physical characteristics:

- Dimensions max. (L x W x H): 235mm x 58mm x 210mm.
- Weight: ca. 1325 gr.

#### ✚ Magnetic Holding Force:

- Ca. 15 kg (Ca. 150 Newton).

#### ✚ Physical Interfaces:

- Internal SIM Card holder (supports 1.8/3 V SIM cards) - **SIM card should be inserted by skilled personnel.**
- 2 x buttons for Truck detection (User configuration dependant - see chapter 6.2)
- Inside Light/Dark sensor for Anti-tamper detection (User configuration dependant - see chapter 6.2).
- 6/8 pin female-socket.

#### ✚ Housing:

- PA6 Plastic; Protection class: IP67.
- Metal plate with 6 magnetic mounts.

#### ✚ Mounting:

- Magnetically mounted by 6 magnetic mounts.

#### ✚ Directive:

- RoHS compliant.

#### ✚ Firmware:

- Embedded TCP/IP stack, including TCP, IP and SMTP protocols.
- Accessible via PFAL commands.
- Upgradable locally via serial port and remotely over the air (GPRS/TCP).

#### Internal memory:

- 8 Mbyte FLASH for configuration, data-logging and firmware storage.
- 2 MByte RAM.

#### Supported protocols:

- NMEA Msg.: **GLL, GGA, RMC, VTG, GSV, GSA**
- FALCOM Msg.: **IOP, GSM, AREA, 3DP, BIN** - see related documents [1] and Table 4.

### 4.1.1 Power consumption

Measurement conditions: DISCO-B5-MAGNET, GSM 1800 MHz, Power Level 10, Tamb=23°C, V<sub>BAT</sub>=4.2 VDC.

Operating modes	Average power consumption		Comments
	Value	Unit	
Max.	1	A	In atransmit burst the current consumption can rise to typical peaks of 1A
CPU on / GSM Off / GPS Off	80	mA	Microcontroller is ON.
CPU on / GSM Off / GPS On	138	mA	GPS-fix valid
CPU on / GSM On / GPS Off	106	mA	GSM idle (registered) and GPRS detached
CPU on / GSM On / GPS On	164	mA	GPRS is attached and TCP-connected. Device sends a TCP packet every 30 sec.

Note: These values may vary over time and environments condition can not be guaranteed.

Table 1: Current consumption @ 12 VDC

Average current consumption in sleep mode	
Sleep Modes	approx. [mA]
IGN	0,2
IGN-Ring	22
IGN-Timer=1:20:00	0,3

Note: These values may vary over time and environments condition can not be guaranteed.

Table 1.1: Current consumption for different sleep modes

### 4.1.2 Operating temperatures

Parameter	Min.	Typ.	Max.	Unit
Storage temperature	-40	+25	+90	°C
Operating temperature	-20	+25	+60	°C
Charging temperature	0	+25	+45	°C
Discharging temperature	-20	+25	+60	°C

Table 2: Operating temperature

### 4.1.3 GSM/GPRS engine features

#### ✚ GSM/GPRS core:

- Telit GE865-Quad-Band module
- Quad-Band: GSM 850, 900, DCS 1800, PCS 1900.
- Compliant to GSM Phase 2/2+

#### ✚ Output power:

- Class 4 (2 W) at EGSM900/850
- Class 1 (1 W) at GSM1800 and GSM 1900

#### ✚ GPRS connectivity:

- GPRS multi-slot class 10
- GPRS mobile station class B

#### ✚ DATA:

##### GPRS

- GPRS data downlink transfer: max. 85.6 kbps (see table 3).
- GPRS data uplink transfer: max. 42.8 kbps (see table 3).
- Coding scheme: CS-1, CS-2, CS-3 and CS-4.

##### CSD

- CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent, V.110.

#### ✚ SMS:

- Text mode.

#### ✚ Ring tones:

- Offers a choice of 30 different ringing tones, easily selectable with PFAL commands.

#### ✚ GPRS Coding scheme:

Coding scheme	1 Timeslot	2 Timeslots	4 Timeslots
CS-1:	9.05 kbps	18.1 kbps	36.2 kbps
CS-2:	13.4 kbps	26.8 kbps	53.6 kbps
CS-3:	15.6 kbps	31.2 kbps	62.4 kbps
CS-4:	21.4 kbps	42.8 kbps	85.6 kbps

**Table 3:** Coding schemes and maximum net data rates over air interface

*Please note that, the values listed above are the maximum ratings which, in practice, are influenced by a great variety of factors, primarily, for example, traffic variations and network coverage.*

#### 4.1.4 GPS engine features

##### ↳ **GPS engine:**

- Single chip from u-blox
- 50-channel u-blox 6 engine
- GPS L1 C/A code

##### ↳ **Accuracy:**

- Position: < 10 m CEP

##### ↳ **Time to First Fix (TTFF):**

- Hot starts < 1 sec., average
- Cold starts 29 sec, average

##### ↳ **Sensitivity:**

- Tracking -160 dBm

##### ↳ **Dynamic Conditions:**

- Velocity < 515 m/s (1000 knots)
- Max. update rate 1 Hz

##### ↳ **A-GPS support:**

- AssistNow Online,
- AssistNow Offline,

##### ↳ **Crystal oscillator (TCXO):**

- Load sensitivity  $\pm 10\%$  load change,  $0.2 \pm \text{ppm}$

## 4.2 NMEA data message

DISCO-B5-MAGNET delivers data in the NMEA-0183 format. Table below lists the NMEA and FALCOM output messages supported by the DISCO-B5-MAGNET device and gives a brief description for each protocol. For further description about these protocols, refer to the related documents [1].

The running firmware inside the device offers the possibility to switch on and off each protocol that is listed in the table below. As mentioned above the firmware inside the device supports a lot of PFAL commands enabling full control of the device. There are also PFAL commands which allow sending of these protocols via SMS, TCP, Data call and e-mail. For example, the PFAL commands "**PFAL,GSM.SMS.Send...**" and "**PFAL,GSM.Send.TCP...**" allow you to send an SMS message to a user or a TCP packet to a TCP server to let him know the current location, GPS state, UTC time, Date, Speed and Course over ground of the device. The received SMS contents or TCP packet can then be forwarded to a map software for graphical representation of the device location. When you install such a device in a vehicle, you are then able to have always full control of the vehicle. In this way you will know where your vehicle is, what is happening with your vehicle, has your vehicle been moved without authorization from a park area, real time vehicle movements and more. The TCP server developed by FALCOM called "**Trace4You**" has a lot of such features allowing you to have full control of your vehicle, fleet and other assets.

NMEA	Description
GGA	<i>Time, position and fix type data</i>
GLL	<i>Latitude, longitude, UTC time of position fix and status</i>
GSA	<i>GPS receiver operating mode, satellites used in the position solution and DOP values</i>
VTG	<i>The direction and the ground speed</i>
GSV	<i>The number of GPS satellites in view, satellite ID numbers, elevation, azimuth and SNR values</i>
RMC	<i>Time, date, position, course and speed data</i>
FALCOM	Description
IOP	<i>The status of the digital/analog inputs and output ports and battery voltage</i>
GSM	<i>The GSM operator, reception, registration status, GSM field strength, area code and cell ID</i>
AREA	<i>The state (entered / remaining) of 32 areas/geofences - such as territory management, route verification, prohibited locations, parking area and more</i>
3DP	<i>The state of the Motion Sensor (hardware option)</i>
BIN	<i>User protocol including time, date, position, course and speed data in binary format (small sized - only 21 characters)</i>

**Table 4:** NMEA Output Messages



## 5 DISCO-B5-MAGNET APPLICATION INTERFACE

### 5.1 Power supply

The DISCO-B5-MAGNET is powered by a 5x2250 mAh Li-Ion rechargeable battery pack. Before using the DISCO-B5-MAGNET device you will need to recharge the internal battery of the device even if it may be shipped pre-charged from the factory. Because it may have been some time in transit and storage before reaching you, it is recommended to charge the battery while turned off for approx. 24 hours before the first use. DISCO-B5-MAGNET uses a special cable called KA33 "Service and Charging Cable" for charging the internal battery. This cable is not included in the DISCO-B5-MAGNET package, so it should be ordered separately. The power supply for recharging internal battery pack has to be a single voltage source of  $V_{+IN} = +10.8\text{ V} \dots +32.0\text{ V DC}$ .

The operating voltage ( $V_{+IN}$  and GND) is protected against voltage spikes and reverse polarity, but not against continuous-overvoltage.

**NOTE:** *Operating voltage range must never be exceeded; care must be taken in order to fulfill min/max voltage requirements.*

#### 5.1.1 Power supply pins (1 and 2) on the 8-pin connector

One +IN pin on the 6/8-pin double row connector is dedicated to connect the supply voltage, and the GND pin for grounding. Both +IN and GND pins serve for charging the internal Li-Ion battery pack.

Signal name	I/O	Parameter	Description
+IN	I	+10.8V...+32.0VDC. The operating voltage must never be exceeded.	Positive operating voltage. <i>For security reason, it is recommended to integrate externally a 2A fuse link between interconnection plug and d.c.-power source.</i>
GND	-	0 V	Ground

#### 5.1.2 Automatic shutdown

Automatic shutdown takes effect if:

- *Battery voltage level runs low and external power supply is disconnected.*

### 5.1.3 Power saving

SLEEP mode reduces the functionality of the modules of the DISCO-B5-MAGNET device to a minimum and thus minimizes the current consumption to the lowest level. Settings can be made using the **\$PFAL,Sys.Device.Sleep** command. For details, see example in table below.

Following SLEEP modes are supported by the DISCO-B5-MAGNET device:

Modes	Description
<b>IGN</b>	Device goes to sleep and wakes up when the device is removed from the asset (both buttons on the back of the device changes their state from Low to High).
<b>Ring</b>	Device goes to sleep and wakes up when the GSM module receives a voice call or an SMS.
<b>Timer=1:20:00</b>	Device goes to sleep and wakes up after the defined time has expired.
<b>Motion=5,20,20</b>	Device goes to sleep and wakes up when motion is detected.
<b>ExtPwrDetect</b>	Device goes to sleep and wakes up when external power (higher than 9 V) is connected to the device.
<b>ExtPwrDrop</b>	Device goes to sleep and wakes up when external power is disconnected or it drops below 8 V.
<b>Example</b>	<b>\$PFAL,Sys.Device.Sleep=IGN+Ring+Timer=1:20:00</b>

**IMPORTANT:** The sleep and wake-up procedures are quite different depending on the selected sleep mode. Please keep in mind that the power saving with "**Ring**" parameter works properly only when PIN authentication has been done and the device is already registered in the GSM network. If you attempt to activate power saving while the device is not registered in the GSM network, the SIM card is not inserted or the PIN not correctly entered, the device responds with an error "**ring shutdown aborted due to bad GSM coverage**" and the power saving does not take place. For more details, refer to the manual "**steppIII\_FOX-LT\_bolero\_It\_PFAL\_Configuration\_Command\_Set.pdf**".

**NOTE** (This note is related to the battery-powered devices only): The internal battery pack of the DISCO-B5-MAGNET must have enough power to safely wake up the device from a sleep mode. If the internal battery of the DISCO-B5-MAGNET device does not have enough power, the device cannot complete the wake up operation.

## 5.2 Determining the External Equipment Type

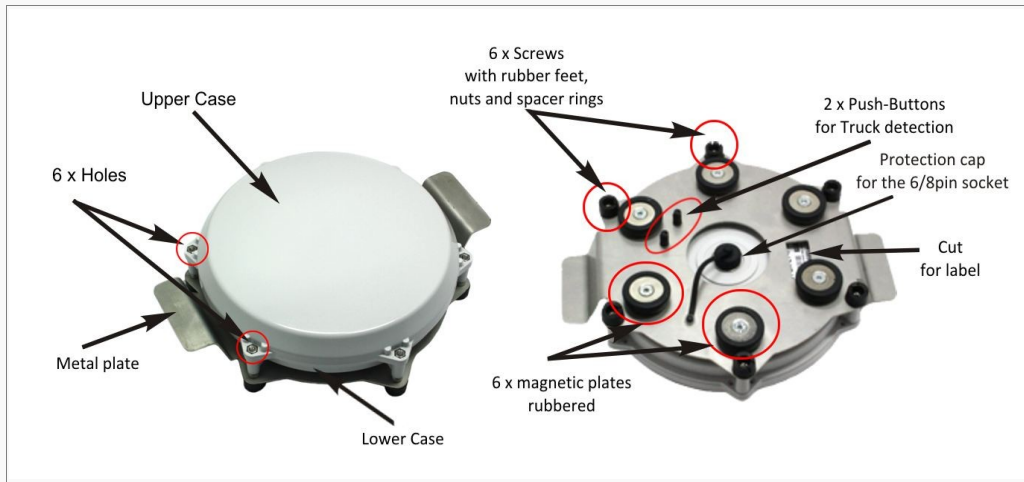
DISCO-B5-MAGNET is designed for use as a DCE device. It communicates with the customer application (DTE) using the following signals:

DISCO-B5-MAGNET Terminal (DCE)	to	Application (DTE)
RxA	<-----	TXD
TxA	----->	RXD

**Table 5:** The signalling definitions between DTE and DCE.

## 6 HARDWARE INTERFACES

This figure shows the main parts of the DISCO-B5-MAGNET.



### 6.1 6/8pin female socket, pin assignments



**Figure 3:** Pin assignments of the 6/8pin female socket.

### 6.1.1 Pinout of the 6/8pin female socket

PIN	NAME	DIRECTION	DISCRIPTION	LEVEL
1	+IN	Input	Power supply input. The power supply must be able to meet the requirements of current consumption. Care must be taken so that the operating voltage applied to the terminal stays within the voltage range. Applying a voltage outside of the voltage range can damage the module. For security reason, it is recommended to integrate externally a 2A fuse link between power source and DISCO-B5-MAGNET.	$V_{+IN} = +10.8 \dots +32.0 \text{ V}$ $I_{max} \leq 2A$
2	GND	-	Ground.	0 V
3	NC	-	-	-
4	NC	-	-	-
5	I/O2	Input/Output	Software configurable pins. Each pin has dual functions as analog or digital. Each digital pin can be individually set to operate either as input or output.	<b>OUT:</b> 100 mA max. @ +0 .. +32.0V DC
6	I/O3			<b>IN:</b> 0 V..+32.0V DC ( <b>High &amp; Low</b> levels are free-programmable)  <b>Analog :</b> Up to 32.0 V DC/10 bits resolution
7	RxA	Input	Serial port (receive data) for direct connection to the host PC (configuration, evaluation, firmware). If not used leave open.	V24, $\pm 12 \text{ V}$
8	TxA	Output	Serial port (transmit data) for direct connection to the host PC (transmitting history data, output GPS protocols and others). If not used leave open.	V24, $\pm 12 \text{ V}$

NC = Not Connected

**Table 6:** Description of the 6/8pin female socket

### 6.1.2 Special pin description (Pins 5, 6)

**Please note:** In the figures below the 6/8pin female socket on the DISCO-B5-MAGNET is represented as an 8pin row connector.

These pins have dual functions. They are controlled by the internal firmware of DISCO-B5-MAGNET. Therefore, the user must specify whether they will be as analog or digital pins.

This function is controlled by the command **PFAL,IO1[2].Config**. If, for example, you want to use **I/O2** as an analog pin, and **I/O3** as digital, the command settings would look like this:

<b>PFAL,IO1.Config=AI,2,11</b>	//1 = I/O2; <b>AI</b> = analog input; <b>2</b> and <b>11</b> = min. and max. voltages for Low and High events.
<b>PFAL,IO2.Config=DI,5,10</b>	//2 = I/O3; <b>DI</b> = digital input; <b>5</b> and <b>10</b> = min. and max. voltages for Low and High events

If the pin **I/O1**, **I/O2** or **I/O3** is configured as a digital pin, then the pin must also be defined to work as input or output. If you want **I/O2** to be an input and **I/O3** to be an output, the command settings would look like the following:

<b>PFAL,IO1.Config=DI,5,10</b>	//1 = I/O2; <b>DI</b> = digital input; <b>5</b> and <b>10</b> = min. and max. voltages for Low and High events.
<b>PFAL,IO6.Set=high[low,hpulse,lpulse,cyclic]</b>	//6 = I/O3; <b>high</b> = sets output to high.

Some examples how to use them are given in sections below.

When using an I/O as digital you must set it to high first (with PFAL command "\$PFAL,IO5[6].Set=high"), otherwise 0V will be measured (*and the device could be damaged*).

#### 6.1.2.1 How to use them as analog inputs

Because these pins can operate either as digital or analog, they have to be configured and calibrated with PFAL commands before using them.

Analog voltages of up to 32.0V with a 10 bits resolution can be processed and remotely evaluated by a server application. A pull-up resistor to a constant input voltage allows for resistive transducers to ground, e.g. fuel sensor or thermistors.

To use these IOs as analog, the following command should be set to the device.

**\$PFAL,IO1[2].Config=AI,2,11**

where 1 and 2 are indices for IO2 (pin 5) and IO3 (pin 6) respectively. While the values 2 and 11 are the min. and max. voltages used to generate Low and High events, respectively.

Detailed information can be found in software manual "*steppIII\_FOX-LT\_bolero\_It\_PFAL\_Configuration\_Command\_Set.pdf*".

#### 1. Connection example 1 (for I/O2 and I/O3):

An analog input can be connected to a temperature sensor (a NTC resistor for instance). In the diagram below is used a fixed resistor is used from the input voltage to the I/O2, and a variable resistor (Negative Temperature Coefficient - whose resistance or capacitance decreases when temperature increases) to ground. It is possible to set a low temperature alarm and a high temperature alarm. Passage through these thresholds will trigger an alarm. We recommend to use SMS or TCP as alarm type with GPIOP protocol. The SMS can be received on a mobile phone, modem or any GSM device when changes are detected. The analog-to-digital converter (ADC) inside the unit has an input voltage range from 0 to 2.5 V. An application example is shown in figure below:

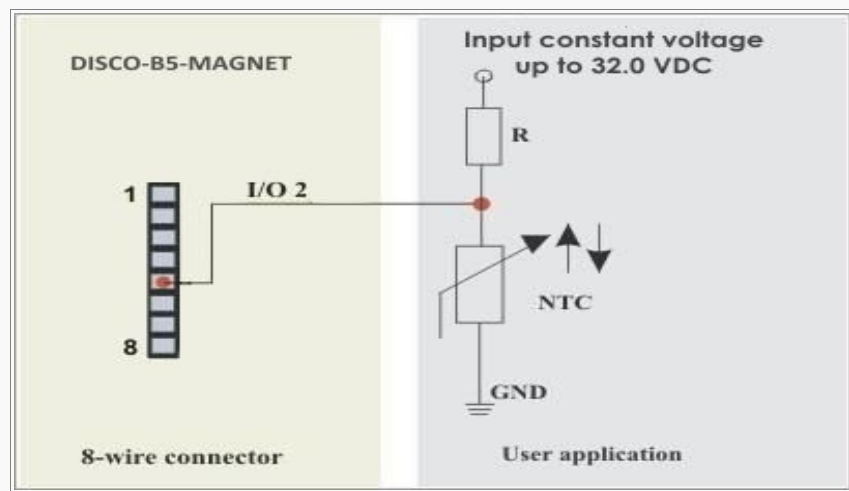


Figure 4: Connection example 1 when used as analog input.

## 2. Connection example 2 (for I/O2 and I/O3):

An analog input can be connected to a tachometer generator. The maximum output voltage of the tachometer should be + 32.0 V (see illustrated example in figure below).

**Both circuit examples (the NTC diagram above and the Tachometer below) are only illustrations to show the aim of these I/Os when used as analog inputs.**

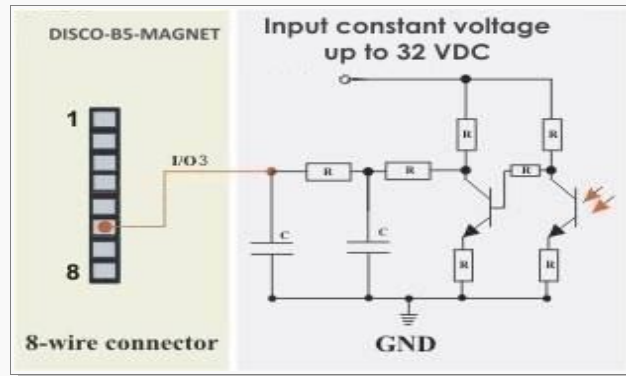


Figure 5: Connection example 2 when used as analog input.

### 6.1.2.2 How to use these pins as digital Inputs (I/O2 and I/O3)

These pins are high active when used as digital inputs, so you can set  $V_{IN(LOW)}$  and  $V_{IN(HIGH)}$  to any levels within the range from +0 to +32.0 VDC. The High and Low levels can be set with PFAL command (e.g. `PFAL,IO1[2].Config=DI,5,10`) - where 1 and 2 are indices for IO2 (pin 5) and IO3 (pin 6) respectively. While the values 5 and 10 are min. and max. voltages used to generate Low and High events respectively. Detailed information can be found in software manual "*steppIII\_FOX-LT\_bolero\_It\_PFAL\_Configuration\_Command\_Set.pdf*".

The figure below illustrates how these inputs can be used in practice. When the internal software detects input changes from *High* to *Low* or vice versa, a *Falling* or *Rising* edge Event is respectively generated. Therefore, depending on the alarm type, the DISCO-B5-MAGNET can react to the input changes and release different alarms such as sending out an SMS, email message, TCP packet, opening a CSD connection or activating an output port. The alarm type is user-dependant.

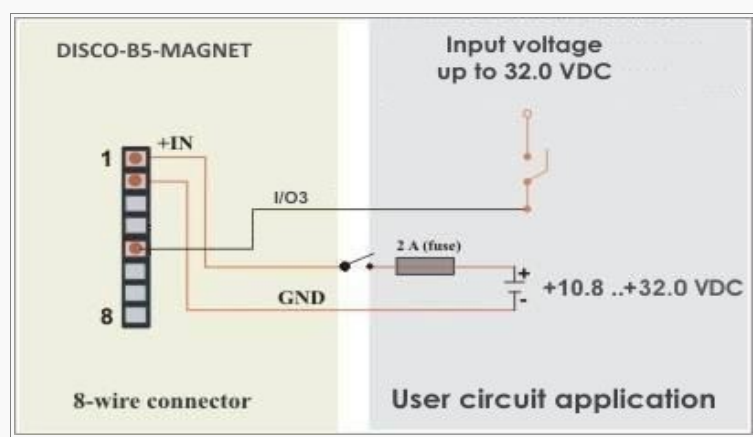


Figure 6: Connection example when using it as digital input

A completed circuit example for all inputs is attached in section 9.1.1.

### 6.1.2.3 How to use these pins as digital outputs (I/O2 and I/O3)

The DISCO-B5-MAGNET device supports two IOs which can be used either as input or output. These outputs are open collectors. They can be directly connected via resistors (R) to LEDs, Relays etc., which need no more than *100 mA @ up to + 32.0 V DC*. The figures below show the schematic of possible output connections. To use and activate these outputs use the command **\$PFAL,IO5[6].Set=high[low,hpulse,lpulse, cyclic]** for I/O2 and I/O3 respectively or you can configure one alarm that activate I/O2 when device gets a valid GPS fix (e.g. **PFAL,Cnf.Set,AL0=GPS.Nav.eFix=valid: IO5.Set=cyclic,1000,2000**).

In order to evaluate this alarm, first send this configuration to the DISCO-B5-MAGNET device and wait until the device gets a valid GPS fix – as result the I/O2 goes High for 1 sec and Low for 2 sec. To set I/O2 to Low, just execute the command **PFAL,IO5.Set=Low**. For more details how to activate an output and how to configure an alarm, refer to the manual “*steppIII\_FOX-LT\_bolero\_It\_PFAL\_Configuration\_Command\_Set.pdf*”. Both figures below show the schematic connections of how to use this output. *Note: Do not apply power directly to an output pin without having a device (e.g. a resistor) between the output pin and external power.*

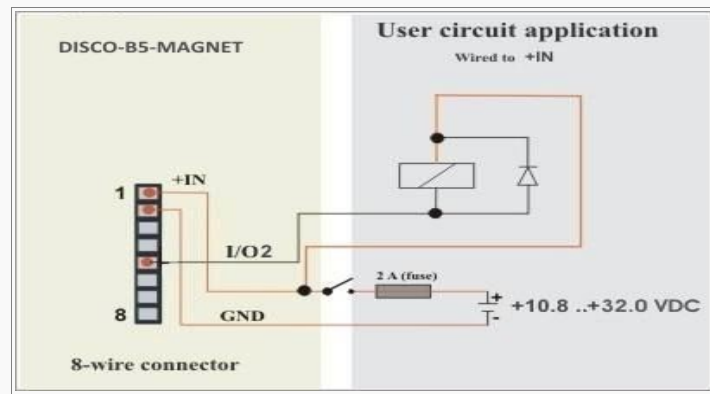


Figure 7: Connection example 1 when using it to control an Relay.

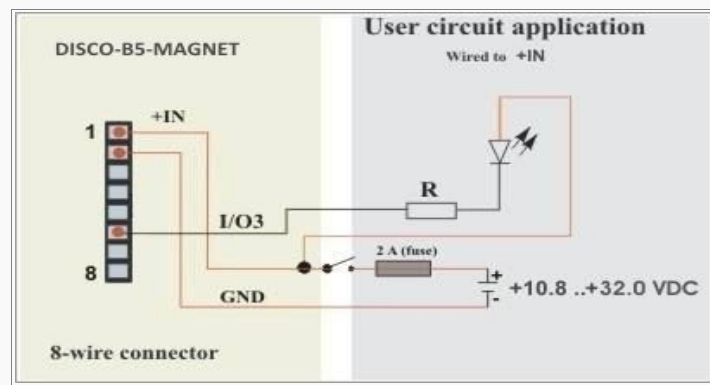


Figure 8: Connection example 2 when using it to control an LED



### 6.1.3 Serial communication signals (RxA and TxA)

The DISCO-B5-MAGNET device incorporates a full duplex serial channel which allows two devices to communicate directly with each other via the RS232 serial port. All supported variable baud rates are software-controlled. It is recommended to use the DISCO-B5-MAGNET Evalboard in order to communicate with the DISCO-B5-MAGNET device, as there you will find all you need to evaluate with it. This serial channel (RxA, TxA) operates at  $\pm 12$  V signal level according to the V.24. The signals on these pins are obtained to RS232 compatible signal levels.

RxA	This is the main receiving channel and it is used to receive software commands to the board from any software (e.g. HyperTerminal). Moreover, the firmware update can also be done through this serial port.
TxA	This is the main transmitting channel and it is used to output navigation, measurement, response and system data to any software (e.g. HyperTerminal, FALCOM Workbench).

## 6.2 How to configure Track and Anti-tamper detection

The DISCO-B2-MAGNET device provides two push-buttons on the back of the device and an light/dark sensor inside the device, which can be used to monitor the Track and Anti-tamper detection.



The two buttons shown on the figure above which are connected to the IGN pin (known from the DISCO-B4 device) can be set to signal that the device has been mounted or removed from the asset. This feature is called "*Track detection*". The Track detection system supports two events `IO.e8=fedge` and `IO.e8=redge`. The Track detection events occur when pushing or releasing BOTH buttons. The Track detection is configurable using the event `IO.e8=fedge` for mounting and `IO.e8=redge` for removing from the asset.

Examples how to configure these events are given below:

```
PFAL,Cnf.Set,AL1=IO.e8=fedge:GSM.SMS.Send,"+491111111",8,"Mounting detected"
PFAL,Cnf.Set,AL2=IO.e8=redge:GSM.SMS.Send,"+491111111",8,"Removing detected"
```

The first alarm automatically sends an alert message with the last known position to the user/contact when the device has been mounted on the asset and the second alarm when the device has been removed from the asset.

```
PFAL,Cnf.Set,AL3=IO.e8=fedge:TCP.Client.Send,8,"Mounting detected"
PFAL,Cnf.Set,AL4=IO.e8=redge:TCP.Client.Send,8,"Removing detected"
```

The first alarm automatically sends an alert message with the last known position to the remote server when the device has been mounted on the asset and the second alarm when the device has been removed from the asset.



The light/dark sensor inside the device which is connected to the I/O1 pin (known from the DISCO-B4 device) can be set to signal that the device has been opened or closed. This feature is called "Anti-tamper detection". The Anti-tamper detection system supports two events `IO.e0=redge` and `IO.e0=fedge`. The Anti-tamper detection is configurable using the event `IO.e0=redge` when the device case is opened and `IO.e0=fedge` when the device case is closed.

To configure the operation condition of the light/dark sensor, you have to send the following configuration settings to the device:

```
$PFAL,CNF.Set,IO0.CFG=DI,5.000,8.000
```

The recommended AiWu settings for waking up automatically the device when opening it:

```
Sys.Device.Sleep=ExtPwrDetect+AiWu=0,1.5
```

Examples how to configure these events are given below:

```
PFAL,Cnf.Set,AL1=IO.e0=redge:GSM.SMS.Send,"+491111111",8,"Opening detected"
PFAL,Cnf.Set,AL2=IO.e0=fedge:GSM.SMS.Send,"+491111111",8,"Closing detected"
```

The first alarm automatically sends an alert message with the last known position to the user/contact when the device case has been opened and the second alarm when the device case has been closed.

```
PFAL,Cnf.Set,AL3=IO.e0=redge:TCP.Client.Send,8,"Opening detected"
PFAL,Cnf.Set,AL4=IO.e0=fedge:TCP.Client.Send,8,"Closing detected"
```

The first alarm automatically sends an alert message with the last known position to the remote server when the device case has been opened and the second alarm when the device case has been closed.

## 7 OPENING THE UNIT AND INSERTING THE SIM CARD IN THE SIM CARD HOLDER

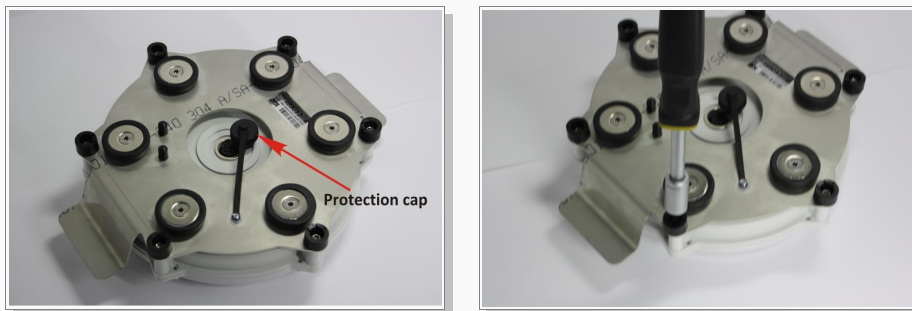
The DISCO-B5-MANET device is equipped with a GSM modem which requires a 3V/1.8V SIM card from a GSM provider for operation. The SIM card holder is inside the device so you must open the case of the device and insert the SIM card in the appropriate SIM card holder. There is no SIM card shipped with the unit, therefore the customer must require a 3V/1.8V SIM card from a GSM provider. Before you start opening the device you must have a screwdriver type TORX T20 to remove the six screws from the metal plate on the back of the device.



**Figure 9:** Opening the device using a screwdriver type TORX T20

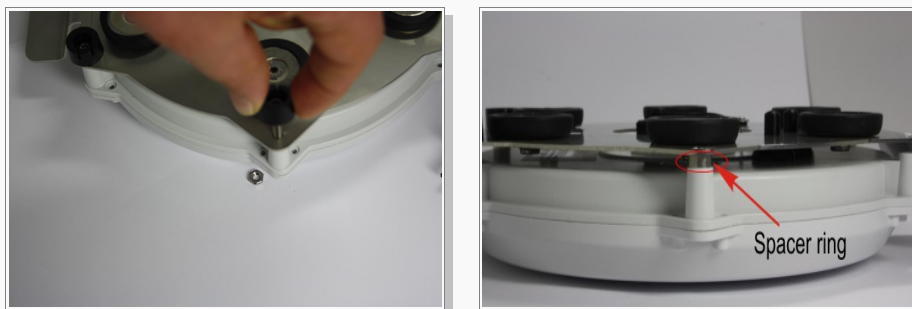
**Attention:** The opening and closing of the device must be performed by qualified electricians.

If the device is already turned on and running, turn it off and remove any power connection. Turn the unit on the back, remove the protection cap for the male socket in the middle of the device and then remove the 6 screws on the outside diameter of the metal plate using the TORX T20 screwdriver as shown in figures below.



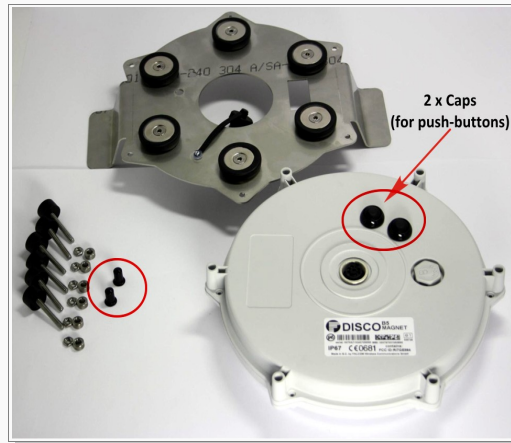
**Figure 10:** Removing the 6 screws on the outside diameter of the metal plate

**Note:** During removing the screws, don't lose the spacer rings between the metal plate and the device (marked on the figure on right side).



**Figure 11:** Removing screws, nuts and spacer rings

Now, separate the metal plate from the device and leave it apart. **Note:** Don't lose the 2 caps (black ones used for the push-buttons) when separating the metal plate from the device.



**Figure 12:** Separating the metal plate from the device

After separating the metal plate from the device, carefully open the device cover with your fingernails or use a flat non-metal object such as an envelope-knife or something like this. Around the lower part (on the inner side) of the case there is a black O-ring rubber used to make the device weatherproof. Improper handling of this O-ring can lose the weatherproof capability of the the device housing.

**Attention:** When opening the device do not remove any of the cable connections inside the device case!

**To insert the SIM card in the SIM card holder, use the figure below as reference:**

- (1) - Locate the SIM card holder (black color) next to the Telit GSM module.
- (2) - Push the slider (metal lock) of the SIM card-holder in the direction marked “->OPEN” and flap the card-holder up. The arrows on the metal slider shows you the direction (Open/Lock).
- (3) - Insert the SIM card into the SIM card-holder (*with care not to damage any components of the circuit board*) - the bevelled corner on the SIM card is facing toward the top of the card-holder and the golden contact area is facing downward when the holder closes. Push the SIM card down until it stops. Make sure, that the SIM card properly fits in the SIM card-holder.
- (4) - Flap the card-holder back (*without force*), then press the slider (*metal lock*), and at the same time move it in the direction marked “<- LOCK” on the card- holder until it stops.

Clean the O-ring (*the black rubber ring that goes around the lower case*). To maintain the life of the O-ring we recommend to grease it with silicone "e.g DC4" before closing the case.

**Hint:** When opening a DISCO-B4-MAGNET device, the O-ring rubber has to be removed and replaced by a new one. The O-ring rubber must be greased using silicone "e.g DC4". For each device you need 5g silicone DC4 for greasing the O-ring. We strongly recommend an annual replacement of the O-ring rubber. Don't use the old O-ring rubber anymore.

- (5) - Hold the lower case in your right hand with the SIM card-holder showing on the right side and the cover in your left hand as shown in figure above.
- (6) - Place the cover back on to the lower case so that the holes at the outer edges of both cases fit exactly to each other.

- (7) - Finally, press smoothly both cases with your hands until they fit together, but with care not to damage the black O'ring.

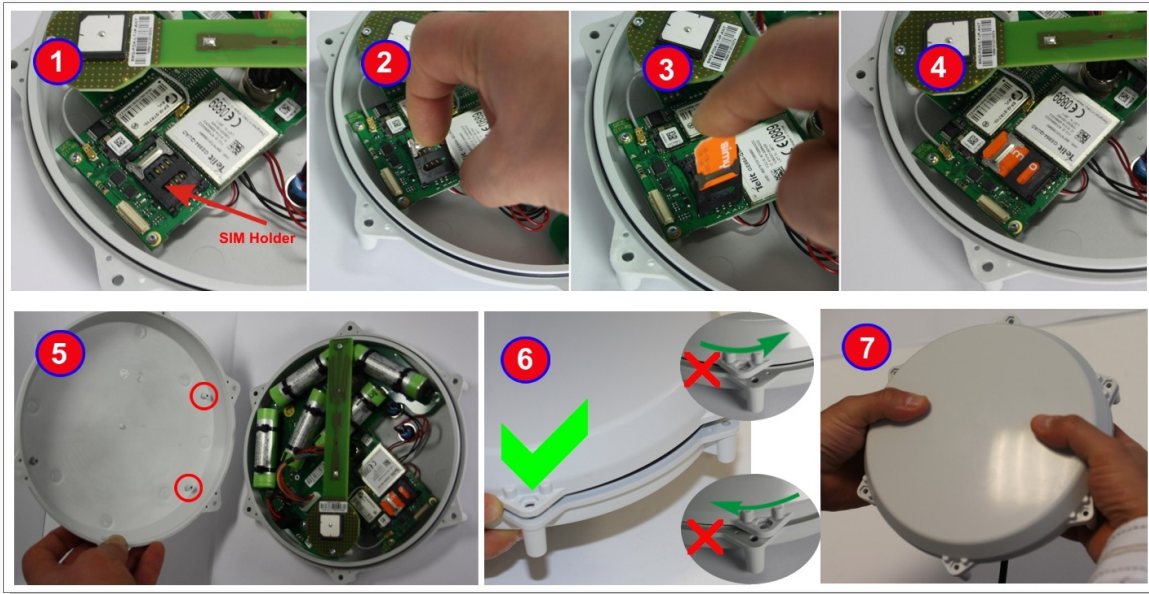


Figure 13: Inserting the SIM card into its holder and closing the device

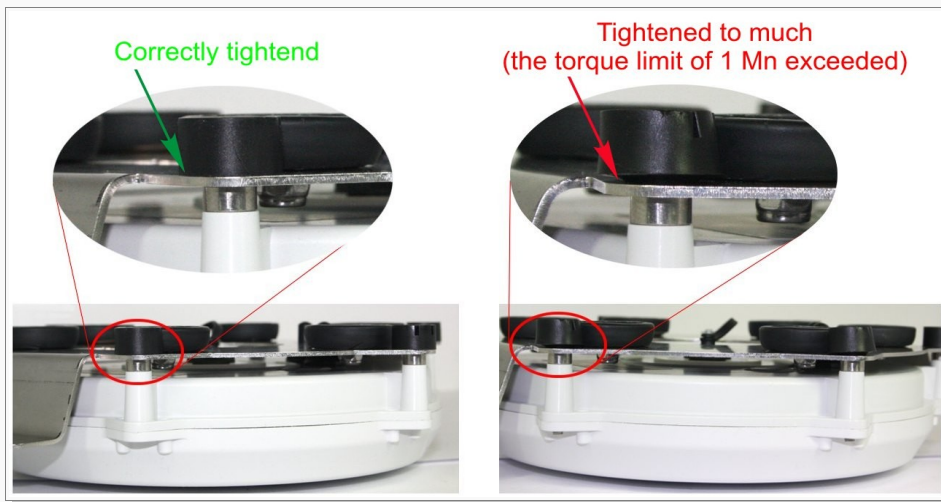
- (8) - Place the metal plate with magnetic plates facing upwards, then insert the 6 TORX screws into the 6 holes on the metal plate (14 a).
- (9) - Put a part of carton or polystyrene on the metal plate (on the side of the magnetic points) then turn the metal plate with the polystyrene upside down, as shown in 10. The polystyrene plate prevents losing the screws from the metal plate while turning it.
- (10) - Insert the 6 x spacer rings (14 c) into the 6 x screws and the 2 x Caps (14 d) into the 2 holes on the metal plate (already surrounded by red color - see fig. 11).
- (12) - Place the device so that the 2 x Push-buttons on the device and the inserted 2 x Caps are opposite to each other. Put the screws of metal plate into the holes of the device.
- (13) - Turn the device with the polystyrene back.
- (14) - Screw back all 6 screws with the TORX T20 screwdriver by holding down every nut (14 b) for every screw (torque limitation 1 Nm). **Hint: The tightening of the screws should be done using an alternating cross over tightening pattern.**



Figure 14: Mounting back the metal plate on the device



**Hint:** The tightening of the screws should be done using an alternating cross over tightening pattern. Applying too much force during tightening may deform the rubber feet as shown in figure below.



**Figure 15:** Tightening of the screws

Now you are ready to enter the PIN of the SIM card and perform the configuration - refer to the chapter 7.2.

### 7.1.1 Procedure for greasing the O-ring

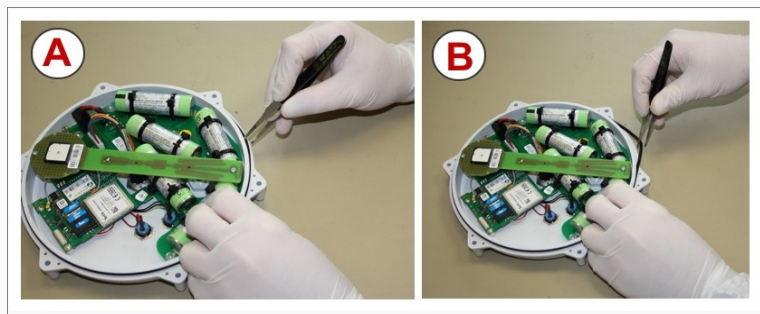
To grease the O-ring you need: **Silicone DC4** and **Rubber gloves (both items are not included)**

The Silicone DC4 can be purchased, for instance, from Farnell website: <http://cpc.farnell.com/1/1/42871-silicone-compond-dc4-2793695-dow-corning.html>

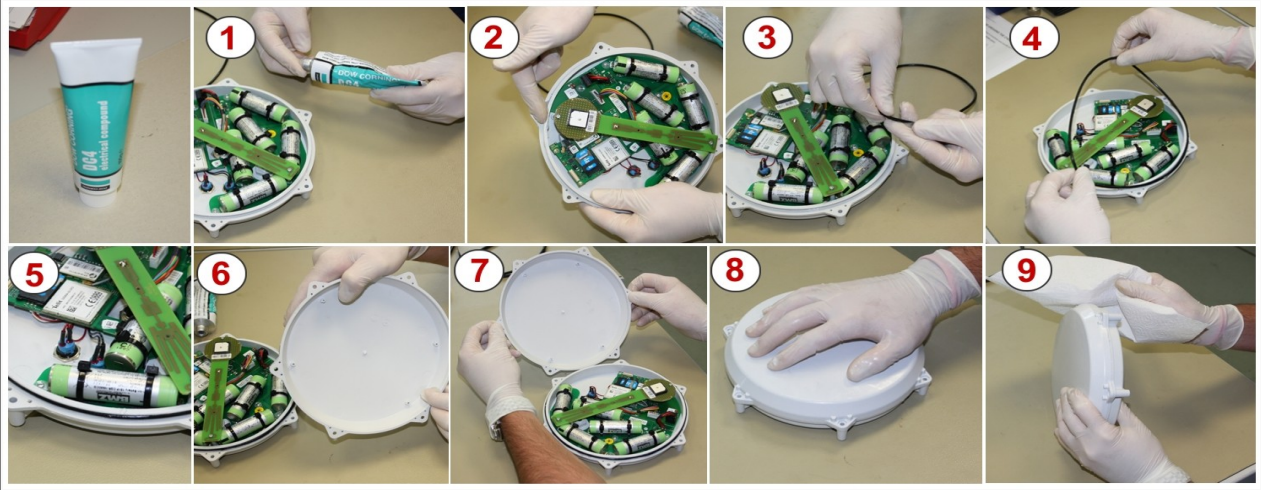


**Picture 16:** Needed

Remove the old O-ring using standard tweezers (not included) as shown below.



1. Put the rubber gloves on and squeeze some of the silicon "DC4" on your forefinger.
2. Run your forefinger with silicone through the O-ring groove until the O-ring groove is covered with silicone.
3. Take the new O-ring and clean the surface of the O-ring before greasing it. Squeeze some of the silicon "DC4" on your forefinger and put the O-ring between your thumb and forefinger and grease it.
4. Fit the O-ring in the O-ring groove.
5. Make sure that the O-ring sits into the groove.



**Figure 16:** Steps for greasing the DISCO-B5-MAGNET with silicone DC4.

6. Take the device upper case (cover) and clean the inner edge of cover and grease it around also with a little silicone on your forefinger.
7. Place the lower case on the left side and keep the cover on the right hand with two marked pins, see figure above (7), parallel to the antenna board. Otherwise, the cover could not be closed.
8. Place the upper case (cover) onto the lower case so that the holes at the outer edges of both cases fit exactly to each other. Press smoothly both cases with your hands until they fit together with care not to damage the O-ring.
9. Finally, clean the rest of silicone around the device case and then assemble the other parts together.

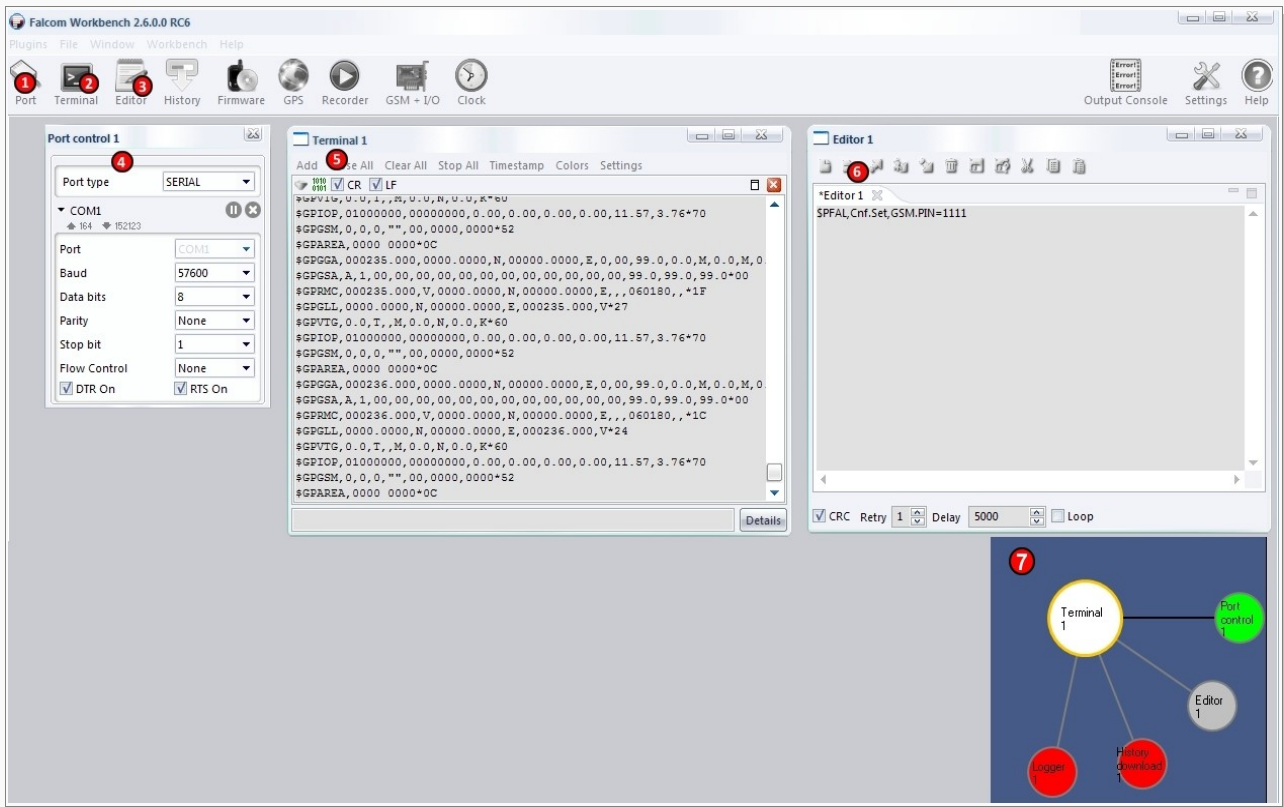
## 7.2 Enter the PIN of the SIM card

To insert the PIN of the SIM card follow the steps below (as reference use fig. 17):

- 1) Install the **FALCOM Workbench** software.
- 2) Connect your DISCO-B5-MAGNET to a free PC COM port via its evalboard or via service and charging cable "KA33" (not included in the DISCO-B5-MAGNET package, should be ordered separately) and then power up your device by pushing both push-buttons on the back of the device (see fig. 12 above).
- 3) Start the **FALCOM Workbench** software, open a **COM Port (1)**, a **Console (2)** and an **Editor (3)**, then select the COM port **(4)** and port settings (57600 bps, 8 Data bits, No Parity bit, 1 Stop bit, None Flow control). Next, click on the **Connect** icon on the left of the text "**Port**", to connect to. Connect the **Console (5)** to the **COM Port** and the **Editor (6)** to

the **Console** by clicking each icon on the **Connection view (7)** separately. For more details refer to the Workbench User's Guide.

- 4) Type the command `$PFAL,Cnf.Set,GSM.PIN=xxxx` on the the editor (xxxx=PIN of your SIM card) and then send it to the device by double-click. For more details refer to the manual *"AVL\_PFAL\_Configuration\_Command\_Set\_x.x.x.pdf"*.
- 5) Finally, remove the service cable from the device and close the male socket by screwing clockwise the protection cap on tightly while making sure that the cap makes this socket completely waterproof.



**Figure 17:** Starting the Workbench software and enter the PIN code of the inserted SIM card.

### 7.3 Magnetic Mount Installation

The DISCO-B5-MAGNET device can be mounted in different flat metal locations. The DISCO-B5-MAGNET device has six strong magnetic mounts designed to hold the device in place during normal driving conditions (highway/city). Since the magnets are very strong to keep the device in place, we recommend to take care about the installation location to prevent any damage on your vehicle even if the six magnetic mounts are rubber covered to protect the vehicles paint. The magnetic mounts also allows to easy remove the device and transferring to other vehicles.

To dismount the magnetically mounted device take the device on the wings using your hands and lift.



**Figure 18:** Mount and dismount the device.



## 8 HOUSING

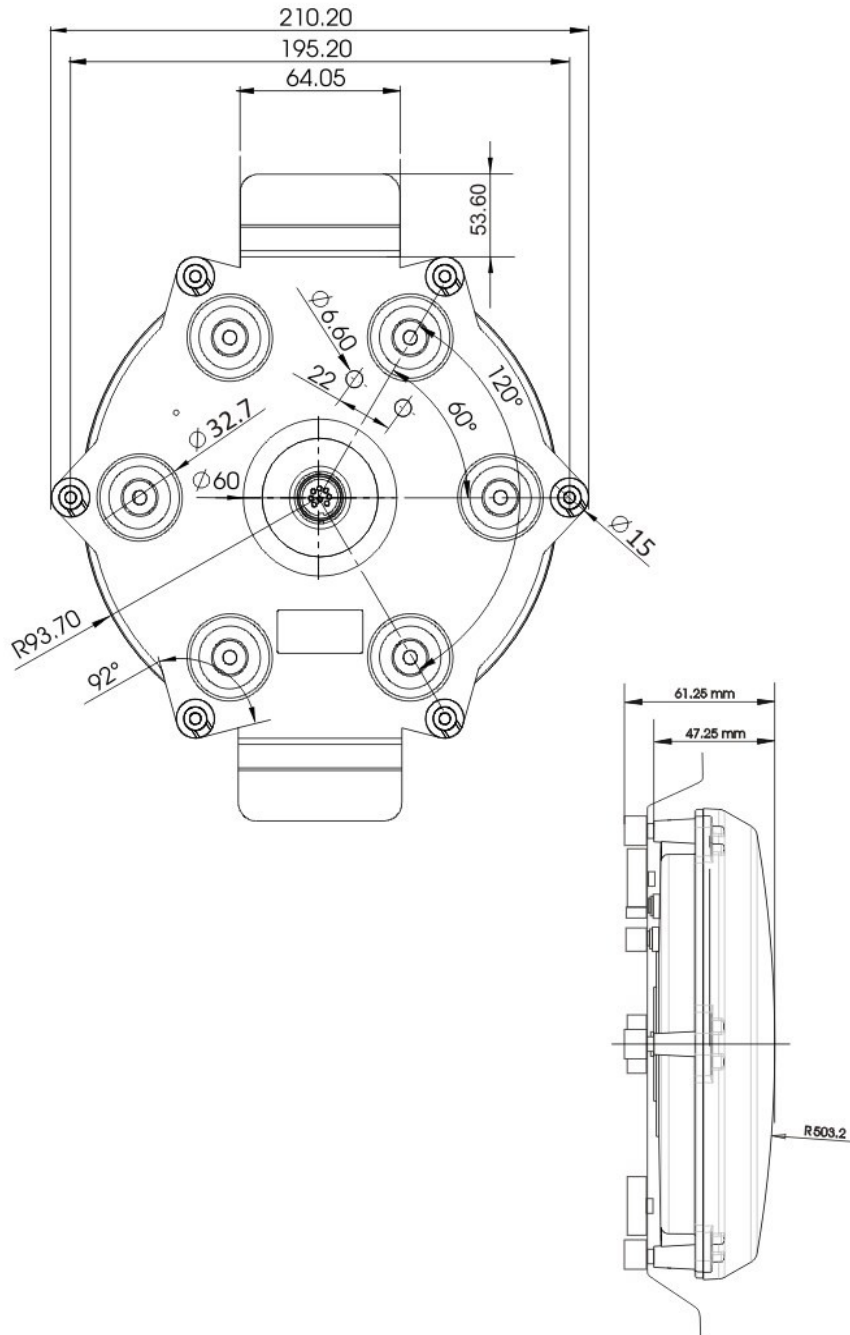


Figure 19: DISCO-B5-MAGNET housing.

## 9 APPENDIX

### 9.1 Schematics

The figure below illustrates a common schematic when you install your DISCO-B5-MAGNET hardware and use the provided input/output pins. For detailed information, refer to the manual [[InVehicleMounting.pdf](#)].

#### 9.1.1 Installation guidance when using the I/Os on the 8-pin socket

On the top of the schematic you can find the corresponding pin out of the 8pin female socket. When installing your DISCO-B5-MAGNET you will not only be able to track and locate objects all the time, but you will also be automatically notified when disagreements occur between the configuration and device behaviours themselves. Depending on your application requirements, the I/O pins can be configured and used as digital outputs to lock/unlock vehicle doors, to activate a relay, buzzer, turn on a lamp; or as digital inputs to detect when something is opened or closed. Input change events can be used to trigger an output to high or low.

**Note:** When installing the device in a vehicle, turn car ignition off before making any connection. Use a common ground point for all ground wires. To avoid ground loops, isolate all ground pins of the DISCO-B5-MAGNET unit from the vehicle body. When charging the battery, do not connect power from different systems to the DISCO-B5-MAGNET.

**The input voltage range must NEVER be exceeded** as device is not protected again continuous overvoltage. For security reasons **it is recommended to integrate externally a 2A fuse link between the positive wire of the DISCO-B5-MAGNET (+IN) and d.c. - power source.**

**To charge the internal batteries connect the power cable to the DISCO-B5-MAGNET.** With the vehicle ignition off attach the power pins to DISCO-B5-MAGNET (FIRST connect the GND pin and then the +IN pin).

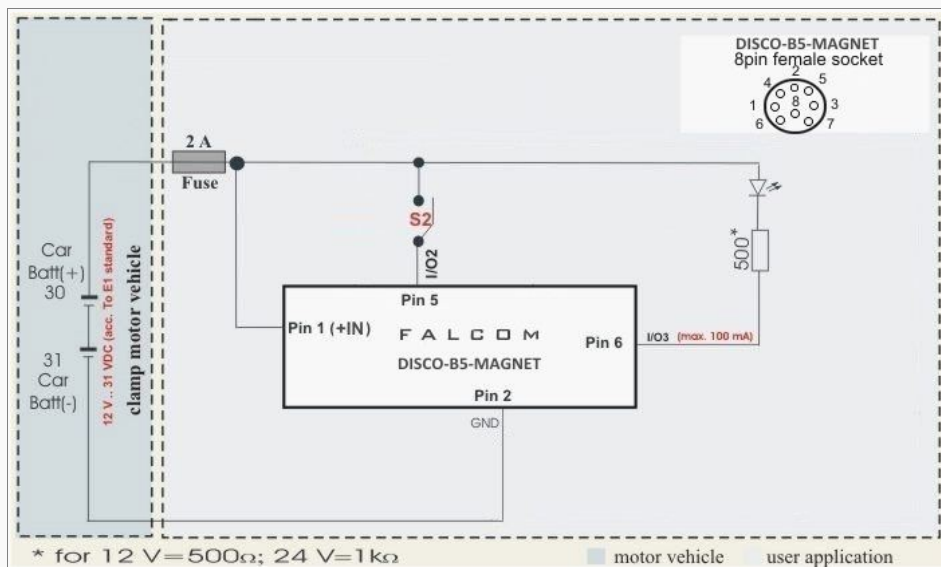


Figure 20: Schematic example of installation guidance.

## 9.2 What should be considered when using the DISCO-B5-MAGNET device

DISCO-B5-MAGNET is a device controlled by PFAL commands in the operating firmware. Therefore, in order to create application with the DISCO-B5-MAGNET device and to obtain maximum benefit from the DISCO-B5-MAGNET device, you have to build a specific configuration inside the device. The configuration can be sent to the DISCO-B5-MAGNET with the help of the Workbench software which is free of charge and can be downloaded from the FALCOM's website (<http://www.falcom.de>). A description of PFAL commands is available in the software manual *"AVL\_PFAL\_Configuration\_Command\_Set.pdf"*.