FALCOM
WIRELESS COMMUNICATIONS GMBH

FOX

Hardware manual

Preliminary

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Table of contents

Version history:

Nnumber	Author	Changes	Change date
1.0.0	F. Beqiri	- Initial version.	04/12/2007

Cautions

Information furnished herein by FALCOM is accurate and reliable. However, no responsibility is assumed for its use.

Please, read carefully the safety precautions.

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1 INTRODUCTION

This product manual is only addressed to qualified personnel which is well skilled in electronical/electrical installation and not addressed to private consumers/end user. The installation, implementing or setting into operation of the product can only be performed by this 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have changed since publication of the data sheet and therefore information in this data sheet on product status may be outdated.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

FALCOM is using state-of-the-art technology to develop unique, low-cost devices, which more effectively manage assets and vehicle tracking than current systems. FOX is a new telematics product designed to be more flexible and efficient for vehicle management, and especially to meet the needs of tracking, controlling and monitoring vehicles with an outstanding safety and security. The FOX terminal comprises an embedded configurable software that provides even greater performance and flexibility for its users and system integrators to develop high-performance applications that allow the tracking of vehicles over the Internet/TCP. The device concept is targeting for direct implementation as a mobile client in a wide range of high volume, low-cost, flexible system solutions like *AVL, fleet management, vehicle security and recovery* and *other related area*. The tracking functionality of the embedded mobile client application is combined with variety of alert messaging capabilities. The configurable alert messages contain current position and status report and use 3 multi-function I/O. In addition to that two predefined digital inputs are detecting ignition line and main power (car battery) failure, and so you may handle these events and use as notification.

By default, FOX is offered without internal battery. Shall you need a FOX device with an internal battery, please see "Ordering Guide" and choose one that meets your specific requirements. *The housing of the new FOX device offers IP65 protection (optional) and can be operated at ambient temperatures up to +85°C.*

The embedded software the embedded software can be controlled by word like "**PFAL**" commands needed for executing particular actions, reading or setting particular configurations. These commands are valid for all kinds of operations including **SMS**, **CSD**, **TCP** and **SMTP**.

FOX provides Geofence features for territory management, route verification, prohibited locations, parking area and more with exception reporting to a wide variety of events, such as arrivals, departures, deliveries, pick-ups, illegal entries, unauthorized movement, etc. FOX contains a data-logger that enables it to archive unique locations in sequence for up to 45 days for later analysis and evaluation (for example, archive interval up to 20 sec.).

The physical interface to the terminal application is made through integrated connector. It is required for controlling the terminal, receiving GPS location data, transferring data and audio signals and providing power supply lines. FOX provides 1 serial interface giving you maximum flexibility for local use.

FOX is equipment that can be configured and integrated onto any asset platform, including:

1. *Trailers*
2. *Trucks*
3. *Delivery vans*
4. *Rail cars*
5. *as well as other industrial monitoring installations.*

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

- *Real time online tracking*
- *Fleet management / monitoring*
- *Security / emergency services*
- *Real time satellite navigation*
- *Territory management*
- *Personalized drivers logbook*
- *Route verification*
- *Trip management / distance calculations*
- *Theft protection*
- *Toll collection / pay as you drive*

The FOX - EVALKIT provides an easy and efficient way to evaluate and configure all system parameters of the mobile client. The configuration of the FOX can be done via local serial link or remotely via the GSM network or GPRS/TCP/Internet. 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.

1.2 Circuit concept

The FOX architecture includes the following major functional components (*a block diagram is available below*):

- ***Architecture Integrates:***
  - *High-performance Quad-Band GSM/GPRS core (operating at 26MHz),*
  - *20 parallel channel low-power GPS core (operating at L1 1575.42 MHz and C/A code 1,023 MHz chip rate),*
  - *ARM7TDMI Processor (at speed 25MHz) that controls all functions of the system,*
  - *Internal SIM card reader (**1.8/3V SIM cards**),*
  - *Internal GSM antenna,*
  - *Internal GPS antenna,*
- ***Options to Fox***
  - *CAN Interface,*
  - ***3D motion** sensor,*
  - ***Micro-SD-Card**,*

- *Rechargeable Li-Polymer battery (see Ordering Guide),*

❖ ***Physical Interfaces:***

- *Power supply line,*
- *3 x Multi-line I/O,*
- *1 x Ignition;*
- *RS232 port*

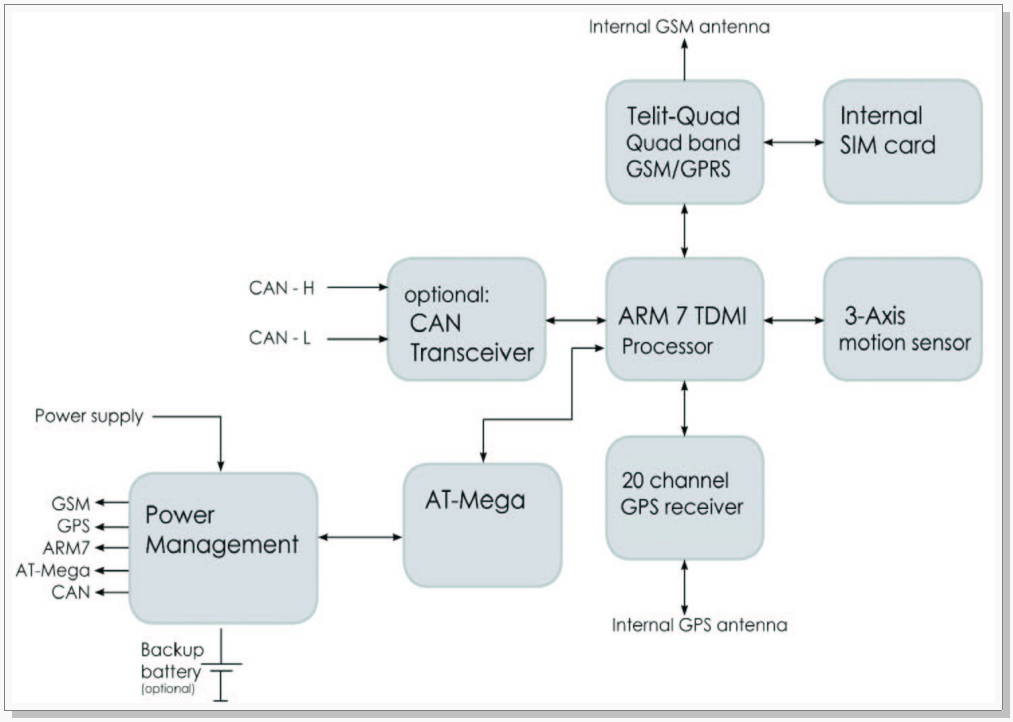

Figure 1: FOX block diagram

1.3 Related documents

Some others 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 FOX 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 and BOLERO-LT.*
[2]	AppNotes_Transform_history_data.pdf	Contains information of how to transform history data that are being transmitted from FOX via TCP connection.
[3]	AppNote_Remote_update.pdf	Contains information of how to upgrade FALCOM AVL devices device to a new firmware revision remotely via TCP.
[4]	AppNotes_connecting_a_bar_code_scanner.pdf	Describes how to connect a bar code scanner to a STEPPII, STEPPIII, FOX etc. and store or transmit the scanned data.
[5]	AppNotes_in_vehicle_mounting.pdf	This document provides all the necessary information to allow your FALCOM product to be properly and safely installed.

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 FOX 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 FOX device. Please read this chapter carefully before starting to use the cellular engine FOX.

2.1 General information

Your FOX device utilizes the GSM 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 FOX 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.

For the use of the acquired devices SIM cards are needed, which are not included in the scope of delivery of the device. The SIM cards can be acquired e.g. by specific providers. From the use of the SIM cards can result additional costs, 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 does not liable also for the fact that the devices are usable with all available SIM cards. The seller also covers no 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 of using a GSM modem. 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 Efficient modem operation

In order to operate your modem at the lowest power level, consistent with satisfactory call quality please take note of the following hints.

- *If your device has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However, your FOX operates more efficiently with the antenna fully extended.*
- *Do not hold the antenna (if externally connected) when the modem is „IN USE". Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.*

2.4 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 FOX 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!

2.5 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.

2.6 Vehicle electronic equipment

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

2.7 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 FOX 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.

2.8 Aircraft

Turn your FOX 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.

2.9 Children

Do not allow children to play with your FOX 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.

2.10 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.

2.11 Potentially explosive atmospheres

Turn your FOX 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.

2.12 Non-ionizing radiation

As with other mobile radio transmitting equipment users are advised that for satisfactory operation and for the safety of personnel, it is recommended that no part of the human body is allowed to come too close to the antenna during operation of the equipment.

The radio equipment shall be connected to the antenna via a non-radiating 50-Ohm coaxial cable.

The antenna shall be mounted in such a position that no part of the human body will normally rest close to any part of the antenna. It is also recommended to use the equipment not close to medical devices as for example hearing aids and pacemakers.

3 SAFETY STANDARDS

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

FOX 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 +35.0 V , suitable for direct connection to an automotive +12V or +24V DC power source (car battery).*
- ***Power saving:***
  - *8 different energy-saving modes - programmable with PFAL commands.*
- ***Operating temperature range:***
  - *-40°C to + 85°C (see chapter 4.1.2 for more details)*
- ***Physical characteristics:***
  - *Size: 56.0 ± 0.1 mm x 172.0 ± 0.1 mm x 39.0 ± 0.1 mm*
  - *Weight: ca. 229 gr.*
  - *Cable length: 1 m*
- ***Physical Interfaces:***
  - *Eight-wire cable with an 8-pin connector on the end:*
    - ✔ *3 x I/Os multi functional (Input/Output and Analog Input),*
    - ✔ *1 x Ignition (with software - controlled feature),*
    - ✔ *1 x Power supply (with software - controlled feature)*
    - ✔ *1 x Serial port (Rx, Tx), Baud rate is controlled by firmware (by default 57600 bps), 8 data bits, no parity, 1 stop bit, no flow control,*
  - *SIM Card interface (for 1.8 and 3 V SIM cards)*
  - *3 x LED indicators (free-programmable by the software)*
- ***Hardware options***
  - ***CAN interface** – occupies 2 of 3 available I/Os (IO2 and IO3),*
  - ***3D motion** sensor,*
  - ***Micro-SD** - for additional memory (CAN),*
- ***Casing:***
  - *Fully shielded*
- ***Certifications:***
  - *Fully type approved confirming with R&TTE directive,*
  - *FTA / FCC /PTCRB/ e1 / CE*
- ***Directive:***
  - *RoHS compliant.*

- ***Firmware:***
  - *Embedded TCP/IP stack, including TCP, IP and SMTP protocols,*
  - *Accessible via PFAL commands,*
  - *Upgrade via serial port and over the air (GPRS/TCP).*
- ***Internal Memory:***
  - *2 MByte FLASH for configuration, data-logging and firmware storage.*
- ***Evaluation kit:***
  - *The FOX Evalboard is designed to test, evaluate and make basis configuration to enable remote monitoring/configuration of the FALCOM FOX. It provides a sample configuration for further developing application.*

4.1.1 Power consumption

To be defined.

4.1.2 Operating temperatures

Parameter	Min.	Typ.	Max.	Unit
Storage temperature (***without internal battery***)	-40	+25	+90	°C
Operating temperature (***without internal battery***)	-40	+25	+85	°C
GSM* (***without internal battery***))	-30	+25	+80	°C
Charging temperature (***with internal battery enabled*** ***)	0	+25	+45	°C
Discharging temperature (***with internal battery enabled*** ***)	-20	+25	+60	°C

* *These temperatures can affect the sensitivity and performance of the GSM engine.*

** *Using configuration **$PFAL,Cnf.Set,EVICE.BAT.MODE=disabled***

*** *Using configuration **$PFAL,Cnf.Set,DEVICE.BAT.MODE=auto***

Table 1: Operating temperature

4.1.3 GSM/GPRS features

- ***GSM/GPRS core:***
  - *Telit GE864-Quad 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 2).*
  - *GPRS data uplink transfer: max. 42.8 kbps (see table 2).*
  - *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.*
- ***GSM antenna:***
  - *Internal.*
- ***Ringing tones:***
  - *Offers a choice of 32 different ringing tones/melodies, 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 2: 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 features

- **GPS engine:**
  - *JP13-S-LP FALCOM GPS product with SiRFstarIII chip set.*
  - ✔ *High sensitive 20 channel, L1 1575.42 MHz, C/A code 1,023 MHz chip rate.*
  - ✔ *SiRF GSW3*
- **Accuracy:**
  - ✔ *Position accuracy: < 10 m CEP without SA*
- **Datum:**
  - ✔ *WGS-84.*
- **Time to First Fix (TTFF):**
  - ✔ *Hot start* — *< 1 sec., average*
  - ✔ *Cold start* * — *< 42 sec, average*
- **Sensitivity:**
  - ✔ *Tracking* — *-159 dBm*
- **Dynamic Conditions:**
  - ✔ *Altitude* — *18,000 meters (60,000 feet) max.*
  - ✔ *Velocity* — *< 515 m/s (1000 knots) max.*
  - ✔ *Max. update rate* — *1 Hz*
- **Supported protocols:**
  - ✔ *NMEA Msg.:* — ***GLL, GGA, RMC, VTG, GSV, GSA***
  - ✔ *FALCOM Msg.:* — ***IOP, GSM, AREA, 3DP, BIN -*** *see related documents [1].*
- **Crystal oscillator (TCXO):**
  - ✔ *Load sensitivity* — *± 10 % load change, 0.2 ± ppm*
- **GPS antenna:**
  - ✔ *Internal.*

* *Capable of cold starts of -144dBm.*

4.2 NMEA data message

FOX delivers data in the NMEA-0183 format. *Table 4* lists each of the NMEA and FALCOM output messages supported by the FOX terminal and a brief description. For further description about NMEA, see related documents *[1]*.

The running firmware offers the possibility to switch on or off each protocol listed below for local use. With the help of PFAL commands supported by this firmware these protocols can also be transferred via SMS, TCP, Data call and e-mail.

NMEA	Description
GGA	*Time, position and fix type data.*
GLL	*Latitude, longitude, UTC time of position fix and status.*
GSA	*GPS receiver operating mode, satellites used in the position solution and DOP values.*
VTG	*The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
GSV	*The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
RMC	*Time, date, position, course and speed data.*
FALCOM	**Description**
IOP	*The status of the digital/analog inputs and output ports and battery voltage (if battery available)*
GSM	*The GSM operator, reception, registration status, GSM field strength, area code and cell ID.*
AREA	*The state of 32 areas*
3DP	*The state of the Motion Sensor (hardware option)*
BIN	*User protocol including time, date, position, course and speed data.*

Table 3: NMEA Output Messages

5 FOX APPLICATION INTERFACE

5.1 Power supply

The power supply for the FOX unit has to be a single voltage source of V_{+IN} = +10.8 V...+35.0 VDC. The operating voltage (V+IN) has to be permanently applied to the FOX unit and able to provide sufficient current of up to 1.9 A.

The operating voltage (V_{+IN} and GND) is protected against voltage spikes and reverse polarity, but not against 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 8-pin 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-Polymer battery (option) and powering the FOX device. FOX has an automatic power ON-function when external power is applied. The power supply for the FOX is capable of utilizing current ranging from V_{+IN} = +10.8 V ... +35.0 VDC designed for automotive application.

Signal name	I/O	Parameter	Description
+IN	I	+10.8 V...+35.0 VDC. The operating voltage must never be exceeded.	Positive operating voltage. *For security reason, it is recommended to integrate externally a 2A fuse link between interconnection plug (8-pin connector) and d.c.-power source (see Fig 14).*
GND	-	0 V	*Ground (should be isolated from the vehicle Grounds)*

5.1.2 Automatic shutdown

Automatic shutdown takes effect if:

- *under voltage is detected when battery level runs low and external power supply is disconnected .*

The automatic shutdown procedure is equivalent to the initiated power-down, i.e. FOX logs off from the network and the software enters a secure state avoiding loss of data.

5.2 Determining the External Equipment Type

Before you connect the serial port pins on the aforementioned terminals (DCE units) to external equipment, you need to determine if the external hardware serial ports are configured as DTE or DCE.

FOX is designed for use as a DCE device. Based on the aforementioned conventions for DCE-DTE connections, it communicates with the customer application (DTE) using the following signals:

FOX Terminal (DCE)	to	Application (DTE)
RxA	<----------	TXD
TxA	---------->	RXD

Table 4: The signalling definitions between DTE and DCE.

6 HARDWARE INTERFACES

This chapter describes the hardware interfaces:

- *8-wire cable connector*
- *SIM Card interface*
- *LED indicators*
- *Mounting holes*

Interface specifications	
8-wire cable connector	*Eight-wire cable with an 8-pin connector on the end and 1 meter cable length*
SIM card interface	*It provides a SIM interface for small SIM cards (1.8/3V)*
Optical LED indicators	*Firmware programmable LED.*
Mounting holes	*4 holes for attaching it to a suitable location (use M4x20 self tapping or machine screws, not included).*

Table 5: Interface specifications

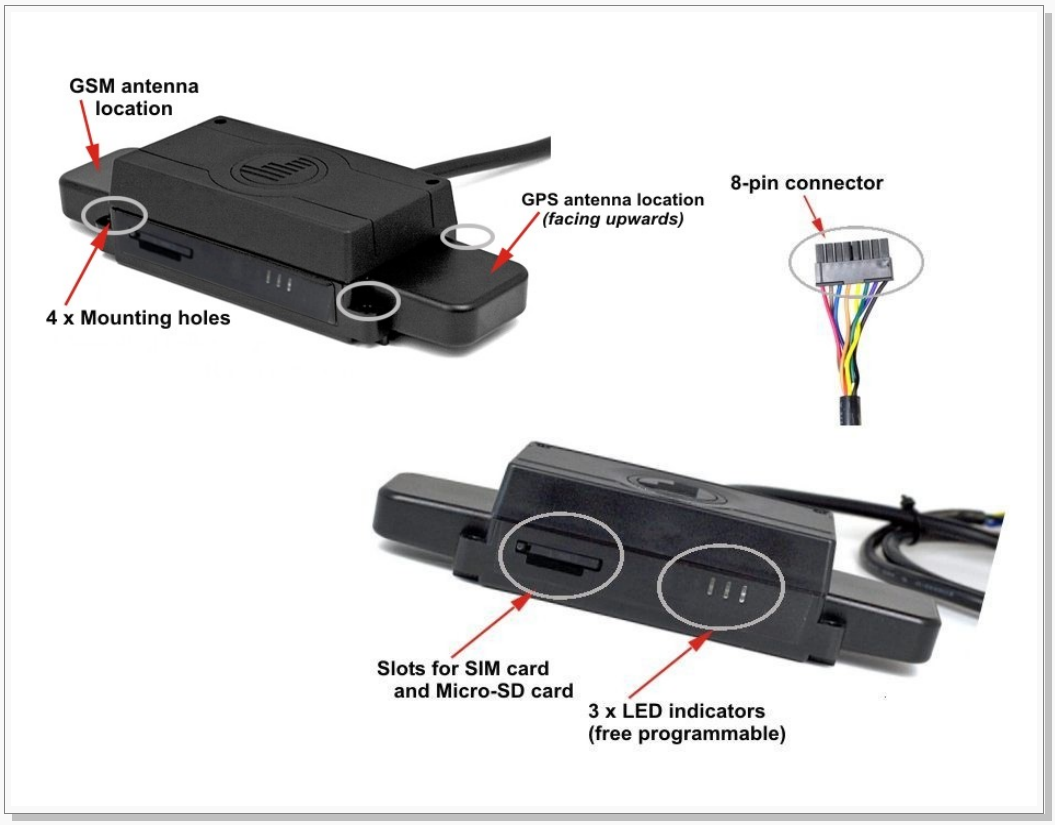

Figure 2: Interface specifications

6.1 8-wire connector, pin assignments

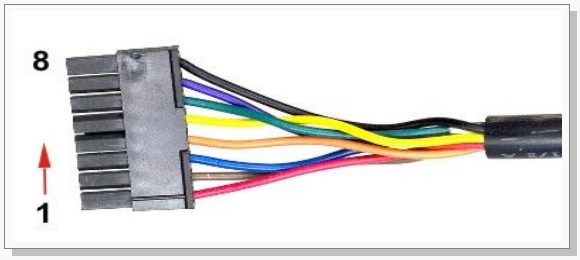

Figure 3: View of the 8-wire connector pin assignments

6.1.1 8-pin connector pinout

PIN	COLOR	NAME	I/O	DISCRIPTION	LEVEL
1	Red	+IN	I	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 stay 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 FOX.	V_{+IN} = + 10.8 ... + 35.0 V Imax ≤ 2A
2	Brown	GND	-	Ground.	0 V
3	Blue	IGN	I	General purpose input. Either connect it to the vehicle ignition and use it for journey START and STOP reports or connect it to the operating voltage +IN and with the help of an external switch you wakeup the FOX device from IGN-Sleep mode *(awaking from this mode requires a HIGH signal)*. See also chapter 6.1.2.4.	**HIGH** ≥+10.8 .. +35.0 V DC; **LOW** = 0V
4	Orange	I/O1	I/O	Software controlled pin. Individually configurable as digital input, analog input or digital output.	**OUT**: 100 mA max. @ +0 .. +35.0V DC
5	Yellow	I/O2			**IN**: 0 V..+35.0V DC (**High** & **Low** = free-programmable)
6	Green	I/O3			**Analog :** Up to 35.0 V DC/10 bits resolution
7	Purple	RxA	I	Serial port (receive data) for direct connection to the host PC (configuration, evaluation, firmware) or to the FOX Eval-Board. If not used leave open.	V24, ±12 V
8	Black	TxA	O	Serial port (transmit data) for direct connection to the host PC (transmitting history data, output GPS protocols and others) or to the FOX Eval-Board. If not used leave open.	V24, ±12 V

Table 6: Pin description of the 8-wire connector

6.1.2 Special pin description (Pins 4, 5, 6)

All these pins are controlled by the internal firmware. All of them can be configured for used either as analog or digital input or digital output. Some examples how to use them are given in sections below.

For IO lines that can work as input or output the corresponding output of this pin has to be set to high (with PFAL command "**$PFAL,IO4*[5,6]*.Set=high"**), otherwise 0V will be measured *(and the device could be damaged).*

6.1.2.1 How to use these pins as analog inputs

Because these pins can operate either as digital or analog inputs, they have to be configured and calibrated with the help of PFAL commands supported by the firmware before using as analog inputs.

Analog voltages of up to 35.0 V with a 10 bits resolution can be processed and remotely evaluated by a server application. 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 inputs, the following configuration is required in the software.

PFAL,IO*0[1,2]*.Config=AI,2,11

where 0, 1 and 2 are indices corresponding to IO1 (pin 4), IO2 (pin 5) and IO3 (pin 6) respectively. While the value 2 and 11 are min. and max. voltages that will be used to generate Low and High events, respectively. Detailed information can be found in software manual "***steppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf***".

↓ Connection example 1 (for I/O1 and I/O2):

Thus, an analog input can be connected to a temperature sensor (a NTC resistor for instance). In the diagram below, it is used a fixed resistor from the input voltage to the I/O 2, 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 (upper and lower values), passed to required temperature. Passage through these thresholds will trigger an alarm. We recommend to use SMS or TCP as alarm type with GPIOP as attachment protocol. The SMS can be received on a mobile phone, modem or any GSM device when changes are notified. 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:

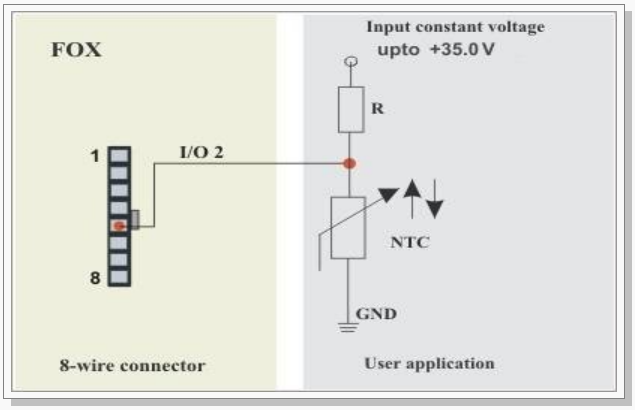

Figure 4: Connection example 1 when using it as analog input.

↓ Connection example 2 (for I/O1 and I/O2):

An analog input can be connected to a tachometer generator. The maximum output voltage of the tachometer should be + 35.0 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 the analog inputs.

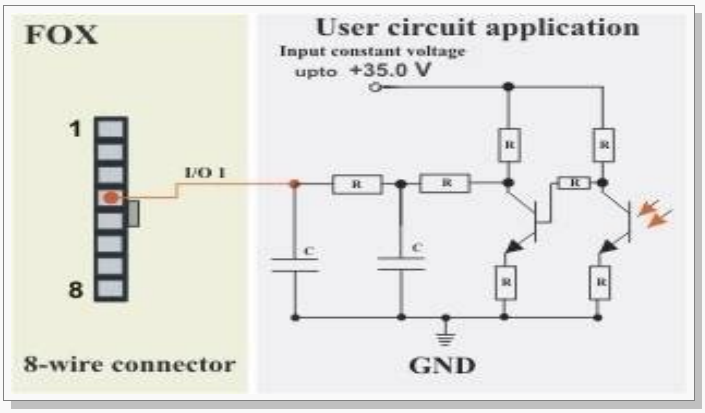

Figure 5: Connection example 2 when using it as analog input.

6.1.2.2 How to use these pins as digital inputs (Pin 4, 5, 6)

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 +35.0 VDC. The High and Low levels can be set by using the PFAL command (e.g. **PFAL,IO*0[1,2]*.Config=DI,5,10**) - *where 0, 1 and 2 are indexes corresponding to IO1 (pin 4), IO2 (pin 5) and IO3 (pin 6) respectively. While the value 5 and 10 are min. and max. voltages that will be used to generate Low and High events respectively.* Detailed information can be found in software manual "***steppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf***". The figure below illustrates how these inputs can be used in practice. When the running firmware detects input changes from High to Low or vice versa, it generates a Falling or Rising edge Event respectively, therefore depending on the alarm type, the FOX 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.

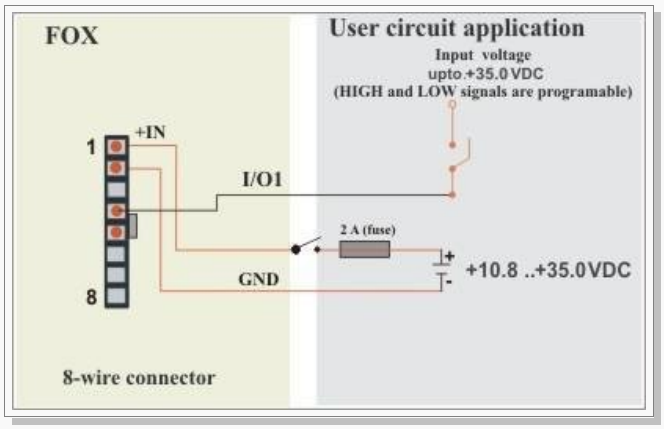

Figure 6: Connection example when using it as digital input

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 (Pin 4, 5, 6)

The FOX device supports three 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 + 35.0 V DC*. The figures below show the schematic of possible output connections. To use and activate these outputs use the command **$PFAL,IO4*[5,6]*.Set=high*[low,hpulse,lpulse,cyclic]*** for **IO1, IO2** and **IO3** respectively or you can configure an or more alarms that activate these outputs when specific events occur (e.g. **PFAL,Cnf.Set,AL0=IO.e8=redge:IO4.Set=cyclic, 1000,2000**). *In order to evaluate this alarm, firstly send this configuration to the FOX device and then trigger IGN-pin to High – as result the IO1 goes High for 1 sec and Low for 2 sec. To set IO1 to Low, just execute the command **PFAL,IO4.Set=Low.*** For more details how to activate an output and how to configure an alarm, refer to the manual "***steppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf***". Both figures below show the schematic connections of how to use this output. *Please note that, no power should be applied directly to an output pin without having e.g. a resistor between output pin and power source.*

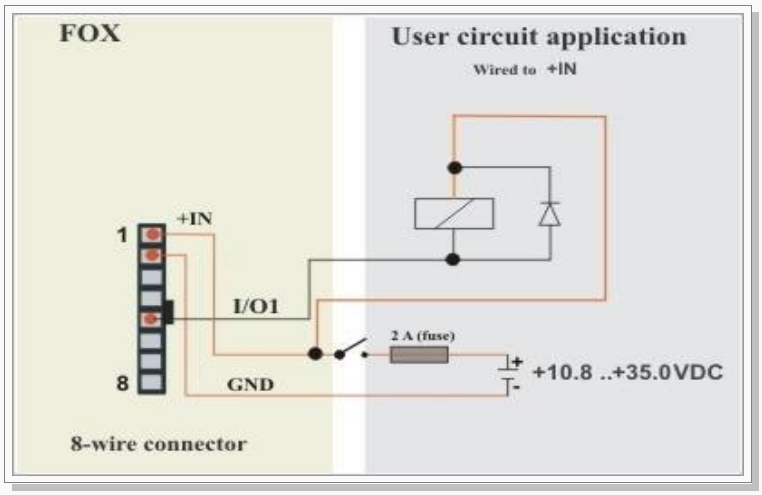

Figure 7: Connection example 1 when using it to control an Relay.

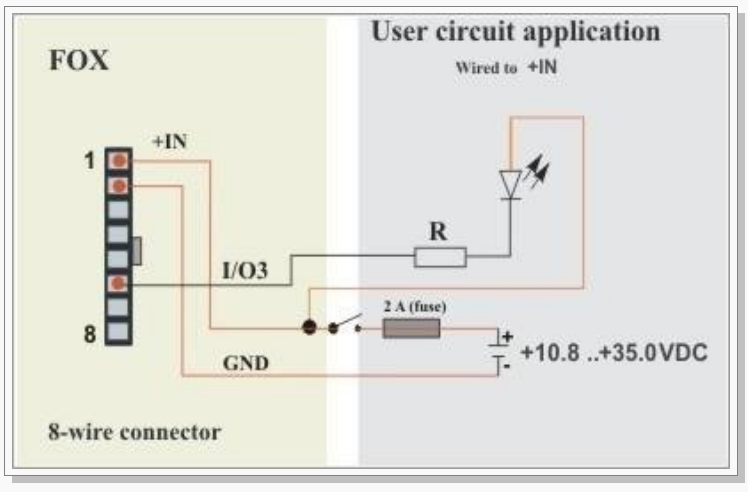

Figure 8: Connection example 2 when using it to control an LED

6.1.2.4 How to use IGN pin(pin 3)

The IGN-pin has two functions:

- ✔ *It wakes up the system FOX from the IGN-sleep mode (when sleeping),*
- ✔ *and can be used to monitor the vehicle ignition state, to report/store the START and STOP of a trip by using the events* ***IO.e8=redge*** *and* ***IO.e8=fedge*** *for* ***START*** *and* ***STOP*** *respectively.*

IGN-sleep mode is one of the eight supported energy-saving modes of operation in which all unnecessary components are shut down. Once the device is awakened by IGN high signal, it returns to full functionality.

Note that, the FOX device powers on automatically when external power is applied, and IGN pin provides an additional "wake up" function for the IGN-sleep mode when it is requested.

Using IGN pin you can configure the system to store a specific location or to deliver an alarm SMS or TCP packet if an unauthorised entry to start your vehicle is attempted. In such a case use the IGN generated event as a condition to start vehicle tracking.

NOTE: All FOX devices that are shipped by the factory with an internal battery, are entered into the IGN-sleep mode. Therefore, to switch that sleep mode off and take the FOX device back to full functionality, just connect it to the d.c.-power source and then set IGN-pin to High.

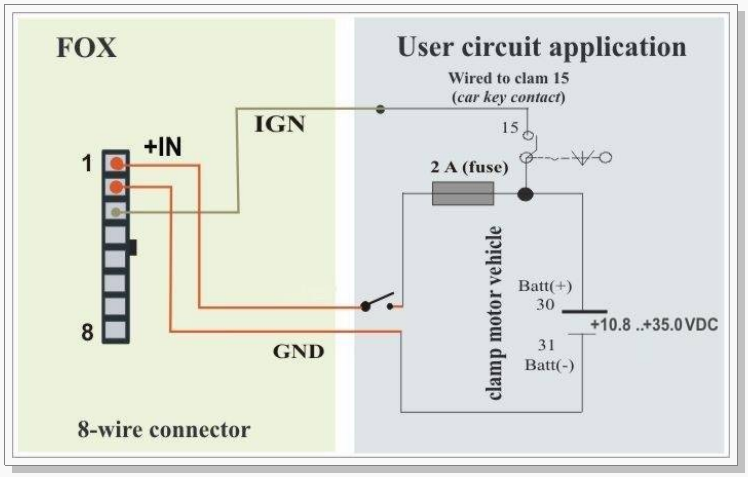

Figure 9: Vehicle ignition monitoring by IGN line

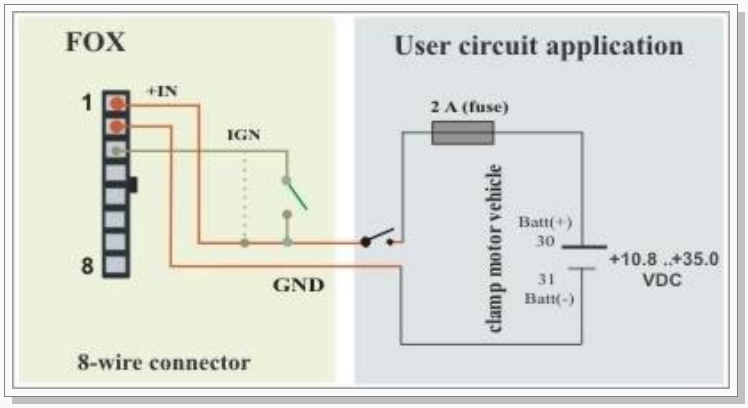

Figure 9.1: Use IGN line for awaking FOX from IGN-Sleep

6.1.2.5 Serial communication signals (RxA and TxA)

The FOX 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 FOX Evalboard in order to communicate with the FOX device, as there you will find all you need to evaluate with it.

This serial channel (RxA, TxA) operates at V24, ±12 V level. The signals on these pins are obtained to RS232 compatible signal levels.

RxA	*This is the main receiving channel and 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 is used to output navigation, measurement, response and system data to any software (e.g. HyperTerminal, FALCOM Workbench).*

You may connect this port to a Bar code scanner and with the help of software configuration (using the serial event **Sys.eSerialData0**) you may process the incoming data from that scanner. Moreover, the incoming data on the serial line may be forwarded/sent via TCP to an internet server and there processed/stored into a database. Therefore, you have this data in real-time unimportant in which country they have been scanned. The interface type and port settings of the bar code scanner must be compatible with the FOX one. More about how to implement such an application, refer to the related documents [4].

6.2 SIM card interface (Molex-91228-0002)

The figure below shows the SIM card reader interface of the FOX.

Figure 10: View of the SIM card interface

The SIM interface (the upper slot) controls an internal small 1.8/3 V SIM card. This interface is fully compliant with GSM 11.11 recommendations concerning SIM functions.

Note: *The SIM card should not be removed, while the module is powered on. The SIM card can only be removed when the FOX is shut down. To remove the SIM card press the Eject button (see figure 10) then pull out the SIM card holder.*

6.3 LED's description

The actual state of the FOX can be displayed by three LED's on the front panel of the unit. These programmable and accessible LEDs can be interfaced to the build-in components to show their state. References how to customize the device configuration can be found in the FOX software manual ***"SteppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf"***.

Figure 11: View of LED indicators

6.4 Interface E (Mounting holes)

The FOX compact unit provides 4 holes for attaching it to a suitable location. As a reference for mounting holes use *Fig. 12* below in this section.

The terminal can be mounted in different locations such as on wall or in vehicle, metal or non-metal sheets.

In order to avoid any damage during mounting of the device, it is required to use properly screws. *There are no screws on the delivery pack.*

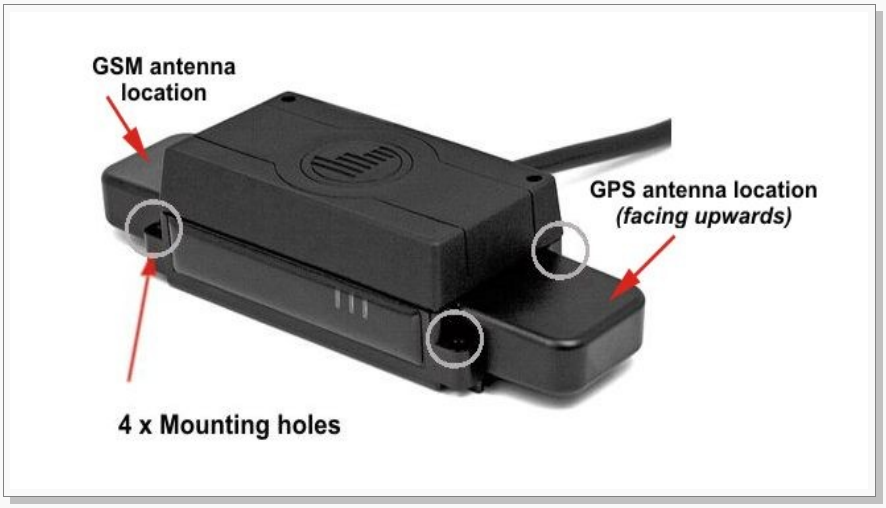

Figure 12: View of the mounting holes

6.4.1.1 Mounting the FOX device

The mounting location is very important, because it can affect the GPS reception quality. Consider that the GPS receiving site is on the right side hand of of the unit(viewing its front panel, see Fig 12).

To *assure maximum visibility of the satellites that provide positioning data*:

- ✔ *Mount the FOX device on flat surfaces with the top facing towards the sky, relatively free of obstructions.*
- ✔ *For a proper reception of GPS signals, orient the unit at an angle from **0** to **60** degrees relative to the horizon, and so that the housing itself does not obstruct GPS signals (see Fig. 12.1).*
- ✔ *Additionally, the mounting location must also be chosen far enough from electronic devices so that no interference takes place. Please, contact your vehicle supplier for more information.*
- ✔ *Finally, fix the unit by using 4 screws M4x20 (or screws with different length). Use a suitable screwdriver to perform the rotation.*
- ✔ *Failure to follow this installation instructions provided here, when installing this unit, can seriously degrade the performance of a GPS system .*

Caution: *In order to comply with RF exposure requirements, install the terminal so that a minimum distance of 20 cm can be maintained between the device and persons.*

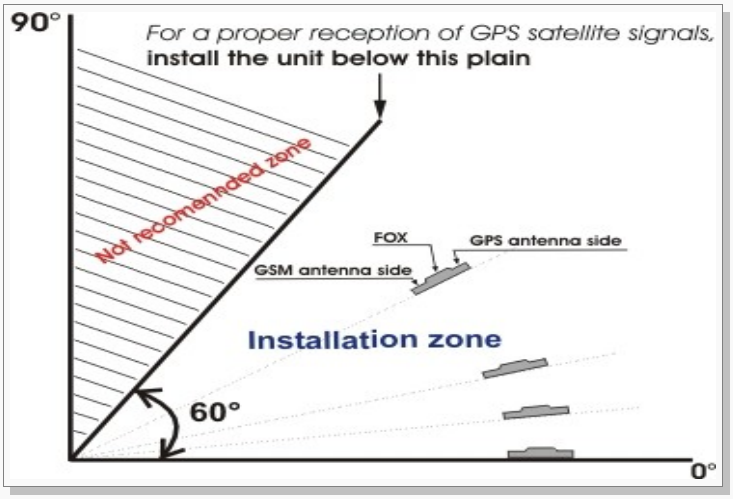

Figure 12.1: Installation area relative to the horizon plain

All radio-transmitting devices send signals, which may cause interference in different electronic devices (PC, television or electronic devices etc). To avoid interference, place the terminal far enough from other electronic devices.

7 HOUSING

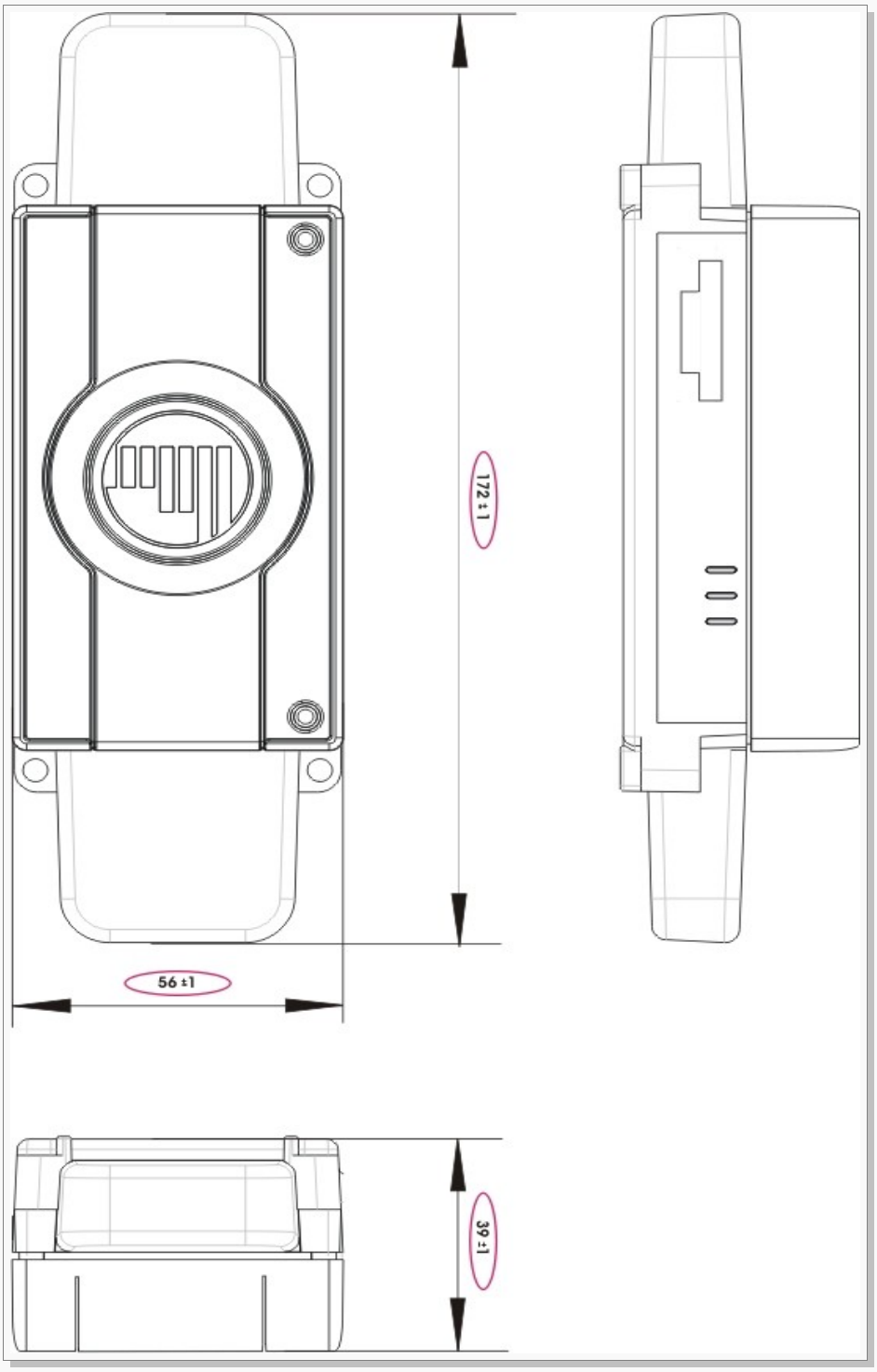

Figure 13: Housing of the FOX.

8 RF EXPOSURES

This device contains 850/900/1800/1900 MHz GSM/GPRS functions that is operational in these frequencies respectively.

The FOX terminal contains 1800 MHz GSM functions that are not operational (must not be used) in U.S. Territories. Filing is only applicable for 850MHz GSM/1900 MHz PCS operations, whereby only these frequencies (850MHz GSM/1900 MHz PCS) are possible to be used in U.S. Territories.

The external antennas used for this mobile transmitter must provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Statement according to FCC part 15.19:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- *this device may not cause harmful interference, and*
- *this device must accept any interference received, including interference that may cause undesired operation.*

Statement according to FCC part 15.21:

Modifications not expressly approved by this company could void the user's authority to operate the equipment.

Statement according to FCC part 15.105:

NOTE: 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 or more 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.*

9 APPENDIX

9.1 Schematics

The figure below illustrates a common schematic when you use the FOX hardware for vehicle security. For detailed information, please, refer to the related documents [*AppNotes_in_vehicle_mounting.pdf*].

9.1.1 Installation guidance for 8-wire cable connector

On the top of the schematic you can find the corresponding pin out of the 8-pin connector.

When installing your FOX in a vehicle, you will not only be able to track and locate the vehicle all the time, but also you will be automatically notified when disagreements with your configuration loaded into the FOX device occur. Furthermore, the firmware-controlled outputs allow you to lock/unlock doors etc. While the IGN input line can be used to monitor the vehicle ignition key, two other inputs can be used as digital or analog and may be individualized for each customer.

***Note that**, the output of the FOX and +IN must connected on the same voltage level as the supply voltage +IN operates.*

*The operating voltage range **MUST** never be exceeded. For security reason, it is recommended to integrate externally a 2A fuse link between the positive wire of the FOX (+IN) and d.c. - power source.*

Please note that, the ground pin of the FOX unit should be isolated from the vehicle body to avoid ground loops.

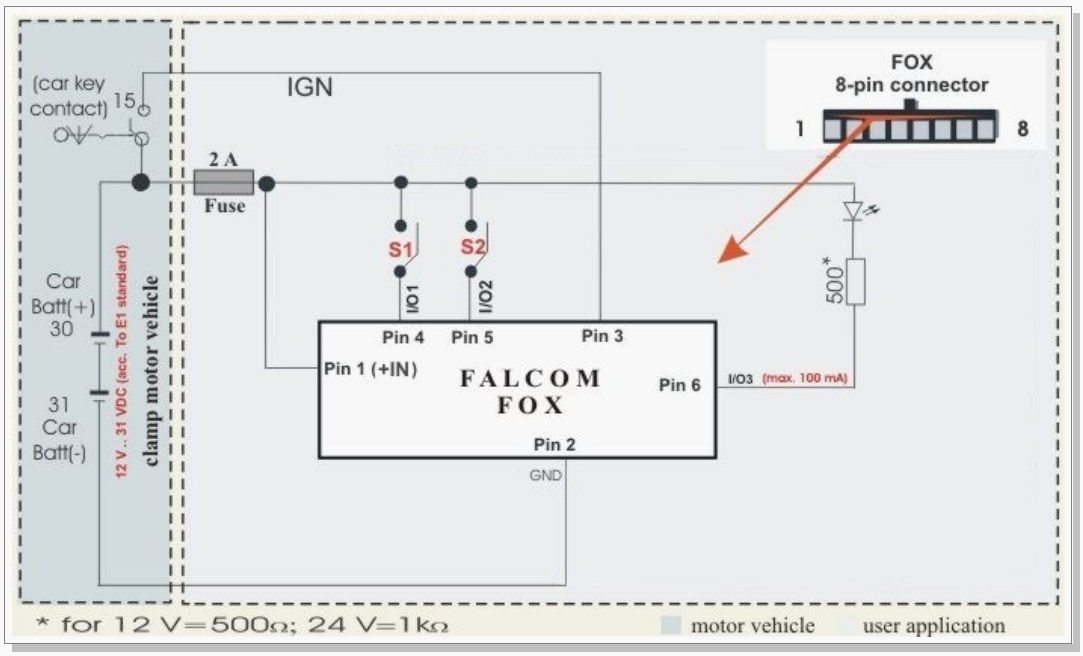

Figure 14: Schematic example of installation guidance.

9.2 What should be considered when using the FOX device

FOX is a device controlled by the operating firmware. In order to start applications with FOX and to obtain maximum benefit from operating firmware, please, refer to the manual "*SteppIII_fox_bolero_lt_PFAL_Configuration_Command_Set.pdf*".