FALCOM
WIRELESS COMMUNICATIONS GMBH

FOX-IN/FOX-EN

Hardware manual

FOX-IN (with internal antenna)

FOX-EN (with external antenna)

Version: 1.0.8; Modified: Tuesday 11 September 2012

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Version history:

This table provides a summary of the document revisions.

Version	Author	Changes	Modified
1.0.8	F. Beqiri	- Added chapter 9 - Statement according to FCC	11/09/2012
1.0.7	F. Beqiri	- Updated the type of the 8pin (2x8) connector from "Neltron: 2417SJ-08" to "Neltron: 5561S-08-F2". - Added the counterpart for the Neltron 5561S-08-F2 connector. (Counterpart: Neltron 5560-08 + Terminal 5560T).	26/06/2012
1.0.6	F. Beqiri	- Added chapter "Safety for Lithium-Polymer Batteries"	15/09/2011
1.0.5	F. Beqiri	- The indices of DI (digital inputs) for I/O-Dongle starts counting at 0 instead of 1. - Updated chapter 6.4	20/06/2011
1.0.4	F. Beqiri	- Added new device FOX-EN device. The difference between FOX-IN and FOX-EN is that the FOX-EN comes with two external antenna ports for connecting a GSM and GPS antenna.	07/03/2011
1.0.3	F. Beqiri	- Added Bluetooth option - see chapter 6.5.4	21/10/2010
1.0.2	F. Beqiri	- Updated Chapter 6.4 - Fasteners can be Hexagon head with collar self drilling screws DIN 7504 K, ST3.5 x 32 mm	18/10/2010
1.0.1	F. Beqiri	- Power consumption updated.	22/07/2010
1.0.0	F. Beqiri	- Initial version.	19/07/2010

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.
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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have changed since publication of the data sheet and therefore information in this data sheet on product status may be outdated.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.

This document applies to the FOX-EN and FOX-IN devices. All illustrations, information, and specifications in this manual apply to both devices, too. The only difference between them is that the FOX-IN is supplied with internal GSM/GPS antennas and FOX-EN with two external antenna ports as shown in chapter 6.

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. The FOX-IN/EN device is an advanced vehicle tracking system that uses a quad-band GSM/GPRS technology for two way communication and the latest GPS technology for positioning. The FOX-IN/EN device 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 vehicle tracking via SMS and over the Internet. 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 configuration of the FOX-IN/EN can be done via local serial link or remotely via SMS or TCP/Internet. 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/Os. In addition to that two predefined digital inputs are detecting ignition line status and main power (car battery) failure, and so you may handle these events and use as notification. With the option Bluetooth® you are enable to communicate wirelessly with FOX-IN/EN device with every Bluetooth® enabled device without needing any cable.

The FOX-IN/EN is equipped with a SIM card holder that is inside the device housing. To use this device you should open the device housing and insert the SIM card.

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 operation channels including **Serial, SMS**, **CSD**, **TCP** and **SMTP**.

FOX-IN/EN 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-IN/EN contains a data-logger (history feature) that enables you to archive unique vehicle 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 device application is made through integrated 8pin connector. It is required for controlling the terminal, receiving GPS location data, transferring data and providing automotive power supply lines. This connector provides 1 serial interface giving you maximum flexibility for local use.

FOX-IN/EN is a device that can be configured and integrated onto any asset platform, including:

- Trailers
- Trucks
- Delivery vans
- Rail cars
- as well as industrial monitoring applications.

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

1.2 Circuit concept

FOX-IN/EN architecture consists of following major components (a block diagram is available below):

❖ **Architecture Integrates:**

- High-performance Quad-Band GSM/GPRS module,
- 50-channel, high sensitivity GPS receiver,
- ARM7TDMI Processor controlling all functions of the system,
- Inside SIM card holder (**1.8/3V** SIM cards),
- Internal GSM/GPS antennas (FOX-IN only),
- External GSM/GPS antenna ports (FOX-EN only),
- 10pin mini-USB-connector.

❖ **Options to FOX-IN/EN**

- **CAN** Interface**,**
- Backup battery (See Ordering Guide),
- Audio interface (AU Option) or SPI interface (US-Option),
- IO-Dongle (IOBOX) plug-in module - Input/Output extension box for US-option only,
- Internal Bluetooth® (Serial Port Profile only)- for US hardware option, only.

❖ **Physical Interfaces:**

- Power supply lines,

- 3 x Multi-line I/O,
- 1 x Ignition,
- 3 x LED indicators,
- 2 x RS232 port (Rx, Tx, GND).

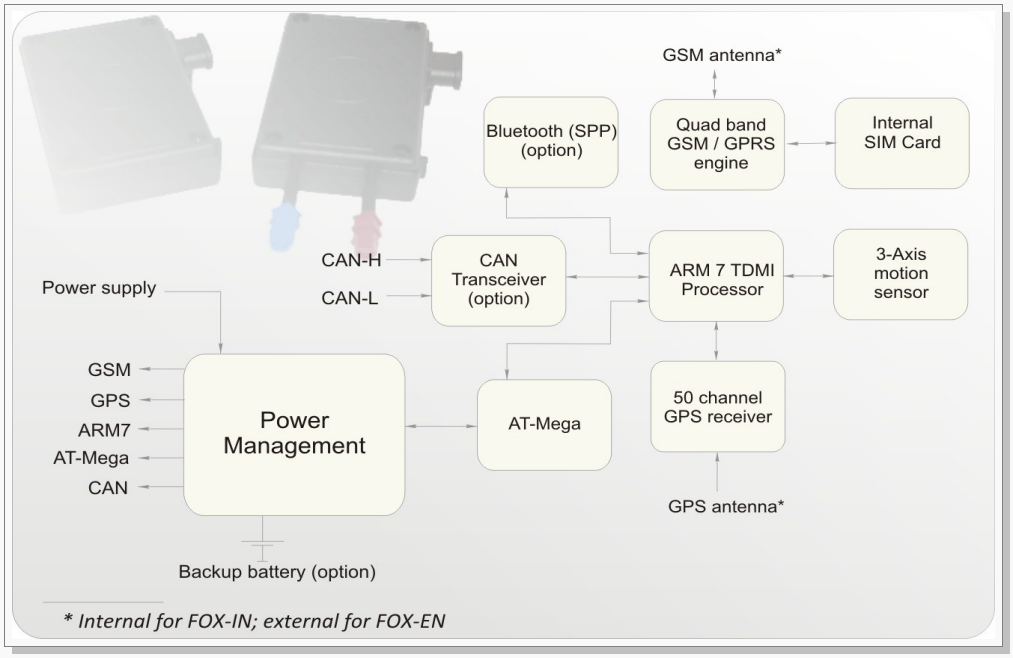

Figure 1: FOX-IN/EN block diagram

1.3 Related documents

In addition to this document, the following files comprise the full set of FALCOM *FOX-IN/EN* product manuals:

NR	PDF file name	Description
[1]	AVL_PFAL_Configuration_Command_Set.pdf	Contains the description of the internal firmware and the supported Configuration Command Set for the AVL *devices.*
[2]	AppNotes_Transform_history_data.pdf	Contains information of how to transform history data that are 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)*.
[5]	AppNotes_in_vehicle_mounting.pdf	This document provides all the necessary information how to install your FALCOM product properly and safely in a vehicle.
[6]	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.
[7]	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 FOX-IN/EN 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-IN/EN device. Please read this chapter carefully before starting to use the cellular engine FOX-IN/EN.

2.1 General information

Your FOX-IN/EN 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 FOX-IN/EN 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 of 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 *FOX-IN/EN* 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 *FOX-IN/EN* 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 *FOX-IN/EN* 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 *FOX-IN/EN* 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 *FOX-IN/EN* 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.

2.11 Safety for Lithium-Polymer Batteries

The safety rules below are applied for the Lithium-Polymer internal battery. Lithium-Polymer (abbreviation: LiPo) batteries require particularly careful handling. This applies to charging and discharging techniques, and also to storage and other aspects of general handling. Mistreating the battery may cause the battery to get hot, crack, or inflame and cause serious injury. In order to avoid any damage and extend the life expectancy of battery, please follow the safety rules listed below before using FOX-IN/EN devices with battery option:

- Do not place the battery on, in or near fires, apparatus that provide heat, or other high-temperature locations. Do not place the battery in direct sunshine, or use or store the battery inside cars in hot weather. Doing so may cause the battery to generate heat, crack, or inflame. Using the battery in this manner may also result in a loss of performance.
- Do not attach the battery to a power supply plug or directly to a car's cigarette lighter.
- Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.
- Do not solder onto the battery contacts.
- Do not allow the battery to get wet.
- Do not disassemble or modify the battery.
- Immediately discontinue use of the battery if, while using, charging, or storing the battery, the battery emits an unusual smell, feels hot, or appears abnormal in any other way.
- Do not place the batteries in microwave ovens, high-pressure containers, or on induction cookware.
- In case the battery drips and the fluid gets into one's eye, do not rub the eye. Rinse well with water and immediately look for medical care. If left untreated the battery fluid could cause damage to the eye.

2.11.1 Safety precautions while charging the battery

Be sure to follow the rules listed below while charging the battery. Failure to do so may cause the battery to become hot, rupture, or ignite and cause serious injury.

- When charging the battery insure that the battery charging conditions specified are met. The temperature range over which the battery can be charged is 0°C to 40°C. Charging is interrupted, if the ambient temperature is outside of this range.

2.11.2 Safety precautions while discharging Lithium-Polymer battery

The temperature range over which the battery can be discharged is -20°C to 60°C. Use of the battery outside of this temperature range may damage the performance of the battery or may reduce its life expectancy.

2.12 Non-ionizing radiation

The FOX-EN device comes with external GSM/GPS antenna. Therefore, care should be taken to install the antenna in such a position that no part of the human body will normally rest within 20 cm of any part of the antenna for more than a few minutes whilst the equipment is in use. It is also recommended to use the device 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-IN/EN 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 V , suitable for direct connection to an automotive +12V or +24V DC power source (car battery).
- **Power saving:**
  - 6 different energy-saving modes - programmable with PFAL commands. See chapter 5.1.3 for more details.
- **Operating temperature range:**
  - - 40°C to + 85°C (see chapter 4.1.2 for more details)
- **Physical characteristics:**
  - Size: 65.0 ± 0.5 mm x 100 ± 0.5 mm x 24.0 ± 0.5 mm
  - Weight (without options): ca. 105 gr.
- **Physical Interfaces:**
  - 8-pins double-row connector comprising:
    - ✔ 3 x I/Os multi functional (each pin has dual functions as analog or digital - software configurable. Each digital pin can individually be set as either an input or output),
    - ✔ 1 x Ignition (software controlled feature),
    - ✔ 1 x Power supply (software controlled feature)
    - ✔ 1 x Serial port (Rx, Tx), Baud rate is controlled by firmware 4800...115200 bps (default=57600 bps), 8 data bits, no parity, 1 stop bit, no flow control,
  - Inside SIM Card holder (supports 1.8/3 V SIM cards),
  - 3-axis motion sensor
  - 3 x LED indicators (Red, Green, Blue) free-programmable.
- **Hardware options**
  - **CAN/FMS interface** – occupies 2 of 3 available I/Os (IO2 and IO3),
    - ✔ For in-car Low-speed & High-speed communications,
  - 10pin mini-USB (for using either Audio interface or SPI interface for IO-Dongle),
  - Internal Bluetooth® (Serial Port Profile only)
  - Backup Li-Polymer battery (see Ordering Guide),
- **Casing:**
  - Fully shielded.

- **Air humidity:**
  - 5 % up to 95 % (non-condensing)
- **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.
- **GSM/GPS antenna:**
  - Internal antennas for FOX-IN device.
  - External antenna connectors for FOX-EN device.

4.1.1 Power consumption for FOX-IN/EN(CH-B1)

All measurements have been performed: DCS 1800 MHz, Power Level 10, Cell Power -75dBm, T_{amb}= 23°C, V_{IN+} = 12 V DC.

Modes	Average power consumption @ +12 V		Comments
	Value	Unit	
Max.	**1**	**A**	*In a transmit burst the current consumption can rise to typical peaks of 1A*
CPU on / GPS off / GSM off	**36**	**mA**	*Microcontroller is ON.*
CPU on / GPS on / GSM off	**59**	**mA**	*GPS-fix valid.*
CPU on / GPS off / GSM on	**62**	**mA**	*GSM idle (registered) and GPRS detached.*
CPU on / GPS on / GSM on	**86**	**mA**	*GPS fix valid, GPRS attached and TCP connected.*

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

Table 1: Power supply and current consumption at 12 VDC

Sleep Modes	Average current consumption in sleep mode @ 12 V *(external power)*	Unit
IGN	860	µA
IGN+Ring	7	mA
IGN+Timer	480	µA

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

Table 1.1: Power supply and current consumption for different sleep modes.

4.1.2 Operating temperatures

Parameter	Min.	Typ.	Max.	Unit
Storage temperature	-40	+25	+90	°C
Storage temperature	-20	+25	+60	°C
Operating temperature	-40	+25	+85	°C
GSM*	-30	+25	+80	°C
Charging temperature (**battery-operated**)	0	+25	+45	°C
Discharging temperature (**battery-operated**)	-20	+25	+60	°C

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

Table 2: Operating temperature

4.1.3 GSM/GPRS engine features

- **GSM/GPRS core:**
  - Quad-Band GSM/GPRS engine: 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 60 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 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:**
  - 50-channel high sensitivity GPS receiver
  - GPS L1 C/A code
- **Accuracy:**
  - Position: 2.5 m CEP
  - SBAS: 2 m CEP
- **Time to First Fix (TTFF):**
  - Hot starts < 1 sec.
  - Cold starts < 26 sec.
- **Sensitivity:**
  - Tracking -162 dBm
  - Cold start -157 dBm
- **Operational limits:**
  - Velocity 500 m/s (972 knots).
  - Altitude 50,000 m.
  - Max. update rate 1 Hz
- **A-GPS support:**
  - AssistNow Offline
- **Crystal oscillator (TCXO):**
  - Load sensitivity ± 10 % load change, 0.2 ± ppm

4.2 NMEA data message

FOX-IN/EN delivers data in the NMEA-0183 format and FALCOM own format. *Table below* lists the NMEA and FALCOM supported protocols and gives also a brief description for each of them. For further description about these protocols, refer to the related documents *[1].*

These protocols can be sent via SMS, TCP, Data call, serial port, e-mail or stored inside the device using the corresponding PFAL-commands. For example, the PFAL-command "***PFAL,GSM.Send.TCP...***" allows sending of the predefined protocols via TCP to a remote server including the current location, GPS state, UTC time, Date, Speed and Course over ground of the device. The received TCP packet can then be used for graphically representation of the device location. Installing such a device in a vehicle, lets you 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 a full control to your vehicle, fleet and other assets.

NMEA	**Description**
GGA	*Contains Time, position and fix type data.*
GLL	*Contains Latitude, longitude, UTC time of position fix and status.*
GSA	*Contains satellites used in the position solution and DOP values.*
VTG	*Contains the number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
GSV	*Contains the number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
RMC	*Contains Time, date, position, course and speed data.*
FALCOM	**Description**
IOP	*Contains the status of the digital/analog inputs and output ports and battery voltage (if battery available)*
GSM	*Contains the GSM operator, reception, registration status, GSM field strength, area code and cell ID.*
AREA	*Contains the state (entered left) of 32 areas and 100 geofences - such as territory management, route verification, prohibited locations, parking area and more.*
3DP	*Contains the state of the Motion Sensor (hardware option)*
BIN	*User protocol including time, date, position, course and speed data in binary format (small sized - only 21 characters).*

Table 4: NMEA Output Messages

5 FOX-IN/EN APPLICATION INTERFACE

5.1 Power supply

The power supply for the FOX-IN/EN unit has to be a single voltage source of V_{+IN} = **+10.8 V**...**+32.0 V** DC. The operating voltage (V_{+IN}) has to be permanently applied to the *FOX-IN/EN* unit and able to provide sufficient current of up to **1.5 A**.

The operating voltage (V_{+IN} and GND) is protected against voltage spikes and reverse polarity, but **NOT** protected 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 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-Polymer battery (option) and powering the FOX-IN/EN device. *FOX-IN/EN* has an automatic power ON-function when external power is applied. The power supply for the FOX-IN/EN is capable of utilizing current ranging from **V_{+IN}=+10.8 V**... **+32.0 VDC** designed for automotive application.

Signal name	I/O	Parameter	Description
+IN	I	+10.8 V...+32.0 VDC. The operating voltage must never be exceeded.	Positive operating voltage. For security reason, it is recommended to protect externally the input voltage by using a 2A fuse between the device and d.c.-power source (see Fig 15).
GND	-	0 V	Ground (should be isolated from the vehicle Grounds when installed in a vehicle)

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 .

5.1.3 Power saving

SLEEP mode reduces the functionality of the modules of the *FOX-IN/EN* 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 FOX-IN/EN device:

Modes	*Description*
IGN	*Device wakes up when IGN (pin 3 - blue color) changes its digital level from Low to High (performs a rising edge).*
Ring	*Device wakes up when the GSM module receives a voice call or an SMS.*
Timer=1:20:00	*Device wakes up after the defined time has expired.*
Motion=5,20,20	*Device wakes up when motion is detected.*
ExtPwrDetect	*Device wakes up when external power is connected to the device.*
ExtPwrDrop	*Device wakes up when external power is disconnected (for battery powered devices only) or it drops below the minimum voltage.*
Example	**$PFAL,Sys.Device.Sleep=IGN+Ring+Timer=1:20:00**

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 error "**ring shutdown aborted due to bad GSM coverage**" and the power saving does not take place. For more details, refer to the manual "AVL_PFAL_Configuration_Command_Set.pdf".

NOTE (This note is related to the battery-powered devices only): When you sent the device to sleep, make sure that the internal battery of the FOX-IN/EN-AU/US-B1 have enough power to safely wake up the device from that sleep mode. If the internal battery of the FOX-IN/EN device does not have enough power, the device can not complete the wake up operation.

5.2 Determining the External Equipment Type

Before you connect the serial port pins of the FOX-IN/EN device to an external equipment, you need to determine if the external hardware serial ports are configured as DTE *(Data Terminal Equipment)* or DCE *(Data Communications Equipment)*.

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

FOX-IN/EN Terminal (DCE)	to	Application (DTE)
RxA	<----------	TXD
TxA	---------->	RXD
GND	-	GND

Table 5: The signalling definitions between DTE and DCE.

6 HARDWARE INTERFACES

This chapter describes the hardware interfaces:

- 8pin double-row connector
- LED indicators
- Mounting holes
- 10pin mini-USB
- external antenna ports (FOX-EN only)

Interface specifications	
8pin double-row connector	*Type: Neltron 5561S-08-F2 (counterpart: Neltron 5560-08 + Terminal 5560T). Provides IN/OUT, power supply and RX/TX lines.*
Optical LED indicators	*Free programmable to show the current state of the device.*
Mounting holes	*4 holes for attaching it to a suitable location (use M4x20 self tapping or machine screws for mounting, not included).*
Mini-USB	10pin Mini-USB connector with two hardware options (either Audio or SPI interface).
External antenna ports	FAKRA-connectors for connecting a GSM/GPS antenna (FOX-EN only)

Table 6: Interface specifications

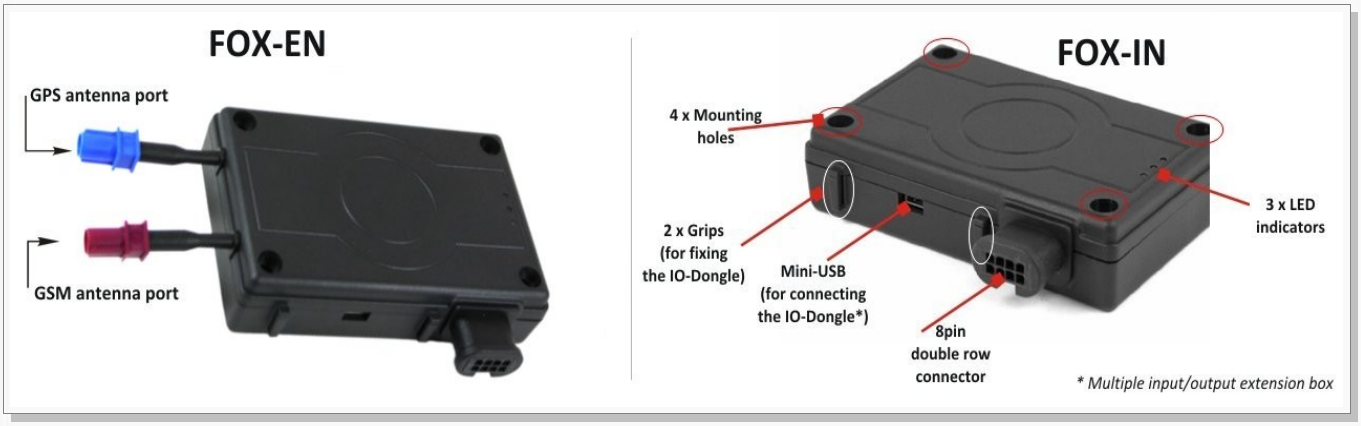

Figure 2: Interface specifications for FOX-IN and FOX-EN devices

6.1 8pin double row connector, pin assignments

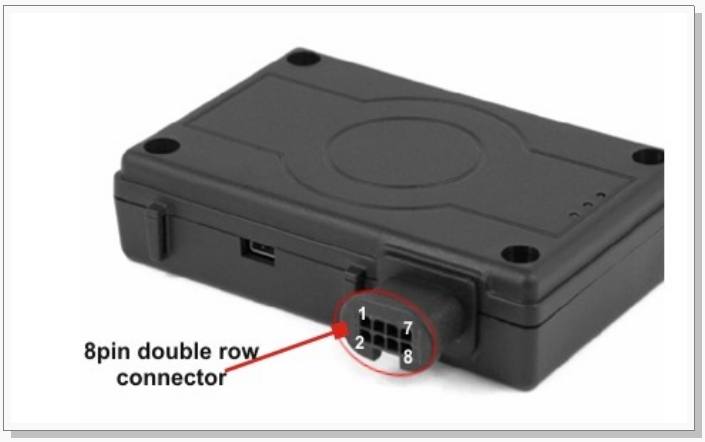

Figure 3: View of the 8-pin (2x8) connector (Type: Neltron 5561S-08-F2) - pin assignments

6.1.1 8-pin connector pinout

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 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-IN/EN.	V_{+IN} = + 10.8 ... + 32.0 V Imax ≤ 1A
2	GND	-	Ground.	0 V
3	IGN	Input	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-IN/EN device from IGN-Sleep mode *(awaking from this mode requires a HIGH signal)*. See also chapter 6.1.2.4.	**HIGH** ≥+10.8 .. +32.0 V DC; **LOW** = 0V
4	I/O1	Input/Output	Software configurable pins. Each pin has dual functions as analog or digital. Each digital pin can individually be set as either an input or output. Upon request the I/O2 and I/O3 can also be supplied for using CAN-Bus features (I/O2 = CAN_L; I/O3 = CAN_H).	**OUT**: 100 mA max. @ +0 .. +32.0V DC
5	I/O2			**IN**: 0 V..+32.0V DC (**High** & **Low** levels are free-programmable)
6	I/O3			**Analog :** Up to 32.0 V DC/10 bits resolution
7	RxA	Input	(**Serial Port 0**) Serial port (receive data) for direct connection to the host PC (configuration, evaluation, firmware). If not used leave open.	V24, ±12 V
8	TxA	Output	(**Serial Port 0**) 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, ±12 V

Table 7: Description of the 8-pin double-row connector

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

These pins have dual functions. All are controlled by the internal firmware of FOX-IN/EN. Therefore, the user must define whether to use them as analog or digital pins.

Their function is controlled by the command **PFAL,IO*0[1,2]*.Config.** If, for example, you want to use **I/O1** as an analog pin, and the **I/O2** and **I/O3** as digital, then use the following commands respectively:

$PFAL,IO*0*.Config=AI,2,11	*// **0** = I/O1; **AI** = analog; **2** and **11** = min. and max. voltages for Low and High events.*
$PFAL,IO*1*.Config=DI,5,10	*// **1**= I/O2; **DI** = digital input; **5** and **10** = min. and max. voltages for Low and High events*
$PFAL,IO2.Config=DI,5,10	*// **2**= I/O3; **DI** = digital input; **5** and **10** = min. and max. voltages for Low and High events*

If you want to use a digital pin, e.g. **I/O2** or **I/O3,** as an digital output pin, then use the following PFAL command:

$PFAL,IO4.Set=high	*//**4**= I/O1; **high** = sets output to high*
$PFAL,IO5.Set=high	*//**5** = I/O2; **high** = sets output to high*
$PFAL,IO6.Set=cyclic,2000,1000	*//**6** = I/O3; **cyclic** = sets output to high for 2 seconds and low for 1 seconds.*

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

When using an **I/O** as digital pin you must set it first to high (with PFAL command "**$PFAL,IO4.Set=high"** or "**$PFAL,IO5.Set=high"** or **"$PFAL,IO6.Set=high"**), otherwise 0V will be measured *(and the device could be damaged).*

6.1.2.1 How to use I/O pins (4, 5, 6) as analog inputs

These pins can operate either as digital or analog inputs, however they should 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 inputs, send the following command the device.

$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 the software manual "***steppIII_FOX_IN_bolero_lt_PFAL_Configuration_Command_Set.pdf***".

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

An analog input can be connected to a temperature sensor (a NTC resistor for instance). In the diagram below 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. 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:

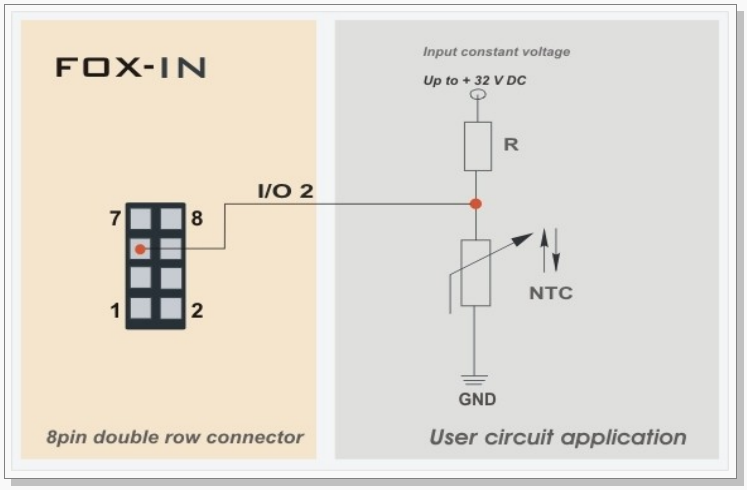

Figure 4: Connection example 1 when used as analog input.

↓ 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 + 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.

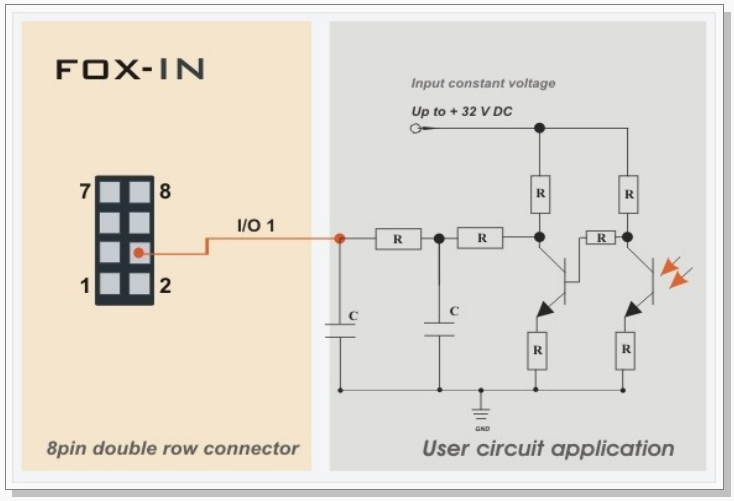

Figure 5: Connection example 2 when used as analog input.

6.1.2.2 How to use I/O pins (4, 5, 6) as digital Inputs

These pins are high active when used as digital inputs, so you can set $\mathbf{V}_{IN(LOW)}$ and $\mathbf{V}_{IN(HIGH)}$ 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,IO*0[1,2]*.Config=DI,5,10**) - *where 0, 1 and 2 are indices corresponding to IO1 (pin 4), IO2 (pin 5) and IO3 (pin 6) respectively. While the values 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 "*AVL_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 FOX-IN/EN 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 configuration-dependant.

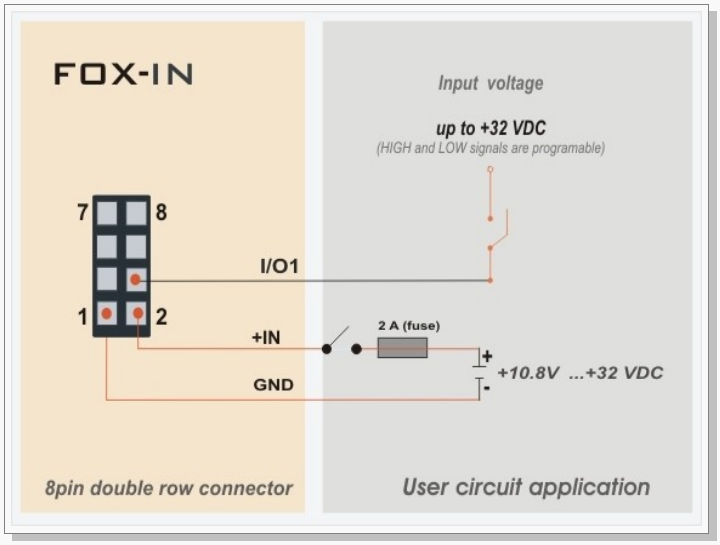

Figure 6: Connection example when using it as digital input

A completed circuit example for all inputs is attached in section 8.1.1.

6.1.2.3 How to use I/O pins (4, 5, 6) as digital outputs

The FOX-IN/EN 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 + 32.0 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-IN/EN 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 "*AVL_PFAL_Configuration_Command_Set.pdf*". Both figures below show the schematic connections of how to use this output. *Please note that, do not apply power directly to an output pin without having e.g. a resistor between them.*

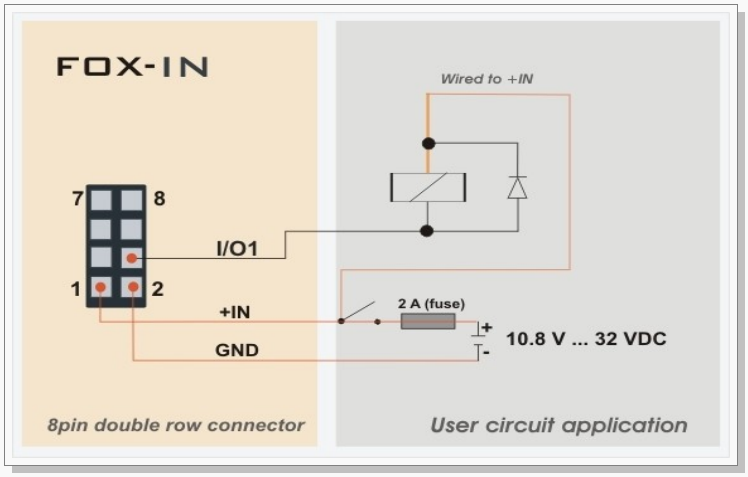

Figure 7: Connection example 1 when using it to control an Relay.

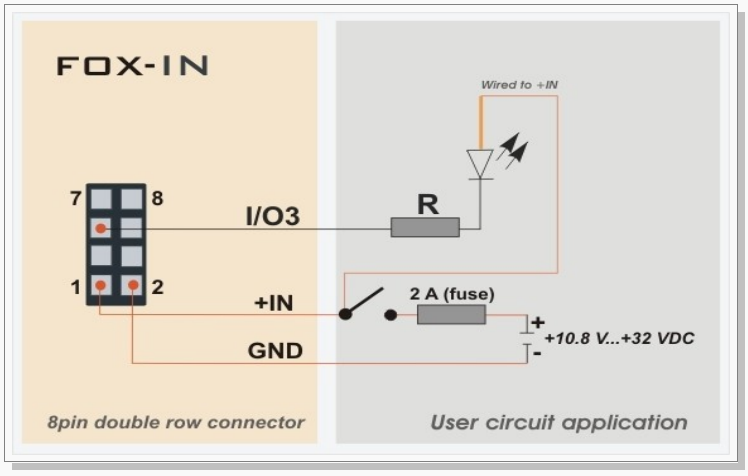

Figure 8: Connection example 2 when using it to control an LED

6.1.2.4 How to use IGN pin(pin 3)

The IGN-pin has two functions:

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

IGN-sleep mode is one of the eight supported energy-saving modes of the device 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-IN/EN 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-IN/EN devices that are shipped by the factory with an internal battery, are entered into the IGN-sleep mode. To wake up them from this sleep mode, connect the IGN-line to the d.c.-power source.

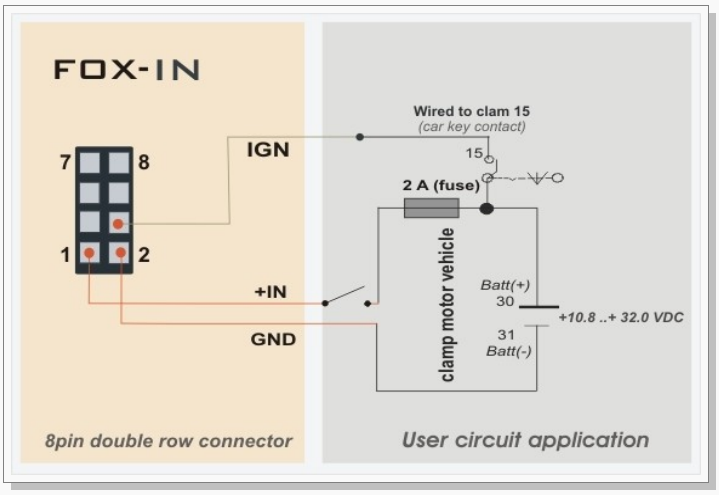

Figure 9: Monitoring vehicle starter by IGN line

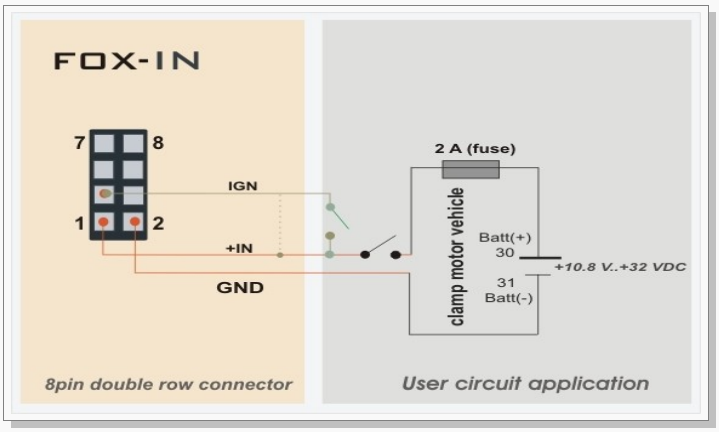

Figure 9.1: Use IGN line to wake FOX-IN/EN from IGN-Sleep

6.1.2.5 Serial Port 0 - Serial communication signals (RxA and TxA)

The FOX-IN/EN 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-IN/EN Evalboard in order to communicate with the FOX-IN/EN 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).

6.2 Inserting the SIM card into the SIM holder inside the device

The FOX-IN/EN device are equipped with a GSM modem that requires a SIM card to put it in use.

The SIM card is obtained from your mobile provider and must be activated for GSM data services before using it. Together with the SIM card, you receive a 4-digit PIN number. Entering of the PIN allows your device to access the mobile network.

To insert the SIM card into the SIM card holder INSIDE the device follow the steps below (*no pictures currently available*):

***Attention**: The opening of the housing must be performed by qualified electricians.*

1) Remove the power supply and any other connections from the device. Use a screwdriver to carefully detach the upper side of the device housing. Turn device on the back and unscrew carefully all screws as shown in steps (1) and (2).

1) Carefully raise the case away **(3)** and with caution to prevent injury of the cable connectors between the device and housing.

   Attention: Do not remove any of the cable connectors!

2) Indicate the SIM card holder. On the leftmost circuit board is the GSM modem, next to it it right is the GPS module and the black-colored SIM card holder **(4)** can be found on the left hand side below the mounted GSM modem. Push the slider (metal lock) of the SIM card-holder in the direction marked "⇨ OPEN" to unlock it.

3) Flap the card holder up **(5)**.

4) Insert the SIM card **(6)** into the SIM card holder (with care not to damage any components of the circuit board)- the bevelled corner on the SIM card is towards the top of the card-holder and the golden contact area is facing downwards 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.

5) Flap the card-holder back (without force) **(7)**, 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.

6) Finally, place the upper case of device housing back to the original position **(8)**, and press the case down until it snaps in the lower case of device housing (with care not to damage the cables inside), then screw all screws with a screwdriver.

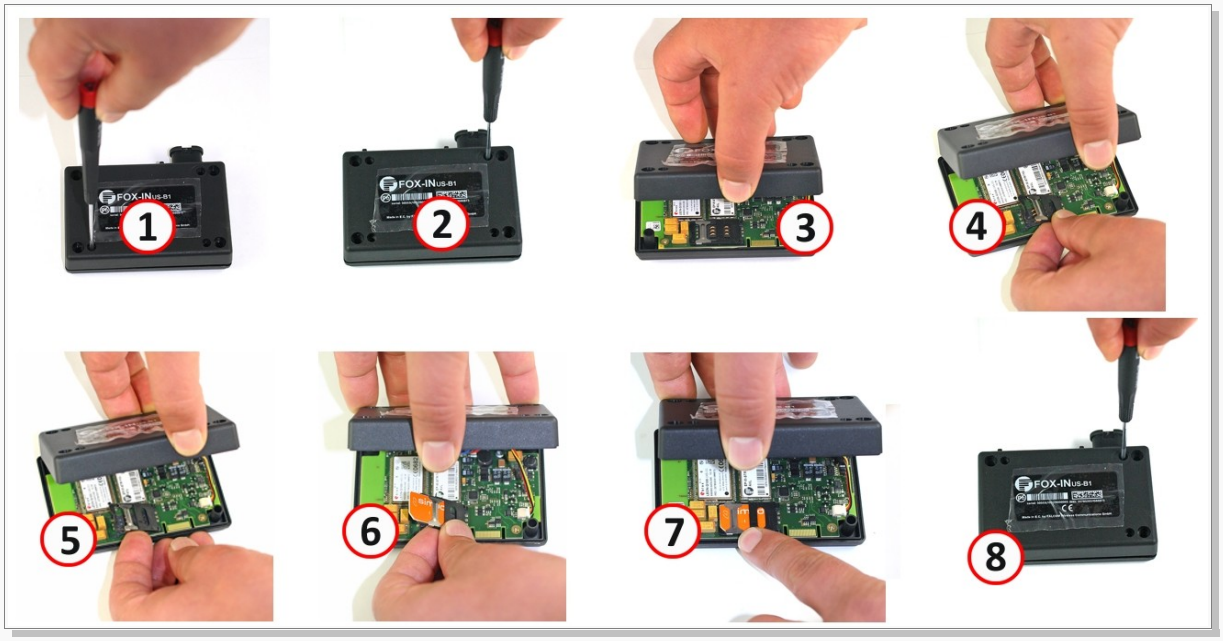

Figure 10: Open the device housing and insert the SIM card.

6.2.1 How to enter the PIN of the inserted SIM card:

To insert the PIN of the SIM card follow the steps below *(as reference use fig. 10)*:

1) Install the **FALCOM Workbench** software.
2) Connect your FOX-IN/EN to a free PC COM port via its evalboard and power up your device. How to set up your FOX-IN/EN, is currently in preparation.
3) Start the **FALCOM Workbench** software, open a **COM Port**❶**,** a **Console**❷ and an **Editor**❸, then select the COM port❹ 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**❺ to the **COM Port** and the **Editor**❻ to the **Console** on the **Connection view**. For more details refer to the Workbench User's Guide.
4) Finally 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.pdf**"**.

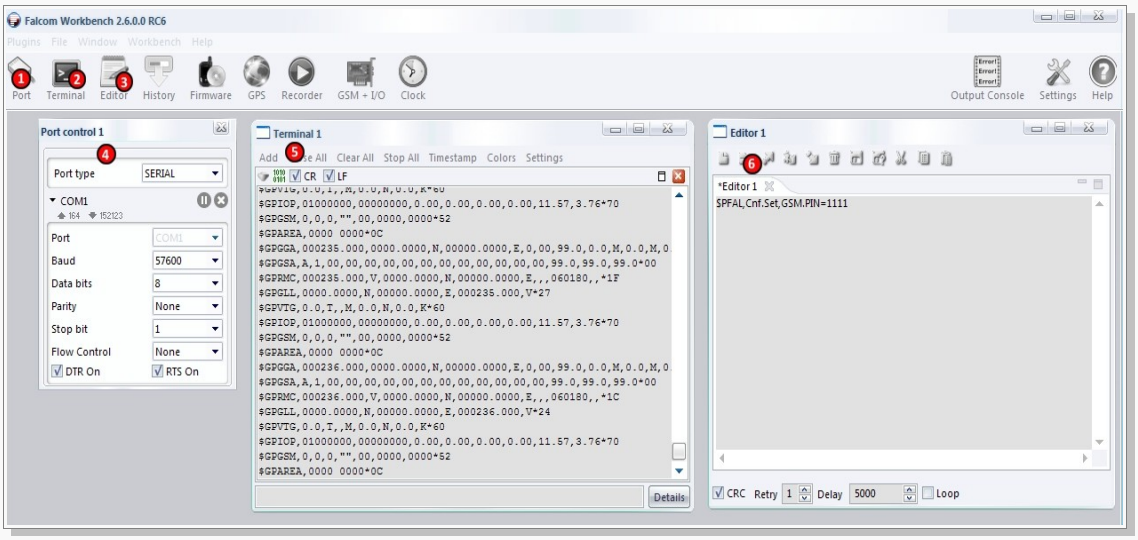

Figure 11: *Enter the PIN code of the inserted SIM card inside the device.*

6.3 LED indicators

The actual state of the FOX-IN/EN 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-IN/EN software manual *"AVL_PFAL_Configuration_Command_Set.pdf"*.

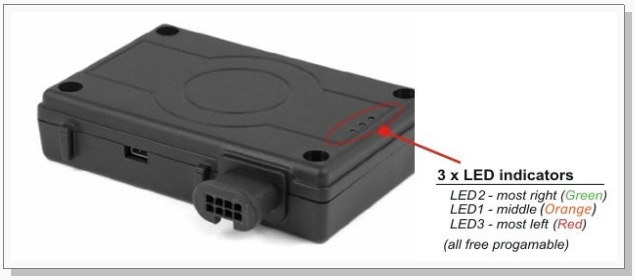

Figure 12: View of LED indicators

To turn on one of these LEDs, use the following command:

```
$PFAL,IO11.Set=high                    // 11=LED1;
$PFAL,IO12.Set=hpulse,2000             // 12=LED2;
$PFAL,IO13.Set=cyclic,2000,1000        // 13=LED3;
```

6.4 Mounting

The FOX-IN has built-in GSM antenna and GPS antenna. During installation, please make sure the receiving side face is up, with no metal object above the device to interfere with GPS reception.

The FOX-EN has two connectors for connecting a GPS and GSM antanna or a combined GSM/GPS antenna such as FAL-ANT-11 *(shown in figure below) or* FAL-ANT-12 from FALCOM. During installation, please make sure the receiving side face of the GSM/GPS antenna is up, with no metal object above the antenna and device to interfere with GPS reception.

The FOX-IN/EN compact unit provides 4 holes for attaching it to a suitable location.

The FOX-IN/EN device can be mounted in different locations such as on wall or in vehicle. *Fasteners can be Hexagon head with collar self drilling screws DIN 7504 K, ST3.5 x 32 mm (or screws with different length). There are no screws included in the delivery pack.*

More detailed information how to install the device in a vehicle, refer to the application note "AppNotes_in_vehicle_mounting.pdf".

Figure 13 View of the mounting holes

6.5 10pin mini-USB (option)

Upon request the FOX-IN/EN device can be supplied with a 10pin mini-USB connector with one of two hardware options: **Audio (AU version)** or **SPI** (**US version**) interface.

6.5.1 FOX-IN/EN-AU (AU-option)

The AU option supports a Serial interface (3.3 V), an audio interface and all other pins are NOT supported, so that they should not be connected. Table below gives you an overview about the supported pins for the AU option.

FALCOM offers an adapter cable called "KA27" that connects FOX-IN/EN to MFD device.

Figure 14: Pin assignments of the 10pin mini-USB (FOX-IN/EN-AU).

Table below shows the pinout of 10pin mini-USB connector for connecting an MFD and an active speaker.

PIN	PIN NAME	I/O	DESCRIPTION
1	SPK Right		Output Audio left channel. It can be connected directly to an active speaker.
2	USB_V+		**DO NOT CONNECT.**
3	SPK Left		Output Audio right channel. It can be connected directly to an active speaker.
4	RX4	I	(**Serial Port 1**) - Second Serial interface *(Receive data)* with 3.3 V TTL level. With the help of KA26 cable (*available by FALCOM*) it can be connected to the MFD 3.3.V serial port. Do not use this port to update the firmware into the FOX-IN/EN device.
5	MIC+		Microphone input from headset.
6	TX4	O	(**Serial Port 1**) - Second Serial interface *(Transmit data)* with 3.3 V TTL level. With the help of KA26 cable (*available by FALCOM*) it can be connected to the MFD 3.3.V serial port. Do not use this port to update the firmware into the FOX-IN/EN device.
7	Detect USB		Not supported. **DO NOT CONNECT.**
8	+IN	I	**=+IN** *(the same function as the Pin 1 on 8pin connector)*.
9	Audio GND	-	Ground (for audio signals) .
10	GND	-	Ground.

Table 8: Pin description of the 10pin mini-USB.

***Serial Port 1** - TTL Low Voltage Level*

Serial1 (RX4, TX4) operates on TTL-Voltage Level 3.3V. This port does not support firmware update. A firmware update can be performed either through **Serial Port 0** or remotely over TCP.

Rx4 This is the second receiving channel and can also be used to receive software commands to the board from the MFD device.

Tx4 This is the second transmitting channel and can also be used to transmit data to the MFD device.

This port can be used to connect the FOX-IN/EN to the MFD device via a special cable that can be provided upon user request by FALCOM. This cable is called "**KA26**" and it looks like in the picture below:

Figure 15: KA26 cable.

Audio interface:

The electrical characteristics for both paths is given separately in tables below:

Microphone path characteristic and requirements:

Microphone type	Electret microphone
Line coupling	AC
Line type	balanced
Differential input voltage	≤ 65mVpp (23mVrms)
Microphone nominal sensitivity	-45 dBVrms/Pa
Analog gain suggested	+10dB
Microphone voltage	3 V

Table 9: Microphone characteristics

Speaker path characteristic and requirements:

Line coupling	DC
Line type	bridged
Output load resistance	≥ 16 Ω
Internal output resistance	4 Ω (>1.7Ω)
Signal bandwidth	150 - 4000 Hz @ -3 dB
Max. differential output voltage	1.310 Vrms (typ, open circuit)
Max. single ended output voltage	656 mVrms (typ, open circuit)
SW volume level step	-2 dB
Number of SW volume steps	10

Table 10: Speaker characteristics

Detailed instructions on using audio parameters are presented in the manual **"**AVL_*PFAL_Configuration_Command_Set.pdf***".**

6.5.2 FOX-IN/EN-US (US option)

The US option supports a Serial interface (*3.3V*), a SPI interface and all other pins are NOT supported, so that they should not be connected. Table below gives you an overview about the supported pins for the US option. This interface allow you to extend device's functionalities by pluging-in the IO-Dongle (optional). It has 4 additional outputs, 1 anlogue input and 8 digital inputs.

Figure 16: Pin assignments of the 10pin mini-USB (FOX-IN/EN-US).

Table below shows the pinout of 10pin mini-USB connector for connecting the IO-Dongle.

PIN	PIN NAME	I/O	DESCRIPTION
1	MOSI	O	Master output, slave input
2	USB_V+		Not supported. **DO NOT CONNECT**
3	MISO	I	Master input, slave output
4	RX4	I	(**Serial Port 1**) - Second Serial interface (Receive data) with 3.3 V TTL level. Do not use this port to update the firmware into the FOX-IN/EN device. This pin is available if no Bluetooth® option is available
5	CLK	O	Serial clock
6	TX4	O	(**Serial Port 1**) - Second Serial interface (Transmit data) with 3.3 V TTL level. Do not use this port to update the firmware into the FOX-IN/EN device. This pin is available if no Bluetooth® option is available
7	Detect USB		Not supported. **DO NOT CONNECT**
8	+IN	I	**=+IN** *(the same function as the Pin 1 on 8pin connector)*
9	CS	O	Chip select
10	GND	-	Ground

Table 11: Pin description of the 10pin mini-USB.

Serial Port 1 - TTL Low Voltage Level

Serial1 (RX4, TX4) operates on TTL-Voltage Level 3.3V. This port does not support firmware update. A firmware update can be performed either through **Serial Port 0** or remotely over TCP, but not through this port.

Rx4 This is the second receiving channel and can also be used to receive software commands to the board from an external device.

Tx4 This is the second transmitting channel and can also be used to transmit data to an external device.

6.5.2.1 I/O-Dongle (IOBOX) Pinout

The I/O-Dongle is only available for the FOX-IN/EN-US version.

FOX-IN/EN-US-BT with I/O-Dongle plugged in

IO-Dongle (IOBOX) Pinout

Table below shows the pinout of IO-Dongle.

PIN	NAME	I/O	DISCRIPTION	LEVEL
1	GND	-	Ground.	0 V
2	IN5	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
3	Tx4	O	**Serial Port 1.** Second Serial interface with limited functionality. Transmit data for direct connection to the host PC. If not used leave open. This pin is available if no Bluetooth® option is available.	V24, ±12 V
4	IN6	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
5	Rx4	I	**Serial Port 1.** Second Serial interface with limited functionality. Receive data for direct connection to the host PC. If not used leave open. This pin is available if no Bluetooth® option is available.	V24, ±12 V
6	IN7	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
7	ANA	I	Analogue Input 10 bits resolution.	0 .. +32.0V DC
8	IN0	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
9	OUT0	O	Open collector output.	100 mA max. @ 0 .. +32.0V DC
10	IN1	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
11	OUT1	O	Open collector output.	100 mA max. @ 0 .. +32.0V DC
12	IN2	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
13	OUT3	O	Open collector output.	100 mA max. @ 0 .. +32.0V DC
14	IN3	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
15	OUT2	O	Open collector output.	100 mA max. @ 0 .. +32.0V DC
16	IN4	I	Digital input.	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)

Table 12: IO-Dongle pinout

The indices of these inputs and outputs can be found in the manual "*AVL_PFAL_Configuration_Command_Set.pdf".*

6.5.3 External connection points for a GSM and GPS antenna for FOX-EN-AU/US

FOX-EN-AU/US is fitted with two male *SMB FAKRA* connectors that accept a wide variety of GSM/GPS antenna styles. The **Bordeaux** connector *(see figure below)* is provided for GSM RF connection. The GSM RF connector has an impedance of 50 Ohm. A GSM antenna can be directly connected to this connector.

The **Blue** connector *(see figure below)* is for GPS RF connection. The GPS RF connector has also an impedance of 50 Ohm. Active antennas have an integrated low-noise amplifier. They can be directly connected to this connector.

FALCOM provides a combined *GSM/GPS* antenna, especially, for the *STEPPIII and FOX-EN-AU/US* devices. The GSM antenna operates on four frequencies: *850/900/1800/1900* MHz. The GPS antenna operates on 1575.42 MHz frequency. The combined GSM/GPS antenna should be ordered by FALCOM, the order name is: **FAL-ANT-11.** Any other GPS antenna connected to the *FOX-EN-AU/US* must draw less than 25 mA. The antenna voltage is supplied internally. *The figure below shows how the FAL-ANT-11 combined antenna should be connected to the antenna ports of the FOX-EN-AU/US device.*

For more details about the FAL-ANT-11, refer to the document "FAL-ANT-11_Datasheet.pdf" available on the Falcom's webpage.

Figure 17: GSM/GPS antenna connectors

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

To connect the **FAL-ANT-11** combined GSM/GPS antenna to the FOX-EN-AU/US device:

- ✔ *plug the **Bordeaux**-colored connector of the antenna to the **Bordeaux** colored connector of the device,*
- ✔ *then plug the **Blue**-colored connector of the antenna to the **Blue** colored connector of the device.*

To remove the **FAL-ANT-11** GSM/GPS antenna from the FOX-EN-AU/US device:

- ✔ *Press down the latch on the antenna connector and then pull the antenna.*

6.5.4 FOX-IN/EN-US-BT (Bluetooth® Option)

The FOX-IN/EN-US-BT is a Bluetooth® enabled device that supports only Serial Port Profile (SPP) (No Audio Profile) allowing users to send messages to the device wirelessly without needing any cable. The IO-Dongle supports 4 digital outputs, 1 anlogue input and 8 digital inputs. Table below gives an overview of the pins supported by this interface. How to set up a Bluetooth® communication with FOX-IN/EN-US-BT refer to the chapter 6.5.4.1 below.

FOX-IN/EN-US-BT with I/O-Dongle plugged in

IO-Dongle (IOBOX) Pinout

Table below shows the pinout of IO-Dongle.

PIN	NAME	I/O	DISCRIPTION	LEVEL
1	GND	-	Ground	0 V
2	IN6	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
3	-	-	-	-
4	IN7	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
5	-	-	-	-
6	IN8	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
7	ANA	I	Analogue Input 10 bits resolution	0 .. +32.0V DC
8	IN1	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
9	OUT1	O	Open collector output	100 mA max. @ 0 .. +32.0V DC
10	IN2	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
11	OUT2	O	Open collector output	100 mA max. @ 0 .. +32.0V DC
12	IN3	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
13	OUT3	O	Open collector output	100 mA max. @ 0 .. +32.0V DC
14	IN4	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)
15	OUT4	O	Open collector output	100 mA max. @ 0 .. +32.0V DC
16	IN5	I	Digital input	0 .. +32.0 V DC ($V_{+IN} \leq$ +IN)

Table 13: IO-Dongle pinout

The indices of these inputs and outputs can be found in the manual "AVL_PFAL_Configuration_Command_Set.pdf".

6.5.4.1 Setting up a Bluetooth® connection with FOX-IN/EN-US-BT

Bluetooth® is a common and simple way for two nearby electronic devices to communicate with each other without wires. Many newer laptop computers come with built in Bluetooth® capabilities. Check to see if your computer is Bluetooth® enabled. If you do not have Bluetooth® adapter already installed, then you will need to purchase one.

Be sure that the computer and your device are close to each other and turn on both the Bluetooth® ability on your computer and on the device. They should start communicating with each other after you have entered the *Bluetooth-PIN-Code* which is "***0000***" (*default*) when the PIN dialog box promts. Remember the COM port assigned to the *FOX-IN/EN-US-BT* device. If they do not, your device should come with some additional software. Install the software and follow the installation instructions.

When the two devices have found each other you will now be able to enjoy a wireless device.

When both device are connected to each other, you can start the *Workbench Software,* open the *COM port* assigned to the *FOX-IN/EN-US-BT* device (e.g. COM 6), select the baudrate to *112500* bps and you will see the data sent from the *FOX-IN/EN-US-BT* device on the *Workbench* terminal. If you want to send any data to an external Bluetooth enabled device, use the PFAL command **$PFAL,MSG.Send.Serial1,0,"Speed=&(Speed)"**. For more details about the Workbench software and how to get data displayed on the its terminal refer to the chapter 6.2.1 above and follow the *Step 3*.

7 HOUSING

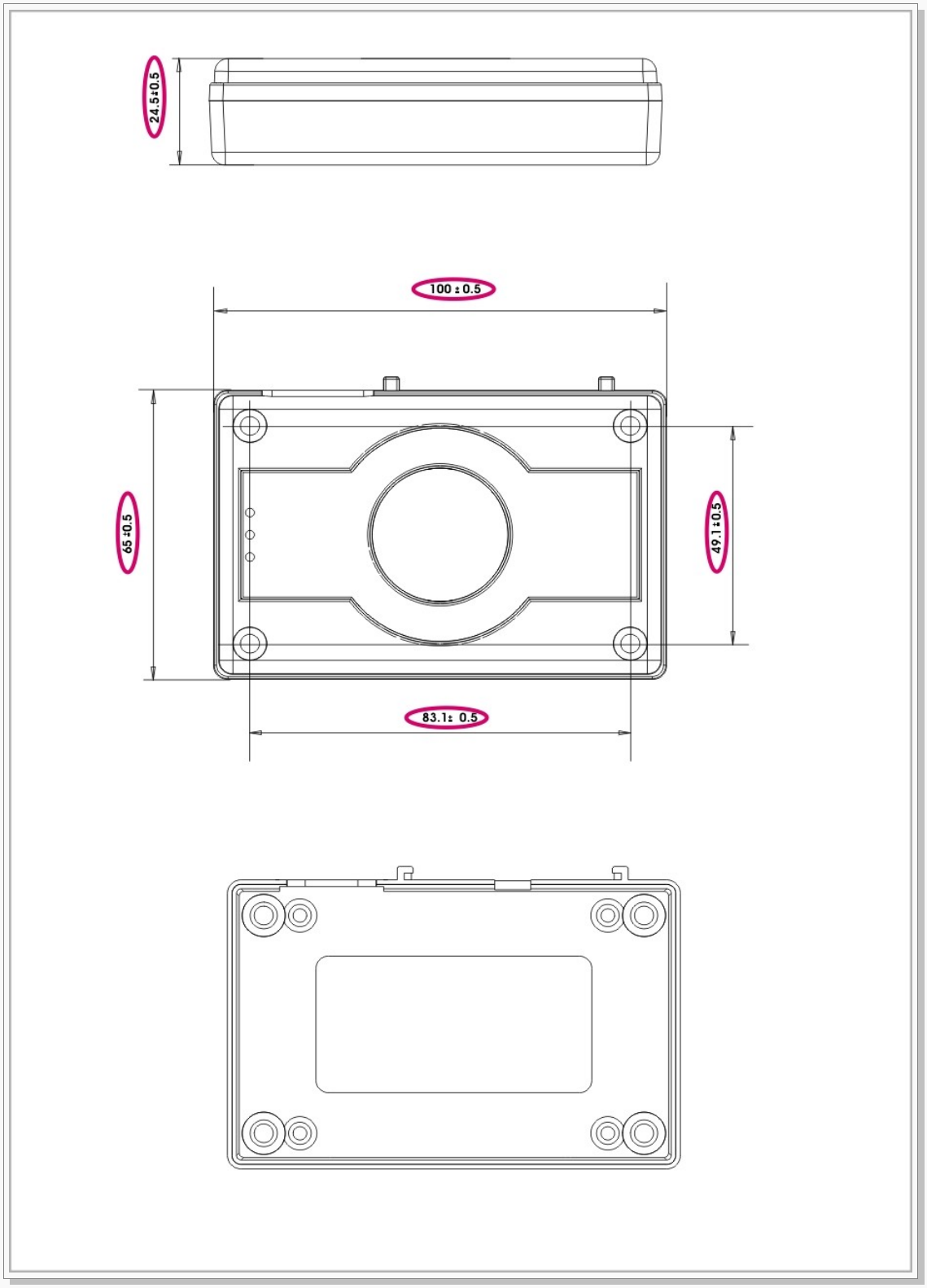

Figure 18: FOX-IN/EN housing.

8 APPENDIX

8.1 Schematics

The figure below illustrates a common schematic for installing your FOX-IN/EN hardware in the vehicle and using it for vehicle security. For detailed information, please, refer to the related documents [*AppNotes_in_vehicle_mounting.pdf*].

8.1.1 Installation guidance for 8-pin double row connector

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

When installing your FOX-IN/EN 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 loaded configuration into the FOX-IN/EN device will occur. Depending on your application requirements, the software configured pins as digital outputs can be used to lock/unlock doors, to activate a relay, buzzer, turn on a lamp, etc. while the configured pins as digital inputs can individually be used e.g. to detect something in vehicle when opened or closed; changes on this input may trigger an output to high. The IGN line can be connected to the vehicle ignition key to monitor its ON/OFF position.

Note: Turn the car ignition off before making any connection. Use a common ground point for all ground wires. To avoid ground loops and second grounds, isolate all grounded pins of the FOX-IN/EN from the vehicle body. Do not connect power from a different system to the FOX-IN/EN.

Software configured outputs of the FOX-IN/EN must operate at the same voltage level as the supply voltage +IN operates.

The operating voltage range MUST never be exceeded, device is not protected again continuous overvoltage. For security reason, it is recommended to integrate externally a 2A fuse link between the positive wire of the FOX-IN/EN (+IN) and d.c. - power source.

The antenna should be mounted in the dash or on the windshield of the vehicle with the GPS side facing the sky and the antenna has clear view to the sky.

Connect the power cable to the FOX-IN/EN - with the vehicle ignition off, and antenna connected, attach the power pins to **FOX-IN/EN (FIRST** connect the **GND** pin and then the **+IN** pin).

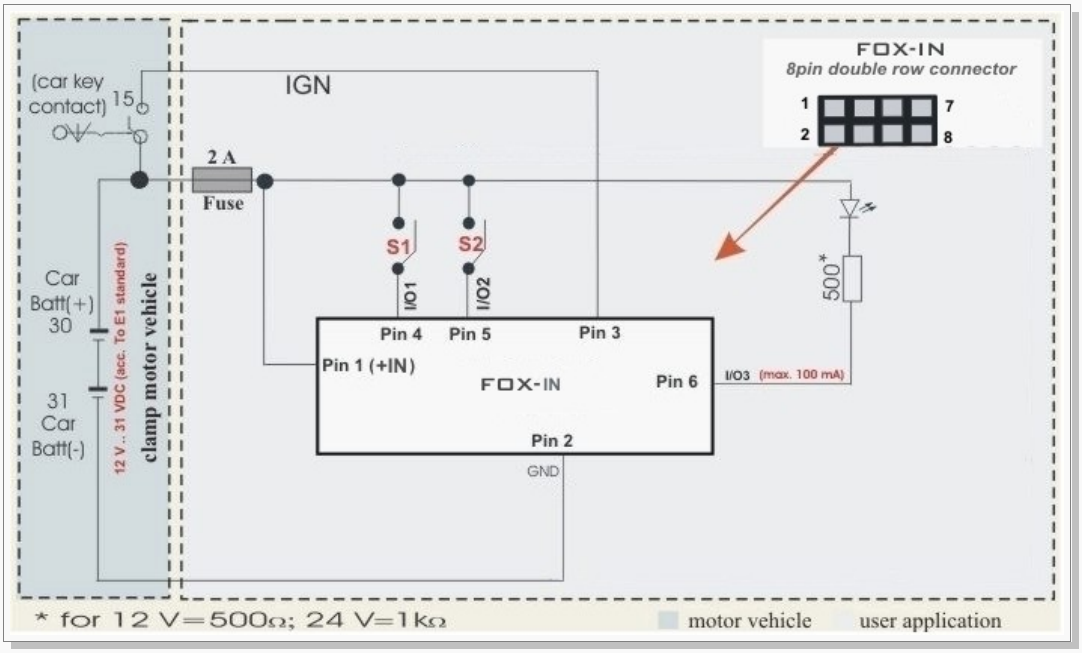

Figure 19: Schematic example of installation guidance.

8.2 What should be considered when using FOX-IN/EN device

FOX-IN/EN is a device controlled by means of the PFAL commands. All PFAL commands can be executed when the operating firmware inside the device is running. To be able to create application with the FOX-IN/EN device and to obtain maximum benefit from the FOX-IN/EN operating firmware, you have to setup a specific configuration and store it inside the device. All PFAL commands can be sent to the FOX-IN/EN 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)*. The commands supported by FOX-IN/EN and other AVL devices are listed and described in a separate manual *"AVL_PFAL_Configuration_Command_Set.pdf"*.

9 STATEMENT ACCORDING TO FCC

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

The device contains 1800 MHz GSM functions that are not operational (may 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.

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.