FALCOM

FOX3

Hardware manual

Version: 1.0.8; Modified: Thursday, February 19, 2015

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Version history:

This table provides a summary of the document revisions.

Version	Author	Changes	Modified
1.0.8	F. Beqiri	- Unnamed: PAID-FEATURE in PREMIUM-FEATURE	02/19/2015
1.0.7	F. Beqiri	- Added point 6 in chapter 6.5.1.1 - Activation of the setting/option "Load-VCP" after installing the FTDI driver.	10/27/2014
1.0.6	F. Beqiri	- Added chapter 2.11.3, "Safety precautions when replacing the battery"	10/24/2014
1.0.5	F. Beqiri	- Added power consumption @ 24 VDC - see Table 2.1	01/07/2014
1.0.4	F. Beqiri	- Added: KA70 (3-Wires installation cable (V+, GND, IGN) - optional accessory)	16/05/2014
1.0.3	F. Beqiri	- Added: Power consumption @ 12 VDC - see chapter 4.1.1 - Added: Installing USB drivers - see chapter 6.5.1.1	14/05/2014
1.0.2	F. Beqiri	- Added figure 1 in chapter 1.1	30/01/2014
1.0.1	F. Beqiri	- Chapter 6.1.3 updated	27/01/2014
1.0.0	F. Beqiri	- Initial version.	15/12/2013

Cautions

The information furnished herein by FALCOM is believed to be accurate and reliable. However, no responsibility is assumed for its use. Please, read carefully the safety precautions.
If you have any technical questions regarding this document or the product described in it, please contact your vendor.
General information about FALCOM and its range of products are available at the following Internet address: http://www.falcom.de/

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Note

Because our products are being continuously improved, 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 who are well skilled in electronical/electrical installation and not to the private consumers/end users. The installation, implementing or setting into operation of the product can be performed only by qualified personnel.

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may have changed since first publication and therefore the information in this document about the product status may be outdated.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

The engineering of this AVL product is built on the same technology combining both versions of the FOX-IN/EN devices with additional hardware extensions into one product. The main characteristic of this product is the on-board auto-switch that it supports connection to both internal and external antennas by automatically switching to the external antennas when connected. This AVL product is the first design to feature a hardware implementation of this technology.

1.1 General

FALCOM is using state-of-the-art technology to develop unique and low-cost devices for managing assets and vehicle tracking more effectively than current systems on the market today. FOX3 is a compact and all-in-one device with powerful integration capability combining all features of the successful FOX-IN/EN family into only 1 unit. It provides analog ports and integrates with 1-Wire interface. The 1-Wire interface supports connection with multiple sensors and actuators, which can simply be built by wiring together without using different wires. 1-wired accessories such as iButton, Temperature Logger, Temperature Sensor, Humidity sensor… etc. can be connected directly to the FOX3 device. A highlight of the FOX3 device is that in addition to its on-board antennas, it supports 2 FAKRA connectors for external antenna connections. This feature allows flexible solutions for both internal and external antenna applications and enables a single flexible product to support multiple applications or installation options. Logistics provider can be performed using the barcode scanner or FALCOM RFID device that communicates to the FOX3 device using RS232 interface.

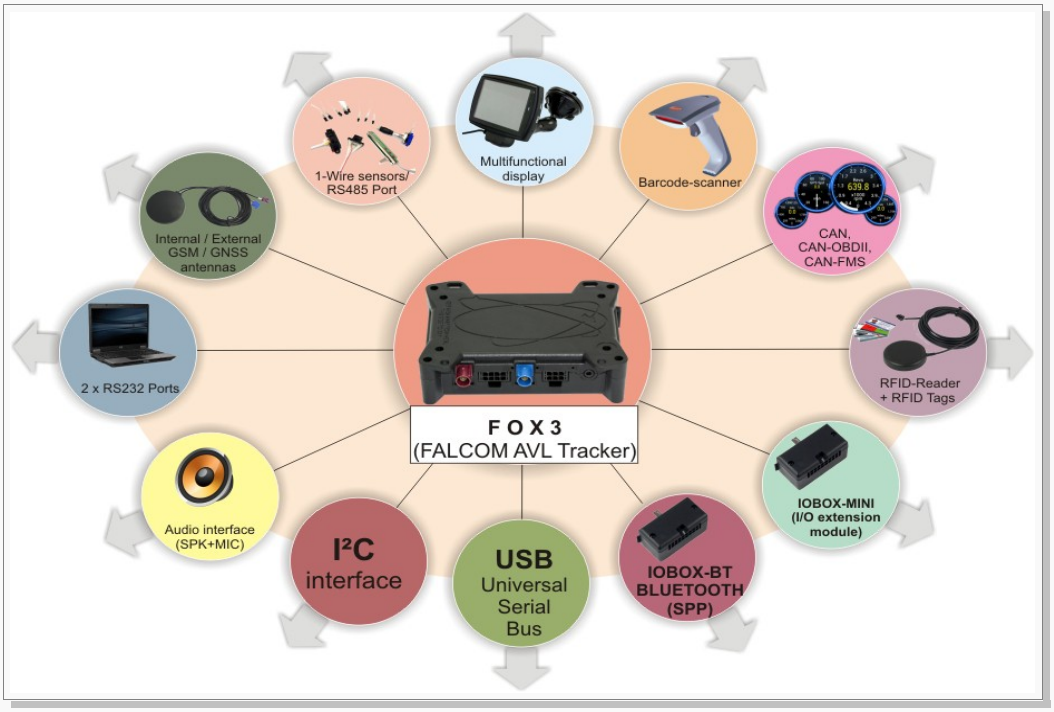


Figure 1: FOX3 networking and interfaces to peripheral devices.

Newly developed FALCOM PREMIUM features show the way to the future of mobile data logging, storing, processing and sending. The needed hardware options can be decided shortly before installation depending on the application. FOX3 can act as a mobile client for various regular applications like AVL, fleet management, security and recovery of assets. The device offers new firmware features like: TCP DATA ENCRYPTION, several HISTORY MODES and ECO-DRIVE/BEHAVIOUR LOGGING beside standard items like status reports, messaging alerts, audio calls, spy calls and Geo-fencing.

The FOX3 unit is delivered without SIM card and without battery. SIM cards must first be purchased and then registered into the GSM network before installing into the device. The battery can be ordered as an option (refer to the Ordering Guide for more information). The setup and configuration of the device is provided through Serial Ports, over SMS and TCP using special commands like “PFAL” and the Workbench Software configuration tool. These "PFAL" commands are special to FALCOM AVL devices and can be used for all kinds of communications including Serial, SMS, CSD, TCP and SMTP. Please read the document "*AVL_PFAL_Configuration_Command_Set.pdf*" for more details about the PFAL-Commands.

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 are also implemented in the firmware. FOX3 contains a data-logger (history feature) that enables you to archive unique vehicle locations in sequence up to 45 days for later analysis and evaluation, for example with an archiving interval up to 20 sec..

The physical interface to the device application is made through integrated main and accessory ports as well as the 10pin mini-USB port. These ports are required for controlling the unit, receiving GPS location data, transferring data, power supply, extending the number of I/Os as well as for the use of extra external devices which are not integrated in the In-Vehicle Computers.

FOX3 is a device that can be configured and integrated onto any asset platform, including:

- Trailers
- Trucks
- Delivery vans
- Rail cars
- Industrial vehicles
- and more

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
- Eco-Drive - (PREMIUM feature)
- Encrypted TCP communication based on AES 128 bit algorithm - (PREMIUM feature)
- and more.

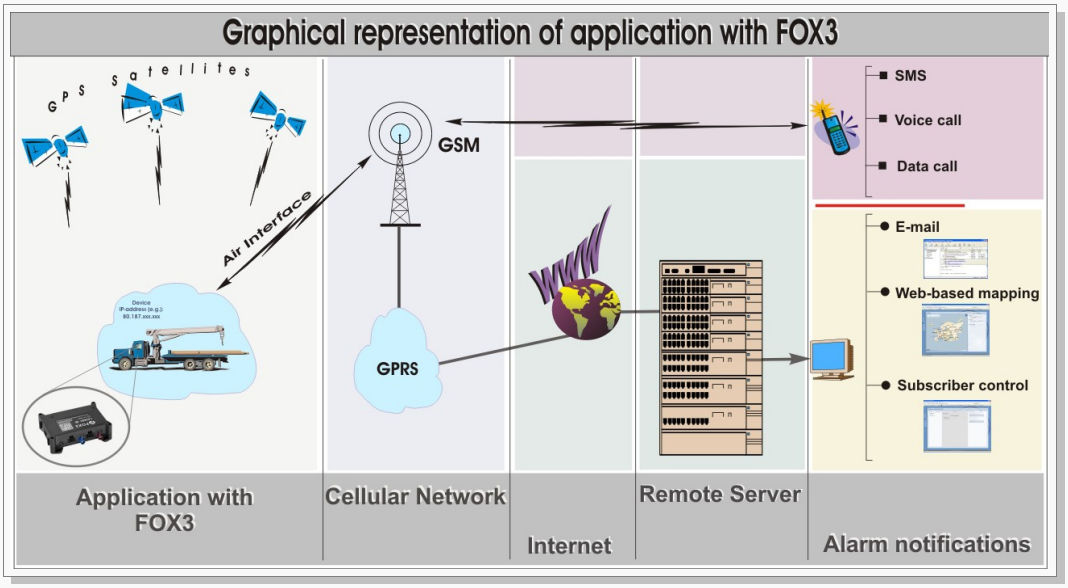


Figure 2: GSM/GPRS and GPS based vehicle tracking applications with FOX3

1.2 Package

The FOX3 device is supplied to the customer in a cardboard box with following content:

Figure 3: FOX3 standard delivery

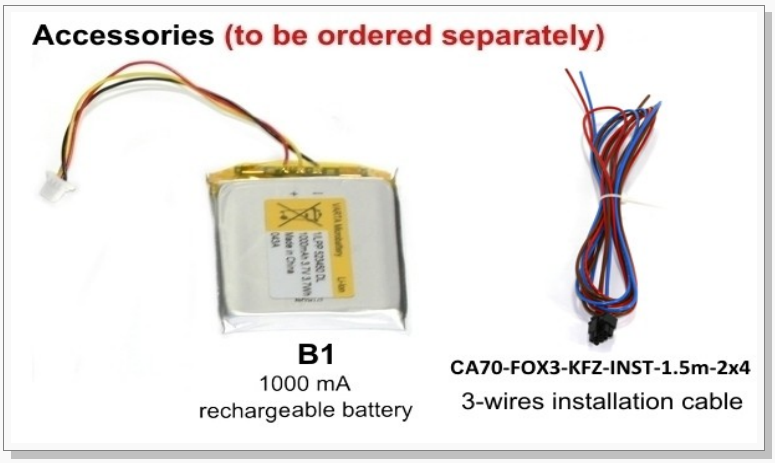


Figure 3.1: FOX3 Accessories (to be ordered separately)

1.3 Circuit concept

The architecture of the FOX3 device consists of the following major components (as shown below):

Architecture Integrates	
- Quad-Band GSM/GPRS module	
- GNSS receiver (GPS + GALILEO + GLONASS) - GLONASS needs to be activated	
- ARM7 processor controlling system functions	
- Inside SIM card holder (**1.8/3V** SIM cards)	
- Internal GSM/GNSS antennas	
- Main Port (Power, RS232 port, I/O ports)	
- Accessory Port (1-Wire, RS232 port, I²C interface)	
- 10pin mini-USB-connector (incl. SPI & USB)	
- Audio connector (Microphone & Speaker)	
- GSM & GNSS antenna ports (for external antennas)	
Physical Interfaces	**FOX3 accessories and hardware PREMIUM features**
- 1 x Power supply lines	- Backup battery 1000 mAh (B1 Option)
- 3 x Multi-line I/O	- IOBOX-MINI - I/O extension module
- 1 x Ignition	- IOBOX-CAN - Second CAN-Bus interface
- 3 x LED indicators	- Car installation cable (KA70-FOX3-KFZ-INST-1.5m-2x4)
- 2 x RS232 port (RX, TX, GND) V24	- CAN-Bus Interface
- 1 x 2.5mm audio port	- RS485 port
- 1 x USB port	
- 1 x SPI interface (for IOBOX-MINI/ BT / CAN)	
- 1 x 1-Wire port	
- 1 x I²C port	
- 2 x External antenna port	
- 8 x Mounting Holes	

Table 1: FOX3 architecture

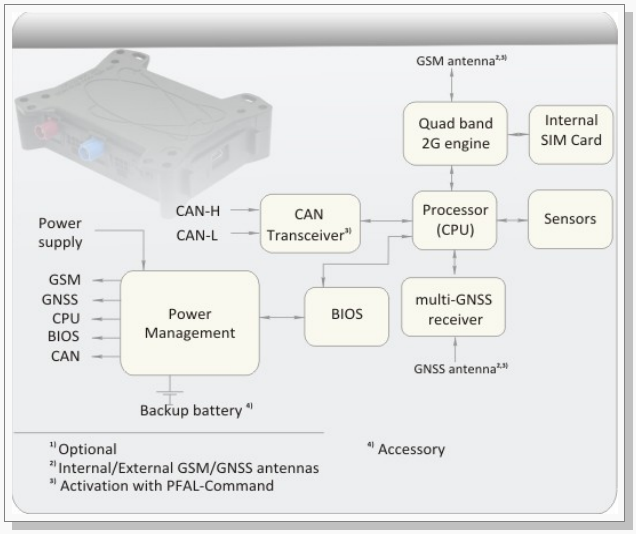


Figure 4: FOX3 block diagram

1.4 Related documents

In addition to this document, the following files comprise the full set of FALCOM *FOX3* 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 decode 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).
[4]	AppNotes_AVL_Installation_Guide.pdf	This document provides all the necessary information how to install your FALCOM product properly and safely in a vehicle.
[5]	AppNotes_ECO-DRIVE-GPS.pdf	This document contains information of how to use the features of the GPS-ECO-DRIVE supported as PREMIUM-FEATURE in the firmware version avl_2.11.0 and above.
[6]	AppNotes_AES_TCP.pdf	This document contains information of how to use the features of the AES_TCP (ADVANCED ENCRYPTION STANDARD) supported as PREMIUM-FEATURE in the firmware version avl_2.10.0 and above.
[7]	AppNotes_HowToActivatePremiumFeatures.pdf	This document contains information of how to activate a PREMIUM-FEATURE on a FALCOM AVL device.
[8]	AVL_AppNote_RFID_Howto.pdf	This document contains information of how to connect and use an RFID-Reader to/with the FALCOM AVL devices.
[9]	AppNotesForCANBusApplication.pdf	This document contains information of how to connect an the FALCOM AVL devices to the vehicle and how to configure and use the CAN-Bus features.
[10]	AppNote_CAN_FMS_CAN_OBDII_Howto.pdf	This document contains information of how to connect an the FALCOM AVL devices to the vehicle and how to configure and use the CAN-Bus/FMS/OBDII features.
[11]	AppNote_WebUpdate_Howto.pdf	This document contains information of how to upgrade an AVL device firmware remotely over the air.
[12]	AVL_STEPPII_AppNote_Connecting_Barcode_Scanner.pdf	This document contains information of how to connect a bar code scanner to a FALCOM AVL device and how to transmit the scanned data.
[13]	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.
[14]	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 FOX3 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 FOX3 device. Please read this chapter carefully before starting to use the cellular engine FOX3.

2.1 General information

Your FOX3 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 FOX3 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 FOX3 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 FOX3 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 FOX3 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 FOX3 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 FOX3 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 Li-Polymer Batteries

The FOX3 device is shipped without battery inside. If a backup battery is needed, please refer to the FALCOM Ordering Guide and follow the safety rules listed below.

The safety rules below are applied for the Li-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 FOX3 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 Li-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.

2.11.3 Safety precautions when replacing the battery

The following notes describe information that you must consider when replacing the battery. The lithium battery must be handled correctly to avoid possible danger.

Replace the battery only with the same battery that comes with the device. Use of another battery invalidates all warranty claims for the device.

Caution: risk of explosion if battery is replaced by an incorrect type.

Dispose of the used battery as required by local ordinances or regulations.

2.12 Non-ionizing radiation

The FOX3 device comes with internal and external GSM/GNSS antennas. Therefore, care should be taken to install the device/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.

FOX3 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 (vehicle battery).
- **Power saving:**
  - 8 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: 83.0 ± 0.5 mm x 105 ± 0.5 mm x 28.0 ± 0.5 mm
  - Weight (without battery): ca. 130 gr.
- **Physical Interfaces:**
  - Main Port (8pin row connector) comprising:
    - ✔ 3 x I/Os multi functional pins (each pin has dual functions as analog or digital - software configurable. Each digital pin can individually be set as an input or output)
    - ✔ 1 x Ignition pin (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=115200 bps), 8 data bits, no parity, 1 stop bit, no flow control.
  - Accessory Port (6pin row connector) comprising:
    - ✔ 1-Wire line for connecting 1-Wire slave devices, such as iButton, temperature & humidity sensors etc.
    - ✔ I²C interface
    - ✔ 1 x Serial port (Rx, Tx), Baud rate is controlled by firmware 4800...115200 bps (default=115200 bps), 8 data bits, no parity, 1 stop bit, no flow control.
  - 10pin mini-USB connector comprising:
    - ✔ USB port
    - ✔ SPI interface.
  - Inside SIM card holder (supports 1.8/3 V SIM cards)
  - Built-in 3D G-sensor for power management, motion and shock alarm
  - 3 x LED indicators (red, green, blue) free-programmable
  - External ports for connecting a GSM / GNSS antenna
  - Audio interface with 2.5 mm female jack for connecting a headset.

- **Accessories (to be ordered separately):**
  - Backup Li-Polymer battery (see Ordering Guide)
  - Car Installation Cable
  - Accessory Installation Cable
  - GSM/GPS quad-band antenna (FAL-ANT11) as external antenna
  - IOBOX-MINI (external I/O extension device - up to 13 inputs/outputs)
- **Casing:**
  - Fully shielded.
- **Air humidity:**
  - 5 % up to 95 % (non-condensing).
- **Directive:**
  - RoHS compliant.
- **Firmware:**
  - Embedded TCP/IP stack, including TCP, IP, SMTP and UDP protocols
  - Accessible via PFAL commands
  - Upgradable locally via serial port and remotely over the air (OTA).
- **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 5.
- **GSM/GNSS antenna:**
  - Internal antennas and external antenna ports with built-in auto switch
  - Connect / Disconnect event generation.

4.1.1 Power consumption for FOX3

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	**38**	**mA**	*Microcontroller is ON.*
CPU on / GPS on / GSM off	**0**	**mA**	*GPS-fix valid.*
CPU on / GPS off / GSM on	**28**	**mA**	*GSM idle (registered) and GPRS detached.*
CPU on / GPS on / GSM on	**50**	**mA**	*Power mode = active, GPS fix valid, GPRS and TCP connected.*
	25	**mA**	*Power mode = auto, GPS fix valid, GPRS and TCP connected.*
	12	**mA**	*Power mode = doze, GPS fix valid, GPRS and TCP connected.*

Table 2: Current consumption at 12 VDC

All measurements have been performed: DCS 1800 MHz, Power Level 10, Cell Power -75dBm, T_{amb}= 23°C, V_{IN+} = 24 V DC

Modes	Average power consumption @ +24 V		Comments
	Value	Unit	
Power mode = active			
CPU on / GSM on /GPS on	**33**	**mA**	*Microcontroller is ON, GPS fix valid, GPRS and TCP connected.*
CPU on / GSM on /GPS off	**25**	**mA**	*Microcontroller is ON, GPRS and TCP connected.*
Power mode = doze			
CPU on / GSM on /GPS on	**15**	**mA**	*Microcontroller is ON, GPS fix valid, GPRS and TCP connected.*
CPU on / GSM on /GPS off	**7**	**mA**	*Microcontroller is ON, GPRS and TCP connected.*

Table 2.1: Current consumption at 24 VDC

Sleep Modes	Average current consumption in sleep mode @ 12 V *(external power)*	Unit
IGN	**< 1**	mA
IGN+Ring	**12**	mA
IGN+Timer	**1.5**	mA
IGN+GPS	**5**	mA

Table 2.2: Power supply and current consumption for different sleep modes.

4.1.2 Operating temperatures

Parameter	Min.	Typ.	Max.	Unit
Storage temperature	-40	+25	85	°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

* *The GSM/GPRS module is fully functional (-20 °C to + 55 °C meets the 3GPPspecifications).*

** *Optional. Storage and using conditions of the device with battery option are limited to the battery temperature range.*

Table 3: 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 4)
  - GPRS data uplink transfer: max. 42.8 kbps (see table 4)
  - 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 4: 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 GNSS engine features

- **GNSS engine:**
  - Multi channel GNSS (GPS + Galileo) receiver + (GLONASS optional)
  - 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: -161 dBm
  - Cold start: -148 dBm.
- **Operational limits:**
  - Velocity: 500 m/s (972 knots)
  - Altitude: 50,000 m
  - Max. update rate: 1 Hz.
- **A-GPS support:**
  - AGPS: Online / Offline / Autonomous.
- **Crystal oscillator (TCXO):**
  - Load sensitivity: ± 10 % load change, 0.2 ± ppm.

4.2 NMEA data message

FOX3 delivers data in the NMEA-0183 format and FALCOM own format. The 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 the protocols via TCP to a remote server including the current device location, GPS state, UTC time, date, speed and course over ground. The received protocols by the server 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, updating vehicle movements in real time and more. The TCP server developed by FALCOM called "***Trace4You***" has a lot of such features allowing you to have a full control of your vehicle, fleet and your assets.

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

Table 5: NMEA Output Messages

5 FOX3 APPLICATION INTERFACE

5.1 Power supply

The power supply for the FOX3 device 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 applied permanently to the FOX3 device and able to provide sufficient current of up to **1.5 A** (pulse).

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 main 8-pin port is dedicated to connect the supply voltage, and the GND pin for grounding.

Both +IN and GND pins serve for charging the connected backup battery (option) and also for powering the FOX3 device. FOX3 has an automatic power ON-function when external power is applied and no battery connected. The power supply for the FOX3 ranges from **V_{+IN}=+10.8 V**... **+32.0 VDC** allowing direct connection to vehicle power system.

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 the input voltage by and external 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 the device is going to be installed in a vehicle)

5.1.2 Automatic shutdown

Automatic shutdown takes effect if:

- under voltage is detected (internal battery level runs below the nominal voltage and the external power supply is disconnected).

5.1.3 Power saving

SLEEP mode reduces the functionality of the modules of the FOX3 device to a minimum and, thus, minimizes the current consumption to the lowest level. The FOX3 can be set into the sleep mode using the command **$PFAL,Sys.Device.Sleep** with one or more parameters listed in the table below.

Following SLEEP modes are supported by the FOX3 device:

Modes	*Description*
IGN	Device wakes-up from Sleep mode on the rising edge (Low to High signal) of the IGN (pin 3 - blue color).
Ring	Device wakes up on incoming voice call or SMS.
Timer=1:20:00	Device wakes up when timeout has expired.
Motion=5,20,20	Device wakes up when motion is detected.
ExtPwrDetect	Device wakes up on external power connection.
ExtPwrDrop	Device wakes up on external power disconnection. For battery powered devices, the device wakes up when the battery voltage drops below the minimum.
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 the 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 FOX3 has enough power to safely wake up the device from that sleep mode. If the internal battery of the FOX3 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 FOX3 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)*.

FOX3 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:

FOX3 Terminal (DCE)	to	Application (DTE)
RxA	<----------	TXD
TxA	---------->	RXD
GND	-	GND

Table 6: The signalling definitions between DTE and DCE.

6 HARDWARE INTERFACES

This chapter describes the hardware interfaces:

Interface specifications	
Main Port	The 8pin double-row connector, type: MOLEX-43045-08-MICRO FIT. It provides IN/OUT, power supply and first serial port (SER0) lines. The same pin functionality as FOX-IN/EN.
Accessory Port	The 6pin double-row connector, type: MOLEX-43045-06-MICRO FIT. It provides 1-Wire bus, I²C master interface, second serial port (SER1).
10pin-Mini-USB	10pin mini-USB port with SPI interface and USB - Master interface.
Optical LED Indicators	3 x LED indicators, free programmable using PFAL commands to show the device current state .
Mounting Holes	4 x mounting holes for attaching the device to a suitable location (use M4x20 self tapping or machine screws for mounting, not included).
Audio interface	The audio connector has a diameter of 2.5 mm which allows to connect a SPK/MIC device to the FOX3.
External Antenna Ports	FAKRA connectors for connecting GSM & GNSS antennas.
Battery tray	It is used to insert and connect the battery to the device.
SIM Holder	It is used to insert your SIM card into the device.

Table 7: Interface specifications

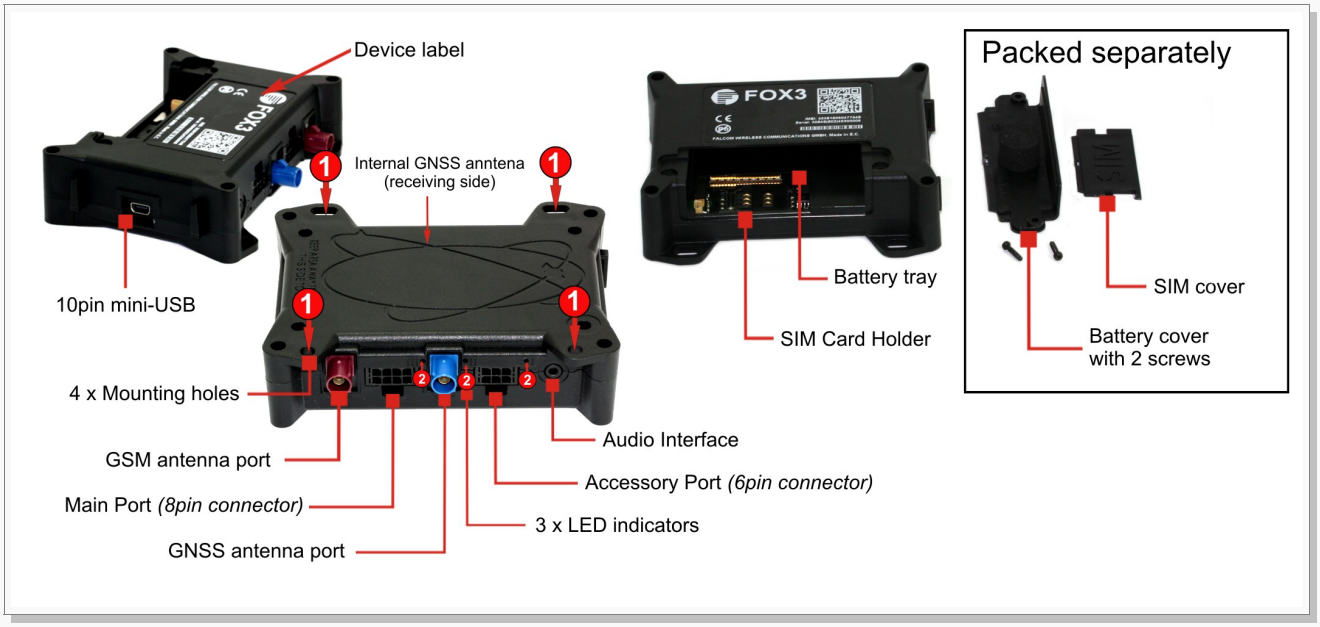


Figure 5: Interface specifications for FOX3 device.

6.1 Main Port (8pin connector)

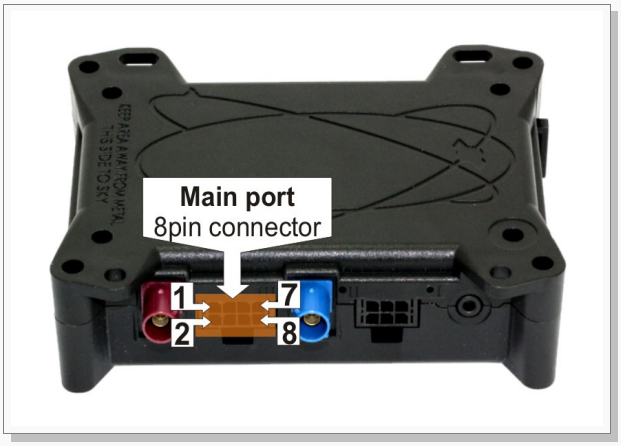


Figure 6: Pin assignments of 8-pin (2x4) connector (Type: MOLEX-43045-08-MICRO FIT)

6.1.1 Main Port Pinout

PIN	NAME	DIRECTION	DESCRIPTION	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 device, stay within the voltage range. Applying a voltage outside of the voltage range can damage the device. For security reason, it is recommended to integrate externally a 2A fuse link between power source and FOX3.	V_{+IN} = + 10.8 ... + 32.0 V Imax ≤ 1.5 A
2	GND	-	Ground.	0 V
3	IGN	Input	General purpose input. It can be either connected to the vehicle ignition and be used for journey START and STOP reports, or be connected to the operating voltage +IN and be used to wakeup the FOX3 device from IGN-Sleep mode *(awaking from this mode requires a HIGH signal)*. See also chapter 6.1.3.4.	**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 either as input or output. Every time the device starts up, a level change occurs on the I/O2 and I/O3 pins. Only I/O1 doesn't change the level on device start up. Pins I/O2 and I/O3 support CAN communication if this interface is activated. The CAN-Bus interface can be activated using the corresponding PFAL command (see PFAL command set for more details). In this case the I/O2 = CAN_L and the 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_0	Input	(**Serial Port 0**) The serial port (receive data) for direct connection to the host PC (for configuration, evaluation, firmware). If this pin is not used leave it open.	V24, ±12 V
8	TxA_0	Output	(**Serial Port 0**) Serial port (transmit data) for direct connection to the host PC (for transmitting history data, output GPS protocols and more). If not used leave it open.	

Table 8: Description of the main port (8-pin connector)

6.1.2 Installation cable (KA70-FOX3-KFZ-INST-1,5M-2x4)

This cable, which is NOT included in the standard delivery, is needed to install your FOX3 to the vehicle. If you need this cable, you can order it by contacting your vendor.

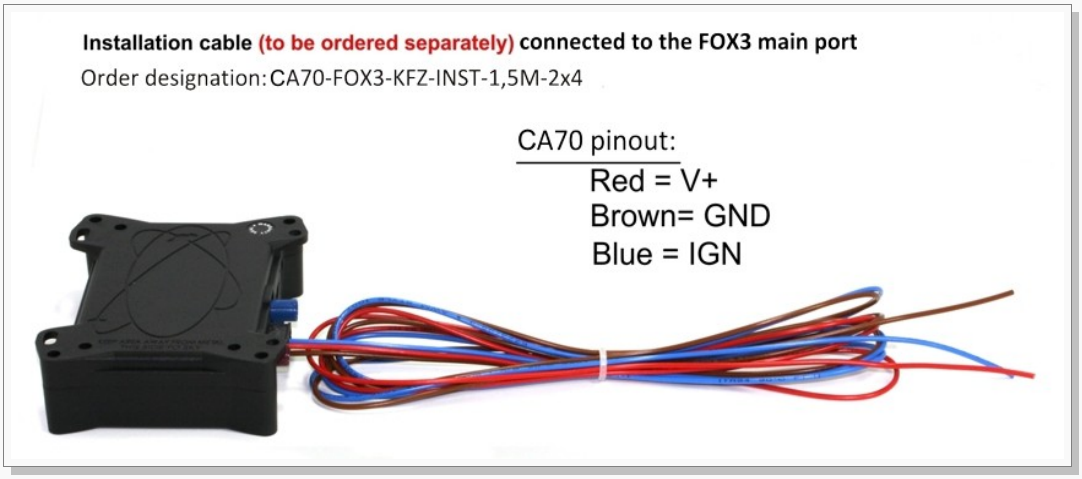


Figure 7: FOX3 installation cable (KA70-FOX3-KFZ-INST-1,5M-2x4).

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

The I/O2 and I/O3 (pin 5 and 6) can also operate as CAN-Bus interface if CAN is activated on the FOX3 device. More details about the CAN interface can be found in the PDF-files:
1) AVL_PFAL_Configuration_Command_Set.pdf,
2) AppNotesForCANBusApplication_xxx.pdf and
3) AppNote_CAN_FMS_CAN_OBDII_Howto_vxxx.pdf.

These pins have dual functions. All are controlled by the internal firmware of FOX3. Therefore, the user must define whether to use them as analog or digital pins. The configured digital pins can be inputs or outputs while the analog pins can only be inputs.

Their function is controlled by the command **PFAL,IO*0[1,2]*.Config.** For example, if 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,IO*2*.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,IO*4*.Set=high	*//**4**= I/O1; **high** = sets output to high*
$PFAL,IO*5*.Set=high	*//**5** = I/O2; **high** = sets output to high*
$PFAL,IO*6*.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 "**$PFAL,IO*4*.Set=high"** or "**$PFAL,IO*5*.Set=high"** or **"$PFAL,IO*6*.Set=high"**), otherwise 0V will be measured *(and the device could get damaged).*

6.1.3.1 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 for such purposes.

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

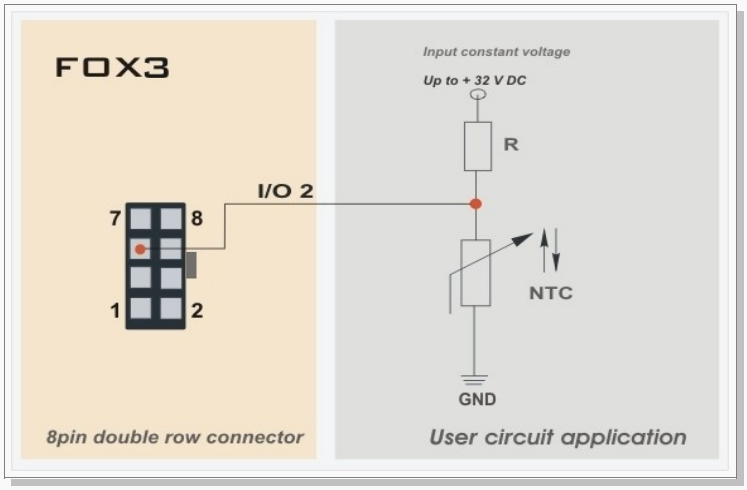


Figure 8: Connection example 1 when using it as analog input.

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 + 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 using them as analog inputs.

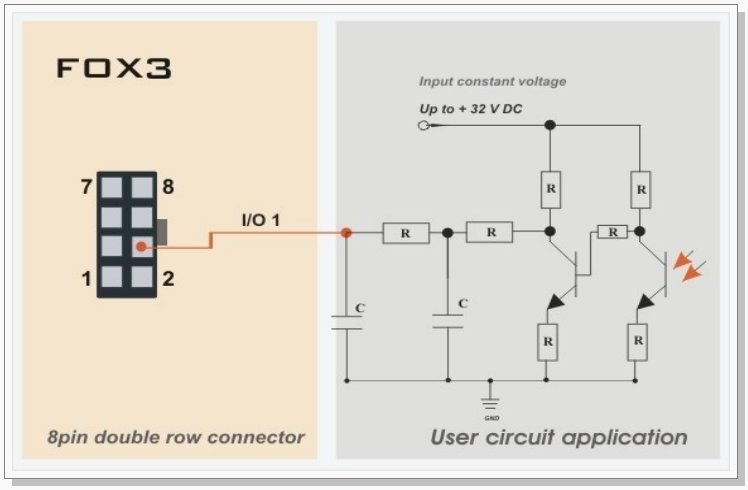


Figure 8.1: Connection example 2 when using it as analog input.

6.1.3.2 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. The values 5 and 10 are min. and max. voltages that will be used to generate Low and High events respectively. Detailed information about PFAL commands 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 FOX3 can react to the input changes and release different alarms such as sending out SMS, email messages, TCP packets, opening a CSD connection or activating output ports. The alarm type is configuration-dependant.

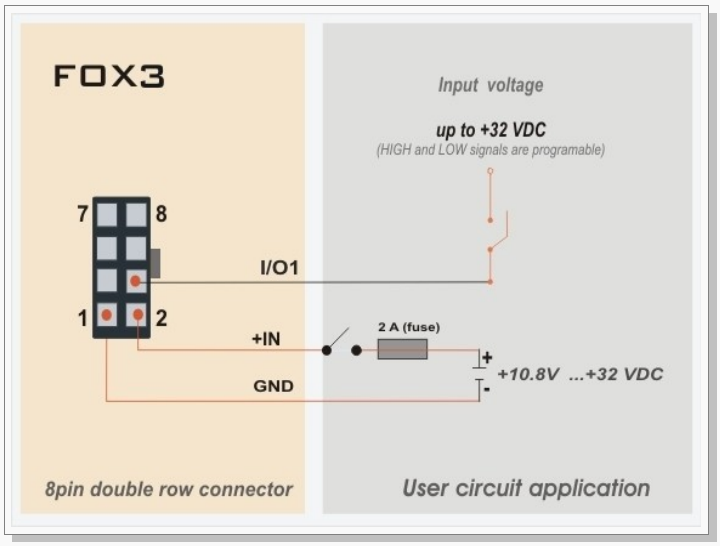


Figure 9: Connection example when using it as digital input.

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

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

The FOX3 device supports three IOs which can be used either as input or output. These outputs are open collectors. They can be connected directly via resistors (R) to LEDs, Relays etc., which need no more power than *100 mA @ up to + 32.0 V DC*. The figures below show the schematic of possible output connections. To activate these outputs use the command **$PFAL,IO4***[5,6]***.Set=high***[low,hpulse,lpulse,cyclic]* for **IO1, IO2** and **IO3** respectively or you can configure one or more alarms that activate these outputs when specific events occur (e.g. **$PFAL,Cnf.Set,AL0=IO.e8=redge:IO4.Set=cyclic,1000,2000**).

In order to evaluate this alarm, send firstly this alarm configuration to the FOX3 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, the power should not be applied directly to an output pin without having e.g. a resistor between them.

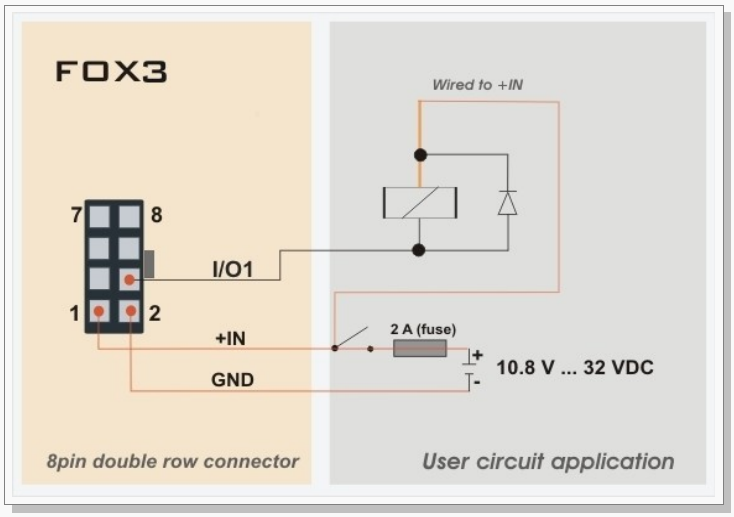


Figure 10: Connection example 1 when using it to control an Relay.

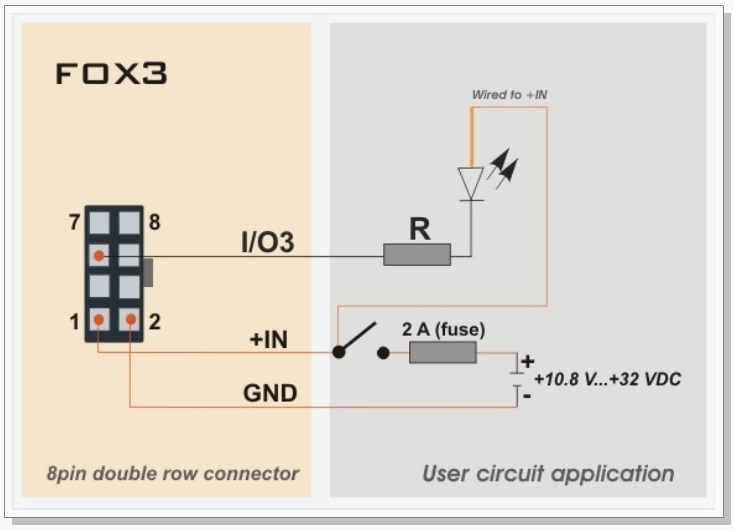


Figure 10.1: Connection example 2 when using it to control an LED.

6.1.3.4 How to use IGN pin(pin 3)

It is strongly recommended to connect this pin to the ignition key to support the IGN-power saving function when the vehicle is off.

The IGN-pin has two functions:

- ✔ It wakes up the system FOX3 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. On IGN wake-up signal, the device returns to full functionality.

Note that, the FOX3 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.

In case of unauthorised vehicle access/start, you are automatically alarmed by SMS or TCP and the vehicle recovery can be started by knowing its exact location. In such a case, use the IGN generated event as a condition to start the vehicle tracking.

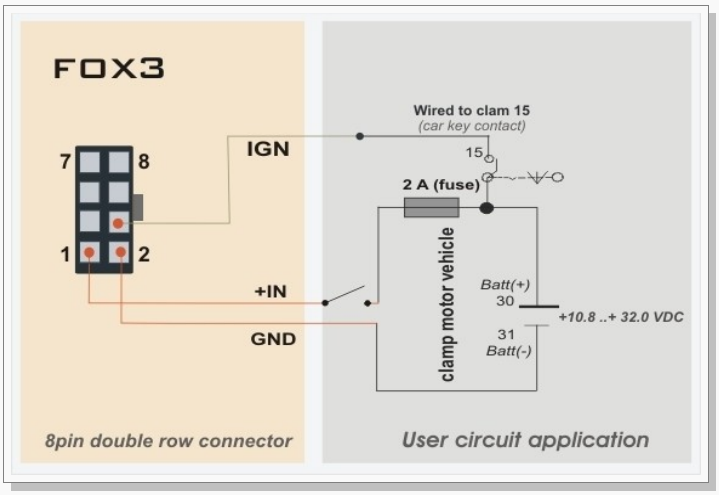


Figure 11: Monitoring vehicle starter by IGN line

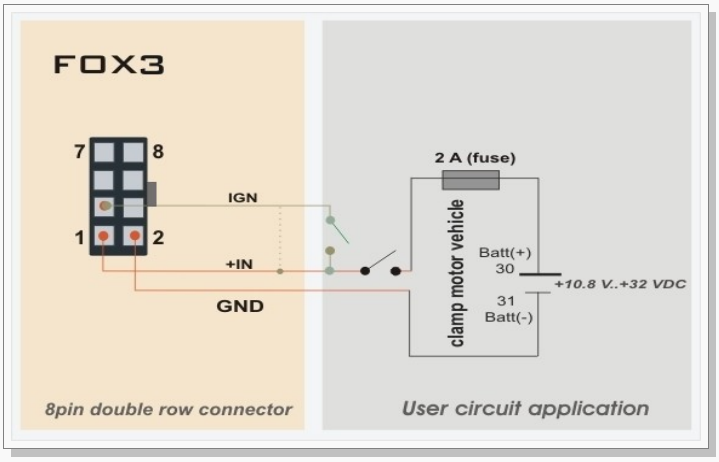


Figure 11.1: Use IGN line to wake FOX3 up from IGN-Sleep

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

The FOX3 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 FOX3 Evalboard in order to communicate with the FOX3 device, since you will find there all you need to evaluate with it. The signals on these pins are obtained to RS232 compatible signal levels.

RxA_0 Main channel 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_0 Main channel used to output navigation, measurement, response and system data to any software (e.g. HyperTerminal, FALCOM Workbench).

6.2 Accessory Port (6pin connector)

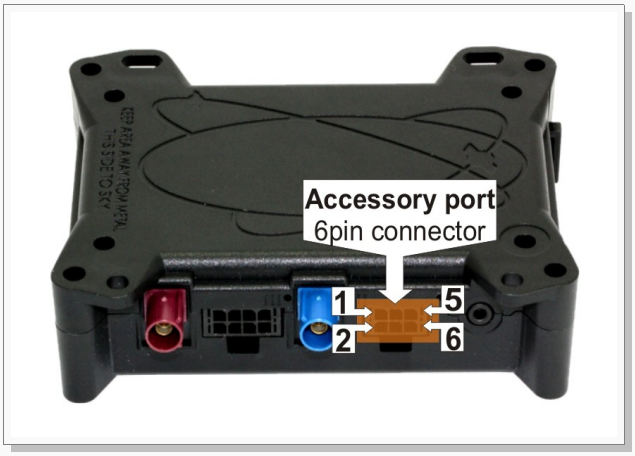


Figure 12: Pin assignments of 6-pin (2x3) connector (Type: MOLEX-43045-06-MICRO FIT)

6.2.1 Accessory Port Pinout

PIN	NAME	DIRECTION	DESCRIPTION	LEVEL
1	1-Wire	Input /Output	1-Wire master interface for Driver ID, temperature and humidity sensors.	V_{OUT} = + 2.8 .. +5.0 V
2	GND	-	Ground Reference.	0 V
3	RxA_1	Input	(**Serial Port 1**) Serial port (receive data) for direct connection to the host PC (configuration, evaluation, firmware). If not used leave it open.	V24, ±12 V
4	TxA_1	Output	(**Serial Port 1**) Serial port (transmit data) for direct connection to the host PC (transmitting history data, output GPS protocols and others). If not used leave it open.	V24, ±12 V
5	SCL	Output	I2C bus interface - Serial Clock line – the signal used to synchronize communication between the master and the slave.	
6	SDA	Input /Output	I2C bus interface - Serial Data line – the signal used to transfer data between the transmitter and the receiver.	

Table 9: Description of the 6-pin (2x3) connector

6.2.2 1-Wire interface description

A 1-Wire bus uses only one wire for signaling and power. One or several 1-Wire devices can be connected to the bus at the same time. Only one master should be connected to the bus.

Driver identification, temperature and humidity sensors are quite often used on vehicle applications. Thanks to the integration of 1-wire interface into the FOX3 device, the system integrators for telematics, fleet management and intelligent transportation system can be cost-benefit and time efficiently for their work due to the use of extra external devices which are not integrated in the in-vehicle computers. Using of the 1-Wire interface, you are able to know which drivers are in which vehicles and at the same time monitor the temperature and humidity of their refrigerated trucks. In this way, shippers can record by their server the transportation and the delivery state of their temperature-sensitive loads.

How does it work?

A 1-Wire network consists of a master controller which is connected to one or many slave devices. The 1-Wire interface on the FOX3 is a master controller. All of the actual monitoring devices (lightning detector, moisture meter, motion detector, barometer, etc.) are slave devices. The FOX3 communicates with these monitoring devices via 1-Wire protocol developed by Dallas Semiconductor, sending and receiving signals over a single data line plus ground reference. The 1-Wire protocol synchronizes the monitoring devices# to the FOX3. The FOX3 initiates and requests all activities on the 1-Wire network. One key feature of the Dallas system is that every 1-Wire slave device has a guaranteed unique address burned on-chip ROM (Read Only Memory). This enables the master to recognize individually each of your slave devices, and means you can have multiple devices of the same type on the same network without conflict.

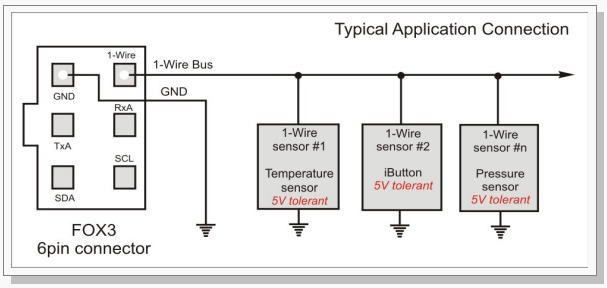


Figure 13: Typical application connection

Setting up a 1-Wire network with the FOX3 device is quite easy. 1-Wire is a simple system of devices such as temperature and humidity sensors, iButton devices etc. that are connected through the 1-Wire data line plus ground reference to the FOX3 device. Remember that you can use and connect to the FOX3 1-Wire line only sensors that require power supply anywhere between 2.8V and 5.0V. The FOX3 device receives on demand the unique address of the temperature, humidity and other information they deliver. This information can then be sent via alarms to the remote TCP server.

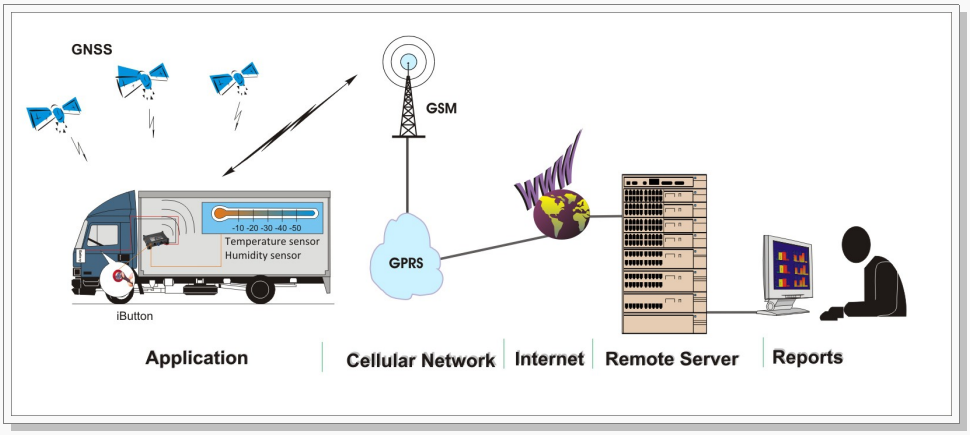


Figure 13.1: Typical application using 1-Wire single line.

How to read the temperature data from 1-Wire sensors:

To enable requests on the 1-Wire interface, activate the 1-Wire interface on the FOX3 device via following command:

```
$PFAL,Sys.1Wire.Enable
```

To request the list of devices connected to the 1-Wire interface, use the following command:

```
$PFAL,Sys.1Wire.Devices
```

To read the temperature data from the connected temperature sensors, use the command:

```
$PFAL,Sys.1Wire.Temperature
```

In this example, 20.0‘C and 21.0‘C are the temperature values reported by the external sensors connected to the FOX3:

```
Sys.1Wire.Temperature>
$device 10c2272e000000E1 value 20.0‘C
$device 10c2272e000001E0 value 21.0‘C
$SUCCESS
$<end>
```

6.2.2.1 Serial Port 1 - Serial communication signals (RxA_1 and TxA_1)

The FOX3 device incorporates a full duplex serial channel in the accessory port which allows two devices to communicate directly with some other devices via RS232 serial ports. All supported baud rate are controlled by PFAL commands. In order to communicate with the FOX3 device, it is recommended to use the FOX3 evalboard since you will find there all what you need for your evaluation. The signals on these pins are obtained to RS232 compatible signal levels.

RxA_1	Accessory channel 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_1	Accessory channel used to output navigation, measurement, response and system data to any software (e.g. HyperTerminal, FALCOM Workbench).

6.3 Inserting a SIM card into the SIM holder

The FOX3 device has a GSM modem that requires a SIM card to access to the mobile network services. 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 FOX3' SIM holder, follow the steps below:

1) Remove the power supply and any other connections from the device. Turn the FOX3 device on its back side as shown in the figure 14 below.
2) Indicate the SIM card holder on the left of the battery try **(1)**. To open it, push the metal slider in direction marked “⇨**OPEN**”.
3) Flip the card holder up **(2)**.
4) Insert the SIM card **(3)** into the card holder in direction as shown in the figure below.
5) Flip the card-holder back (without force) **(4)**, then hold it pressed and move the metal slider in direction marked "⇦**LOCK**" until it stops.
6) Insert the SIM card cover in the direction as shown in picture below **(5)** and slide it until it stops.

7) If you have already ordered a backup battery to connect it to the FOX3 (e.g. B1 - 1000 mAh battery, see figure 14.1 below), just plug in the 3pin connector of the battery cable to the battery connector on the left side in the battery tray (FOX3 PCB).

8) Finally, place the battery cover and then screw it with both screws and a T6-TORX screwdriver **(6)**.

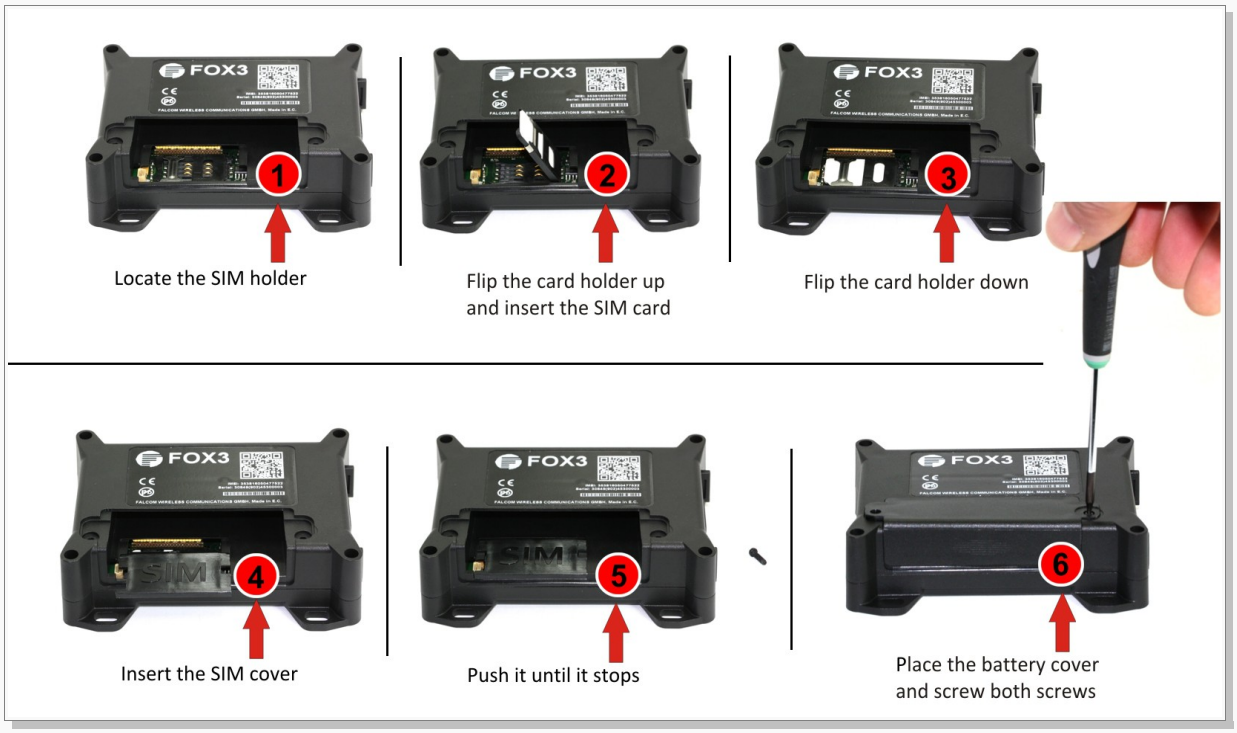


Figure 14: Steps for inserting the SIM card

Figure 14.1: Connecting the battery to the FOX3

6.3.1 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. 15)*:

1) Install the **FALCOM Workbench** software,
2) Connect your FOX3 to a free PC COM port via its evalboard and power up your device. How to set up your FOX3 using a Evalboard, is currently in preparation.
3) Start the **FALCOM Workbench** software, open a **COM Port (1),** a **Terminal (2)** and an **Editor (3)**, then select the COM port **(4)** and port settings (115200 bps, 8 Data bits, No Parity bit, 1 Stop bit, None Flow control).
4) Next, click on the **Connect** icon (II) on the left of the text "**Port**", to connect to. Connect the **Console (5)** to the **COM Port** and the **Editor (6)** to the **Console** on the **Connection view**. For more details refer to the Workbench User's Guide.
5) 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*".

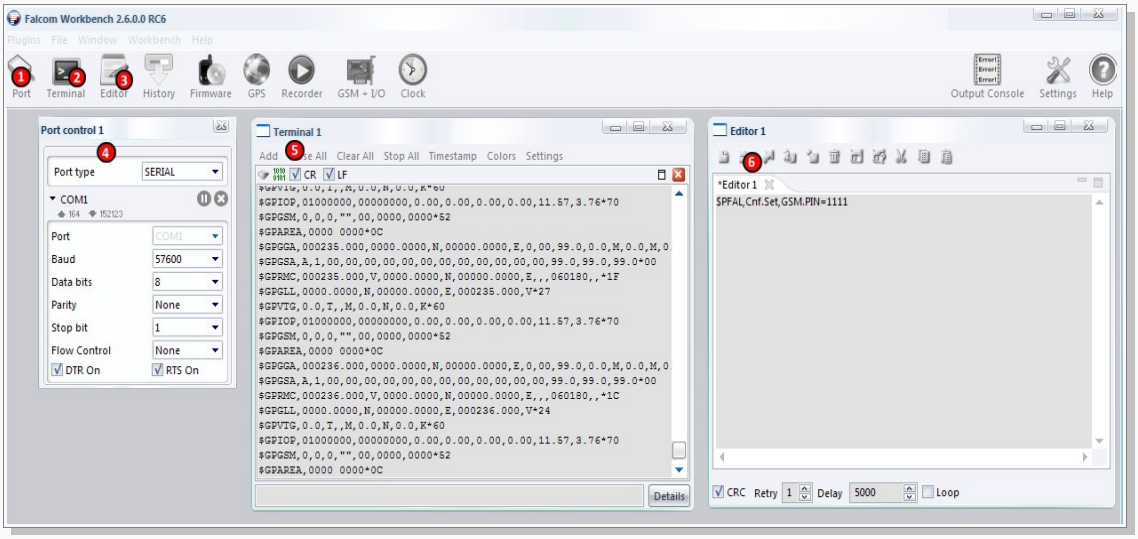


Figure 15: Entering the PIN code of the inserted SIM card.

6.4 LED indicators

The actual state of the FOX3 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 FOX3 software manual *"AVL_PFAL_Configuration_Command_Set.pdf"*.

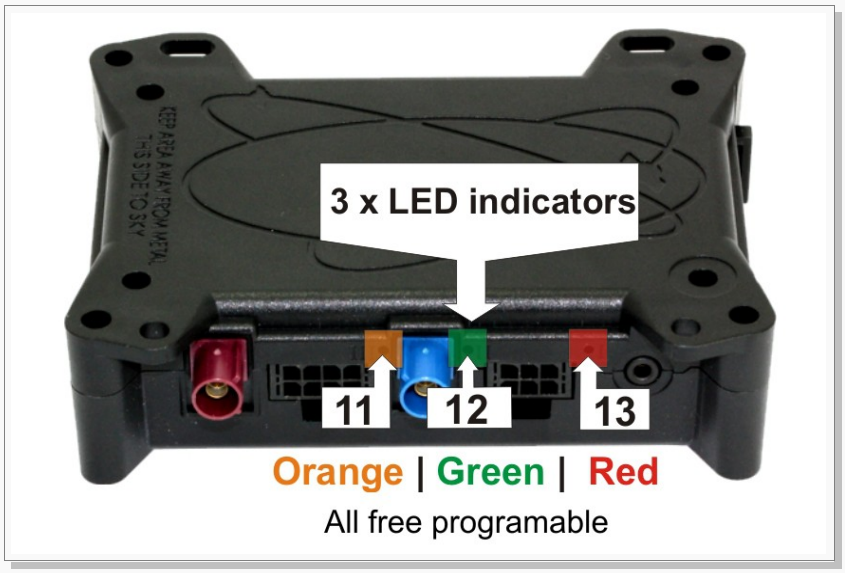


Figure 16: View of LED indicators

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

```
$PFAL,IO11.Set=high                    // 11=LED Orange;
$PFAL,IO12.Set=hpulse,2000             // 12=LED Green;
$PFAL,IO13.Set=cyclic,2000,1000        // 13=LED Red;
```

To turn off these LEDs, use the following command with corresponding index number:

```
$PFAL,IO[11,12,13].Set=low
```

6.5 10pin mini-USB port

This port supports a SPI and a USB 2.0 interface. The following table gives you an overview about the provided pins on this 10pin mini-USB-port.

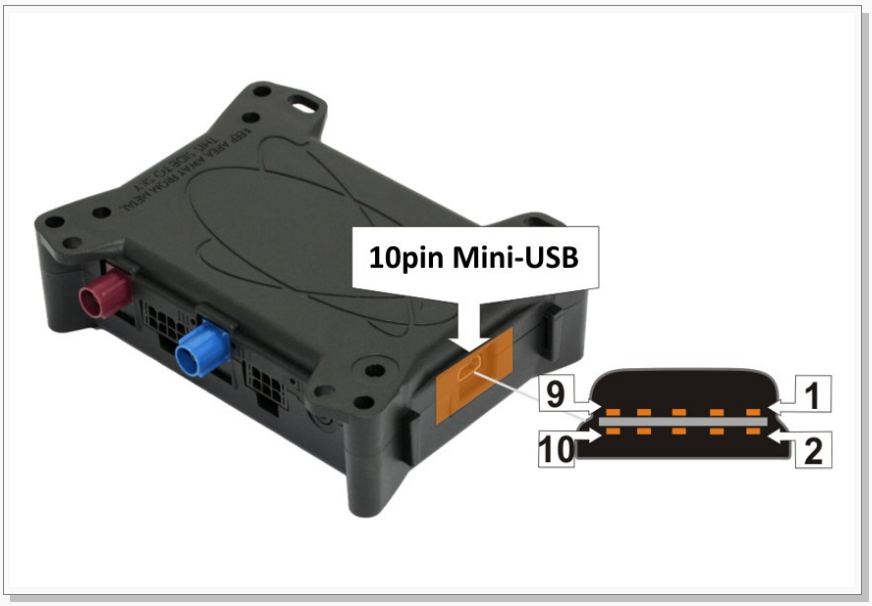


Figure 17: Pin assignments of the 10pin mini-USB port.

This table shows the pinout of 10pin mini-USB connector.

PIN	NAME	DIRECTION	DESCRIPTION	LEVEL
1	MOSI	Output	Master output, slave input	
2	USB_V+	Input / Output	Power supply for IO-BOX	+ 3.6 ... + 5.25 V
3	MISO	Input	Master input, slave output	
4	DM	Input	USB Data -	Complies to the USB 2.0 specifications
5	CLK	Output	Serial clock	
6	DP	Output	USB Data +	Complies to the USB 2.0 specifications
7	Detect USB		Detects the connection to a USB master port.	
8	+IN	Input	**=+IN (***Pin 1 on 8pin connector)*	V_{+IN} = + 10.8 ... + 32.0 V ; Imax ≤ 1A
9	CS	Output	Chip select	
10	GND	-	Ground	

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

This port can be used to connect the FOX3 to the IOBOX-MINI device, which is offered as an accessory to the FOX3 device.

6.5.1 Setting up a USB connection for FOX3

To setup a USB connection with FOX3, do the following steps:

1. Download the USB driver free of charge from the FALCOM's website "FTDI-USB-Driver_v2.10.zip".
2. Connect the FOX3 to a free USB port on your PC via your own mini-USB to USB cable and install the driver. How to install the USB driver refer to the sub-chapter below.
3. Open a terminal program and send the command $PFAL,MSG.Send.USB,0,"Speed=&(Speed)" from the serial port (e.g. Serial 1/0) to the FOX3. The answer to this command will be shown on the terminal program where FOX3 is connected to.

6.5.1.1 Installing the USB driver files for FOX3

To install the FOX3 USB driver, do the following steps:

1. After downloading the driver from the FALCOM's website "FTDI-USB-Driver_v2.10.00.zip". Unzip the contents to a separate folder.
2. Connect the FOX3 to your PC. You will see a message pop up that installation failed.
3. Right-click the popup, and choose "Browse my computer for Driver Software",

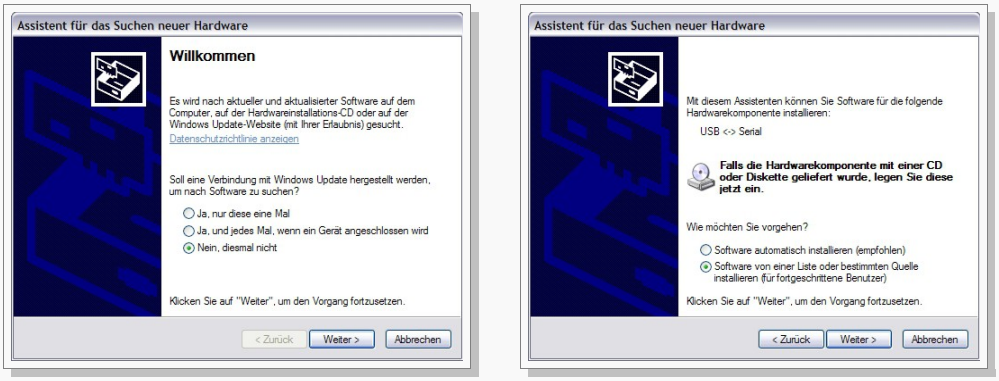


Figure 18: Search for USB drivers for FOX3 hardware.

4. In the Browse window, navigate to the folder where you extracted the contents of the Zip driver file. Please note that a double (manual) driver installation is required. In the ZIP file of the FOX3 USB driver you can find two different driver files: "*ftdiBus.inf*" for the native USB driver and "*ftdiPort.inf*" for the virtual COM port (VCP). You have to install both.

Figure 19: Navigate to the USB driver folder.

5. Follow the remaining prompts and Windows will install the driver.

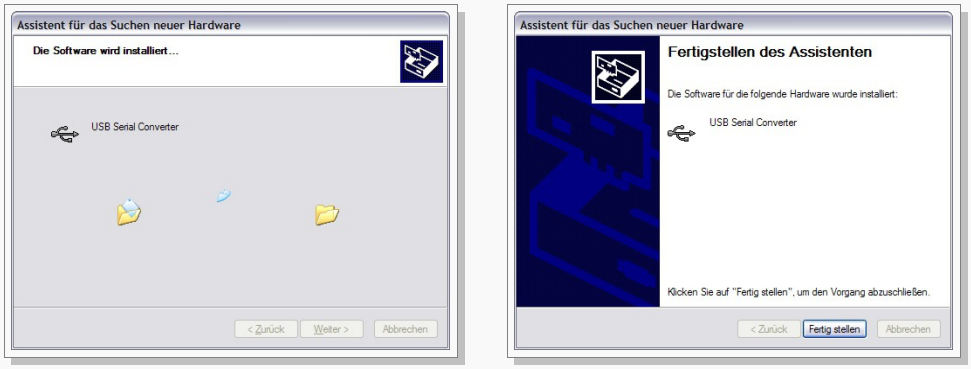


Figure 20: Installing the USB drivers.

6. Now open Device Manager, go to the "USB Serial Converter", right click on it and start Properties. Select the Tab "Advanced" and check/activate the setting/option "Load-VCP" (as shown in figure below).

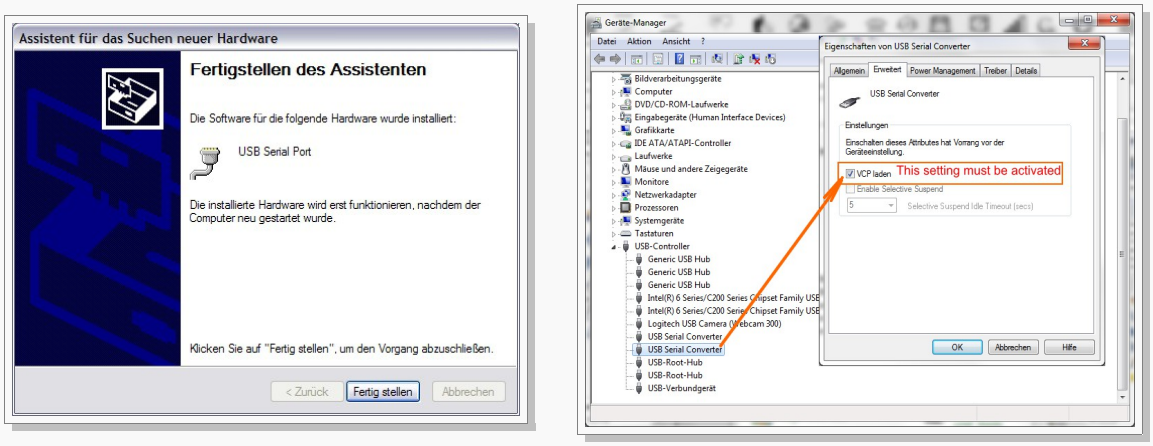


Figure 21: Search for the assigned USB serial port number.

7. After installation is complete, you can delete the files you downloaded. Windows will reuse the installed driver information for any future FOX3 device.
8. To communicate with FOX3 via the USB port, use a Terminal program and select the USB serial port number assigned by the Windows to the installed USB driver in the Device Manager.

6.5.2 IOBOX-MINI accessory device for FOX3

6.5.2.1 Connecting IOBOX-MINI to FOX3

Requirements for mounting the IOBOX-MINI to the FOX3 device:

- T6-TORX screwdriver

To mount the IOBOX-MINI to the FOX3 device, follow next steps:

1. Remove the power supply and any other connections from the device. Use a T6-TORX screwdriver as shown in step (1) and unscrew 4 screws as shown in step (2).
2. Open the casing of the FOX3 device as shown in step (3).
3. Indicate the USB connector on the FOX3 PCB and plug in the IOBOX-MINI to it as shown in steps (4) and (5).
4. Hold pressed the front of the IOBOX-MINI as shown in step (6) and place the lower case on to the upper case of the device. Insert carefully the two tabs of the IOBOX-MINI into the two slots of the lower case of the device (6) and then slide the lower case until it stops (7).
5. Close the device with all 4 screws (8). Make sure that both cases fit to each other and there is no space between them.

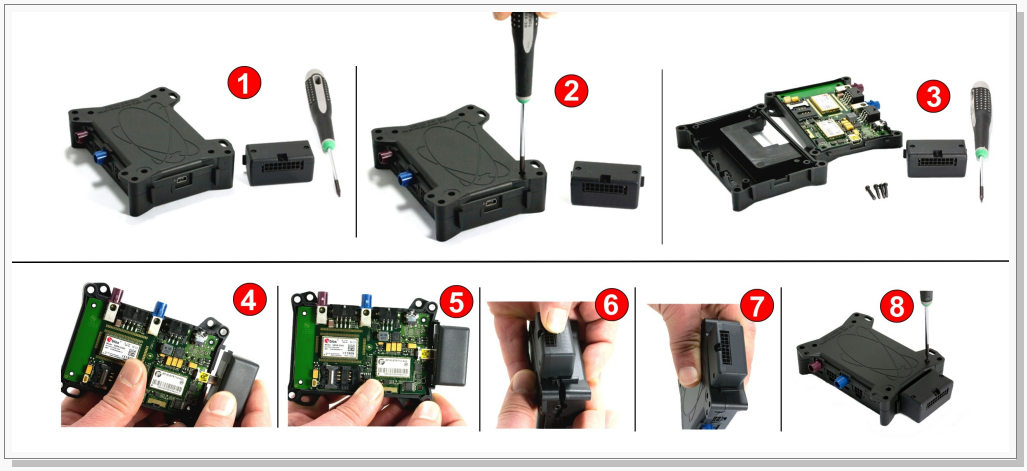
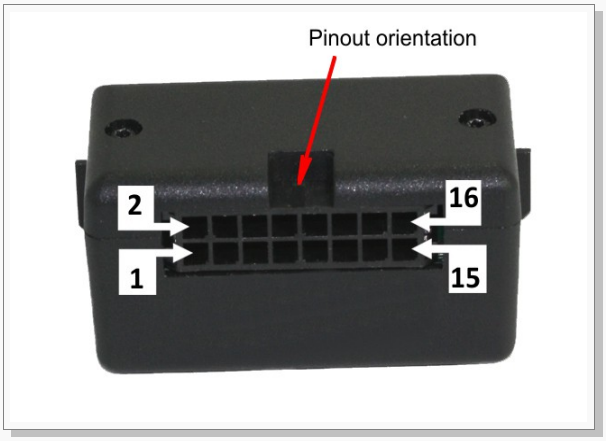


Figure 22: Mounting IOBOX-MINI to the FOX3 device.

6.5.2.2 IOBOX-MINI pinout

The IOBOX-MINI is offered for the FOX3 as an accessory for input/output extensions.

FOX3 with IOBOX-MINI plugged in



IOBOX-MINI assignment

Figure 23: IOBOX-MINI pinout.

This table shows the pinout of IOBOX-MINI.

PIN	NAME	I/O	DESCRIPTION	LEVEL
1	GND	-	Ground.	0 V
2	IN5	I	Digital input.	0 .. +32.0 V DC (V_{+IN} = +IN)
3	-	-	No function	-
4	IN6	I	Digital input.	0 .. +32.0 V DC (V_{+IN} = +IN)
5	-	-	No function	-
6	IN7	I	Digital input.	0 .. +32.0 V DC (V_{+IN} = +IN)
7	ANA	I	Analogue input with 10 bits resolution.	0 .. +32.0V DC
8	IN0	I	Digital input.	0 .. +32.0 V DC (V_{+IN} = +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} = +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} = +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} = +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} = +IN)

Table 11: IOBOX-MINI pinout

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

6.6 Mounting

The FOX3 offers different mounting possibilities, depending on the kind of the antenna used.

1. When installing a FOX3 with internal antennas, please make sure the FOX3' back side with the text "THIS SIDE TO SKY" is facing up to the sky, with no metal objects above or under the device case that can interfere with GPS reception.
2. When installing a FOX3 with external antennas, there are two connectors on the device for connecting a GPS/GNSS antenna such as FAL-ANT-11 *(shown in figure below) or* FAL-ANT-12 from FALCOM. During the installation, please make sure the receiving side of the GSM/GPS antenna is up, with no metal object above or under the antenna and device that interfere with GPS reception.

The FOX3 unit provides 8 holes to be attached to suitable locations (see figure below). It can be mounted in different directions and 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(12) mm and different length. There are no screws included in the delivery pack. More detailed information how to install the device in the vehicle, refer to the application note "AppNotes_AVL_Installation_Guide.pdf".

The FOX3 is NOT a waterproof or sealed device. Care must be taken to ensure the device is kept away from water or any other liquids.

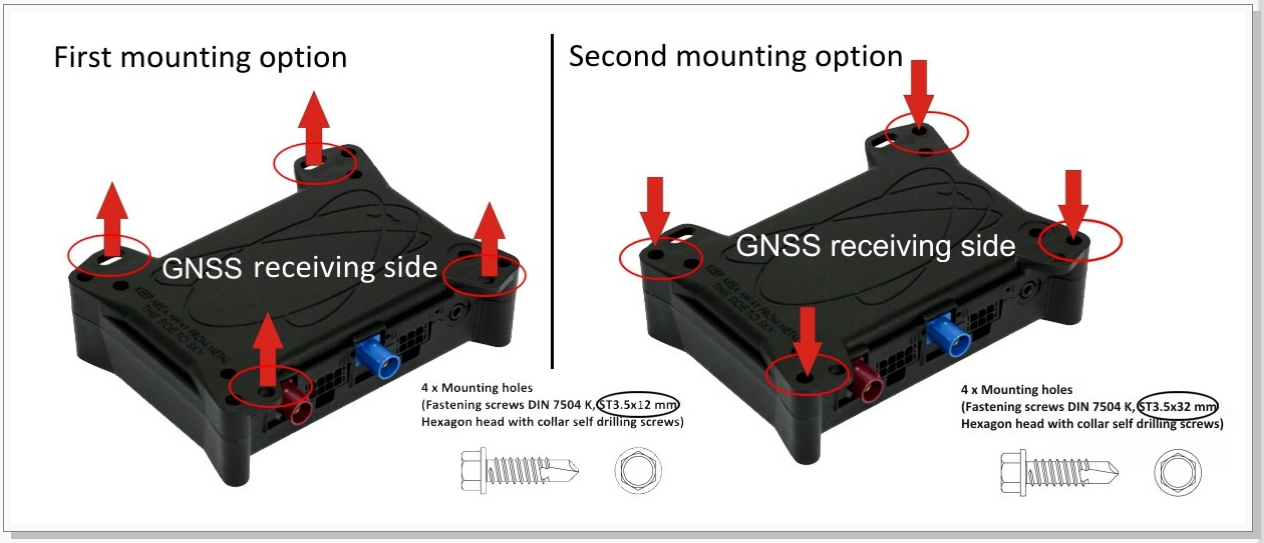


Figure 24: View of the mounting holes

6.6.1 External Antenna Ports

FOX3 is fitted with two male *SMB FAKRA* connectors that accept a wide variety of GSM/GNSS antenna styles for using external antennas instead of the internal ones. The **Bordeaux** connector *(see figure below)* is for connecting a GSM antenna. The **Blue** connector *(see figure below)* is for connecting a GNSS antenna. There is no antenna included in the standard delivery, it needs to be ordered separately.

FALCOM provides a combined *GSM/GPS* antenna, especially, for the STEPPIII and FOX-EN 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 FOX3 device must draw less than 25 mA. The antenna voltage is supplied internally. The figure below shows how to connect the FAL-ANT-11 to the FOX3 device.

For more details about the FAL-ANT-11, refer to the data sheet "*FAL-ANT-11_Datasheet.pdf*" available on the Falcom web page.

Figure 25: GSM/GPS antenna ports

CAUTION : Be careful not to accidental swap the GSM and GPS connectors. The device will not function if the antennas are swapped.

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

To connect the **FAL-ANT-11** combined GSM/GPS antenna to the FOX3 device:

- ✔ Plug the **Bordeaux-**coloured connector of the antenna to the **Bordeaux** coloured connector of the device.
- ✔ Plug the **Blue-**coloured connector of the antenna to the **Blue** coloured connector of the device.

To remove the **FAL-ANT-11** GSM/GPS antenna from the FOX3 device:

- ✔ Press down the latches on the antenna connectors and then pull the antennas.

Do not mount the antenna visible on the dashboard but mount it in a location underneath the dashboard. Hiding the antenna is key to successful security in the event of theft. The FOX3 device generates an event in case of the GPS antenna is connected, disconnected or cut off. If an intruder cuts off the GPS antenna cable, an event is generated which can be used to trigger alarm notifications to the user.

6.7 Audio Interface

The FOX device has a 2.5 mm audio female 4pin connector for connecting a SPK/MIC device to the FOX3.

Figure 26: Audio plug 4pin connector

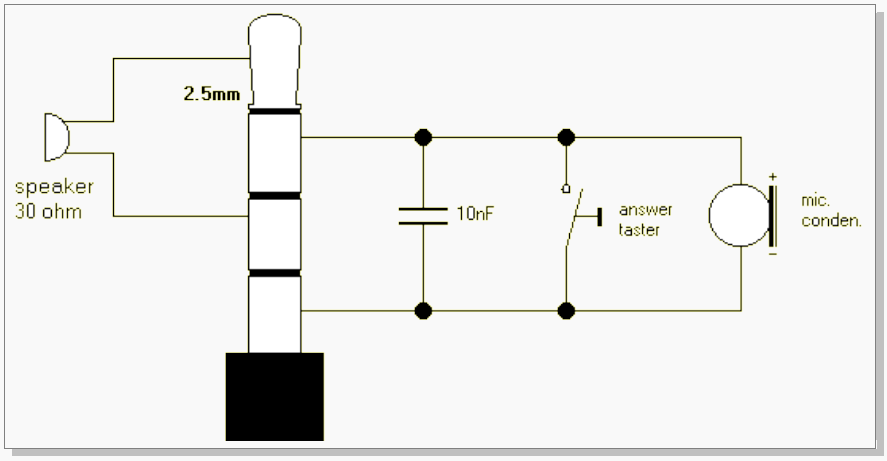


Figure 26.1: Audio plug 4pin connector

To know the pinout of the audio jack on the FOX3, see the pinout of the audio plug shown in figure above.

Pin number	Pin name	Description
1	MIC	Mic -
2	R_SPKR	Right audio speaker
3	MIC	Mic +
4	L_SPKR	Left audio speaker

The following table lists some typical electret microphone electrical characteristics:

Microphone
The microphone should be a electret condenser microphone @ 2.2 k.

The following table lists some typical speaker electrical characteristics:

Speaker
The speaker should be a passive headset with 8O ohm or a active speaker with symmetric balanced input. Asymmetric non balanced input will cause GSM noise in the speaker.

7 HOUSING

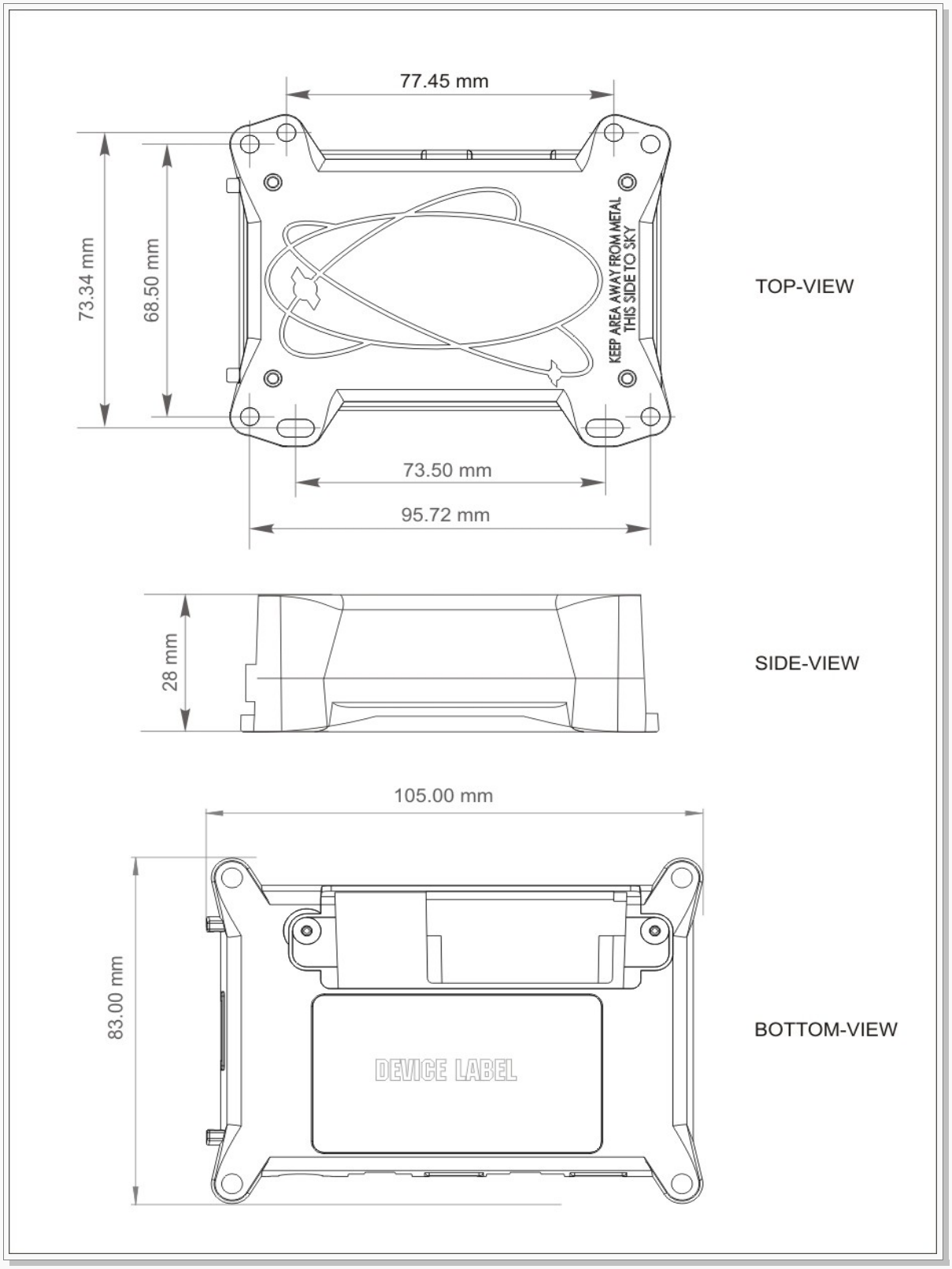


Figure 28: FOX3 housing

8 APPENDIX

8.1 Schematics

The figure below illustrates a common schematic of how to install the FOX3 device in the vehicle. For detailed information, refer to the related documents [*AppNotes_AVL_Installation_Guide.pdf*].

8.1.1 Installation guidance for 8-pin double row connector

When installing the FOX3 in a vehicle, you will be able to track and locate the vehicle all the time and also you will be automatically notified when disagreements with your stored configuration into the FOX3 device are occurred. Depending on the user requirements, the operator may program the digital outputs to activate something e.g. a relay, buzzer, turn on a lamp, etc. The digital inputs can individually be configured e.g. to detect something when it is opened or closed; changes on digital inputs may trigger an output to activate, for example, a relay or buzzer. 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 device ground pins. To avoid ground loops and second grounds, isolate all grounded pins of the FOX3 from the vehicle body. Do not connect power from a different system to the FOX3.

The outputs of the FOX3 device must be supplied with the same voltage applied to the (+IN) pin. The operating voltage MUST never exceed its range, due to the device is not protected again continuous overvoltage. For security reasons, it is recommended to integrate an external 2A fuse between the positive wire of the FOX3 (+IN) and d.c. - power source.

When using an external antenna, be sure to mount it on the dash or on the windshield of the vehicle with the GPS side facing the sky.

Apply power to the FOX3 device only with external antenna connected (if used) and vehicle ignition off. First, connect the GND pin and finally, apply power to the +IN pin of the FOX3.

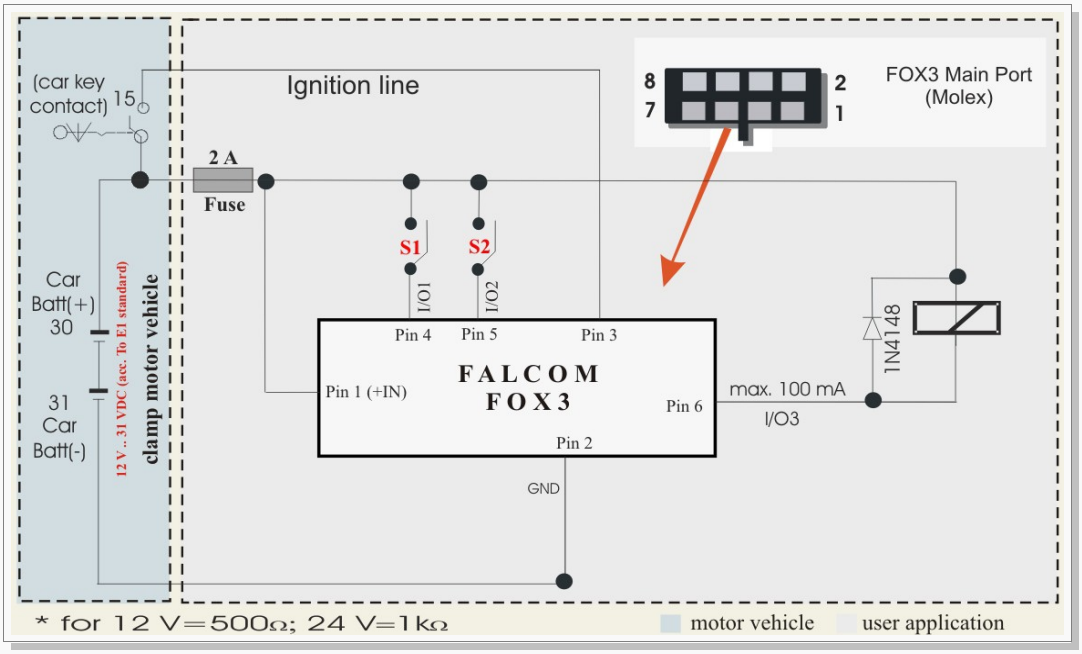


Figure 29: Schematic example of installation guidance.

8.2 What should be considered when using FOX3 device

FOX3 is a device controlled by means of the PFAL commands developed by FALCOM. PFAL commands can be executed when the operating firmware inside the device is running. In order to create application with the FOX3 device and to obtain maximum benefit from the FOX3 operating firmware, you have to setup a specific configuration and store it in the device. PFAL commands can be sent to the FOX3 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 FOX3 and other AVL devices are listed and described in a separate manual *"AVL_PFAL_Configuration_Command_Set.pdf"*.