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Version history:
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<tr>
<th>Version</th>
<th>Author</th>
<th>Changes</th>
<th>Modified</th>
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<tr>
<td>1.0.2</td>
<td>D. Gerloff</td>
<td>- GPS receiver data update, power consumption</td>
<td>12/07/2010</td>
</tr>
<tr>
<td>1.0.1</td>
<td>F. Beqiri</td>
<td>- Added new values in the mechanical drawing.</td>
<td>12/07/2010</td>
</tr>
<tr>
<td>1.0.0</td>
<td>F. Beqiri</td>
<td>- Initial version.</td>
<td>09/12/2008</td>
</tr>
</tbody>
</table>
Cautions

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

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

Note

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

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

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product status may be outdated.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

1.1 General

FALCOM is using state-of-the-art technology to develop unique, low-cost devices,
which more effectively manage assets and vehicle tracking than current systems. The
new FOX-LT 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-LT 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-LT 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/O. In addition to that two
predefined digital inputs are detecting ignition line status and main power (car battery)
failures, and so you may handle these events and use as notification.

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

FOX-LT 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-LT 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. A separate USB 10pin
 connector provides audio signals for connecting a headset.
FOX-LT is a device that can be configured and integrated onto any asset platform, including:
- Trailers
- Trucks
- Delivery vans
- Rail cars
- as well as other industrial monitoring installations.

and it can be used in a variety of applications, including:
- 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-LT architecture consists of following major components (a block diagram is available below):

**Architecture Integrates:**
- High-performance Quad-Band GSM/GPRS core,
- 50 parallel channel, high sensitive GPS core,
- ARM7TDMI Processor controlling all functions of the system,
- Inside SIM card holder (1.8/3V SIM cards),
- External GSM antenna connector,
- External GPS antenna connector,

**Options to FOX-LT**
- CAN Interface,
- 3D motion sensor,
- Micro-SD-Card (internal),
- Rechargeable Li-Polymer battery (see Ordering Guide),
- Audio interface for voice call,
- IP65 protection from dust and jets of water,
- 10pin mini-USB.
**PHYSICAL INTERFACES:**
- Power supply line,
- 3 x configurable digital/analog inputs with open collector output (100mA)
- 1 x Ignition,
- 3 x LED indicators
- RS232 port (Rx, Tx).

**Figure 1:** FOX-LT block diagram

### 1.3 Related documents

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

In addition to this document, the following files comprise the full set of FALCOM FOX-LT product manuals:

<table>
<thead>
<tr>
<th>NR</th>
<th>PDF file name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SteppIII_fox_bolero_LT_PFAL_Configuration_Command_Set.pdf</td>
<td>Contains the description of the internal firmware and the supported Configuration Command Set for the FALCOM STEPPIII, FOX-LT and BOLERO-LT.</td>
</tr>
<tr>
<td>2</td>
<td>AppNotes_Transform_history_data.pdf</td>
<td>Contains information of how to transform history data that are being transmitted from a FALCOM AVL device via TCP connection.</td>
</tr>
<tr>
<td>3</td>
<td>AppNote_Remote_update.pdf</td>
<td>Contains information of how to upgrade FALCOM AVL devices to a new firmware revision remotely via TCP (server based application).</td>
</tr>
<tr>
<td>5</td>
<td>AppNotes_in_vehicle_mounting.pdf</td>
<td>This document provides all the necessary information to allow your FALCOM product to be properly and safely installed in a vehicle.</td>
</tr>
<tr>
<td>NR</td>
<td>PDF file name</td>
<td>Description</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>[6]</td>
<td>AppNotes_connecting_a_bar_code_scanner.pdf</td>
<td>Describes how to connect a bar code scanner to a STEPPII, STEPPIII, FOX etc. and store or transmit the scanned data.</td>
</tr>
<tr>
<td>[7]</td>
<td>STEPPIII_FOX_BOLERO_LT_Software_Update.pdf</td>
<td>Contains information how to upgrade a FALCOM AVL device to a new firmware version locally via serial port.</td>
</tr>
<tr>
<td>[8]</td>
<td>AppNotesRemoteUpdateWithWorkbench.pdf</td>
<td>Contains information how to upgrade a FALCOM AVL devices to a new firmware version remotely via TCP.</td>
</tr>
</tbody>
</table>

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](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-LT 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-LT device. Please read this chapter carefully before starting to use the cellular engine FOX-LT.

2.1 General information

Your FOX-LT 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-LT is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your modem, the cellular system handling your calls controls both the radio frequency and the power level of your cellular modem.

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

2.2 Exposure to RF energy

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

If you are concerned about exposure to RF energy, there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular modem efficiently by following the guidelines below.
2.3 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-LT 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-LT 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-LT 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-LT 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-LT device **OFF** when in any area with a potentially explosive atmosphere. It is rare, but your modems or their accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust or metal powders.

Do not transport or store flammable gas, liquid or explosives, in the compartment of your vehicle, which contains your modem or accessories.

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

Your GSM/GPRS/GPS device complies with all applicable RF safety standards. FOX-LT 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 +12 V or +24 V DC power source (car battery).

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

❖ Operating temperature range:
  ➢ -40°C to +85°C (see chapter 4.1.2 for more details)

❖ Physical characteristics:
  ➢ Size: 60.0 ± 0.1 mm x 90.0 ± 0.1 mm x 24.0 ± 0.1 mm
  ➢ Weight (without options): ca. 110 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 x LED indicators (Red, Green, Blue) free-programmable.

❖ Hardware options
  ➢ CAN interface – occupies 2 of 3 available I/Os (IO2 and IO3),
    ✔ For in-car Low-speed & High-speed communications,
  ➢ 10pins mini-USB (for headset),
  ➢ 3D motion sensor (already available in basic version),
  ➢ Micro-SD - for additional memory,
  ➢ Degree of protection (the housing of the FOX-LT device offers IP65 protection from dust and jets of water),
  ➢ Internal GSM/GPS antenna.

❖ Casing:
  ➢ Fully shielded.
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 3.

GSM/GPS antenna connectors:

➢ External (separate connectors).

4.1.1 Power consumption

➢ Average power consumption: < 80 mA at 12 V DC

4.1.2 Operating temperatures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature (without internal battery)</td>
<td>-40</td>
<td>+25</td>
<td>+90</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature (with internal battery)</td>
<td>-20</td>
<td>+25</td>
<td>+60</td>
<td>°C</td>
</tr>
<tr>
<td>Operating temperature (without internal battery)</td>
<td>-40</td>
<td>+25</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>GSM* (without internal battery)</td>
<td>-30</td>
<td>+25</td>
<td>+80</td>
<td>°C</td>
</tr>
<tr>
<td>Charging temperature</td>
<td>0</td>
<td>+25</td>
<td>+45</td>
<td>°C</td>
</tr>
<tr>
<td>Discharging temperature</td>
<td>-20</td>
<td>+25</td>
<td>+60</td>
<td>°C</td>
</tr>
</tbody>
</table>

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

Table 1: Operating temperature
4.1.3 GSM/GPRS engine features

- **GSM/GPRS core:**
  - Telit GE864-Quad module
  - Quad-Band: GSM 850, 900, DCS 1800, PCS 1900.
  - Compliant to GSM Phase 2/2+

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

- **GPRS connectivity:**
  - GPRS multi-slot class 10
  - GPRS mobile station class B

- **DATA:**
  - **GPRS**
    - GPRS data downlink transfer: max. 85.6 kbps (see table 2).
    - GPRS data uplink transfer: max. 42.8 kbps (see table 2).
    - Coding scheme: CS-1, CS-2, CS-3 and CS-4.
  - **CSD**
    - CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent, V.110.

- **SMS:**
  - Text mode.

- **Ring tones:**
  - Offers a choice of 60 different ringing tones/melodies, easily selectable with PFAL commands.

- **GPRS Coding scheme:**

<table>
<thead>
<tr>
<th>Coding scheme</th>
<th>1 Timeslot</th>
<th>2 Timeslots</th>
<th>4 Timeslots</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-1:</td>
<td>9.05 kbps</td>
<td>18.1 kbps</td>
<td>36.2 kbps</td>
</tr>
<tr>
<td>CS-2:</td>
<td>13.4 kbps</td>
<td>26.8 kbps</td>
<td>53.6 kbps</td>
</tr>
<tr>
<td>CS-3:</td>
<td>15.6 kbps</td>
<td>31.2 kbps</td>
<td>62.4 kbps</td>
</tr>
<tr>
<td>CS-4:</td>
<td>21.4 kbps</td>
<td>42.8 kbps</td>
<td>85.6 kbps</td>
</tr>
</tbody>
</table>

Table 2: Coding schemes and maximum net data rates over air interface

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

GPS engine:
➢ UBX-G5010 single chip from u-blox
➢ 50-channel u-blox 5 engine
➢ GPS L1 C/A code

Accuracy:
➢ Position: < 2.5 m
➢ SBAS: < 2 m

Time to First Fix (TTFF):
➢ Hot starts < 1 sec., average
➢ Warm start < 29 sec, average
➢ Cold starts < 29 sec, average

Sensitivity:
➢ Tracking -160 dBm (12 dBHz)
➢ Acquisition -160 dBm
➢ Cold start -144 dBm

Dynamic Conditions:
➢ Velocity < 500 m/s (972 knots).
➢ Altitude 50,000 m
➢ Max. update rate 1 Hz

A-GPS support:
➢ AssistNow Online
➢ AssistNow Offline

Crystal oscillator (TCXO):
➢ Load sensitivity ± 10 % load change, 0.2 ± ppm
4.2 NMEA data message

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

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

<table>
<thead>
<tr>
<th>NMEA</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GGA</td>
<td>Time, position and fix type data.</td>
</tr>
<tr>
<td>GLL</td>
<td>Latitude, longitude, UTC time of position fix and status.</td>
</tr>
<tr>
<td>GSA</td>
<td>GPS receiver operating mode, satellites used in the position solution and DOP values.</td>
</tr>
<tr>
<td>VTG</td>
<td>The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.</td>
</tr>
<tr>
<td>GSV</td>
<td>The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.</td>
</tr>
<tr>
<td>RMC</td>
<td>Time, date, position, course and speed data.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FALCOM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOP</td>
<td>The status of the digital/analog inputs and output ports and battery voltage (if battery available)</td>
</tr>
<tr>
<td>GSM</td>
<td>The GSM operator, reception, registration status, GSM field strength, area code and cell ID.</td>
</tr>
<tr>
<td>AREA</td>
<td>The state of 32 areas</td>
</tr>
<tr>
<td>3DP</td>
<td>The state of the Motion Sensor (hardware option)</td>
</tr>
<tr>
<td>BIN</td>
<td>User protocol including time, date, position, course and speed data</td>
</tr>
</tbody>
</table>

Table 3: NMEA Output Messages
5 FOX-LT APPLICATION INTERFACE

5.1 Power supply

The power supply for the FOX-LT unit has to be a single voltage source of \( V_{\text{IN}} = +10.8 \text{ V} \ldots +32.0 \text{ V} \) DC. The operating voltage (\( V_{\text{IN}} \)) has to be permanently applied to the FOX-LT unit and able to provide sufficient current of up to \( 1.9 \text{ A} \).

The operating voltage (\( V_{\text{IN}} \) and GND) is protected against voltage spikes and reverse polarity, but not for 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-LT device. FOX-LT has an automatic power ON-function when external power is applied. The power supply for the FOX-LT is capable of utilizing current ranging from \( V_{\text{IN}} = +10.8 \text{ V} \ldots +32.0 \text{ V} \) DC designed for automotive application.

<table>
<thead>
<tr>
<th>Signal name</th>
<th>I/O</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+IN</td>
<td>I</td>
<td>+10.8 V \ldots +32.0 V DC.</td>
<td>Positive operating voltage. For security reason, it is recommended to integrate externally a 2A fuse link between interconnection plug (8-pin connector) and d.c.-power source (see Fig 15).</td>
</tr>
<tr>
<td>GND</td>
<td>-</td>
<td>0 V</td>
<td>Ground (should be isolated from the vehicle Grounds)</td>
</tr>
</tbody>
</table>

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-LT 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-LT device:

<table>
<thead>
<tr>
<th>Modes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGN</td>
<td>Device wakes up when IGN (pin 3 - blue color) changes its digital level from Low to High (performs a rising edge).</td>
</tr>
<tr>
<td>Ring</td>
<td>Device wakes up when the GSM module receives a voice call or an SMS.</td>
</tr>
<tr>
<td>Timer=1:20:00</td>
<td>Device wakes up after the defined time has expired.</td>
</tr>
<tr>
<td>Motion=5,20,20</td>
<td>Device wakes up when motion is detected.</td>
</tr>
<tr>
<td>ExtPwrDetect</td>
<td>Device wakes up when external power (higher than 9 V) is connected to the device.</td>
</tr>
<tr>
<td>ExtPwrDrop</td>
<td>Device wakes up when external power is disconnected or it drops below 8 V.</td>
</tr>
<tr>
<td>AiWu=5.1,12</td>
<td>System wakes up when the voltage on I/O1 (pin 4 used as analog input) exceeds the defined upper or lower threshold.</td>
</tr>
</tbody>
</table>

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 "steppIII_FOX-LT_bolero_lt_PFAL_Configuration_Command_Set.pdf".

**NOTE** (This note is related to the battery-powered devices only): the internal battery of the FOX-LT must have enough power to safely wake up the device from a sleep mode. If the internal battery of the FOX-LT 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 on the aforementioned terminals (DCE units) to external equipment, you need to determine if the external hardware serial ports are configured as DTE or DCE.

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

<table>
<thead>
<tr>
<th>FOX-LT Terminal (DCE)</th>
<th>to</th>
<th>Application (DTE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RxA</td>
<td>&lt;--------</td>
<td>TXD</td>
</tr>
<tr>
<td>TxA</td>
<td>--------&gt;</td>
<td>RXD</td>
</tr>
</tbody>
</table>

**Table 4:** The signalling definitions between DTE and DCE.
6 HARDWARE INTERFACES

This chapter describes the hardware interfaces:

- 8pins double-row connector
- LED indicators
- GSM/GPS antenna connectors
- Mounting holes

<table>
<thead>
<tr>
<th>Interface specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>8pin double-row connector</td>
</tr>
<tr>
<td>Optical LED indicators</td>
</tr>
<tr>
<td>GSM/GPS antenna connectors</td>
</tr>
<tr>
<td>Mounting holes</td>
</tr>
<tr>
<td>10pins mini-USB</td>
</tr>
</tbody>
</table>

Table 5: Interface specifications

---

Figure 2: Interface specifications
## 6.1 8pin double row connector, pin assignments

![8pin double row connector](image)

Figure 3: View of the 8-pin double row connector - pin assignments (Type:Neltron 2417SJ-08)

### 6.1.1 8-pin connector pinout

<table>
<thead>
<tr>
<th>PIN</th>
<th>NAME</th>
<th>DIRECTION</th>
<th>DESCRIPTION</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+IN</td>
<td>Input</td>
<td>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-LT.</td>
<td>( V_{IN} = +10.8 \ldots +32.0 \text{ V} ) Imax ≤ 2A</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>-</td>
<td>Ground.</td>
<td>0 V</td>
</tr>
<tr>
<td>3</td>
<td>IGN</td>
<td>Input</td>
<td>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-LT device from IGN-Sleep mode (awaking from this mode requires a HIGH signal). See also chapter 6.1.2.4.</td>
<td>HIGH ≥ +10.8 \ldots +32.0 \text{ V DC}; LOW = 0V</td>
</tr>
<tr>
<td>4</td>
<td>I/O1</td>
<td>Input/Output</td>
<td>Software configurable pins. Each pin has dual functions as analog or digital. Each digital pin can individually be set as either an input or an open collector output. I/O1 (pin 4) can be used to wake up the FOX-LT device from AiWu sleep mode. Upon request the I/O2 and I/O3 can also be supplied for CAN-Bus (in this case: I/O2 = CAN_L; I/O3 = CAN_H).</td>
<td>OUT: open collector 100 mA max. @ +0 \ldots +32.0V DC</td>
</tr>
<tr>
<td>5</td>
<td>I/O2</td>
<td>Input/Output</td>
<td></td>
<td>IN: 0 V..+32.0V DC (High &amp; Low levels are free-programmable)</td>
</tr>
<tr>
<td>6</td>
<td>I/O3</td>
<td>Input/Output</td>
<td></td>
<td>Analog : Up to 32.0 V DC/10 bits resolution</td>
</tr>
<tr>
<td>7</td>
<td>RxA</td>
<td>Input</td>
<td>Serial port (receive data) for direct connection to the host PC (configuration, evaluation, firmware). If not used leave open.</td>
<td>V24, ±12 V</td>
</tr>
<tr>
<td>8</td>
<td>TxA</td>
<td>Output</td>
<td>Serial port (transmit data) for direct connection to the host PC (transmitting history data, output GPS protocols and others). If not used leave open.</td>
<td>V24, ±12 V</td>
</tr>
</tbody>
</table>

Table 6: Description of the 8-pin double-row connector
6.1.2 Special pin description (Pins 4, 5, 6)

These pins have dual functions. All of them are controlled by the internal firmware of FOX-LT, therefore, the user must specify whether they will be as analog or digital pins. This function is controlled by the command PFAL,IO0[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, the command settings would look like this:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFAL,IO0.Config=AI,2,11</td>
<td>//0 = I/O1; AI = analog; 2 and 11 = min. and max. voltages for Low and High events.</td>
</tr>
<tr>
<td>PFALIO1.Config=DI,5,10</td>
<td>//1 = I/O2; DI = digital; 5 and 10 = min. and max. voltages for Low and High events</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFAL,IO1.Config=DI,5,10</td>
<td>//1 = I/O2; DI = digital; 5 and 10 = min. and max. voltages for Low and High events.</td>
</tr>
<tr>
<td>PFAL,IO6.Set=high[low,hpulse,lpulse,cyclic]</td>
<td>//6 = I/O3; high = sets output to high.</td>
</tr>
</tbody>
</table>

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

When using an I/O as digital you must set it to high first (with PFAL command “$PFAL,IO4[5,6].Set=high”), otherwise 0V will be measured (and the device could be damaged).

6.1.2.1 How to use them as analog inputs

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

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

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

```
PFAL,IO0[1,2].Config=Al,2,11
```

where 0, 1 and 2 are indices corresponding to I/O1 (pin 4), I/O2 (pin 5) and I/O3 (pin 6) respectively. While the value 2 and 11 are min. and max. voltages that will be used to generate Low and High events, respectively. Detailed information can be found in software manual “steppIII_FOX-LT_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 these pins as digital Inputs (Pin 4, 5, 6)

These pins are high active when used as digital inputs, so you can set $V_{IN(\text{LOW})}$ and $V_{IN(\text{HIGH})}$ 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_IO0{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 “steppll\_FOX-LT\_bolero\_lt\_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-LT can react to the input changes and release different alarms such as sending out an SMS, email message, TCP packet, opening a CSD connection or activating an output port. The alarm type is user-dependant.

![Figure 6: Connection example when using it as digital input](image)

A completed circuit example for all inputs is attached in section 8.1.1.
### 6.1.2.3 How to use these pins as digital outputs (Pin 4, 5, 6)

The FOX-LT 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,I04[5,6].Set=high[low, hpulse, lpulse, cyclic]` for I01, I02 and I03 respectively or you can configure an or more alarms that activate these outputs when specific events occur (e.g. `PFAL,Cnf.Set,AL0=I0.e8=redge:I04.Set=cyclic,1000,2000`).

In order to evaluate this alarm, firstly send this configuration to the FOX-LT device and then trigger IGN-pin to High – as result the I01 goes High for 1 sec and Low for 2 sec. To set I01 to Low, just execute the command `PFAL,I04.Set=Low`. For more details how to activate an output and how to configure an alarm, refer to the manual “steppIII_FOX-LT_bolero_lt_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 a Relay.](image1)

![Figure 8: Connection example 2 when using it to control an LED.](image2)
6.1.2.4  How to use IGN pin (pin 3)

The IGN-pin has two functions:

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

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

Note that, the FOX-LT 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-LT devices that are shipped by the factory with an internal battery, are entered into the IGN-sleep mode. Therefore, to wake them up just 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-LT from IGN-Sleep
6.1.2.5 Serial communication signals (RxA and TxA)

The FOX-LT 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-LT Evalboard in order to communicate with the FOX-LT device, as there you will find all you need to evaluate with it.
This serial channel (RxA, TxA) operates at V24, ±12 V level. The signals on these pins are obtained to RS232 compatible signal levels.

RxA
This is the main receiving channel and is used to receive software commands to the board from any software (e.g. HyperTerminal). Moreover, the firmware update can also be done through this serial port.

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

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

6.2 SIM card holder inside the device

The FOX-LT device is equipped with a GSM modem. To use it, you must insert a SIM card in the appropriate holder inside the device.

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

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:

1) Remove the power supply and any other connections from the device.
2) Use a screwdriver to carefully detach the upper side of the device housing. Unscrew carefully both screws on the top side of the device.
3) Carefully raise the case away and with caution to prevent injury of the cable connectors between the device and housing.

Attention: Do not remove any of the cable connectors!

4) On the rightmost circuit board is the GSM modem, the black-colored SIM card holder can be found on the left hand side of GSM modem. Push the slider (metal lock) of the SIM card-holder in the direction marked "OPEN" to unlock it.
5) Flap the card holder up.
6) Insert the SIM card into the SIM card holder (with care not to damage any components of the circuit board)- the bevelled corner on the SIM card is 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.

7) Flap the card-holder back (without force), then press the slider (metal lock), and at the same time move it in the direction marked “⇌ LOCK” on the card holder until it stops.

8) Finally, place the upper case of device housing back to the original position, 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 both screws with a screwdriver.

6.2.1 How to enter the SIM card PIN:
To insert the PIN of the SIM card follow the steps below:

1) Install and start the FALCOM Workbench software.

2) Connect your FOX-LT to a free PC COM port (see chapter 6.1.2.5) and power up your device (see chapter 6.1).

3) Open a COM Port, a Console and an Editor. Select the COM port and port settings (57600 bps, 8 Data bits, No Parity bit, 1 Stop bit, None Flow control) and then click on the Connect icon on the left of the text “Port”, to connect to. Connect the Console to the COM Port and the Editor to the Console on the Connection view. For more details refer to the Workbench User's Guide.

4) Finally send from the editor this command $PFAL,Cnf.Set,GSM.PIN=xxxx to the FOX-LT (xxxx = PIN of your SIM card). For more details refer to the manual “SteppIII_FOX-LT_bolero_gt_PFAL_Configuration_Command_Set.pdf”.

6.3 LED indicators
The actual state of the FOX-LT 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-LT software manual “SteppIII_FOX-LT_bolero_gt_PFAL_Configuration_Command_Set.pdf”.

To turn on a LED, use one setting on the following command:

(\text{where} \ 11 = \text{LED1}; \ 12 = \text{LED2}; \ 13 = \text{LED3})
6.4 GSM/GPS antenna connectors

FOX-LT 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 provided 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, FOX-LT devices, the GSM antenna operates on four frequencies: 850/900/1800/1900 MHz. The GPS antenna operates on 1575.42 MHz frequency. The order name is: **FAL-ANT-7**

Any other GPS antenna connected to the FOX-LT must draw less than 25 mA. The antenna voltage is internally supplied.

*The figure below shows the position of GSM/GPS connectors.*

![GSM/GPS antenna connectors](image)

To connect the **FAL-ANT-7** combined GSM/GPS antenna to the FOX-LT 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-7** GSM/GPS antenna from the FOX-LT device:

✔ Press down the latch on the antenna connector and then pull the antenna.
6.5 4 x Mounting holes

The FOX-LT compact unit provides 4 holes for attaching it to a suitable location. The FOX-LT device can be mounted in different locations such as on wall or in vehicle. The holes on the FOX-LT support M4x20 screws (or screws with different length). There are no screws 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”.

![Mounting holes](image)

Figure 12: View of the mounting holes

6.6 10pins mini-USB (option)

Upon request the FOX-LT device can be supplied with a 10pins mini-USB connector. This connector currently supports only the audio interface all other pins are currently not supported they should not be connected.

![10pin Mini-USB](image)

Figure 13: 10pins mini-USB, pin assignments

Table below shows the pinout of 10pins mini USB connector for headset.

<table>
<thead>
<tr>
<th>PIN</th>
<th>PIN NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPK Right</td>
<td>Output Audio left channel to earpiece</td>
</tr>
<tr>
<td>2</td>
<td>VCC +5V</td>
<td>Not supported yet. DO NOT CONNECT.</td>
</tr>
<tr>
<td>3</td>
<td>SPK Left</td>
<td>Output Audio right channel to earpiece</td>
</tr>
</tbody>
</table>
The electrical characteristics for both paths is given separately in tables below:

**Microphone path characteristic and requirements:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone type</td>
<td>Electret microphone</td>
</tr>
<tr>
<td>Line coupling</td>
<td>AC</td>
</tr>
<tr>
<td>Line type</td>
<td>balanced</td>
</tr>
<tr>
<td>Differential input voltage</td>
<td>( \leq 65 \text{mVpp (23mVrms)} )</td>
</tr>
<tr>
<td>Microphone nominal sensitivity</td>
<td>(-45 \text{ dBVrms/Pa})</td>
</tr>
<tr>
<td>Analog gain suggested</td>
<td>(+10\text{dB})</td>
</tr>
<tr>
<td>Microphone voltage</td>
<td>(3\text{ V})</td>
</tr>
</tbody>
</table>

**Speaker path characteristic and requirements:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line coupling</td>
<td>DC</td>
</tr>
<tr>
<td>Line type</td>
<td>bridged</td>
</tr>
<tr>
<td>Output load resistance</td>
<td>(\geq 16\ \Omega)</td>
</tr>
<tr>
<td>Internal output resistance</td>
<td>(4\ \Omega\ (&gt;1.7\ \Omega))</td>
</tr>
<tr>
<td>Signal bandwidth</td>
<td>(150 - 4000\ \text{Hz @ -3 dB})</td>
</tr>
<tr>
<td>Max. differential output voltage</td>
<td>(1.310\ \text{Vrms (typ, open circuit)})</td>
</tr>
<tr>
<td>Max. single ended output voltage</td>
<td>(656\ \text{mVrms (typ, open circuit)})</td>
</tr>
<tr>
<td>SW volume level step</td>
<td>(-2\ \text{dB})</td>
</tr>
<tr>
<td>Number of SW volume steps</td>
<td>(10)</td>
</tr>
</tbody>
</table>

Detailed instructions on using audio parameters are presented in the manual "Stepplli_fox_bolero_it_PFAL_Configuration_Command_Set.pdf".
7 HOUSING

Figure 14: FOX-LT housing.
8 APPENDIX

8.1 Schematics

The figure below illustrates a common schematic when you install your FOX-LT hardware in the vehicle and use 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-LT 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-LT device 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 car ignition off before making any connection. Use a common ground point for all ground wires. To avoid ground loops, isolate all ground pins of the FOX-LT unit from the vehicle body. Do not connect power from a different system to the FOX-LT.

Software configured outputs of the FOX-LT 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 against continuous overvoltage. For security reason, it is recommended to integrate externally a 2A fuse link between the positive wire of the FOX-LT (+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-LT - with the vehicle ignition off, and antenna connected, attach the power pins to FOX-LT (FIRST connect the GND pin and then the +IN pin).
8.2 What should be considered when using the FOX-LT device

FOX-LT is a device controlled by the operating firmware. In order to start applications with FOX-LT and to obtain maximum benefit from operating firmware, you have to configure it and adapt its configuration to your needs. Therefore, refer to the manual "SteppIII_fox_bolero_LT_PFAL_Configuration_Command_Set.pdf".

Figure 15: Schematic example of installation guidance.