FALCOM
WIRELESS COMMUNICATIONS GMBH

STEPPIII

GSM/GPRS/GPS Terminal

Hardware Description

Preliminary - Subject to change

Version 1.0.0; Created: Tuesday 29 May 2007

Index of contents

Version history:

Version number	Author	Changes	Changed date
1.0.0	Fadil Beqiri	- Initial release	29/05/2007

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1 INTRODUCTION

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

1.1 General

This description is focused on the GSM/GPRS and GPS terminal STEPPIII from FALCOM GmbH. It contains information about purpose and use of the STEPPIII concept.

In order quickly to start and immediately and comprehensive to use all functions and to avoid any mistakes of STEPPIII terminal on your utilization, we recommend to read the following references and suggestions for using your new STEPPIII terminal.

The STEPPIII concept represents further development of the FALCOM STEPP and STEPP II concept. The new device can be easily integrated into existing STEPPII designs or into a variety of new applications. It is functional, mechanical and software compatible to the popular STEPPII-55/56-GPRS device family.

Compared to previous STEPP and STEPP II terminals the new STEPPIII concept embeds Quad Band GSM/GPRS core, high-sensitivity 20-channel GPS core, 3D-motion sensor, 1100 mA/h Li-Polymer battery.

The STEPPIII terminal is a Plug & Play GSM/GPRS/GPS terminal with an embedded configurable software that provides even greater performance and flexibility for its users and system integrators to develop high-performance applications. STEPPIII is a completely self-contained and battery-powered system with a stand-alone software that provides location-based applications. It is designed for indoor fixed mounting. The device concept is targeting for direct implementation as a mobile client in a wide range of high volume, low-cost, flexible system solutions like *AVL, fleet management, vehicle security and recovery* and *other related area*. The tracking functionality of the embedded mobile client application is combined with variety of alert messaging capabilities. The configurable alert messages contain current position and status report and use 2 digital inputs, 4 analog or digital inputs and 4 digital outputs as hardware back-bone. Depending on how the system is set up, 4 digital outputs allow remote control of external actuators. In addition to that two predefined digital inputs are detecting ignition line and main power (car battery) failure, and so you may handle these events and use as notification. Nevertheless, if the external power source fails, the internal rechargeable 1100 mA Li-Polymer battery provides continuous operation for about 10-12 hour after full charged (configuration dependent).

The embedded software comprises a set of word-like commands termed "**PFAL**" needed for executing particular actions, reading or setting particular configurations. These commands are valid for all kinds of operations including **SMS**, **CSD**, **TCP** and **SMTP**.

STEPPIII 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. STEPPIII contains a data-logger that enables it to archive unique locations in sequence for up to 45 days for later analysis and evaluation (for example, archive interval up to 20 sec.).

The physical interface to the terminal application is made through integrated connectors. These are required for controlling the terminal, receiving GPS location data, transferring data and providing power supply lines. STEPPIII provides 2 serial interfaces giving you maximum flexibility for local use.

Figure 1 shows the front and backside of the STEPPIII.

a) front side b) back side

Figure 1: Front and back side of STEPPIII

STEPPIII terminal can be implemented into 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:

- *Fleet management*
- *Vehicle management*
- *Remote tracking and monitoring*
- *Safety and security*
- *Off-road applications*
- *Real-time Navigation and Positioning*
- *Finding streets and routes*
- *Travel planning and many others …*

The STEPPIII - EVALKIT provides an easy and efficient way to evaluate and configure all system parameters of the mobile client. The configuration of the STEPPIII can be done via local serial link or remotely via the GSM network. The STEPPIII concept reduces the efforts for the creation of a turn key tracking and security solution to the definition of the server (dispatcher) application. In this way the time-to-market, the design-in risk and the total cost of solution are substantially reduced.

1.2 Circuit concept

The STEPPIII architecture includes the following major functional components (*see figure 2*):

- ***Architecture integrates:***
  - ✓ *High-performance Quad-Band GSM/GPRS core*
  - ✓ *High sensitivity 20 parallel channel SiRFStarIII*
  - ✓ *ARM7TDMI processor that controls all functions of the system*
  - ✓ *Rechargeable 1100 mA Li-Polymer battery*
  - ✓ *CAN bus (optional)*
  - ✓ *3D motion detection*
  - ✓ *Interface circuitry*
- ***Physical interfaces:***
  - ✓ *Molex connector (Type: Molex 43045-1609, and counterpart: Casing: 43025-1600 and Box type spring contact: 43031-0001) for power supply and I/O's (16-pin connector)*
  - ✓ *AMP connector (Type: AMP5-558556-1, and counterpart: 558666-1) for serial interfaces (15-pin connector)*
  - ✓ *SIM Card reader (Type: Molex-91228-0002 small SIM Card)*
  - ✓ *GSM antenna interface (Type: Connector 50 Ω Fakra/Radiall SMB-male)*
  - ✓ *GPS antenna interface (Type: Connector 50 Ω Fakra/Radiall SMB-male)*
  - ✓ *LED*

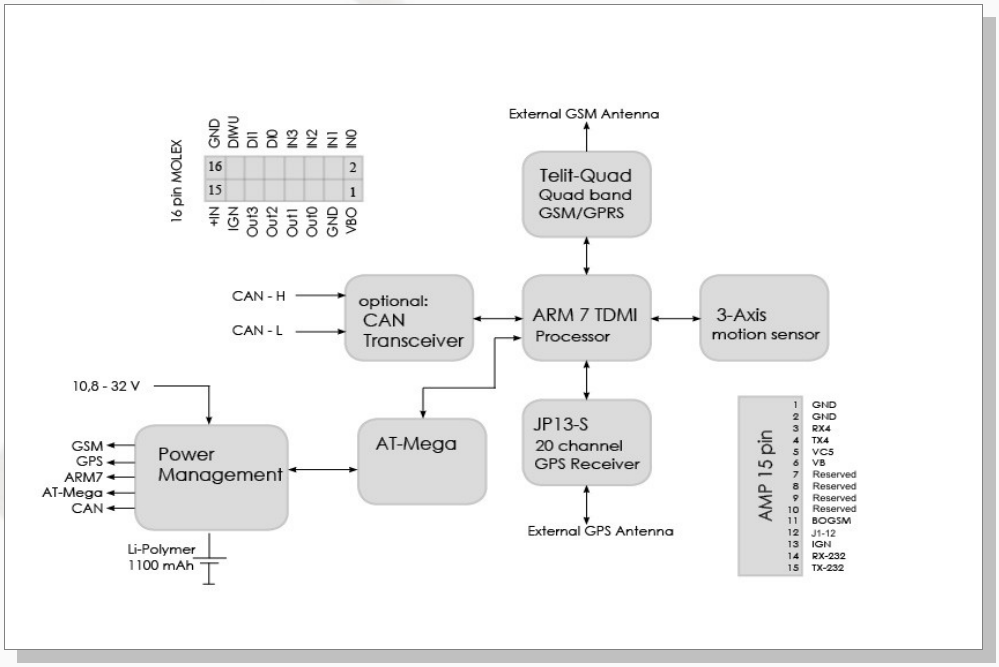

Figure 2: Architecture of the STEPPIII terminal

1.3 Used abbreviations

Abbreviation	Description
ASIC	Application Specific Integrated Circuit
DOP	Dilution of Precision
GPS	Global Positioning System
GSM	Global Standard for Mobile Communications
GGA	GPS Fixed Data
HDOP	Horizontal DOP
HW	Hardware
IMEI	International Mobile Equipment Identity
I/O	Input/Output
NMEA	National Marine Electronics Association
PRN	Pseudorandom Noise Number – The Identity of GPS satellites
RF	Radio Frequency
RTC	Real Time Clock
RXQUAL	Received Signal Quality
SIM	Subscriber Identification Module
SMS	Short Message Service
SRAM	Static Random Access Memory
TA	Terminal Adapter
TE	Terminal Equipment
TP	Transmit Protocol
TTFF	Time to First Fix
SA	Selective Availability
WAAS	Wide Area Augmentation System
MSK	Minimum Shift Keying

Table 1: Used abbreviations

1.4 Related documents

1. *ETSI GSM 07.05:"Use of Data Terminal Equipment–Data Circuit terminating Equipment interface for Short Message Service and Cell Broadcast Service"*
2. *ETSI GSM 07.07"AT command set for GSM Mobile Equipment"*
3. *ITU-T V.25ter "Serial asynchronous automatic dialing and control"*
4. *SiRF binary and NMEA protocol specification;*
   www.falcom.de/Service/Manuals/SiRF
5. *steppIII_firmware_2.5.xx_manual.pdf (supporting GSM & GPRS services)*
6. *Application_notes_on_vehicle_mounting.pdf*
7. *AppNotes_connecting_a_bar_code_scanner_to a_STEPPIII.pdf*

2 SECURITY

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

Your cellular engine STEPPIII 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 STEPPIII. Please read this chapter carefully before starting to use the cellular engine STEPPIII.

2.1 General information

Your STEPPIII device utilizes the GSM/GPRS/GPS standard for cellular technology. GSM/GPRS 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 modem is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your modem, the cellular system handling your calls controls both the radio frequency and the power level of your cellular modem.

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

2.2 Exposure to RF energy

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

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

2.3 Efficient modem operation

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

If your modem has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However, your modem operates more efficiently with the antenna fully extended.

Do not hold the antenna when the modem is „IN USE“. Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

2.4 Antenna care and replacement

Do not use the modem with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the modem and may contravene local RF emission regulations or invalidate type approval.

2.5 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 modem 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 fulfill road-safety instructions of the current law!

2.6 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.

2.7 Vehicle electronic equipment

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

2.8 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 STEPPIII 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.

2.9 Aircraft

Turn your STEPPIII 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.

2.10 Children

Do not allow children to play with your STEPPIII 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.

2.11 Blasting areas

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

2.12 Potentially explosive atmospheres

Turn your STEPPIII device **OFF** when in any area with a potentially explosive atmosphere. It is rare, but your modem or its 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.

2.13 Non-ionizing radiation

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

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

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

3 SAFETY STANDARDS

This GSM/GPS modem complies with all applicable RF safety standards.

The embedded GSM/GPRS/GPS modem 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 General specifications of terminal STEPPIII

- ***Power supply:***
  - ✔ *Supply voltage from +10.8 V to +32.0 V (absolute maximum ratings) suitable for direct connection to an automotive +12V or +24V DC supply.*
- ***Power saving:***
  - ✔ *Sleep modes minimize power consumption to 3 … 15 mA. For more details refer to the chapter on page.*
- ***Battery:***
  - ✔ *Built-in a rechargeable Li-Polymer battery with a capacity of 1100 mA/h.*
- ***Temperature:***
  - ✔ *Normal operation: -30 °C to + 80 °C (see chapter **4.1.3** for further details)*
- ***Evaluation kit:***
  - ✔ *The STEPPIII EvalBoard is designed to test, evaluate and make basis configuration to enable remote monitoring/configuration of the FALCOM STEPPIII. It provides a sample configuration for application.*
- ***Physical characteristics:***
  - ✔ *Size: 55.0 ± 0.15 mm x 80.0 ± 0.15 mm x 25.0 ± 0.15 mm*
  - ✔ *Weight: ca. 90 g*
- ***I/O interface:***
  - ✔ *2 x digital inputs (hardware predefined)*
  - ✔ *2 x digital inputs (hardware predefined as **Ignition-pins**)*
  - ✔ *1 x digital inputs (hardware predefined as **Wakeup pin**)*
  - ✔ *4 x analog/digital inputs (controlled by firmware as **digital** or **analog** inputs)*
  - ✔ *4 x digital outputs (hardware predefined)*
  - ✔ *1 x power supply output*
- ***Sleep ON/OFF functions:***
  - ✔ *4 x Sleep modes - programmable with PFAL commands.*

- ***Firmware:***
  - ✔ *User customisable*
- ***Upgradeable:***
  - ✔ *STEPPIII firmware upgradeable via serial interface and over air GPRS network.*
- ***Sensor:***
  - ✔ *3D motion sensor*
- ***Memory:***
  - ✔ *2 MByte FLASH for configuration, data-logging and firmware storage*
- ***Serial ports:***
  - ✔ *2 x full duplex serial communication (**Serial Port 0** and **Serial Port 1**)*
- ***Serial Interface Setting:***
  - ✔ *Full duplex serial communication, CMOS level*
  - ✔ *4-wire (2 x Rx and 2 x Tx) serial communication*
  - ✔ *Baud rate on the serial ports (user selectable):*
  - ✔ *8 data bits, no parity, 1 stop bit, no hardware*
- ***Casing:***
  - ✔ *Fully shield*

4.1.1 Backup Battery Technical Data (1100 mA/h)

❖ ***Electrical characteristics:***

- *Nominal voltage (V)* *3.70*
- *Typical capacity 20°C (mA/h)* *1100 mA/h @ 4.2 V*

❖ ***Operating conditions:***

- *Charging method* *Constant Current/ Constant Voltage*
- *Charging voltage* *4.2 VDC*
- *Charging current* *470 mA*
- *Charging temperature range* *0°C to + 40°C*
- *Discharge current* *1C max. continuous*
- *Discharge temperature range* *-20°C to +60°C*

4.1.2 Power consumption

To be defined.

4.1.3 Operating temperatures

Parameter	Min	Typ	Max	Unit
Ambient temperature (according to GSM 11.10)	-40	25	+85	°C
Operating temperature (internal battery disabled) *	-30 °C	25	+80	°C
Charging temperature (internal battery enabled)	0 °C	25	+40	°C
Discharging temperature (internal battery enabled)	20 °C	25	+60	°C

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

Table 2: Operating temperature

4.2 Technical specifications of GSM/GPRS engine

- ***Frequency bands:***
  - ✔ *Quad band: EGSM 900, EGSM 850,GSM 1800, GSM 1900*
  - ✔ *Compliant to GSM Phase 2/2+*
- ***GSM class:***
  - ✔ *Small MS*
- ***Transmit power:***
  - ✔ *Class 4 (2 W) at EGSM900 and GSM850*
  - ✔ *Class 1 (1 W) at GSM1800 and GSM 1900*
- ***GPRS connectivity:***
  - ✔ *GPRS multi-slot class 10*
  - ✔ *GPRS mobile station class B*
- ***DATA:***

  GPRS ⇒
  - ✔ *GPRS data downlink transfer: max. 85.6 kbps (see table 3).*
  - ✔ *GPRS data uplink transfer: max. 42.8 kbps (see table 3).*

  CSD ⇒
  - ✔ *CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent, V.110.*
- ***SMS:***
  - ✔ *Text mode*
- ***SIM interface:***
  - ✔ *Support SIM card: 3 V*
- ***GSM Antenna:***
  - ✔ *External GPS antenna connector.*
- ***Real time clock:***
  - ✔ *Implemented*

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

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

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

4.3 Technical specifications of GPS receiver

- ***GPS features:***
  - ✔ *OEM single board high sensitive 20 channel GPS receiver, L1 1575.42 MHz, C/A code 1,023 MHz chip rate.*
  - ✔ *GPS receiver with SiRFstarIII chip set*
  - ✔ *Processor type ARM7/TDMI*
  - ✔ *SiRF GSW3*
- ***Horizontal position accuracy:***
  - ✔ *Autonomous* *< 2.5 meters.*
  - ✔ SBAS <2.0 meter
- ***Datum:***
  - ✔ *WGS-84.*
- ***Sensitivity:***
  - ✔ *Autonomous acquisition* *-142 dBm*
  - ✔ GSM /UMTS coarse time aided -155 dBm
  - ✔ CDMA precise time aided -155 dBm
  - ✔ Tracking -159 dBm
- ***Time to First Fix (TTFF):***
  - ✔ *Hot start* *< 1 sec., average*
  - ✔ *Warm start* *< 35 sec., average*
  - ✔ *Cold start* *<35 sec, average*
- ***Dynamic Conditions:***
  - ✔ *Altitude* *18,000 meters (60,000 feet) max.*
  - ✔ *Velocity* *< 515 meters/second (1000 knots) max.*
  - ✔ *Max. update rate 1 Hz*
- ***Supported protocols:***
  - ✔ *NMEA Msg.:* ***GLL, GGA, RMC, VTG, GSV, GSA***
  - ✔ *Additional:* ***IOP, GSM, AREA, BIN*** *are also supported by the software developed by the FALCOM, see related documents .*
- ***Crystal oscillator (TCXO):***
  - ✔ *Load sensitivity* *± 10 % load change, 0.2 ± ppm*
- ***GPS antenna***
  - ✔ *External GPS antenna connector.*
- ***Memory***
  - ✔ *Combo-Memory (2 MB Flash–512 KB SRAM)*

4.4 NMEA data message

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

Option	Description
GGA	*Time, position and fix type data.*
GLL	*Latitude, longitude, UTC time of position fix and status.*
GSA	*GPS receiver operating mode, satellites used in the position solution and DOP values.*
VTG	*The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
GSV	*The number of GPS satellites in view satellite ID numbers, elevation, azimuth and SNR values.*
RMC	*Time, date, position, course and speed data.*

Table 4: NMEA Output Messages

5 STEPPIII APPLICATION INTERFACE

5.1 Power supply

The power supply for the STEPPIII terminal has to be a single voltage source of V_{VC+} = +10.8 V...+32.0 VDC. It must be able to provide sufficient current which typically rises to **1.6** A. The operating voltage (V_{VC+} and GND) is protected from reverse pole connection.

5.1.1 Power supply pins (15 and 16) on the MOLEX 16-pin connector

One VC+ pin on the MOLEX 16-pin connector is dedicated to connect the supply voltage, 4 GND pins are recommended for grounding.

The VC+ and GND pins serve for charging the internal Li-Polymer battery and powering the STEPPIII device. STEPPIII has automatic power ON-function when external power is applied. The power supply for the STEPPIII is capable of utilizing current ranging from V_{VC+} = +10.8 V ... +31.0 VDC designed for automotive application.

Signal name	I/O	Parameter	Description
VC+	I	+10.8 V...+32.0 VDC. The operating voltage must never be exceeded.	Positive operating voltage. This line must be protected against overcurrent (by a 2A fuse) and protected against over-voltage.
GND	-	0 V	Ground (should be isolated from the vehicle Grounds)

5.1.2 Automatic shutdown

Automatic shutdown takes effect if:

- *the STEPPIII board is exceeding the critical limits of over or under temperature.*
- *the battery is exceeding the critical limits of over or under temperature.*
- *under voltage is detected.*

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

5.2 Determining the External Equipment Type

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

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

STEPPIII Terminal (DCE)	to	Application (DTE)
Rx	<----------	TXD
Tx	---------->	RXD

Table 5: The signalling definitions between DTE and DCE.

6 HARDWARE INTERFACES

This chapter describes the hardware interfaces:

- *Molex 16-pin connector pinout*
- *AMP 15-pin connector pinout*
- *RF interfaces*
- *SIM interface*
- *LED's indicator*

Interface specifications	
Interface A	Molex 16-pin connector (43045-1609)
Interface B	SIM card reader for small SIM cards (3V)
Interface C	GPS RF Connector 50 Ω Fakra/Radiall (SMB-Male)
Interface D	GSM RF Connector 50 Ω Fakra/Radiall (SMB-Male)
Interface E	AMP 15-pin connector (5-558556-1)
Interface F	Optical LED indicators. Free programmable.

Table 6: Interface specifications

Figure 3: Interface specifications

6.1 Interface A (16-pin Molex 43045-1609)

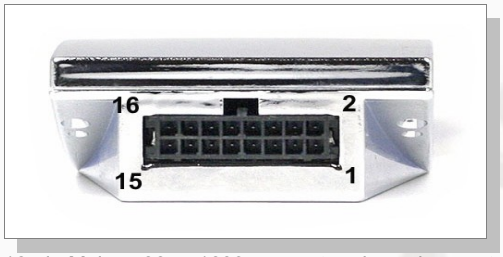

Figure 4: View of the 16-pin Molex 43045-1609 connector pin assignments

6.1.1 MOLEX connector pinout

PIN	NAME	I/O	DISCRIPTION	LEVEL
1	VBO		**Do not connect.** Leave disconnected.	-
2	IN0	I	Individually configurable as digital or analog input in software. The default configuration of this pin is an analog input.	**As analog :** Up to 32 V DC/10 bits resolution **As input:** +10.8 ... +32 V DC ($V_{IN} \leq$ VC+)
3	GND	-	Negative operating voltage (ground).	0 V
4	IN1	I	Individually configurable as digital or analog input in software. The default configuration of this pin is an analog input.	**As analog :** Up to 32 V DC/10 bits resolution **As input:** +10.8 ... +32 V DC ($V_{IN} \leq$ VC+);
5	OUT0	O	Open collector output.	100 mA max. @ +10.8 .. +32V DC
6	IN2	I	Individually configurable as digital or analog input in software. The default configuration of this pin is a digital input.	**As analog :** Up to 32 V DC/10 bits resolution **As input:** +10.8 ... +32 V DC ($V_{IN} \leq$ VC+)
7	OUT1	O	Open collector output.	100 mA max. @ +10.8 .. +32V DC
8	IN3	I	Individually configurable as digital or analog input in software. The default configuration of this pin is a digital input.	**As analog :** Up to 32 V DC/10 bits resolution **As input:** +10.8 ... +32 V DC ($V_{IN} \leq$ VC+)
9	OUT2	O	Open collector output.	100 mA max. @ +10.8 .. +32V DC
10	DI0	I	Currently as digital input only. CAN bus option.	**HIGH** = programmable; **LOW** = programmable
11	OUT3	O	Open collector output.	100 mA max. @ +10.8 .. +32V DC
12	DI1	I	Currently as digital input only. CAN bus option.	**HIGH** = programmable; **LOW** = programmable
13	IGN	I	General propose input. Connect it to the vehicle ignition.	**HIGH** ≥+10.8 .. +32 V DC; **LOW** = 0V
14	AOO/ DiWu	I	This pin can be used to put to sleep and wake up the main microcontroller .	**HIGH** = programmable; **LOW** = programmable
15	VCC	I	Power supply input (Input 7). 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.	V_I = +10.8 ... +32.0 V
16	GND	-	Negative operating voltage (ground).	0 V

Table 8: Pin description of the Molex 16-pin connector

6.1.2 Special pin description

6.1.2.1 Analog inputs (2, 4, 6, 8)

Analog voltages up to 32 V with 10 bit resolution can be processed and remotely evaluated by a server application. Pull-up resistor to a constant input voltage allows for resistive transducers to ground, e.g. fuel sensor or thermistors. *Because the pins 2, 4, 6, and 8 can operate either as digital or analog, they have to be configured and calibrated for such purposes before using as analog outputs.*

↓ Connection example for analog input 0 (IN0):

Thus, an analog input can be connected to a temperature sensor (a NTC resistor for instance). It is possible to set a low temperature alarm and a high temperature alarm (upper and lower values), passed to required temperature. Passage through these thresholds will trigger an alarm. We recommend to use SMS or TCP as alarm type with GPIOP as attachment protocol. The SMS can be received on a mobile phone, modem or any GSM device. An application example is shown in figure below:

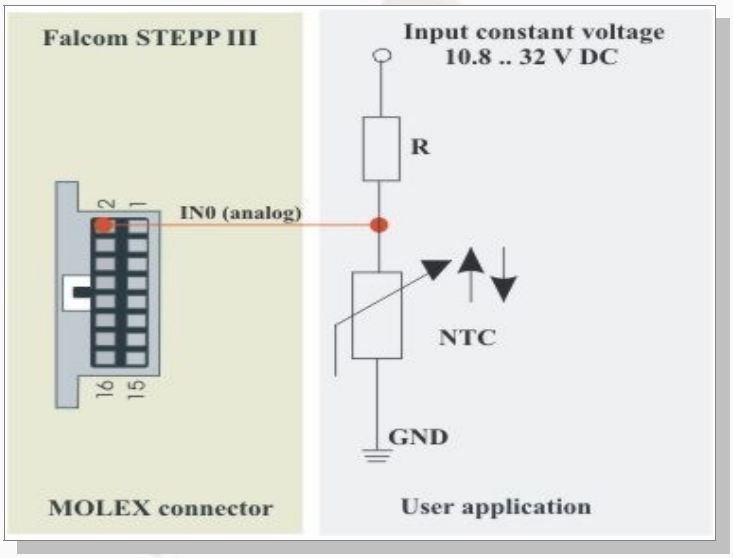

Figure 5: Connection example for analog input (IN0)

↓ Connection example for analog input 1 (IN1):

Likewise, on another analog input you can install a tachometer generator. The maximum output voltage of the tachometer is + 32 V *(see illustrated example in figure below)*.

Both circuit examples (the NTC diagram above and the Tachometer) are only illustrations to show the aim of the analog inputs.

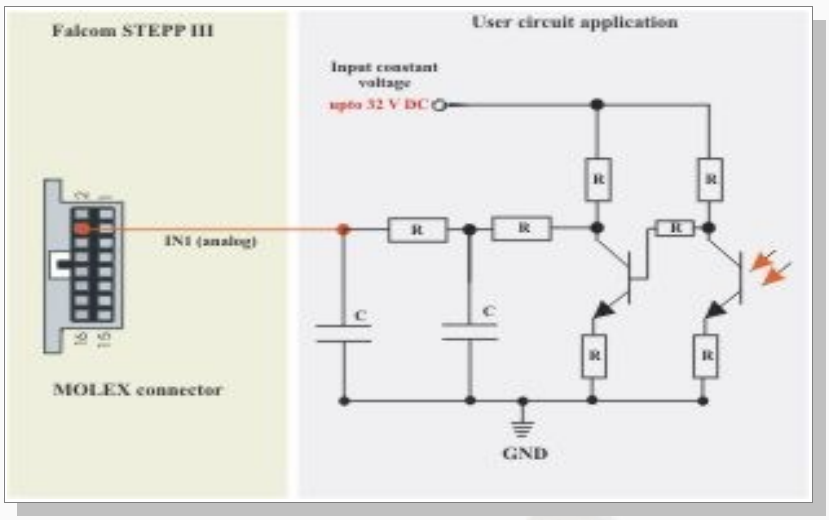

Figure 6: Connection example for analog input (IN1)

6.1.2.2 Digital Inputs (pin 10,12)

The inputs (pin 10, 12) on the MOLEX 16-pin connector are high active so they can be connected to + 5 V ... 32 V DC. The figure below illustrates how to connect these inputs. If one of the connected pins (inputs) is activated (for at least 1 sec), STEPPIII will release an alarm (SMS or data connection). The alarm type and the alarm text (alarm type SMS) depend on the software configuration done by the user. The inputs can be configured by using the Command Set manual. All inputs reserved for customer specific applications can be connected as shown below:

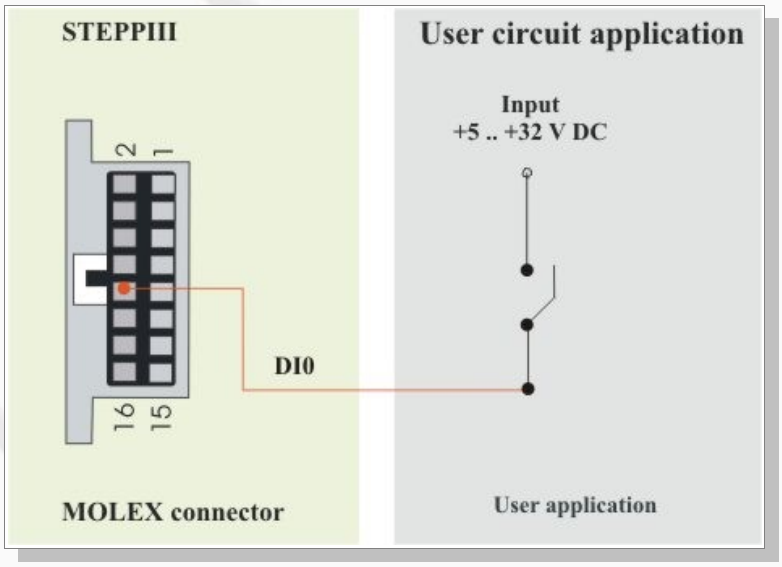

Figure 7: Connection example for digital input (DI0)

A completed circuit example for all inputs is attached in section 10.1.1.

6.1.2.3 Outputs (pin 5, 7, 9, 11)

The STEPPIII supports four outputs. These can be set remotely by the server application. The figures below show the schematic of possible output connections. Each output can be directly connected to a LED, Relay etc., which needs no more than 100 mA. The figures below show the schematic of possible output connections.

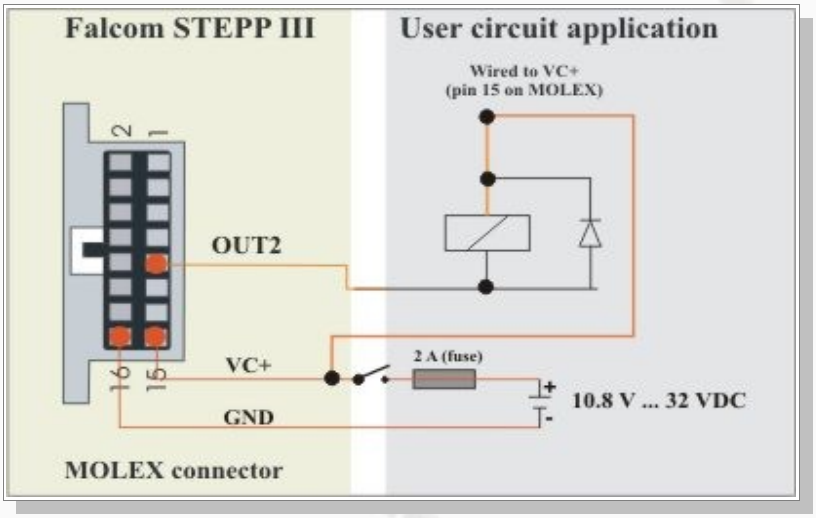

Figure 8: Connection example 1 for an output (Relay, OUT2)

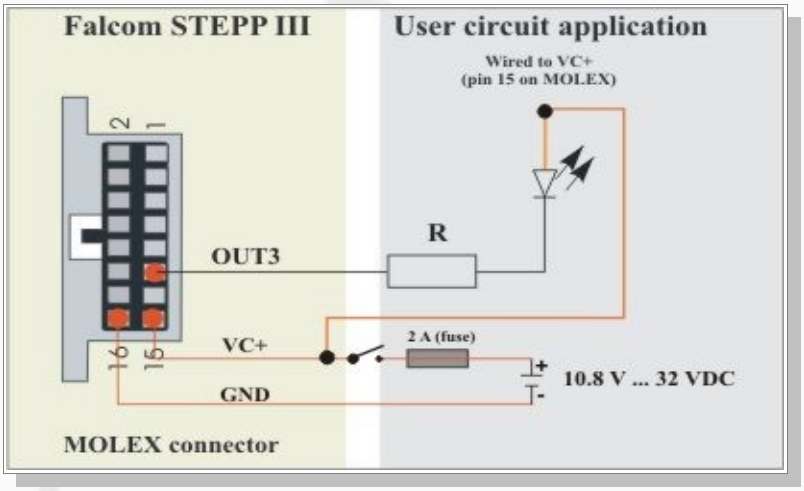

Figure 9: Connection example 2 for an output (LED, OUT3)

6.1.2.4 Ignition (pin 13)

STEPPIII provides two Ignition pins, one on the Molex connector (pin 13) and one on the AMP connector (pin 13). Their functionality is the same. The vehicle ignition line (starter lock clamp 15) can be connected to one of the IGN pins of terminals (Pin 13). Thus, it is possible to send an alarm SMS (by starting the car engine), prerequisite, the input IGN of the STEPPIII should be configured for this purpose. Both pins 13 on the Molex connector and AMP connector are internally connected with each other, so they can be alternatively used. For more information see the corresponding figure in chapter 10.1.1.

Note that, the IGN pins on the STEPPIII are not assumed to switch on the STEPPIII terminal, they are only input pins, which can be used to control, for example, the vehicle Ignition key.

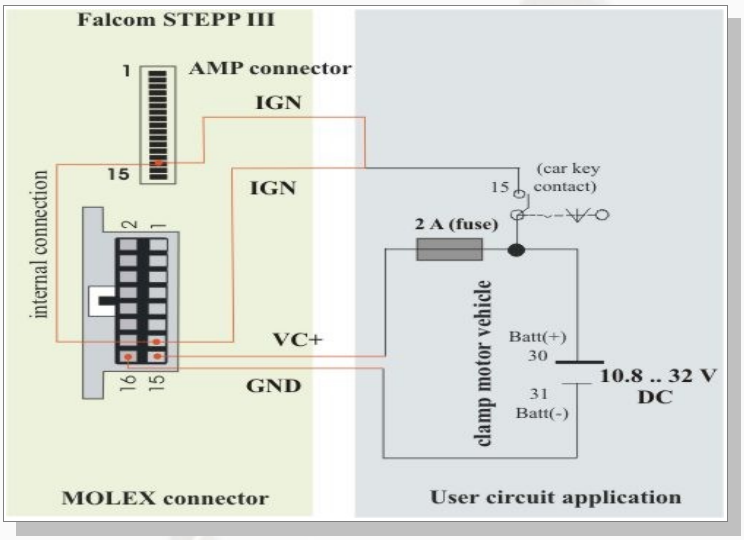

Figure 10: Ignition connection example

6.2 Interface B (SIM card interface Molex-91228-0002)

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

Figure 11: View of the SIM card interface

The SIM interface controls an internal small 3 V SIM card. This interface is fully compliant with GSM 11.11 recommendations concerning SIM functions.

Note: *The SIM should not be removed, while the module is powered on. The SIM must only be removed when the STEPPIII is shut down. To remove the SIM card press the Eject button (see figure 11) then pull out the SIM card holder.*

Note: *The unit is not designed for use of single 5 V SIM cards. These cards will generate an error which cannot be distinguished from a faulty SIM card.*

6.3 Interfaces C and D

The STEPPIII is fitted with two male SMB FAKRA connectors that accept a wide variety of GSM/GPS antenna styles. One of them (right) (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 other left-one is provided for GPS RF connection. The GPS RF connector (see figure below) has an impedance of 50 Ohm. Active antennas have an integrated low-noise amplifier. They can be directly connected to this connector. The integrated low-noise amplifier of the antenna is internally supplied with the specified voltage.

FALCOM GmbH provides a combined GSM/GPS antenna, especially, for the STEPP devices, the GSM antenna operates on four frequencies: GSM 850/900 MHz and DCS 1800/1900 MHz. The GPS antenna operates on 1575.42 MHz frequency. This antenna is suitable for mounting, covertly if required, in various locations.

The order name of combined GSM/GPS antenna is: **FAL-ANT-5**

In order to operate properly the GPS part, it is recommended the GPS active antenna should not exceed 25 mA. The antenna voltage is supplied internally. The GPS antenna is protected from reverse pole connection.

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

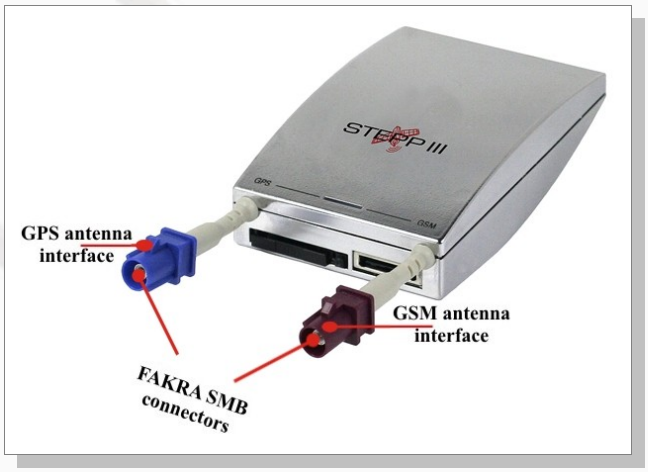

Figure 12: View of the GSM/GPS antenna cable.

Both GSM/GPS antenna cables with their FAKRA connectors are connected to STEPPIII. Both GSM and GPS antenna cables have the same length.

6.4 Interface E (AMP 558556-1 Connector)

Figure 13: View of the 15-pin AMP5-558556-1 connector pin assignments

CAUTION INSERT THE 15-PIN AMP ADAPTER KINDLY INTO THE AMP SLOT OF TERMINAL. FORCING THE ADAPTER MAY DAMAGE THE CONNECTOR PINS. IF YOU FEEL ANY RESISTANCE WHILE INSERTING THE ADAPTER INTO THE AMP SLOT OF TERMINAL, REMOVE IT IMMEDIATELY AND CHECK FOR ANY DAMAGE OF ITS CONNECTOR OR BEND PINS.

6.4.1 AMP connector pinout

PIN	NAME	I/O	DESCRIPTION	LEVEL
1	GND	-	Negative operating voltage (grounds).	0 V
2	GND	-	Negative operating voltage (grounds).	0 V
3	RX4	I	Second Serial interface (Receive data). Do not use for firmware update	V24, ±12 V
4	TX4	O	Second Serial interface (Transmit data). Do not use for firmware update	V24, ±12 V
5	VC5	O	Power output for external accessories. This pin delivers either **5 V** or **3.3 VDC**. By default it delivers **5V**.	100 mA @ 3.3 VDC
6	VB	O	Power output for external accessories. This pin delivers the same voltage level as internal battery.	V_{OUT}= 3.5V .. 4.2 VDC
7	-	-	Reserved	-
8	-	-	Reserved	-
9	-	-	Reserved	-
10	-	-	Reserved	-
11	BoGSM	I	**Do not connect.** Leave disconnected	-
12	J1-12	-	**Do not connect.** Leave disconnected	-
13	IGN2	I	General propose input. Connect it to the vehicle ignition. It is the same pin as pin 13 on MOLEX connector.	**HIGH** ≥+10.8 .. +32 V DC; **LOW** = 0V
14	RxA RS232	I	First Serial interface (receive data) for direct connection to the host PC (configuration, evaluation, firmware) or to the STEPPIII Eval-Board. If not used leave open.	V24, ±12 V
15	TxA RS232	O	First Serial interface (transmit data) for direct connection to the host PC (transmitting history data, output GPS protocols and others) or to the STEPPIII Eval-Board. If not used leave open.	V24, ±12 V

Table 9: Pins description of 15-pin AMP connector

6.4.2 Special pin description

6.4.2.1 VC 5

This output can be used to power some external accessories requiring up to 100 mA @ 5 VDC. Upon request, this pin can be equipped to deliver 3.3 VDC. This power supply is available when the terminal is switched on.

6.4.2.2 Serial communication signals (RxA, TxA and Rx4, Tx4)

The board supports two full duplex serial channels. Both serial connections are at V24, ±12 V level. You do not need to use any level shifter. The signals on these pins are obtained to RS232 compatible signal levels. All supported variable baud rates can be controlled from any terminal software. You can directly communicate with a PC serial port. It is recommended to use the STEPPIII Evalboard in order to communicate with the terminal.

First serial interface

RxA	*This is the main receiving channel and is used to receive software commands to the board from any terminal software (e.g. HyperTerminal) or from user written software. Firmware update can be done only through this serial port.*
TxA	*This is the main transmitting channel and is used to output navigation and measurement data to any terminal software (e.g. HyperTerminal) or user written software. Firmware update can be done only through this serial port.*

Second serial interface

Rx4	*This is the second receiving channel and can also be used to receive software commands to the board from any terminal software (e.g. HyperTerminal) or from user written software, but not firmware update.*
Tx4	*This is the main transmitting channel and is used to output navigation and measurement data to any terminal software (e.g. HyperTerminal) or user written software, but not firmware update.*

6.5 Interface F (LED's description)

The actual state of the STEPPIII can be displayed by three LED's on the interface D of the terminal. These programmable and accessible LEDs can be interfaced to build-in components to show their state. References, to customize the device configuration, are available in the STEPPIII software manual ***"STEPPIII_firmware_2.5.x_user_manual.pdf"***.

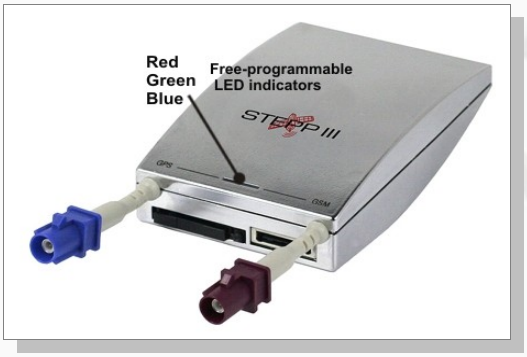

Figure 14: View of the Red, Green, Blue LED indicators

6.6 Interface E (Mounting holes)

The STEPPIII compact terminal provides 4 holes for attaching it to the suitable cradle. As a reference for mounting holes use figure 15 below in this section. The cradle is available in the sales package. For detailed information about mounting, please, refer to the related documents [1.4].

In order to avoid any damage during mounting of the terminal is required to use (choose if the screws are damaged) properly the screws delivered with STEPPIII. Fasteners are 22 x 6 mm screws plus suitable washers, or customized screws.

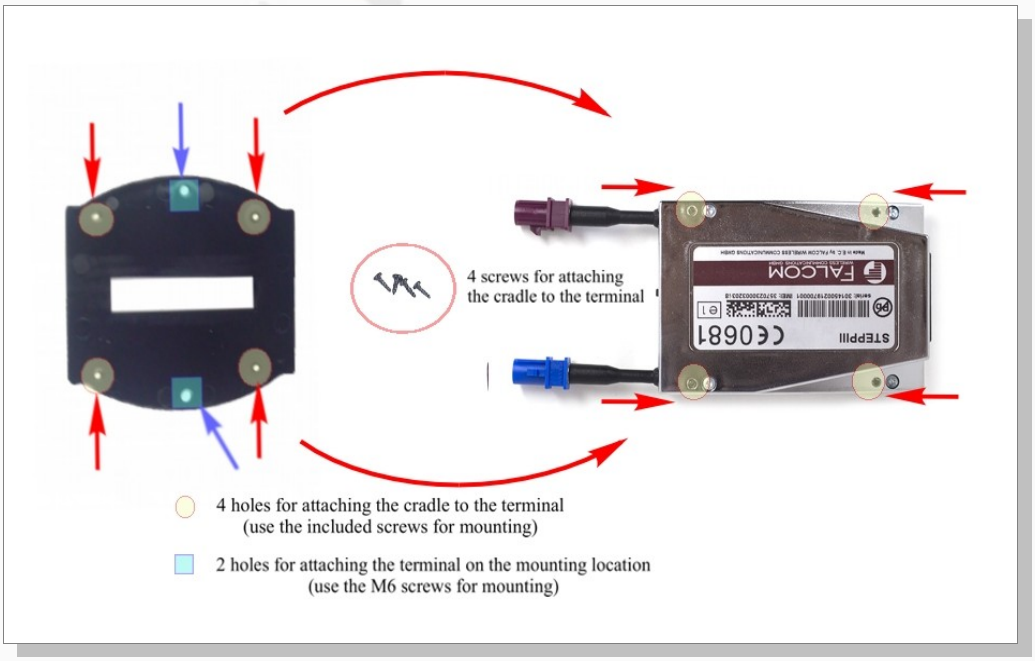

Figure 15: View of the mounting holes

6.6.1.1 Mounting the cradle to the terminal

Figure 16: Attached cradle to the terminal.

In order to avoid any damage during mounting, place the terminal (if needed) on the cradle and push it up/down until you see both terminal and cradle holes are facing each other. Screws must be inserted with the screw head on the bottom of cradle through to the provided holes on the bottom of the STEPPIII. Use a suitable screwdriver to perform the rotation. Screw up kindly the appropriate screws. To avoid short circuits ensure that the customized screws (screws with different length) do not come into contact with the STEPPIII PCB since there are a number of test points. Make sure that the STEPPIII does not move up and down inside the cradle.

After you have secured up the cradle to the terminal, choose the mounting location (see next section). The terminal can be mounted in different locations on a wall or vehicle, metal or non-metal sheets. It depends on the user's application. As a reference for mounting holes use figure 15 (blue colour).

6.6.1.2 Placing the terminal

CAUTION: IN ORDER TO COMPLY WITH RF EXPOSURE REQUIREMENTS, INSTALL THE TERMINAL SO THAT A MINIMUM DISTANCE OF 20 CM CAN BE MAINTAINED BETWEEN THE ANTENNA AND PERSONS. INSTALL THE EXTERNAL ANTENNA SO THAT A MINIMUM DISTANCE OF 20 CM CAN BE MAINTAINED BETWEEN THE ANTENNA AND PERSONS, WITH ANTENNA GAIN NOT EXCEEDING 3 DBI.

1. *Place mounted terminal in a proper location:*
2. *The mounting location must be chosen far enough from electronic devices so that no interference takes place. Please, contact your vehicle supplier for more information.*
3. *Make sure the screws are suitable for mounting plate.*
4. *Drill appropriate screws (M6) the two indentations on the cradle.*
5. *Secure the cradle and terminal and firmly fixed on the selected mounting place.*

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

7 HOUSING

The housing material: Galvano-ABS, gloss-chromium-plated.

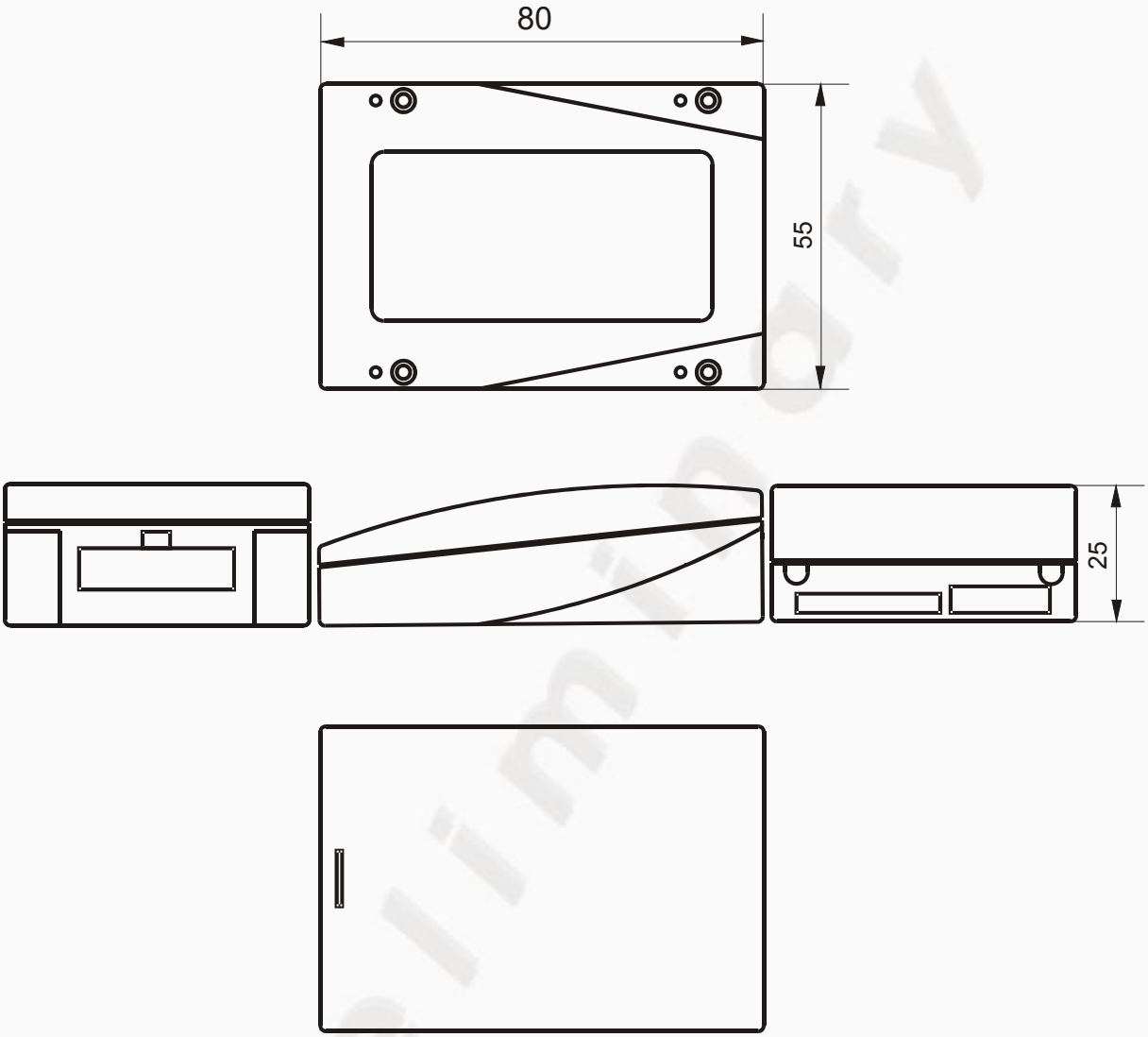

Figure 17: Housing of the STEPPIII.

8 STEPPII-MOUNTING CRADLE

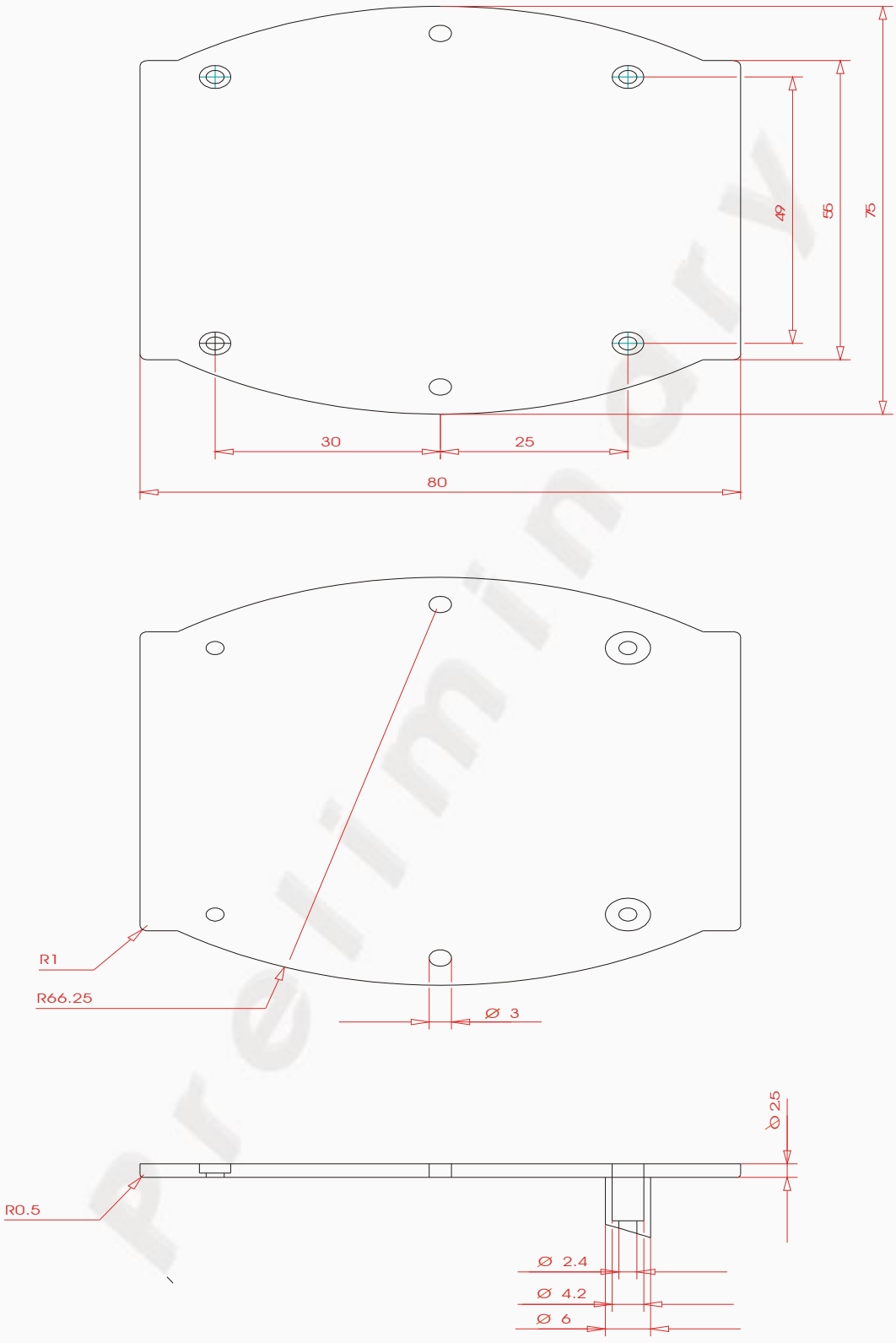

Figure 18: Mounting cradle of the STEPPII

9 RF EXPOSURES

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

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

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

Statement according to FCC part 15.19:

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

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

Statement according to FCC part 15.21:

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

Statement according to FCC part 15.105:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

10 APPENDIX

10.1 Schematics

The figures below illustrate the recommended schematics for the connection of the Molex and AMP connectors. For detailed information, please, refer to the related documents [1.4].

10.1.1 Installation guidance for 16-pin Molex connector

On the top of the schematic the corresponding pin out of the 16-pin Molex connector can be found.

A general purpose terminal providing multiple digital and analogue inputs as well as outputs for a variety of uses.

The STEPPIII comprises 5 inputs, 4 outputs and 4 analog or digital inputs *(software configuration dependent)*.

Of the 5 inputs, 2 inputs are free available for the user application. Three of the inputs are predefined by the factory as follow:

- ***1 x Power supply*** : *Connect to the vehicle battery (clamp 30).*
- ***2 x Ignition lines :*** *Connect to the vehicle starter lock (clamp 15) and use it for triggering alarms whenever the vehicle ignition key is closed (engine started).*

4 digital inputs can be used to trigger any alarm type (SMS or data), *i.e.* they can be connected to the car alarms or to a door switch, etc.

4 digital outputs allow remote control of external actuators. A schematic below in this section shows how digital inputs/outputs can be used.

Note that*, the outputs of the STEPPIII and VC+ must connected on the same voltage level as the supply voltage VC+ operates.*

STEPPIII device *is* ***not protected*** *against* ***over-voltage*** *and* ***over-current****. The operating voltage range must never be exceeded. The positive wire of the STEPPIII (input power supply) must always be protected manually with a 2A fuse at +10.8 … +32 VDC. See circuit diagram below*

Please note that*, all ground pins of the STEPPIII unit should be isolated from the vehicle body to avoid ground loops.*

CAUTION IF YOU USE A GROUND-MOUNTED ANTENNA, TO AVOID ANY FAULT CURRENT ENSURE THAT ANTENNA GROUND DOES NOT COME INTO CONTACT WITH VEHICLE BODY. PLEASE, DOUBLE-CHECK ALL GROUNDS AND OTHER USED LINES WHETHER THEY ARE ISOLATED FROM VEHICLE GROUND.

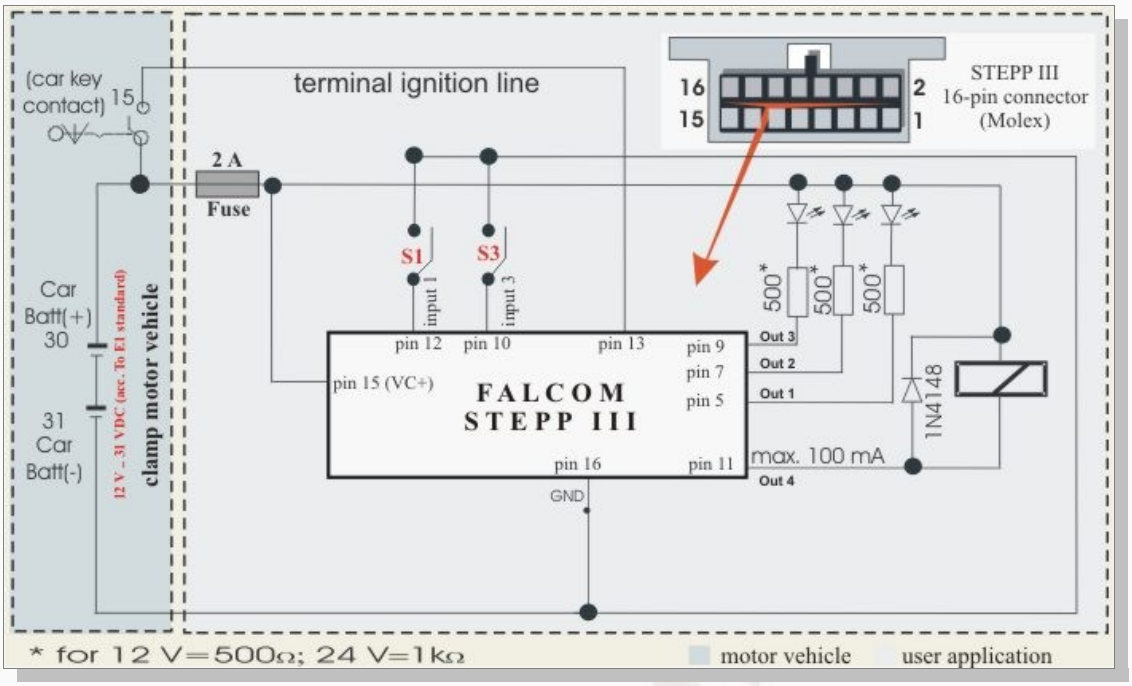

Figure 19: Schematic example of installation guidance