



- **Connecting a RFID reader**
- **to a STEPP III, BOLERO-LT**
- **or FOX/-LT device**
-
- **Application Notes**



VERSION HISTORY:

This table provides a summary of the document revisions.

Version	Author	Changes	Modified
1.0.2	F. Beqiri	<ul style="list-style-type: none"> - Added chapter 1.3, "RFID Reader - Technical data" - The new RFID reader supports ISO14443 type A/B. - Added chapter 1.5.1.1.5, "How to use the RFID reader with only one transponder ID (Tag)". - Added configuration \$PFAL,Cnf.Set,DEVICE.COMM.BINEVENT="0x44,0x30",0D,e[i] in chapter 1.5.1.1.6 - Sets filters for incoming data on the Serial Port 0. 	19/02/2010
1.0.1	F. Beqiri	<ul style="list-style-type: none"> - Replaced Figure 2 and added a note. - Changed settings for Serial0 port from \$PFAL,MSG.Mode.SERIAL0=0,C to \$PFAL,MSG.Mode.SERIAL0=40,C - allowing execution of PFAL commands "\$PFAL,MSG.Send.(Raw)Serial0,<protocols>,<"text">" and a Note added as well. - Corrected dynamic entry from &(Sys.eSerialData0) to &(SerialData0). 	24/04/2009
1.0.0	F. Beqiri	- Initial version	15/04/2009

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1 INTRODUCTION

This document describes the basic interaction between the RFID transponder and reader, in particular how to read the RFID transponder identifier using a STEPPIII, BOLERO-LT or FOX/-LT device with external RFID reader and evaluate this identifier in an appropriate way.

1.1 What is RFID and how it works ?

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify items, such as goods, package delivery, people or other objects. In principle an RFID system consists of at least three components, two transponder and one reader. The transponder is the backbone of the RFID system since they contain the data that identify the items. The reader produces a weak high frequency over an antenna electromagnetic field. If a transponder passes within this magnetic field, the transponder gets once operating energy from the reader and sends out contactless its identifier (*in the form of a unique serial number*) to identify itself. The reader receives this identifier (*from here on this identifier will be referred to "ID"*) and then sends it as is through its serial line to the connected device. If the transponder leaves the HF-field of reader, its chip becomes again inactive.

Basically there are two variants of transponder technology:

Passive transponders: Such transponders do not have any internal power source and their energy source is radiated by the reader which powers up the transponder within the reading zone. The maximum reading zone on such systems is usually not to long (only some centimeter).

Active transponders: Such transponders have their own battery and thus have a longer reading zone than passive transponders.

There are systems with 125kHz, 134kHz, 13.56MHz, 868MHz, 915MHz, 2.45GHz which have naturally different read characteristics and ranges.

1.2 Related documents

In addition to this document, the following listed documents should be also available to help you to get started and to configure your AVL device.

NR	PDF file name	Description
[1]	STEPPIII_EVALKIT_getting_started.pdf	Contains an introduction how to get started with STEPPIII EVALKIT, how do the software and hardware operate, factory preloaded configuration settings etc.
[2]	FOX_EVALKIT_getting_started.pdf	Contains an introduction how to get started with FOX EVALKIT, how do the software and hardware operate, factory preloaded configuration settings etc.
[3]	BOLERO_LT_EVALKIT_getting_started.pdf	Contains an introduction how to get started with BOLERO-LT EVALKIT, how do the software and hardware operate, factory preloaded configuration settings etc.
[4]	steppIII_fox_bolero_lt_PFAL_Configuration_Command_Set_2.6.2.pdf	Contains the reference PFAL commands guide.
[5]	AppNotes_in_vehicle_mounting.pdf	This document provides all the necessary information to allow your FALCOM product to be properly and safely installed in a vehicle.

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>

1.3 RFID Reader - Technical data

- Supports ISO/IEC 14443 A / MIFARE® mode
- Supports all layers of the ISO/IEC 14443 B communication scheme
- Uses ISO/IEC 14443-4 and/or ISO/IEC 14443 B transport protocols, anticollision implemented
- Operating distance for communication to a ISO/IEC 14443A / MIFARE® up to 50 mm
- Supports MIFARE® Classic authentication and encryption
- Operating frequency: 13.56 MHz
- Operating voltage: STEPPIII = 5 VDC ; FOX/-LT and BOLERO-LT = 12 VDC;
- Magnetic field strength (H) 7.5 A/m (Ampere per meter) maximum, as defined in ISO/IEC 14443-2
- Cable length 5 meter
- Reader dimensions 70 mm (diameter) x 13 mm (high)
- Connector type : 4-pin double row MOLEX connector
- Communication settings: **38400** bps baud rate, **8** data bits, **no** parity, **1** stop bit
- Provides audio feedback when passing the transponder within HF-field of the reader.

1.4 What is needed to get started with RFID ?

The following components should be available to operate with FALCOM RFID reader:

1. One STEPPIII, BOLERO-LT, FOX or FOX-LT with the corresponding Evalboard that is needed for device configuration (incl. cables and power supply),
2. One 5V external RFID reader with 5 m cable + RFID-to-STEPPIII adapter cable or one 12VDC external RFID reader with 5 m cable + installation cable for FOX/-LT, BOLERO-LT,
3. One or more RFID transponders (Tags),
4. Workbench software to load the configuration.

1.5 Hardware setup

This chapter explains how to connect and get started with RFID reader.

Installing the RFID reader in three-step process:

1. Set up the device connection and load the configuration in the device.
2. Connect the external RFID to the device.
3. Power the device up and test the loaded configuration.

1.5.1 Loading the configuration in your device

Before starting the evaluating of the RFID reader, you need to load a simple configuration in your device. The configuration should take place locally via serial line. Therefore, first you have to connect your AVL device to its evalboard and then connect the assembled kit to your PC via a RS232 cable (for more details, refer to the manual "[xxx_EVALKIT_getting_started.pdf](#)" where xxx - is the device name that is being used). Thereafter, start the Workbench software (if already installed, otherwise install it first) and then perform the configuration given in chapter 1.5.1.1, [Firmware configuration](#).

1.5.1.1 Firmware configuration

Before you start with the configuration here are some information and application possibilities with an AVL device and RFID reader.

As mentioned above, when a RFID transponder is passed within the magnetic field of the RFID reader, the transponder sends out in the form of a unique serial number contactless its ID. The reader receives this ID and then passes it through its serial line. The internal firmware running on the STEPPIII, BOLERO-LT, FOX or FOX-LT device provides an event (*Sys.eSerialData0="identifier"*) that is automatically generated each time a text message terminated by the line feed <LF> character comes in the device's serial port. Each transponder has a unique 64-bit ID (e.g. *0A0B0C0D01020402*) programmed in the transponder during the manufacturing process and can never be changed afterwards. The event (*Sys.eSerialData0*) generated in the device can then be used as a condition to release different alarms in the device such as:

1. *Passing the transponders ID on the second serial interface*
2. *Saving the transponders ID into the history*
3. *Sending the transponders ID to a remote server*
4. *Using the transponders ID to control other devices*

In order to read and store or sent out the transponder ID, you have to make a simple configuration in the used FALCOM device. The serial data event can be used to respond either to only the transponder with a matching ID (e.g. *Sys.eSerialData0="0A0B0C0D01020402"*) or to all transponders ID (e.g. *Sys.eSerialData0*) coming in the device's serial port.

1.5.1.1.1 Reading and sending transponders ID through the second serial interface (STEPPIII only)

The example below demonstrates how to forward each transponder ID from the first serial port (SER0) to the second serial port (SER1) of the STEPPIII device. When you pass a transponder within the magnetic field of the reader and the reader is serially connected to the device then the read ID is passed automatically through the serial interface (SER0). To forward this ID to the second serial interface (SER1), use the following configuration:

```
$PFAL,CNF.Set,AL1=SYS.Device.eStart:MSG.Send.RawSerial0,0,"start"&MSG.Send.RawSerial1,0,"start"
$PFAL,CNF.Set,AL7=Sys.eSerialData0:MSG.Send.Serial1,8,"ID: &(SerialData0)"
```

or (specific IDs)

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0="0A0B0C0D01020402":MSG.Send.Serial1,8,"ID:
&(SerialData0)"
```

1.5.1.1.2 Saving transponders ID into the history

Besides sending the read ID from a transponder from first serial port to the second one, it is also possible to store such IDs (or specific one) inside the device and read it out later. If the transponders ID should only be stored in history, then the configuration can be defined as follow:

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0:GPS.History.Write,8,"ID: &(SerialData0)"
```

or (specific IDs)

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0="0A0B0C0D01020402":GPS.History.Write,8,"ID: &(SerialData0)"
```

1.5.1.1.3 Sending transponder numbers to a remote server

The example below demonstrates how to send the transponders ID to a TCP server. To send the ID read from a transponder together with the actual date, time and position to an internet server, then the configuration can be defined as follow:

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0:TCP.Client.Send,8,"ID: &(SerialData0)"
```

or (specific IDs)

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0="0A0B0C0D01020402":TCP.Client.Send,8,"ID: &(SerialData0)"
```

To test this configuration, first you have to connect the device to a remote TCP server then send the configuration above to the device. While the first AL7 responds to all IDs/messages coming in the serial port (SER0), the second AL7 responds only to the ID "0A0B0C0D01020402".

1.5.1.1.4 Evaluating the transponder numbers to open/close something

The following configuration demonstrates how to control an LED indicator (e.g. Output 1) using transponders ID. This configuration requires, two transponders, one reader that is connected to a FALCOM device. You can also use specific transponders ID in combination with an output port, for example to lock/unlock specific components in your vehicle. How to test this example, refer to the chapter "[Testing the loaded configuration](#)".

```
$PFAL,CNF.Set,AL7=Sys.eSerialData0="D00218A765FBD301":IO4.Set=high
```

```
$PFAL,CNF.Set,AL8=Sys.eSerialData0="D00218A765FBD302":IO4.Set=low
```

1.5.1.1.5 How to use the RFID reader with only one transponder ID (Tag)

New added: If you want to use the RFID reader with only one transponder ID then you have to clear the transponder ID stored in the RFID reader each time you pass the Tag over the RFID reader. It can be done by sending the bin code `&(bin=0x01,0x21)` from the AVL device to the RFID reader after a user-defined timeout as shown in the following alarm. The timeout prevents double reading of the RFID Tag when it is passed over the Reader. If you are going to use the configuration below, the same RFID tag can be read every 3 seconds:

```
$PFAL,Cnf.Set,AL9=Sys.eSerialData0="0A0B0C0D01020402":MSG.Send.Serial1,8,"ID: &(SerialData0)"&SYS.Timer0.start=single,3000
```

After the Timer0 runs out (3 seconds has passed), the device deletes the stored RFID tag.

```
$PFAL,Cnf.Set,AL10=Sys.Timer.e0:MSG.Send.Serial0,0,"&(bin=0x01,0x21)"
```

1.5.1.1.6 Adjusting device serial port (SER0) settings

Default operation of the RS232 port (SER0) on the STEPPIII, BOLERO-LT and FOX/-LT is the command mode and using a baud rate of 57000bps. The RFID reader communicates with other devices using fixed settings: **38400** bps baud rate, **8** data bits, **no** parity, **1** stop bit. Therefore, the serial interface (SER0) on the FALCOM device where the reader is connected should manually be changed from default (**57000bp**) to **38400**bps. To change it, use the following command:

```
$PFAL,Cnf.Set,DEVICE.SERIAL0.BAUDRATE=38400
```

New added: if you want to receive only transponders ID starting with specific characters and exclude specific characters from them, then use the following configuration. *Do not forget to set the Serial0 into the Binary Event Mode if you are going to use the BINEVENT.*

```
$PFAL,Cnf.Set,DEVICE.COMM.BINEVENT="0x44,0x30",0D,e
```

```
$PFAL,MSG.Mode.SERIAL0=40,B //sets Serial0 into Binary Event Mode
```

// This configuration generates the event **Sys.eSerialData0** only when the serial interface (Serial0) is set into the Binary Event Mode and the transponder ID received on the Serial0 starts with **D0**. The AVL device excludes/removes the **<CR>** from the received ID.

New added: if you want to receive only transponders ID starting with specific characters and include specific characters to them then use the following configuration. *Do not forget to set the Serial0 into the Binary Event Mode if you are going to use the BINEVENT.*

```
$PFAL,Cnf.Set,DEVICE.COMM.BINEVENT="0x44,0x30",0A,i
```

```
$PFAL,MSG.Mode.SERIAL0=40,B //sets Serial0 into Binary Event Mode
```

// This configuration generates the event **Sys.eSerialData0** only when the serial interface (Serial0) is set into the Binary Event Mode and the transponder ID received on the Serial0 starts with **"D0"**. The AVL device includes/appendes the **<LF>** at the end of the received ID.

In the command mode, the protocols and debug information are periodically send to the serial port and the device listens to PFAL commands the user can send. Because the RFID reader will be connected serially to these devices, all outputs messages on this interface should be switched off, otherwise the incoming messages from the reader may be misinterpreted on this serial port. Therefore, change it using the following command. *Do not use this configuration if the device is you are using the BINEVENT and the device is set into the Binary Event Mode.*

```
$PFAL,MSG.Mode.SERIAL0=40,C
```

Parameters for command mode=**40,C**

- 40:** Except the commands "\$PFAL,MSG.Send.(Raw)Serial0,<protocols>,<"text">", all other outgoing messages from the SER0 to RFID reader are switched off.
- C:** Sets the **Serial0** into the command mode. This mode allows also event generation for incoming text messages.

This command should be sent to the device after one of the configuration examples given in chapters above is already loaded into the device and the SER0 baud rate is already changed to **38400** bps.

Note: After sending this command to the device, the **SERIAL0** is no more accessible externally until the command "**PFAL,MSG.Mode.SERIAL0=7F,C**" is sent via SMS, TCP or SERIAL1 (for STEPPIII only) to the device.

1.5.2 Connecting the external RFID reader

When the device is configured to be used with an external RFID reader, then disconnect it from the evalboard and host PC and connect the RFID reader to the STEPPIII device with the help of the RFID-to-STEPPIII adapter cable.



Figure 1: Connecting a RFID reader to a STEPPIII device.

The shipped RFID package includes one reader (with an adapter cable or installation cable) and one or more transponders. The RFID reader operates at 13.56MHz and the RFID transponders are passive ones. If you would like to use other RFID transponders with our reader, then select only transponders that use chips like **SRIX512** or compatible, other chip types have different read characteristics (protocols) and frequency and can not communicate with our RFID readers. The following are listed the key features for selecting a compatible transponder:

- ✓ **ISO 14443 B communication scheme**
- ✓ **ISO 14443 - 4 and 14443 B transport protocols**
- ✓ **ISO 14443 A MIFARE® mode**
- ✓ **13.56MHz Carrier Frequency**
- ✓ **847kHz Sub-carrier Frequency**
- ✓ **106 kbit/s Data Transfer**
- ✓ **8 bit Chip_ID based anti-collision system**
- ✓ **64-bit Unique Identifier**

The RFID reader is designed for short range applications. It allows to identify the transponders in its operating range. When there are several transponders present in the reader field, only one transponder can be in read at a time. Reading of the same transponder ID two times in consequence is blocked (*to prevent double-read out*), therefore, to read the same transponder ID again you must pass another transponder over the reader first.

The reader is shipped with a 5 meter external cable which interfaces with the FALCOM devices through the serial interface. At the end of this cable there is a 4pin connector which can be connected to either the RFID-To-STEPPIII adapter cable and then to a STEPPIII or use the corresponding installation cable in order to connect it to a FOX/-LT, BOLERO-LT (see Fig.2 below).

Our RFID Readers are designed to operate from a single +5 VDC or +12 VDC. The RFID reader for STEPPIII device is a 5 VDC product and it can be connected to a STEPPIII device via the RFID-To-STEPPIII adapter cable. The RFID reader for FOX/-LT and BOLERO-LT is a 12 VDC product and it can be connected to a FOX/-LT or BOLERO-LT device via the corresponding installation cable. As reference use Fig.2 below.

The type of connector at the end of the external cable of the RFID reader is a 4pin double-row connector and it is the same for both 5V and 12 VDC products.



Figure 2: RFID reader for FOX device

Important note ! When connecting the RFID reader to the installation or RFID-To-STEPPIII adapter cable, both levers on the RFID cable and pitches on the installation or RFID-To-STEPPIII adapter cable should face the same direction before plugging in.

The RFID to STEPPIII adapter cable or the installation cable allows the reader to be powered and to send the number read from the transponder through its serial port to the FALCOM AVL devices. The RFID reader communicates with fixed settings: **38400** bps baud rate, **8** data bits, **no** parity, **1** stop bit. Therefore, the serial interface (SER0) on the FALCOM AVL device where the reader is connected should manually be changed from default (**57000**bp) to **38400**bps (see chapter [1.5.1.1.6](#)).

1.5.3 Testing the loaded configuration

This chapter describes how to test the configuration given in chapter [1.5.1.1.4](#). To see how the configuration (**AL7** and **AL8**, given in that chapter) works, either connect the 16-pin MOLEX connector to the STEPPIII evalboard or connect an output (e.g. OUT1, pin 7) of the STEPPIII to an LED indicator (how to connect an LED to an output port, refer the hardware manual of the used device). Finally, power up the device.

The configuration (**AL7** and **AL8**) indicates: when a transponder is passed over the reader, then the read ID is checked by device and verified whether this ID is authorized to turn on or off that LED. The LED indicator is turned on if the transponder with ID="D00218A765FBD301" is passed over the reader and turned off if the transponder with ID="D00218A765FBD302" is passed over the reader.

Please note that, to find the transponder ID you have to configure an alarm that sends out this ID via TCP, SMS or saves it inside the device.

*To access the device on the **SERIAL0** externally, the command "**PFAL,MSG.Mode.SERIAL0=7F,C**" should be sent via SMS, TCP or SERIAL1 (for STEPPIII only) to the device.*