FALCOM
WIRELESS COMMUNICATIONS GMBH

How to get started
With
Keyfob & I/O-BOX
#
Application Note

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Version history:

This table provides a summary of the document revisions.

Number	Author	Changes	Modified
1.0.0	F. Beqiri	- Initial version	20/01/2009

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Note

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1 ABOUT THIS DOCUMENT

The purpose of these application note is to illustrate how to get started with Keyfob and I/O-BOX and how to connect them to a FALCOM products which supports ***IEEE 802.15.4*** applications. In this document the **MAMBO2-IE** device is used as an example. The same steps given for MAMBO2 can also be used for the *BOLERO-LT-IE* device.

Upon request the following FLACOM products can be supplied with ***IEEE 802.15.4****:*

BOLERO-LT and MAMBO2

1.1 Audience

This application note is intended for system integrators and application developers.

1.2 About I/O-BOX

I/O-BOX, offered in *85x62x24mm form factor*, is a battery-powered device that supports the *IEEE 802.15.4* standard for wireless communication. It can easily be added to the MAMBO2-IE/BOLERO-LT-IE architecture to expand their field of operation. The I/O-BOX has two connectors: *a 16pin MOLEX connector that offers 5 digital inputs, 2 analog inputs and 4 digital outputs* and *an 8pin connector at the end of the cable that provides 2 digital inputs, 2 analog inputs and 2 digital outputs*. Depending on your application requirements, the I/O-BOX can be shipped either with a 16pin MOLEX connector or an 8pin connector. All inputs and outputs on the I/O-BOX are free-programmable. It is an excellent device designed for industrial markets such as telemetry, security in vehicles etc.. When the I/O-BOX detects changes on an input *(from low to high or vice-versa*), it sends the input state or occurred event to the target device (connected one). This event/state can then be used as a condition to trigger different alarms (send SMS, set an output to high etc.).

For more technical details refer to the corresponding flyer available on the FALCOM's webpage ***www.falcom.de***.

Figure 1: Keyfob remote control

1.3 About Keyfob

Keyfob, offered in *66x46x20mm* form factor, is a battery-powered remote control that supports the *IEEE 802.15.4* standard for wireless communication. It can easily be added to the MAMBO2-IE/BOLERO-LT-IE architecture to expand its field of operation. It offers 3 x buttons and 3 x LED indicators all free programmable on the MAMBO2-IE/BOLERO-LT-IE software. Each button supports three different events *(short, long and double)* when pressed. When a button on the Keyfob is pressed, it transmits an event to the connected device *(MAMBO2-IE or BOLERO-LT-IE). This event* can then be used as an alarm condition to trigger different alarms *(e.g make/hang up a voice call, send an SMS/TCP packet, make an SOS call, start a timer etc.)*. The LEDs on the Keyfob can be used as indicators to show that something has happened on the MAMBO2 software or to confirm button presses. The Keyfob supports also vibration alerts and beep tones used to give information or warnings.

For more technical details refer to the corresponding flyer available on the FALCOM's webpage ***www.falcom.de***.

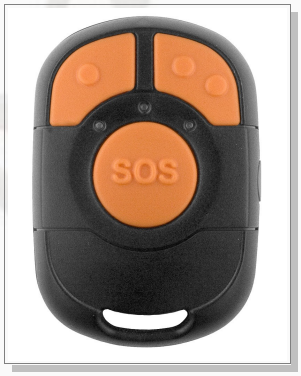

Figure 2: I/O-BOX

2 HOW TO CONNECT A KEYFOB OR AN I/O-BOX DEVICE TO A MAMBO2

2.1 Setting up an IEEE connection

Set up connection in eight-step process:

1. *Turn on the MAMBO2 device (press the right key to turn on),*
2. *When the first screen on the MAMBO2 is displayed, either connect it to a free USB port of your PC or create a Bluetooth connection,*
3. *Install and start the **FALCOM Workbench** software - see **Fig. 3** below,*

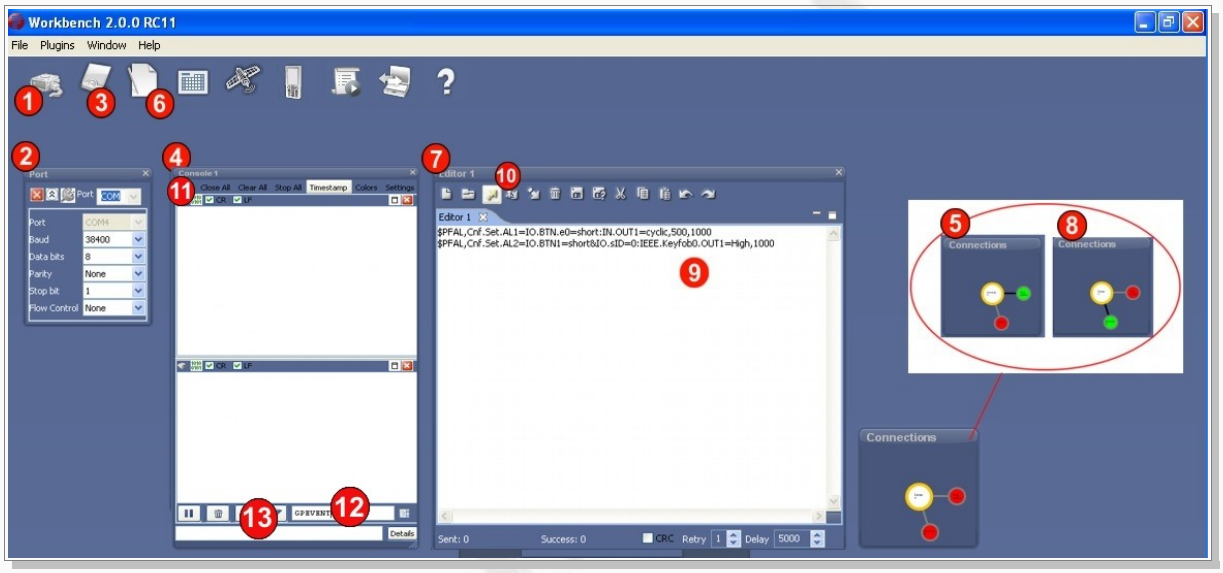

Figure 3: FALCOM Workbench software.

4. *Open a new **COM Port** from the **Toolbar**❶, on the **COM Port view**❷ choose the Port where MAMBO2 is connected and define the port settings (**57600** bps, **8** Data bits, **No** Parity bit, **1** Stop bit, **None** Flow control). Finally, click on the **Connect** icon on the left of the text "**Port**",*
5. *Open a new **Console** from the **Toolbar**❸, click on the **Console1**❹, then go to **Connection view** and click on **COMPort**❺,*
6. *Open a new **Editor** from the **Toolbar**❻, click on the **Editor1**❼, then go to **Connection view** and click on **Console1**❽,*
7. *To send commands to the MAMBO2 device, type them on the **Editor**❾ and then click on **Start sending configuration**❿ or double click with left mouse each configuration line on the **Editor**❾ individually,*
8. *To see all events generated by the MAMBO2 device, either open a new console "**Console2**" or on the **Console1**❹, click "**Add**"**11**, activate "**Show filter**" on the added console menu, enter the filter text "**EVENT**"* on **12**, and finally click the button **"Filter incoming"13.***

* *Enter the text without quotation marks (" "). More then one filter text separated by **vertical bar** ("pipe symbol") can be entered e.g. **GPEVENT|GPERROR**. That means filter all incoming messages containing the entered string.*

2.1.1 Connecting a Keyfob to the MAMBO2

To connect a Keyfob or an I/O-BOX to a MAMBO2, you need only to load the following configuration into the MAMBO2 device:

1. *Specify the IEEE network identifier and send the following command to the MAMBO2,*

Set configuration	$PFAL,Cnf.Set,IEEE.PANID=CAF0,3

2. *The following command specifies the MAC address of the Keyfob to be connected. The 16-digits MAC address is available on the sticker inside the Keyfob battery tray (see Fig. 4). This address is unique to each Keyfob. How to open/close the battery cover, refer to the chapter 3.1,*

Set configuration	$PFAL,Cnf.Set,IEEE.KEYFOB0=0,0017920010010F64

Figure 4: The location of MAC address on Keyfob.

3. *Copy the configuration above, past them on the **Editor**❾ and then click on **Start sending configuration**❿ or double click each command/configuration on the **Editor**❾ to sent them separately,*
4. *Power up the Keyfob device as described in chapter 3.1,*
5. *When Keyfob is powered on, an event "`IEEE.Device.eRequest="xxxxxxxxxxxxxx"`" is shown on the **Console1**❽ where **x** is the MAC address of Keyfob. Please note, that there are only the last 14-digits shown to this event and not all 16-digits. First two digits are always "00",*
6. *When the Keyfob is successfully connected to the MAMBO2 device, the event "**$GPEVENT:IEEE.Keyfob0.State.eConnected**" will be displayed on the **Console1**❹,*
7. *Refer to the chapter 2.1.3 below to run the test.*

2.1.2 Connecting an I/O-BOX to MAMBO2

Connecting an I/O-BOX device to a MAMBO2 in six-step process *(as reference use **Fig. 1**)*:

1. *Start Workbench software if not started yet (follow steps **1.. 7** given in chapter 2.1 above),*
2. *Specify the IEEE network identifier (if still not specified) and send the following command to the MAMBO2,*

Set configuration	$PFAL,Cnf.Set,IEEE.PANID=CAF0,3

3. *The following command defines the MAC address of the I/O-BOX to be connected. The16-digits MAC address is available on the sticker on the back of the I/O-BOX (see Fig.5). This address is unique to each I/O-BOX,*

Set configuration	$PFAL,CNF.Set,IEEE.IOBOX0=0,2,0,2,F,0017920030000DA8

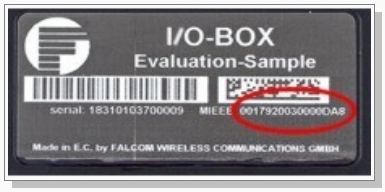

Figure 5: The location of MAC address on Keyfob.

4. *Copy the configuration above, past them on the **Editor**❾ and then click on **Start sending configuration**⓾ or double click each command/configuration on the **Editor**❾ to sent them separately,*
5. *Connect the I/O-BOX to the Evalboard as described in chapter 3.2,*
6. *When I/O-BOX is powered on, an event "`IEEE.Device.eRequest="xxxxxxxxxxxxxx"`" is shown on the **Console1**❸ where **x** is the MAC address of I/O-BOX. Please note, that there are only the last 14-digits shown to this event and not all 16-digits. First two digits are always **"00"**,*
7. *When the I/O-BOX is successfully connected to the MAMBO2-device, the event "**$GPEVENT:IEEE.IOBox0.State.eConnected**" will be displayed on the **Console1**❹.*

2.1.3 Run the test

Below are listed the steps you must take to test a simple configuration on the MAMBO2 device related to the Keyfob or I/O-BOX operation.

1. *To run the test, you have to configure some alarms that respond when a button on the Keyfob is pressed or an input on the I/O-BOX changes its state. These alarms are given in table below,*

Keyfob
$PFAL,Cnf.Set,AL1=IO.BTN.e4=short&IO.BTN.sID=0:IEEE.Keyfob0.Beep1=hpulse,1
$PFAL,Cnf.Set,AL2=IO.BTN.e3=short&IO.BTN.sID=0:IEEE.Keyfob0.LED1=high
$PFAL,Cnf.Set,AL3=IO.BTN.e3=long&IO.BTN.sID=0:IEEE.Keyfob0.LED1=low
I/O-BOX
I/O-BOX with 16pin Molex connector
$PFAL,Cnf.Set,AL4=IEEE.IOBox0.IN.e0=redge:IEEE.IOBOX0.OUT0=hpulse,1000
$PFAL,Cnf.Set,AL5=IEEE.IOBox0.IN.e1=redge:IEEE.IOBOX0.OUT2=high
$PFAL,Cnf.Set,AL6=IEEE.IOBox0.IN.e1=fedge:IEEE.IOBOX0.OUT2=low
I/O-BOX with 8pin connector
$PFAL,Cnf.Set,AL4=IEEE.IOBox0.IN.e0=redge:IEEE.IOBOX0.OUT0=hpulse,1000
$PFAL,Cnf.Set,AL5=IEEE.IOBox0.IN.e4=redge:IEEE.IOBOX0.OUT1=high
$PFAL,Cnf.Set,AL6=IEEE.IOBox0.IN.e4=fedge:IEEE.IOBOX0.OUT1=low

Table 1: Alarms to be stored for testing Keyfob & I/O-BOX .

2. *Copy all 3 alarms (AL1 to AL3 for Keyfob or AL4 to AL6 for I/O-Box) from the table above, past them on the **Editor**❾ and then send them to MAMBO2 either by clicking on **"Start sending configuration"**❿ or double click each PFAL command separately,*
3. *To test the loaded alarms, just perform a single short-press **BTN4** on the Keyfob, after releasing this button, a beep tone will be heard on the Keyfob. Figure below shows the designation of buttons and LEDs on the MAMBO2 and Keyfob,*

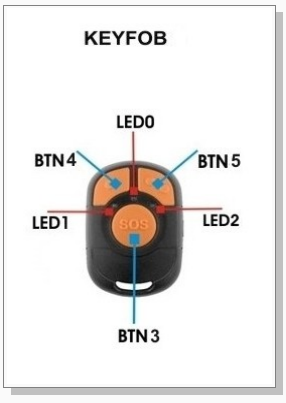

Figure 6: Allocated keys and LEDs on Keyfob.

4. *To test Alarm 2 and 3, perform a single short-press on **BTN3** on the Keyfob, after releasing this button, the **LED 1** on the Keyfob will light constantly,*

5. *A further long-press on **BTN3** (press and hold this button for 2 sec.) will turn off this LED,*
6. *To delete all alarms (AL1, AL2 and AL3), just send the alarms below without settings to the MAMBO2 device as follow:*

$PFAL,Cnf.Set,AL1
$PFAL,Cnf.Set,AL2
$PFAL,Cnf.Set,AL3

Table 2: Delete configured alarms.

7. *To test Alarms 4 to 6, perform a rising edge (Low to High signal) on **IN0** and **IN4** on the I/O-BOX Eval-Board, the **OUT1** on the I/O-BOX Eval-Board will light for 1 second and **OUT2** will light constantly. Performing a falling edge (High to Low signal) on **IN4** on the I/O-BOX Eval-Board, the **OUT1** on the I/O-BOX Eval-Board will go off.*
8. *To delete all alarms (AL4, AL5 and AL6), just send the alarms below without settings to the MAMBO2 device as follow:*

$PFAL,Cnf.Set,AL4
$PFAL,Cnf.Set,AL5
$PFAL,Cnf.Set,AL6

Table 2.1: Delete configured alarms.

3 APPENDIX

3.1 Preparing and using the Keyfob

To prepare your Keyfob for the use with MAMBO2, complete the following steps:

1. *Unpack the Keyfob from the box. With its back facing upwards, remove the cover by pressing and sliding it in the direction shown on the cover. When it stops lift the cover off (see Fig. 7),*
2. *Unpack both AAA batteries from the box, remove the plastic cover and insert them into the battery tray. Be sure to align the plus and minus ends of the batteries properly as marked on the tray, then replace the cover.* ***Your Keyfob turns ON and connects automatically to the MAMBO2 when inserting batteries,***

Figure 7: Inserting included batteries in Keyfob.

9. *The following table lists and describes the operation of the Keyfob indicated by the middle LED (LED0),*

LED				
	LED	**Color**	**Operation**	**Meaning**
	LED0	Red	Flashes 3 x approx. 7 seconds	When no co-ordinator (MAMBO2) found „Keyfob goes to sleep"
		Red	First flashes as above then flashes green shortly	Keyfob and MAMBO2 are connected.
		Red	Flashes 1:1	Batteries are empty - replace them.
		Red	After each connection attempt, lights approx. 7 seconds *(the time to wait between re-connection attempts extends automatically).* Keyfob will turn off after approx. 13 min. attempt.	When radio link is out of range or co-ordinator is lost. Press one key on Keyfob to restart connection attempts.
		Green	Flashes shortly every 5 seconds	When Keyfob is back into the radio range
BTN				
	Pressing simultaneously all 3 buttons will reset all functions on Keyfob			

Table 3: Keyfob LED0 operation on start up.

10. *All events and commands supported by the MAMBO2 software for Keyfob are given and explained in the manual "**Mambo2PFALCommandsReferenceGuide.pdf**",*

3.2 Preparing and using the I/O-BOX

To prepare your I/O-BOX for the use with MAMBO2, complete the following steps:

1. *Unpack the shipped box. If there is no Evalboard in the box, jump to the step 6,*
2. *Take the 16-pin MOLEX cable and connect one end of the this cable to the I/O-BOX and other end to the EVALBOARD as shown in Fig. 8,*

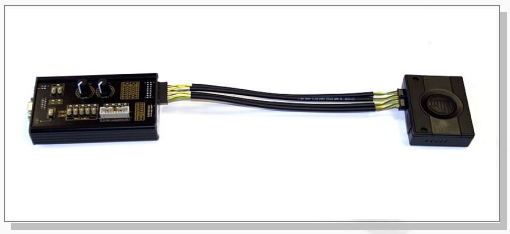

Figure 8: I/O-BOX connect to I/O-BOX-EVALBOARD via 16-pin MOLEX cable.

3. *If the option with an 8-pin extension cable is ordered, then the 8-pin connector to the 8-pin connector jack on the EVALBOARD (see Fig. 9),*

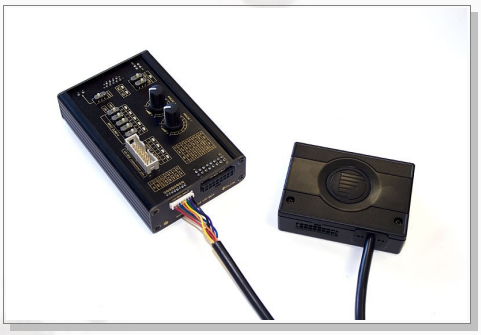

Figure 9: I/O-BOX connect to I/O-BOX-EVALBOARD via 8pin cable (hardware option).

4. *Take the AC adaptor **"PS-002-N/JP3"** from the box and plug its 4-pin connector into the input jack on the left-side of the I/O-BOX-EVALBOARD marked "**POWER 10.8V …32V**". Then plug the AC adapter into the wall socket of your 220V electric mains (see Fig. 10),*

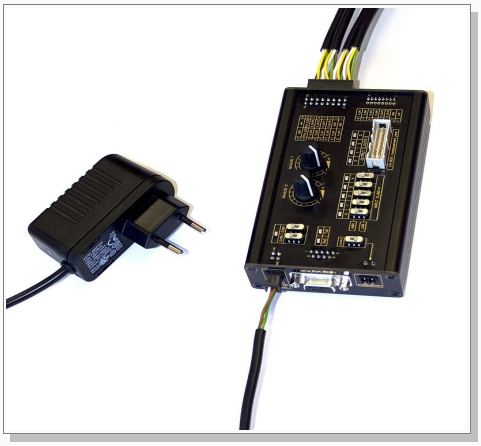

Figure 10: Connect AC adaptor to EVALBOARD.

5. *Turn on the switches marked "**E/ON**" and "**D/ON**" on the top-left of I/O-BOX-EVALBOARD (see Fig. 11),*

   "***E/ON***" *Supplies power to the I/O-BOX-EVALBOARD, when it is ON.*

   "***D/ON***" *Supplies power to the connected I/O-BOX device, when it is ON.*

Figure 11: Supply power to I/O-BOX.

6. *I/O-BOX device has a built-in power converter that allows it to be operated and the internal backup battery to be recharged directly from one external power source.* ***Your I/O-BOX automatically turns on when external power is applied and automatically registered (connected) to the MAMBO2 if the I/O-BOX MAC address is already added into the MAMBO2 configuration****,*

7. *There are 5 x LED indicators located on the right side of the I/O-BOX device. The table below shows the behaviour of these LEDs (left-to-right order),*

Figure 12: 5 x LED indicators.

LED	LIGHT COLOR	POSITION	DESCRIPTION	
1	**Blue**	Outermost left	RF-Activity (Connected-State).	
2	**Green**	Second left	MCU-Activity (Connected-State).	
3	**Red/Orange**	Third left	Scanning for Networks.	
4	**Green**	Forth left	Internal battery is full charged.	Both light when device temperature is out of range.
5	**Yellow**	Outermost right	Internal battery is charging.	

Table 4: LED indicators operation.

8. *All events and commands supported by the MAMBO2 software for I/O-BOX are given and explained in the manual "**Mambo2PFALCommandsReferenceGuide.pdf**".*

3.2.1 I/O-BOX-EVALBOARD – Hardware description

The following gives a brief description of the I/O-BOX EVALBOARD hardware overview. I/O-BOX EVALBOARD allows you to quickly and easily evaluate the I/O-BOX unit. The function of inputs and outputs can be controlled by switches supplied on the evalboard. The main components of the *EVALBOARD* can be identified from ***Fig. 11***, ***12*** and ***13***.

Fig.11 shows the front panel, ***Fig.12*** shows the back panel and ***Fig.13*** shows the top panel.

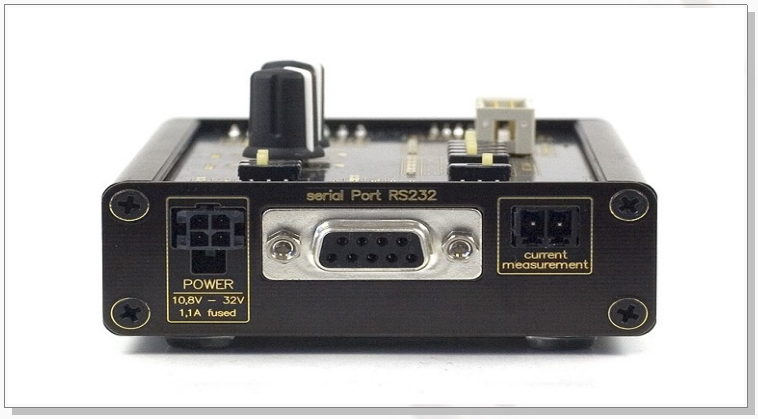

Figure 13: Front panel of the I/O-BOX-EVALBOARD.

A description of each of the items on the front panel is given in *Table 5*.

ITEM	DESCRIPTION
Power (10.8V – 32V) (outmost left)	Power input for operation of the *EVALBOARD* and *I/O-BOX* unit. Required input is 10.8 - 32 volts. Left pins are positive.
Serial Port RS232	Port that is used to transmit data to a COM port. Via a standard user serial cable you can connect the EVALBOARD to a RS232 serial port. Currently the serial port of the I/O-BOX device is not fully supported.
Current measurement (outmost right)	A current meter can be used to measure the amount of current the device draws.

Table 5: Item description on the front panel of the I/O-BOX-EVALBOARD.

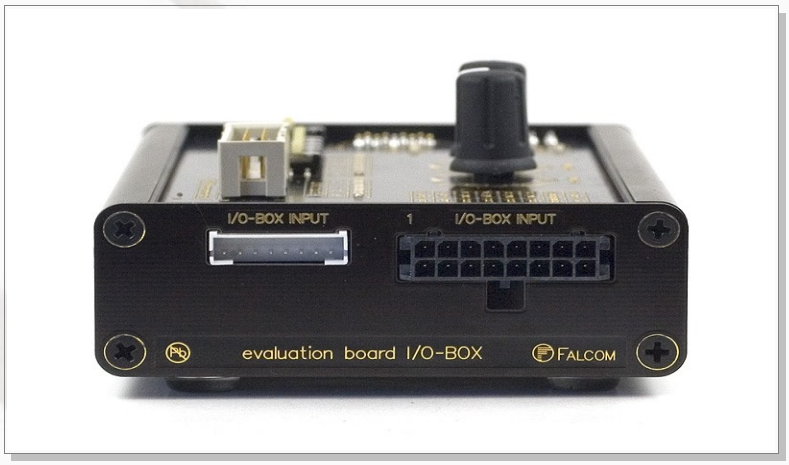

Figure 14: Back panel of the I/O-BOX-EVALBOARD.

A description of each of the items on the back panel is provided in *Table 6* below.

ITEM	DESCRIPTION
I/O BOX INPUT (Outermost left)	Used to connect the 8-pin cable of the *I/O-BOX* unit to the *EVALBOARD* and evaluate the provided pins.
I/O BOX INPUT	Via the included 16-pin *MOLEX* cable you can connect the *I/O-BOX* unit to the *EVALBOARD* and evaluate the provided pins.

Table 6: Item description on the top panel of the I/O-BOX-EVALBOARD.

Figure 15: Top panel of the I/O-BOX-EVALBOARD.

A description of each of the items on the top panel is provided in *Table 7* below.

ITEM	DESCRIPTION	
D/ON - switch	Two way switch - enables or disables power to the I/O-BOX.	When both switches are ON the LED lights, otherwise the LED is off.
E/ON -switch	Two way switch - enables or disables power to the EVALBOARD.	
RxD/TxD LEDs	Used to display the status of the serial interface. RxD LED lights when the I/O-BOX transmits data to the RS232 serial port of the host device. TxD LED lights when the I/O-BOX receives data from the RS232 serial port of the host device.	
Current-switch	Two way switch - enables or disables the measurement of current the device draws. ON (up-position) = enabled	
Analog 0/1	Adjustable regulators (0 and 1). **ANALOG 0** with a voltage range from 0V to +3 V while **Analog 1** from 0 to +12 V.	
INPUT D_IN0-4	Two way switches (from 0 to 4) - controls the inputs state (high/low) accordingly. ON (up-position) = high active (corresponding LED lights). *Note: Switch 4 controls the state of the D_IN4 line, which is available on the 8-pin connector only.*	
OUTPUT	LED indicators for provided output ports. A LED indicator (from 0 to 3) lights when the corresponding output is set to high level.	
I/O-BOX measurement pins	Used to measure the voltage provided on the pins of MOLEX connector.	

Table 7: Item description on the top panel of the I/O-BOX-EVALBOARD.

On the lower-right-corner of the *EVALBOARD (where the 8-pin female connector of the I/O-BOX connects to the 8-pin male connector of the I/O-BOX-EVALBORD)* there is the pinout of the 8-pin connector of the I/O-BOX extension cable *(see Fig. 12 and 13)*. While on the upper right corner is the pinout of the 16-pin connector. The numbering of pins in both connectors *(including 16-pin MOLEX connector)* is shown in *Fig.14*.

Figure 16: 16pin MOLEX connector and 8pin connector at the end of extension cable.

A description of each pin on the **16**-pin MOLEX connector *is given in table 8 below*:

PIN	NAME	DIRECTION	DESCRIPTION	LEVEL
1	VBO	O*	Output voltage (standard).	VOUT = 50 mA @ 3.3 V DC
2	A_IN0	I	Analog input, wired to the ANALOG 0 regulator.	VIN = 0 V .. 3 V
3	GND	-	Negative operating voltage (Ground)	0 V
4	A_IN1	I	Analog input, wired to the ANALOG 1 regulator.	VIN = 0 V .. 12 V
5	D_OUT0	O	Open collector digital output, wired to the Output LED1.	100 mA @ 10.8V .. 32VDC
6	D_IN0	I	Digital input, wired to the switch input 0.	Low=0V..1VDC; High= 3V.. 5VDC;
7	D_OUT1	O	Open collector digital output, wired to the Output LED1.	100 mA @ 10.8V.. 32VDC
8	D_IN1	I	Digital input, wired to the switch input 1.	Low=0V..1VDC; High= 3V.. 5VDC;
9	D_OUT2	O	Open collector digital output, wired to the Output LED1.	100 mA @ 10.8V .. 32V DC
10	D_IN2	I	Digital input, wired to the switch input 2.	Low=0V..1VDC; High= 3V.. 5VDC;
11	D_OUT3	O	Open collector digital output, wired to the Output LED1.	100 mA @ 10.8V .. 32V DC
12	D_IN3	I	Digital input, wired to the switch input 3.	Low=0V..1VDC; High= 3V.. 5VDC;
13	TxA_232**	I	Receive data (DCE-related). **Currently not supported.** RS-232 compatible receiver input.	V.24 Specification.
14	RxA_232	O	Transmit data (DCE-related). RS-232 compatible transmitter output.	V.24 Specification.
15	+IN	I	Positive operating voltage. This line must be protected by a fuse rated maximum 2A, 32 V.	10.8 V .. 32 VDC
16	GND	-	Negative operating voltage (Ground)	0 V

* *Optional pin. Upon request it can be provided to charge/discharge a rechargeable battery.*

** *It is reserved for future use.*

Table 8: Description of the 16pin MOLEX connector (standard order).

A description of each pin on the **8-pin** connector is given in *Table 9 below*:

PIN	COLOR	NAME	DIRECTION	DESCRIPTION	LEVEL
1	Black	+IN	I	Positive operating voltage (+). This line must be protected by a fuse rated maximum 2A, 32 V.	10.8V .. 32 VDC
2	Lilac	GND	-	Negative operating voltage (Ground).	0 V
3	Green	D_OUT0	O	Digital output, wired to the Output LED 0.	100 mA @ 10.8V .. 32VDC
4	Yellow	D_OUT1	O	Digital output, wired to the Output LED 1.	100 mA @ 10.8V .. 32VDC
5	Orange	D_IN0	I	Digital input, wired to the switch input 0.	Low=0V..1VDC; High=3V.. 5VDC;
6	Blue	D_IN4	I	Digital input, wired to the switch input 4 – Additional pin provided only in the 8-pin connector.	Low=0V..1VDC; High=3V.. 32VDC;
7	Brown	A_IN0	I	Analog input, wired to the ANALOG 0 regulator.	VIN = 0V.. 3V

8	Red	A_IN1	I	Analog input, wired to the ANALOG 1 regulator.	VIN = 0 V .. 12 V

Table 9: Description of the **8**-pin connector ***(optional, available upon request)***.

In the box there is a 16-wires cable called "**Vehicle installation cable"** which can be used for in-vehicle installation. This cable has different color codes. *Table below lists the wire colors and their meaning of this cable***.**

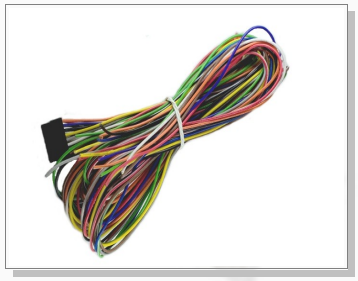

Figure 17: Vehicle mounting cable.

To use this cable, first strip off about 2 cm of the outer insulation the end of the wires your application uses, then connect the end with connector to the STEPPIII device and finally, connect the other stripped ends DI0 (grey) to the *CAN_High* and DI1 (white) to the *CAN_Low of the* the CAN bus on your vehicle, and when you are sure the CAN connection is properly made, apply power to the device by connecting the *GND-pin* first and then *VCC-pin*.

*The following table lists the color codes on the Vehicle mounting cable***:**

COLOR	NAME	I/O	DESCRIPTION (EB = EvalBoard)	LEVEL
Orange-White	VBO	O*	Output voltage (standard).	VOUT = 50 mA @ 3.3 V DC
Orange	A_IN0	I	Analog input, wired to the ANALOG 0 regulator.	VIN = 0 V .. 3 V
Green-White	GND	-	Negative operating voltage (Ground)	0 V
Lilac	A_IN1	I	Analog input, wired to the ANALOG 1 regulator on EB.	VIN = 0 V .. 12 V
Brown-White	OUT0	O	Open collector digital output, wired to the Output LED1 on EB.	100 mA @ 10.8V .. 32VDC
Black	N0	I	Digital input, wired to the switch input 0 on EB.	Low=0V..1VDC; High= 3V.. 5VDC;
Yellow-White	OUT1	O	Open collector digital output, wired to the Output LED1 on EB .	100 mA @ 10.8V.. 32VDC
Yellow	N1	I	Digital input, wired to the switch input 1 on EB .	Low=0V..1VDC; High= 3V.. 5VDC;
Red-White	OUT2	O	Open collector digital output, wired to the Output LED1 on EB.	100 mA @ 10.8V .. 32V DC
Grey	IN2	I	Digital input, wired to the switch input 2 on EB.	Low=0V..1VDC; High= 3V.. 5VDC;
Black-White	OUT3	O	Open collector digital output, wired to the Output LED1 on EB.	100 mA @ 10.8V .. 32V DC
White	IN3	I	Digital input, wired to the switch input 3 on EB.	Low=0V..1VDC; High= 3V.. 5VDC;
Blue	TxA**	I	Receive data (DCE-related). **Currently not supported.** RS-232 compatible receiver input.	V.24 Specification.
Green	RxA	O	Transmit data (DCE-related). RS-232 compatible transmitter output.	V.24 Specification.
Red	+IN	I	Positive operating voltage. This line must be protected by a fuse rated maximum 2A, 32 V.	10.8 V .. 32 VDC
Brown	GND	-	Negative operating voltage (Ground)	0 V

* *Optional pin. Upon request it can be provided to charge/discharge a rechargeable battery.*

** *It is reserved for future use.*

Table 10: *Vehicle mounting cable pinout.*