EnBOX

Dual Encoder Readout Box

(with 10/100/1000 Ethernet connectivity and BEST-ENC SFP connectivity)

CAENels
Gear for Science

User's Manual

2.3

BEAMLINE ELECTRONIC INSTRUMENTATION

This product is CE & UKCA compliant.

CAEN ELS s.r.l.
SS14 km 163.5
34149 – Basovizza (TS) – Italy
Registered office: via Vetraia 11, 55049 – Viareggio (LU)

Mail: info@caenels.com
Web: www.caenels.com

Table of Contents

1. INTRODUCTION 9

1.1 EnBOX overview 9
1.2 EnBOX at a Glance 10
1.3 Encoder Interface 13
1.3.1 RESOLUTE™ Interface 13
1.3.2 TONiC™ Interface 14
1.4 Ordering Codes 15

2. SOFTWARE COMMANDS 16

2.1 Command Syntax 16
2.2 Command Table Summary 18
2.3 Command description 19
2.3.1 GET Command 19
2.3.2 ENC_SEL Command 20
2.3.3 TONIC Command 21
2.3.3.1 TONIC:GET? Command 21
2.3.3.2 TONIC:AUX? Command 21
2.3.3.3 TONIC:AUX_CLEAR Command 22
2.3.3.4 TONIC:SETUP? Command 22
2.3.3.5 TONIC:ZERO? Command 22
2.3.4 STATUS Command 23
2.3.5 TEMP command 23
2.3.6 VER Command 24
2.3.7 HWRESET Command 24

3. ETHERNET COMMUNICATION 25

3.1 IP Address Assignment 25
3.2 CAENels Device manager 26
3.2.1 Searching for connected devices 26
3.2.2 Device Configuration 28
3.2.3 Firmware Upgrade 29

4. I/O CONNECTORS 31

4.1 Absolute Encoder Interface 31
4.2 Relative Encoder Interface 32
4.3 Power Connector 33
4.4 Interlock and General I/O Connector 33
4.5 Ethernet and SFP Connector 34

5. TECHNICAL SPECIFICATIONS 35

6. MECHANICAL DIMENSIONS 36

7. ENBOX POWER SUPPLY 37

7.1 The PS1112S Linear Power Supply 37
7.2 The PS1112S at a Glance 37
7.3 Technical Data 38
7.4 I/O Connectors 39

7.4.1 AC Line Input Connector *39*
7.4.2 Output *40*
7.4.3 Status LED *41*
7.4.4 Fixations *41*
7.5 MOUNTING POSITION 42
7.6 TECHNICAL SPECIFICATIONS 44

Document Revision	Date	Comment
1.0	April 10th, 2017	First Release
2.0	November 20th, 2018	Document updated with new features
2.1	October 10th, 2019	Document Updated
2.2	April 22th, 2022	Firmware upgrade for compatibility with new BEST-ENC features (BEST-ENC firmware ≥ 1.2.20). Removed MATH_SEL command.
2.3	November 22nd, 2022	Added UKCA compliance logo

Safety information - Warnings

CAEN ELS will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

Please read carefully the manual before operating any part of the instrument

WARNING

Do NOT open the boxes

CAEN ELS S.r.l. declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly this User's Manual before any kind of operation.

CAEN ELS S.r.l. reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

Disposal of the Product

The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.

Read over the instruction manual carefully before using the instrument.
The following precautions should be strictly observed before using the EnBOX device:

WARNING

- Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in this manual.
- Do not use the device if it is damaged. Before you use the device, inspect the instrument for possible cracks or breaks before each use.
- Do not operate the device around explosives gas, vapor or dust.
- Always use the device with the cables provided.
- Turn off the device before establishing any connection.
- Do not operate the device with the cover removed or loosened.
- Do not install substitute parts or perform any unauthorized modification to the product.
- Return the product to the manufacturer for service and repair to ensure that safety features are maintained

CAUTION

- This instrument is designed for indoor use and in area with low condensation.

The following table shows the general environmental requirements for a correct operation of the instrument:

Environmental Conditions	Requirements
Operating Temperature	0°C to 40°C
Operating Humidity	30% to 85% RH (non-condensing)
Storage Temperature	-10°C to 60°C
Storage Humidity	5% to 90% RH (non-condensing)

1. Introduction

This chapter describes the general characteristics and main features of the CAEN ELS EnBOX - Dual Encoder Readout Box.

1.1 EnBOX overview

The CAEN ELS EnBOX is a stand-alone readout device that must be used to interface the BEST system with RENISHAW TONiC™ and RESOLUTE™ in-air or UHV encoders. The EnBOX provides a TCP/IP server to obtain data from encoders, to configure the device and to check the operational status. The SFP interface on the back provides a communication link to transmit the measurement data to the CAEN ELS BEST Central Unit over an optical fiber connection.

The EnBOX provides a BiSS® interface to communicate with RENISHAW RESOLUTE™ encoders and quadrature encoder readout logic to interface with RENISHAW TONiC™ encoders. Please note that any monitoring instrument using the same two communication protocols can be read by an EnBOX unit. Contact CAENels or S.RI.Tech for details in case of need to interate devices different from the RENISHAW encoders mentioned above.

The EnBOX front-end, composed of interface circuitry and power supply circuitry is galvanically separated from digital and chassis ground.

The EnBOX has two integrated power supply circuits (one power supply is dedicated to "REL 1" and "ABS 1" connectors and one to "REL 2" and "ABS 2" connectors). Each power supply circuit can provide up to 3W of power at 5V rail. This is more than enough to power RENISHAW RESOLUTE™ encoders which require 1.25W and RENISHAW TONiC™ encoders which require just 1W of power.

The EnBOX is housed in a light, robust and extremely compact metallic box that can be placed either close to the encoders or next to the BEST central control unit.

The EnBOX provides an embeeded TCP/IPv4 server running on standard 10/100/1000 Mbps Ethernet.

1.2 EnBOX at a Glance

The EnBOX unit and its I/O connections can be seen in **Figure 1** (front) and in **Figure 2** (rear).

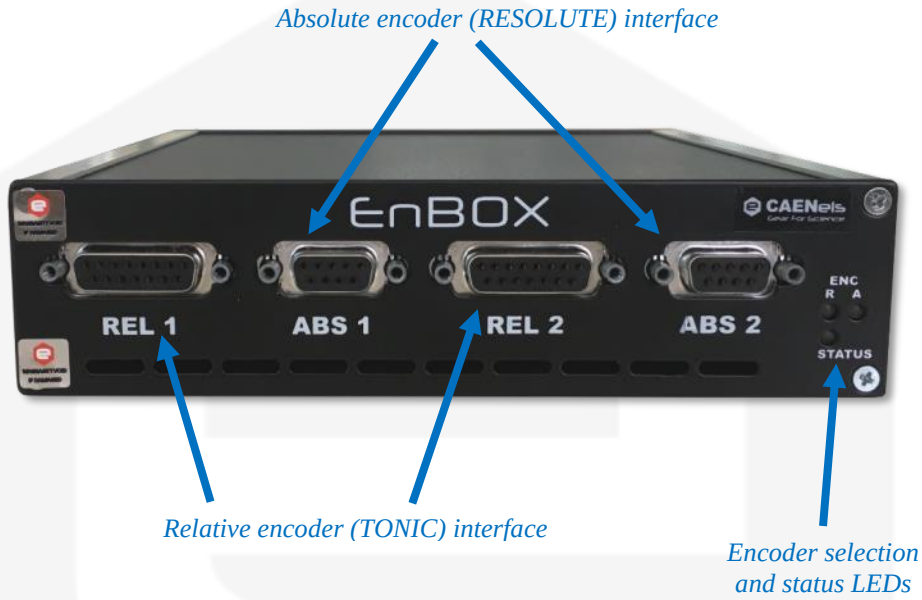


Figure 1: front view of an EnBOX unit

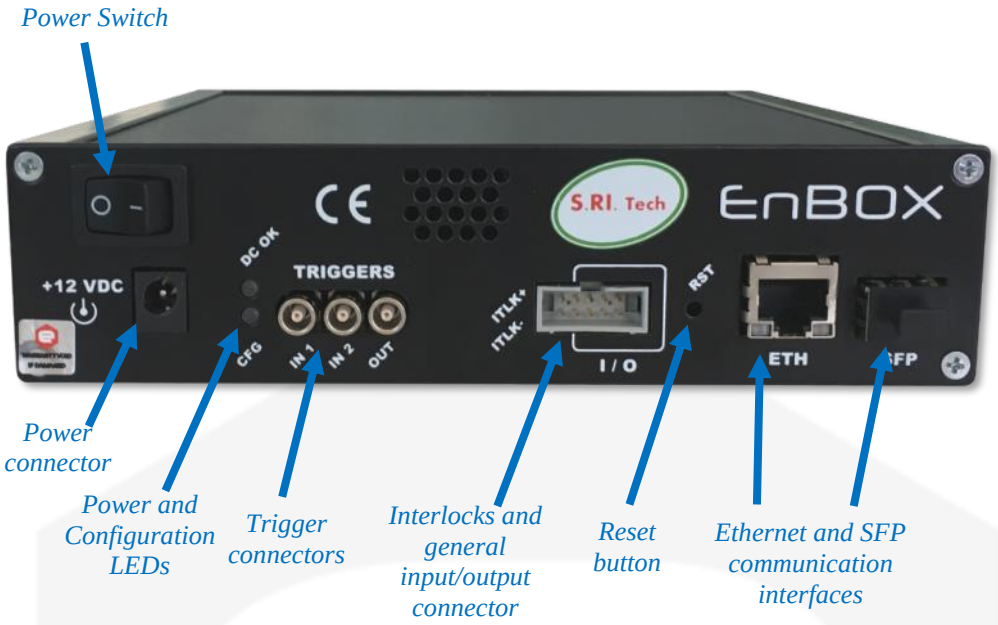


Figure 2: rear view of a EnBOX unit

Two D-Sub DE-9 connectors for the absolute encoders (RESOLUTE) and two D-Sub DA-15 connectors for relative encoders (TONIC) are placed on the front side. Two LEDs designated with "R" (relative) and "A" (absolute) show which encoders are selected in firmware (see "ENC_SEL" command).

A blue "Status LED" is used to signal the correct operation of the device. During normal operation of the EnBOX unit the "Status LED" is blinking with a frequency of 0.5Hz – i.e. the LED changes its status every 2 seconds – on the other hand, if a fault condition arises, the LED blinks with a higher frequency than 2 Hz.

The power connector, power switch, two LEDs, LEMO connectors for I/O triggers, interlock and general I/O connector, a standard RJ45 Ethernet connector and an SFP connector are placed on the rear panel of the device.

The blue "CFG" led shows that the unit's FPGA is correctly configured (in this case the LED is turned on). The green "DC OK" LED indicates that the internal sections are correctly powered.

The three LEMO connectors for I/O triggers are also placed on the rear panel. Two of them act as inputs (annotated as "IN 1" and "IN 2") and one acts as an output (annotated as "OUT"). The connectors are reserved for future use.

The "Interlocks and general I/O connector" has the pinout configuration shown in **Figure 3**:

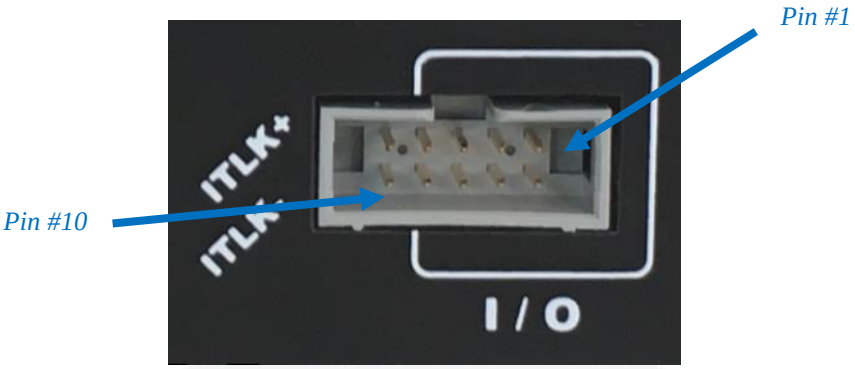


Figure 3: Interlock and general I/O connector

Pin #	Function
1-2	*Reserved*
3-4	*Reserved*
5-8	General purpose I/O
9-10	External interlock

The external and general purpose I/O pins are not yet used and are reserved for future use.

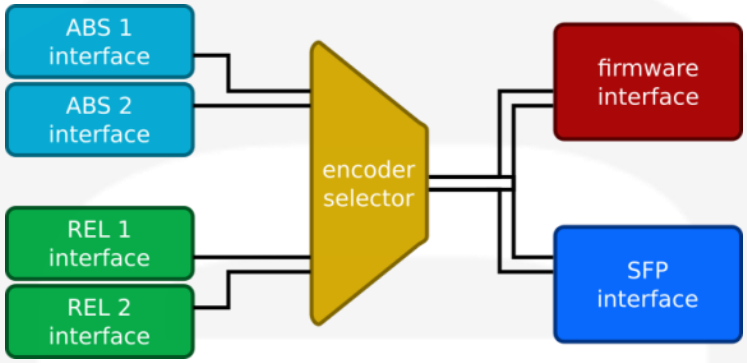
On the rear panel of the EnBOX there is a small hole that gives access to a reset button ("RST"), which can be used to reset the unit.

A RJ45 Ethernet connector ("ETH"), which is used to communicate with the unit and a Small form-factor pluggable transceiver ("SFP") which is used to communicate with the BEST system are placed next to the reset button.

1.3 Encoder Interface

The EnBOX provides two different communication protocols with encoders: a BiSS® interface to communicate with RENISHAW RESOLUTE™ encoders and a quadrature encoder readout logic to interface with RENISHAW TONiC™ encoders.

Users can select one of the two protocols from the software. Data from the selected interface is then provided to the firmware (e.g. for "GET" command), and sent over an SFP interface to the BEST Central Unit.



Please note that any monitoring instrument using the same two communication protocols can be read by an EnBOX unit. Contact CAENels or S.RI.Tech for details in case of need to interate devices different from the RENISHAW encoders mentioned above

1.3.1 RESOLUTE™ Interface

The BiSS® interface implemented in the EnBOX follows the 32-bit version of the protocol. The MA clock frequency is set to very conservative 500 kHz, which, according to "BiSS® C-mode (unidirectional) for RESOLUTE™ encoders" can accomodate up to 20 m long cables. Please contact CAENels or S.RI.Tech in case longer optical fiber cables are required. Since the communication protocol requires transmission of 42 bits for each sample (ack, start, position, warn, error, crc) the maximum data rate is limited to 11 kHz. Therefore, the EnBOX samples the encoder output at 5 kHz and with the same rate the packets are sent to BEST Central Unit.

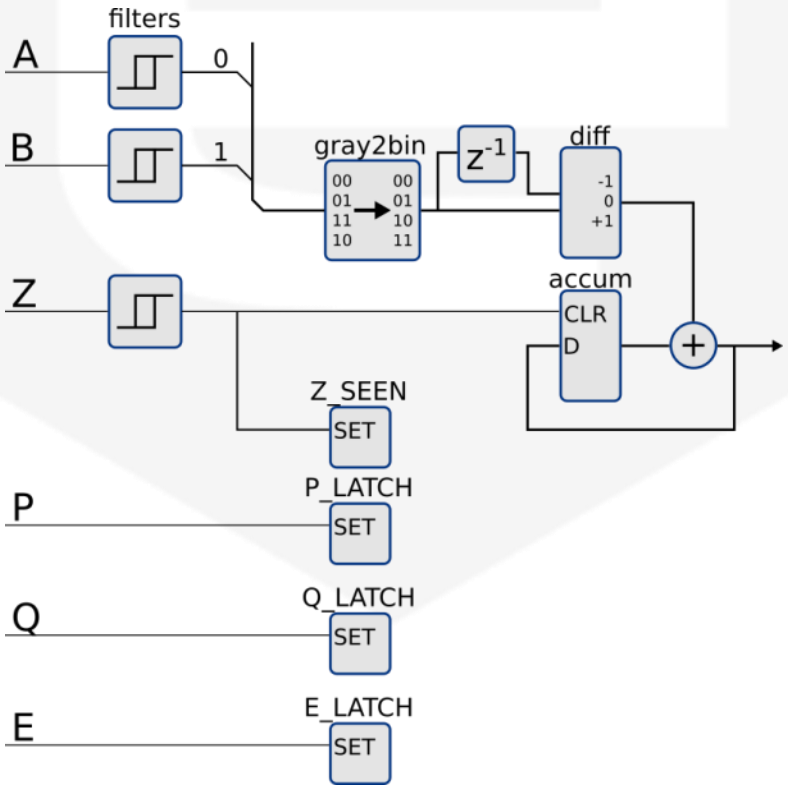
1.3.2 TONiC™ Interface

The quadrature-encoder logic decodes Gray code received from the encoder and increases or decreases an accumulator when changes are detected. TONiC™ encoders also provide the reference mark signal; this signal is used to reset the accumulator to zero and set Z_SEEN register (see "TONIC:ZERO?" command).

To remove possible disturbances on the line the input signals are filtered with hysteresis-based filter which will reject all pulses shorter than 60ns. This limits the maximum stepping rate at 16 kHz.

In some configuration, TONiC™ encoders also provide alarm signal and end-switch indicators. EnBOX monitors these inputs and provides both direct output and latched output (see "TONIC:AUX?" and "TONIC:AUX_CLEAR" commands).

The quadrature-encoder itself does not have any intrinsic data rate; however, to be consistent with the RESOLUTE™ interface data rate, also the TONiC™ interface sends new data out at 5 kHZ.



Example of compatible encoder:

TONIC Ti 0400 E 1 A

1.4 Ordering Codes

The ordering codes for the items included in this manual are the following:

Ordering Code	Description
COMP-BEI0009	EnBOX - Encoder Read BOX for BEST-ENC

2. Software Commands

This chapter describes the software commands used for configuration of the EnBOX unit and for data readout from encoders. For more information about the Ethernet settings see the Ethernet Communication chapter.

2.1 Command Syntax

The command syntax used by the EnBOX protocol is described in the following sections.

Commands must be sent in ASCII format and are composed by a *"command field"* and one, two or none *"parameter field"*, separated by a colon (*':'* or *'0x3A'* in hexadecimal notation). The number of *"parameter fields"* depends on the specific command. Commands are **NOT case sensitive** and therefore the command string can be sent either using uppercase or lowercase characters (conversion to uppercase characters is performed internally). Each instruction must be terminated with a '*carriage return\line feed*' sequence '***\r\n***' (or *'0x0D 0x0A'* in hexadecimal notation or commonly CRLF).

Command Example:

ENC_SEL:ABS\r\n

- *"**ENC_SEL**"* is the command field;
- *':'* is the parameter's separation character;
- *'**ABS**'* is the first parameter field;
- *'**\r\n**'* are the termination sequence of the command.

Commands are processed one at a time; therefore, user must wait for a response from the unit before sending the next command. All the responses from the EnBOX device are in upper case and are terminated with the same *'carriage return\line feed'* sequence ('***\r\n***') – i.e. CRLF – used in the command.

The reply from the device depends on the given command; for more information about the single command please refer to the specific command section.

There are two specific replies that are commonly used in many command, which indicate that the command has been correctly elaborated or not. Those replies are hereafter presented:

- **ACK**nowledge (*'**ACK**'*) indicates that the command is valid and it was correctly elaborated by the device:

ACK\r\n

  - *"ACK"* is the **ACK**nowledged response to a valid command;
  - *'\r\n'* is the termination sequence of the reply.

- **N**ot **A**c**K**nowledge (*'**NAK**'*) indicates that the command is either not valid or that it was not accepted by the devic:

NAK\r\n

  - *"NAK"* is the **N**ot **A**c**K**nowledged response to an invalid command;
  - *'\r\n'* is the termination sequence of the reply.

The list of commands used by the EnBOX and the corresponding syntax is hereafter presented as well as a description of each command purpose and any special requirements related to the specific command. The commands are hereafter described and are grouped in categories based on their purpose.

2.2 Command Table Summary

Command	Purposes	Parameters
GET	Read a single measurement	?
TONIC	Read a single measurement from TONiC interface	GET?
	Read the value from setup signal from TONiC interface	SETUP?
	Read the value of zero-crossing detector from TONiC interface	ZERO?
	Read the values of auxiliary signals (alarms) from TONiC interface	AUX?
	Clear the latches for alarms from TONiC interface	AUX_CLEAR
ENC_SEL	Gets current value of encoder selector	?
	Selects absolute encoder interface	ABS
	Selects relative encoder interface	REL
HWRESET	Perform a hardware and firmware reset	/
STATUS	Query device status	?
TEMP	Read the devices internal temperature	?
VER	Query the device firmware version	?

2.3 Command description

2.3.1 GET Command

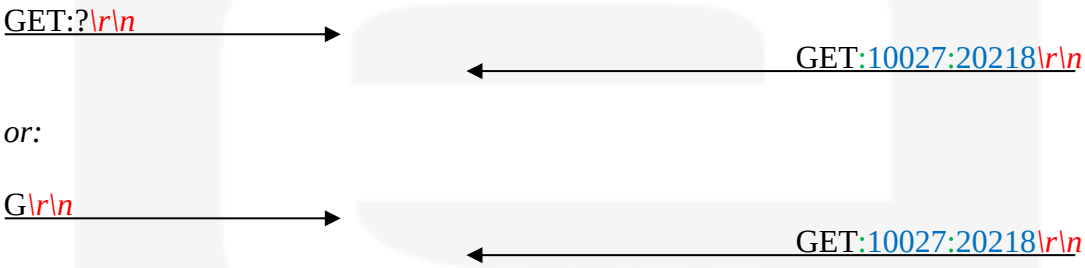
The purpose of the GET command is to read back a single snapshot of the values for the active channels. The "G\r\n" command is a useful shortcut fully equivalent to the "GET:?\r\n" command.

Get will return "GET:" string and two decimal numbers, separated by colon (":") which represent encoder counts. In case of absolute encoders this are values read from the encoders, in case of relative encoders this are values of accumulators.

The data returned from GET command is dependent on ENC_SEL value.

Examples:

GET example:



or:

2.3.2 ENC_SEL Command

The ENC_SEL command can be used to select between ABSolute encoders (RESOLUTE™) or RELative encoders (TONiC™). The current value of selector is indicated by a LED on front-panel and can be also retrieved with "ENC_SEL:?" Command. The value of selector is stored in non-volatile memory and will be preserved during power cycles.

To select the absolute encoder, an "ENC_SEL:ABS" command must be sent, to which EnBOX will return ACK\r\n. To select relative encoder, an "ENC_SEL:REL" command must be send, to which EnBOX will return "ACK".

To retrieve the current value of selector, an "ENC_SEL:?" command must be sent, to which EnBOX will return either "ENC_SEL:REL" if relative encoder or "ENC_SEL:ABS" if absolute encoder is selected.

For invalid argument (neither ABC nor REL nor ?) the EnBOX will return "NAK".

Examples:

Getting the value of selector:

ENC_SEL:?\r\n →

← ENC_SEL:REL\r\n

Setting the value to absolute encoder:

ENC_SEL:ABS\r\n →

(short delay to write to non-volatile memory)

← ACK\r\n

2.3.3 TONIC Command

The TONIC command allows reading the position values and some other auxiliary information (end-switches, alarm) from relative encoders. This command does not depend on the of ENC_SEL value.

2.3.3.1 TONIC:GET? Command

This command gets a single measurement from both relative encoders. The returned string is composed of "TONIC:GET:" literal and two decimal values, separated with comma (","):

Example:

TONIC:GET\r\n →

← TONIC:GET:10088,20711\r\n

2.3.3.2 TONIC:AUX? Command

This command returns the values of alarm, and P and Q end-switches. Both direct value and latched value are returned. Latches get set when the input signal is high and can be cleared from the software command (see TONIC:AUX_CLEAR command).

The returned string is composed of "TONIC:AUX:" literal and two numbers in hexadecimal format which represent the values of aux input for each of the two encoders. The following table shows position of individual bits in returned value:

Bit position	Register name	Description
31:19	Reserved	-
18	P_LATCH	P latched
17	Q_LATCH	Q latched
16	E_LATCH	E latched
15:3	Reserved	-
2	P	P direct
1	Q	Q direct
0	E	E direct

Example:

TONIC:AUX?\r\n →

← TONIC:AUX:00010000,00020002\r\n

2.3.3.3 TONIC:AUX_CLEAR Command

This command clears the latches for alarm, P, and Q end-switches.

Example:

TONIC:AUX_CLEAR\r\n →

← ACK\r\n

2.3.3.4 TONIC:SETUP? Command

This command returns the value read on the setup pin on TONiC™ interface. The command returns "TONIC:SETUP:" literal followed by two floating point values, separated by comma (","). The two values represent the value read on the input proportional to internal 5V reference.

Returned value	Value at pin X
0.0	0V
0.2	1V
1.0	5V

Example:

TONIC:SETUP?\r\n →

← TONIC:SETUP:0.20327, 0.20527\r\n

2.3.3.5 TONIC:ZERO? Command

This command indicates whether the quadrature-encoder logic has detected the reference mark signal (Z). When the quadrature-encoder logic detects the reference mark signal, the position accumulator is reset.

The command returns "TONIC:ZERO:" literal followed by two numbers, separated by comma (","). The numbers are either "0" to indicate that reference mark was not yet seen or "1" to indicate that reference mark was already seen.

Example:

TONIC:ZERO?\r\n →

← TONIC:ZERO:1,1\r\n

2.3.4 STATUS Command

The internal status register of the EnBOX shows the status of the unit. The status is composed of 6 bytes – i.e. 48 bits. As of version 1.0.98, no bit in the STATUS register has an assigned role and all bits are fixed to 0.

The internal status register can be read with the "STATUS:?\r\n" command. The reply from the EnBOX unit to this command is in the format "STATUS:*value*\r\n", where *value* is the ASCII representation of the internal status register value, composed by 12 hexadecimal digits – corresponding to the 6-byte wide status register (every byte is represented by two hexadecimal digits).

Example:

STATUS *read example:*

STATUS:?\r\n →

← STATUS:0000000000\r\n

2.3.5 TEMP command

TEMP Command ("TEMP:?\r\n") allows the user to read temperature from an internal temperature sensor. The temperature value is updated every 10 seconds. In case the temperature rises over 50°C, the over-temperature fault is set.

The reply to the TEMP command is in the following format: "TEMP:*value*\r\n", where *value* is the integer read temperature value expressed in °C.

Example:

TEMP *read example:*

TEMP:?\r\n →

← TEMP:28\r\n

2.3.6 VER Command

The "VER\r\n" command returns information about the EnBOX unit and the currently installed firmware version.

The reply to the "VER\r\n" command is in following format:

VER:*model*:*ver*:\r\n

where:

- *model*: is a string indicating the device (i.e. "ENBOX");
- *ver*: contains the string corresponding to the installed firmware version;

Example:

VER *example:*

VER:?\r\n →

← VER:ENBOX:1.0.98\r\n

The "ENBOX" device of the previous example has the "1.0.98" firmware version installed.

2.3.7 HWRESET Command

The "HWRESET\r\n" command performs a complete reset of the hardware and firmware on the on-board FPGA, thus re-initializing the entire EnBOX module control electronics. The unit replies with an acknowledgment string ("ACK\r\n") before resetting the module.

Example:

HWRESET *example:*

HWRESET\r\n →

← ACK\r\n

3. Ethernet Communication

The communication with the EnBOX unit is based on a 10/100/1000 Mbps Ethernet link.

The factory network configuration and the "CAENels Device Manager" software are described in the following sections.

3.1 IP Address Assignment

The device is shipped with default IP address, subnet mask, gateway and TCP-IP communication port:

Parameter	Factory value
IP address	**192.168.0.10**
Subnet mask	**255.255.255.0**
Gateway	**192.168.0.1**
TCP/IP port	**10001**

For a point-to-point connection it is not necessary to use a twisted cable because the used Ethernet link has an automatic detection of the communication direction – i.e. auto-sensing.

To change the device network setup it is necessary to use the free *"CAENels Device Manager"* software that can be downloaded from the CAENels website www.caenels.com. A briefly description of this software is given in next section.

3.2 CAENels Device manager

The free software *"CAENels Device manager"* can be used to search for all the EnBOX devices connected to the local network and to configure them. This software also allows to set the network configuration of the found devices and to update their firmware.

The *"CAENels Device manager"* is available for Windows and Linux platform and the system requirements hereafter listed:

- Windows minimum system requirements:
  - Windows® XP or newer
  - Intel® or equivalent processor
  - 80 MB available HD space
  - Ethernet network card

- Linux minimum system requirements:
  - Linux kernel 2.2.x or newer
  - Intel® or equivalent processor
  - 80 MB available HD space
  - Ethernet network card

3.2.1 Searching for connected devices

Please follow the next steps in order to search for the EnBOX devices connected to the local network:

- connect the host PC and the EnBOX directly with an Ethernet cable (or through a network);

- verify that the *"Link LED"* on the RJ45 connector is turned on (amber for a 1 Gbps connection as shown in **Figure 4** or green for a 100 Mbps connection). The LED is turned off if the Ethernet cable is not connected or if the speed of connection is limited to 10 Mbps (in this last case the device is working correctly even if it is not recommended to use a slow connection since the data transfer rate is limited);

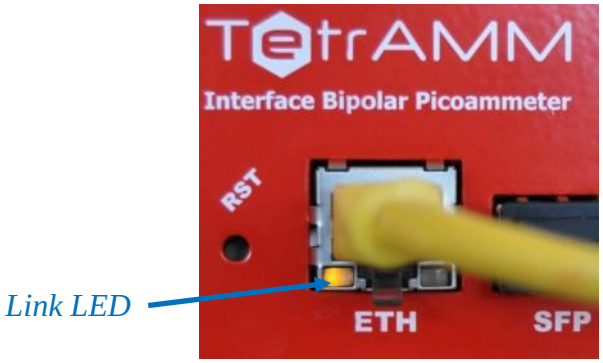


Figure 4: Ethernet Link

- connect the EnBOX to the AC/DC power supply unit and switch it on;
- install and launch the *"CAENels Device manager"* software;
- perform a scan to discover the connected EnBOX devices by clicking the *"Scan"* button as indicated in **Figure 5**. If there are multiple available networks it is possible to select the network/networks to be scanned in the *"Selected network interfaces"* window available under the "*Options*" menu. All the information about the selected devices is shown in the right side of the main window.

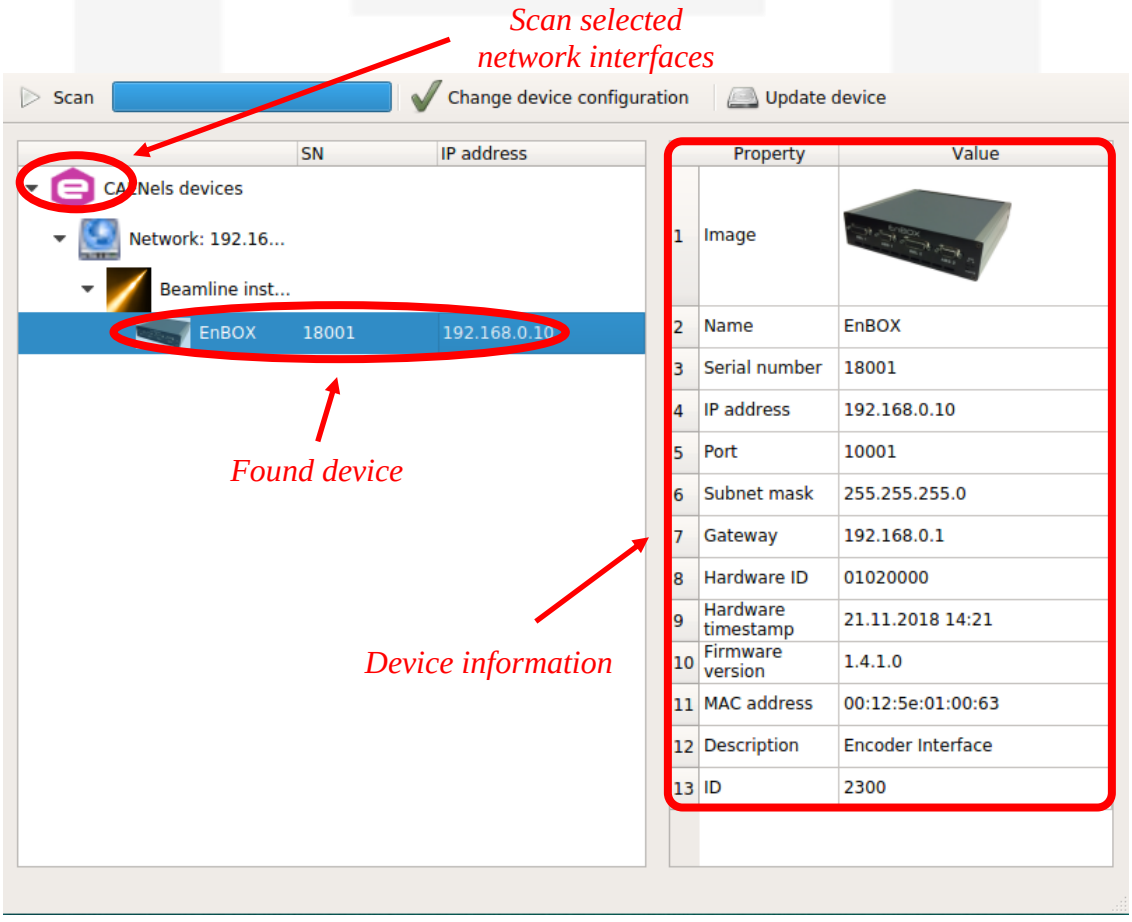


Figure 5: Main interface

If you have a firewall enabled on your router or on your computer, please make sure that the firewall is not preventing communication between your computer and the EnBOX device.

The "*CAENels Device manager"* uses **UDP port 30719** to find the device, so make sure that the UDP traffic is allowed in both directions on that port.

3.2.2 Device Configuration

It is possible to change the Network configuration of the found devices. In order to set the Network configuration it is necessary to select the desired device and to click on the "*Change device configuration*" button in the main window as shown in **Figure 6**. The configurable Network options are:

- Device IP address;
- TCP/IP communication port;
- Subnet mask;
- Gateway.

To apply the changes on the device configuration it is necessary to edit the corresponding fields and then to click on the "*Save*" button. A screenshot of a sample device configuration is shown in the following picture:

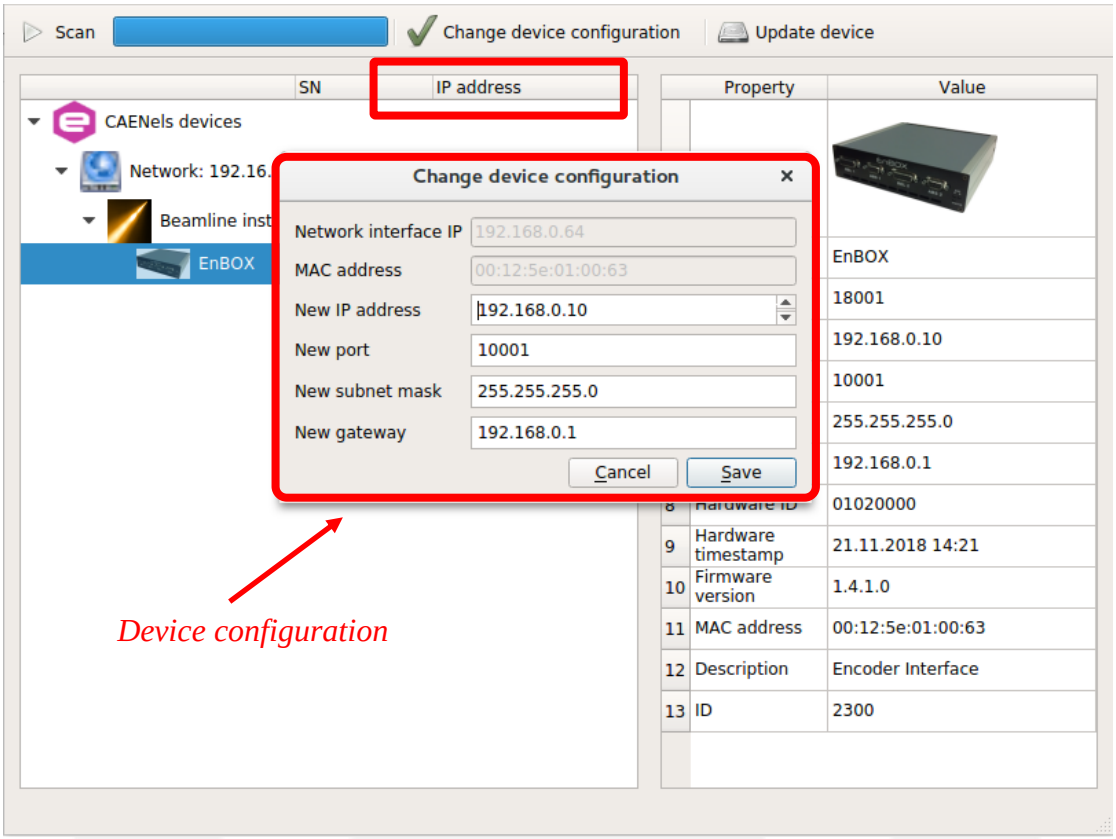


Figure 6: Change device configuration

3.2.3 Firmware Upgrade

The *"CAENels Device manager"* software also allows remotely updating the firmware of the EnBOX devices. Once the desired device is found, it is possible to perform the firmware update by clicking on the "*Update device*" button as shown **Figure 7**. The new opened window allows to select the new firmware file *(Flash file - *.flash)*.

Once the flash file has been selected it is possible to start the firmware update by clicking the *"Update!"* button. The firmware update task will take a few minutes. A screenshot of the update menu is shown hereafter:

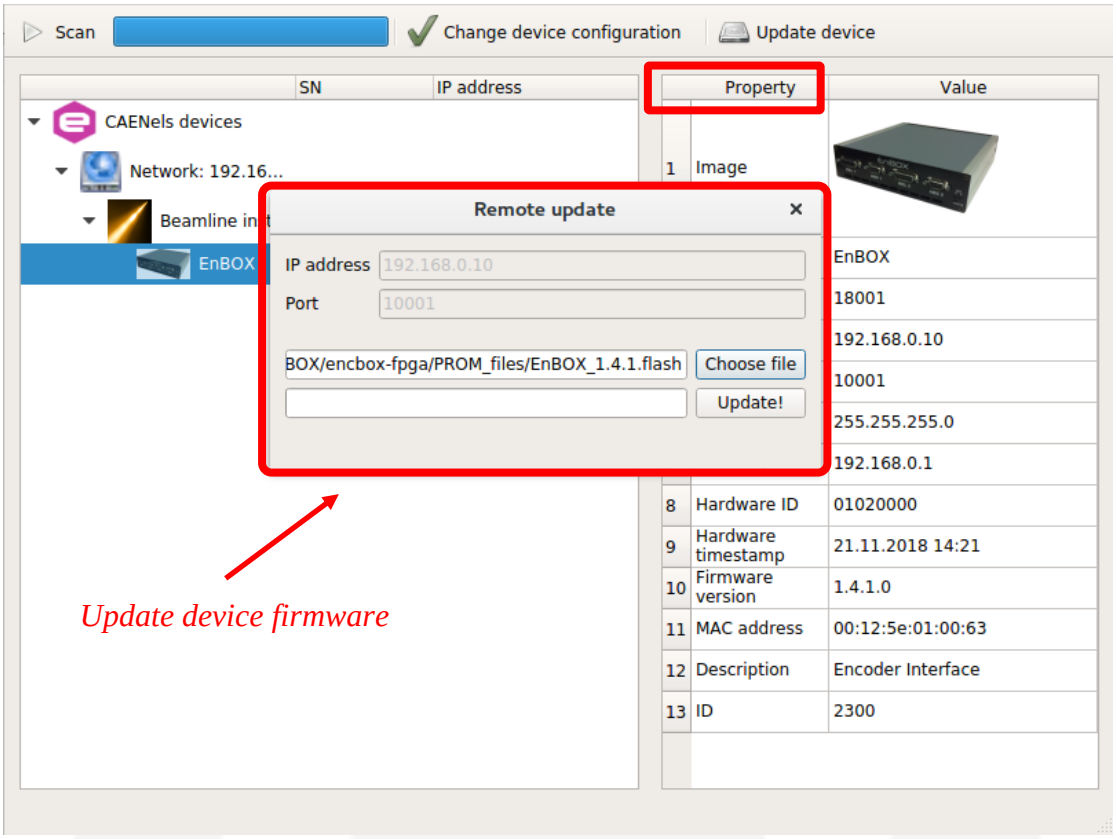


Figure 7: Update device

4. I/O Connectors

This chapter describes the I/O connectors located on the device front and rear panels, their corresponding pinout and the functionality of each signal.

4.1 Absolute Encoder Interface

The two D-Sub DE-9 female connector, annotated with "ABS 1" and "ABS 2" provide an interface with RENISHAW RESOLUTE™ encoders. The front-end electronics will provide a 5V output to power the encoder electronics and will start reading the encoder position over BiSS two-wire communication protocol. **Figure 8** shows the pinout of the connector.

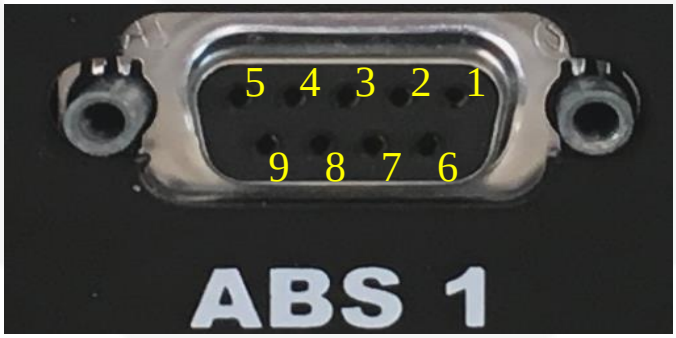


Figure 8: Absolute encoder connector

Pin	Signal
1	GND
2	MA+
3	MA-
4	5V
5	5V
6	SLO+
7	SLO-
8	GND
9	GND

4.2 Relative Encoder Interface

The two D-Sub DA-15 female connector, annotated with "REL 1" and "REL 2" provide an interface with RENISHAW TONiC™ encoders. The front-end electronics will provide a 5V output to power the encoder electronics, capture the encoder position from two quadrature signals and read status of the alarm and end-switch signals. **Figure 9** shows the pinout of the connector.

Figure 9: Relative encoder connector

Pin	Signal
1	X
2	GND
3	E-
4	Z-
5	B-
6	A-
7	5V
8	5V
9	GND
10	Q+
11	P+
12	Z+
13	B+
14	A+
15	5V

4.3 Power Connector

The input power connector is a standard male locking jack socket. The input voltage is rated at +12V (±3%) with a maximum input current of 1A.

The input ON/OFF switch is placed above the input power connector which allows turning ON or OFF the device. The used connector is shown in **Figure 8**:

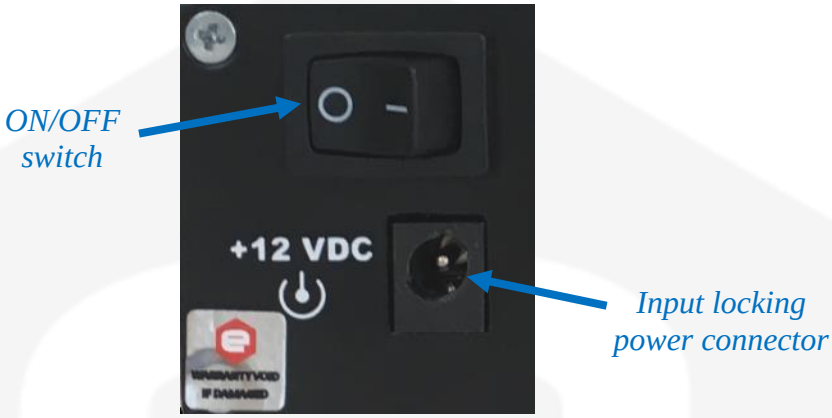


Figure 10: Power connector and switch

4.4 Interlock and General I/O Connector

The "Interlocks and general I/O" connector, that has the pinout configuration described in **Figure 10**, is located on the rear panel of the EnBOX unit:

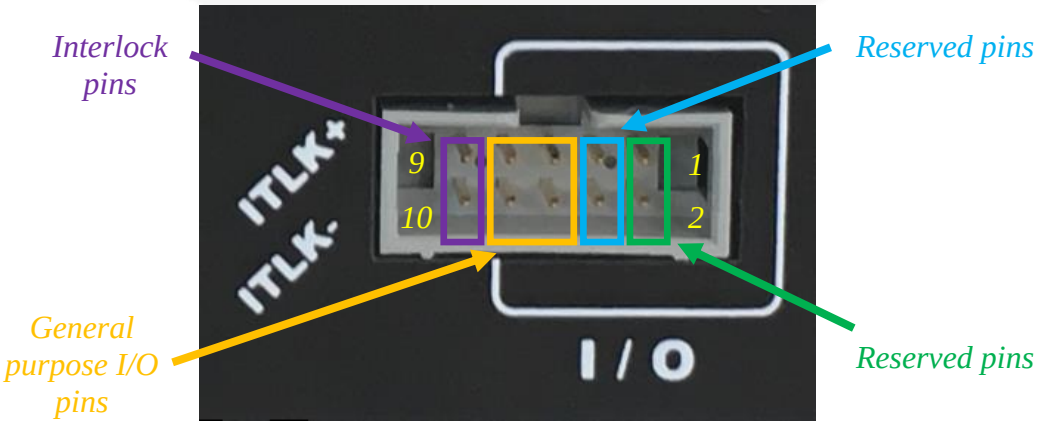


Figure 11: Interlock and I/O connector

The pin functions are summarized in the next table:

Pin #	Function
1-2	Reserved pins
3-4	Reserved pins
5-8	General purpose I/O pins
9-10	External interlock pins

The *"General purpose I/O pins"* (pins 5-8) are connected to the internal digital section and they are reserved for future system applications.

The *"Reserved pins"* (pins 1-4) are connected to the internal digital section and are reserved for internal use, so they must NOT be connected.

4.5 Ethernet and SFP Connector

On the rear side of the EnBOX unit there are also a RJ45 Ethernet connector and a small form-factor pluggable (SFP) slot as indicated in **Figure 11**:

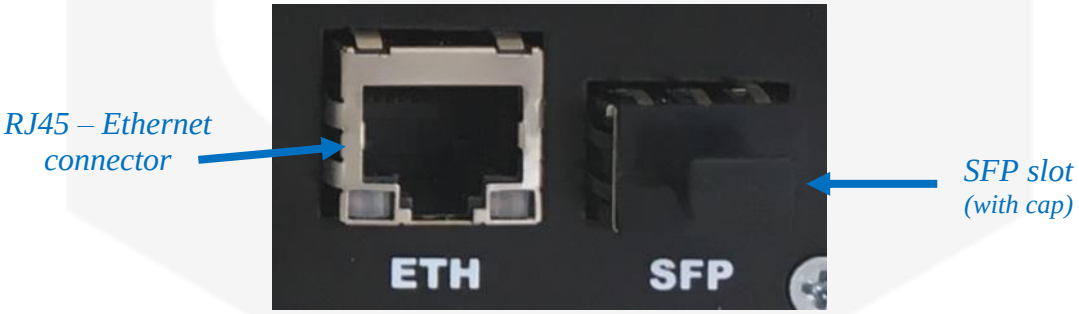


Figure 12: Ethernet and SFP connections

The RJ45 Ethernet slot is used to communicate with the EnBOX unit. The connector is linked to a true 10/100/1000 Mbps physical device. For more information about the Ethernet communication see the Ethernet Communication section.

The SFP slot allows connecting a copper or optic platform to the internal digital system with a fixed speed of 1 Gbps and it is reserved for beamline local feedback system.

5. Technical Specifications

The main technical specifications of the EnBOX unit are summarized in the following table:

Characteristic	Value
Compatible encoders (Factory Default)	RENISHAW TONiC™ RENISHAW RESOLUTE™
Supported communication protocols	BiSS-C (for RESOLUTE™) Quadrature encoder (for TONiC™)
Encoder power supply	+5V (max 3W per channel)
Sampling Frequency	5 kHz
Communication	Ethernet 10/100/1000 TCP-IP
Extra Communication interface	SFP – Small form-factor pluggable
External Signals	Configurable Trigger/Gate Trigger Outptut External Interlock
Input connectors	DE-9 (for RESOLUTE™) DA-15 (for TONiC™)
Additional Features	Firmware remote update
Input Voltage Supply	+12 V
Cooling Method	Blower Fan
Dimensions	195 x 173 x 45
Weight	850 g

6. Mechanical Dimensions

The mechanical dimensions of the EnBOX unit, including connectors, are hereafter presented in **Figure 13**:

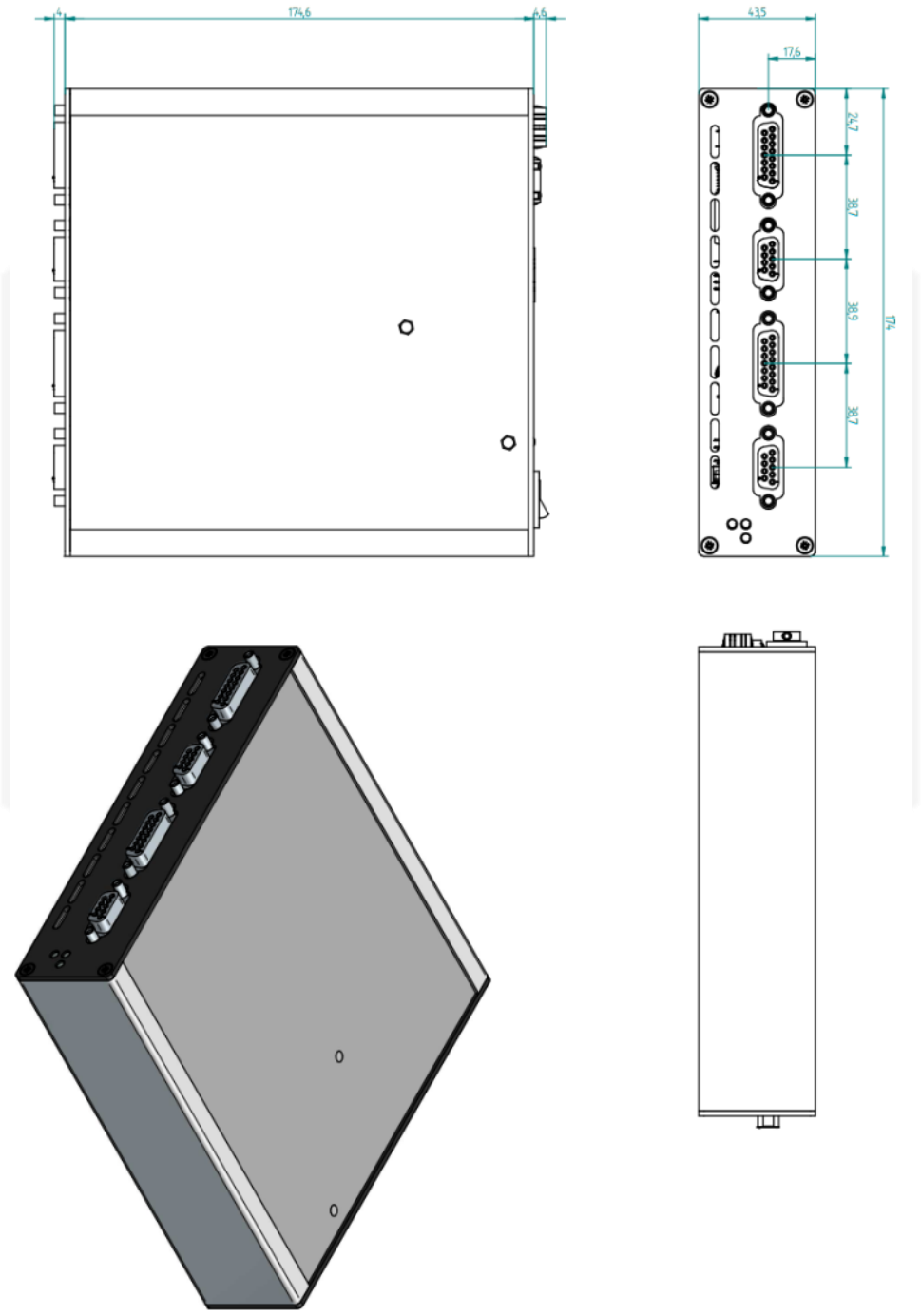


Figure 13: EnBOX mechanical dimensions

7. EnBOX Power Supply

This chapter describes the general characteristics and the main features of the EnBOX low-noise power supply called PS1112S. This power supply is specifically designed for operation with the CAEN ELS EnBOX unit.

7.1 The PS1112S Linear Power Supply

The CAEN ELS PS1112S is a single-output +12V mixed switching-linear power supply that is designed in order to obtain low-noise operation and high efficiency and it is especially suited for measurement systems where switching power supplies could corrupt measuring noise, accuracy and precision.

The power supply is housed in a robust and compact stainless steel box that can be placed next to the supplied device in order to reduce cable lengths and minimize consequent possible noise pick-up.

7.2 The PS1112S at a Glance

The PS1112S linear power supply and its I/Os are represented in **Figure 14**. The PS1112S is an isolated power supply, with a 3-pole output connector, specifically designed to supply low current to precision instrumentation.

The AC Power Line input is placed on the left side of the box while the output connectors on the right side; a LED monitor (indicating the presence of the output voltage) is placed on the front side.

Figure 14: overall view of a PS1112S power supply

The AC Power Line input is placed on the left side of the box while the output connectors on the right side; LED monitor (indicating the presence of the output voltage) is placed on the front side.

The PS1112S has a standard +12V output voltage, as indicated in the following table:

	Positive Output Voltage
PS1112S	+12 V @ 1.2A

7.3 Technical Data

The PS1112S power supply has an output voltage accuracy of ±3% - i.e. from 11.64 V to 12.36 V.

Maximum peak-to-peak voltage noise measured at the device output terminals is rated at 4 mV. This value is measured over a 1 MHz bandwidth using a LeCroy MSO 44MXs-B, 400MHz, 5GS/s with AC Coupling at full load. A typical output waveform used to estimate the peak to peak noise value is shown in **Figure 15**.

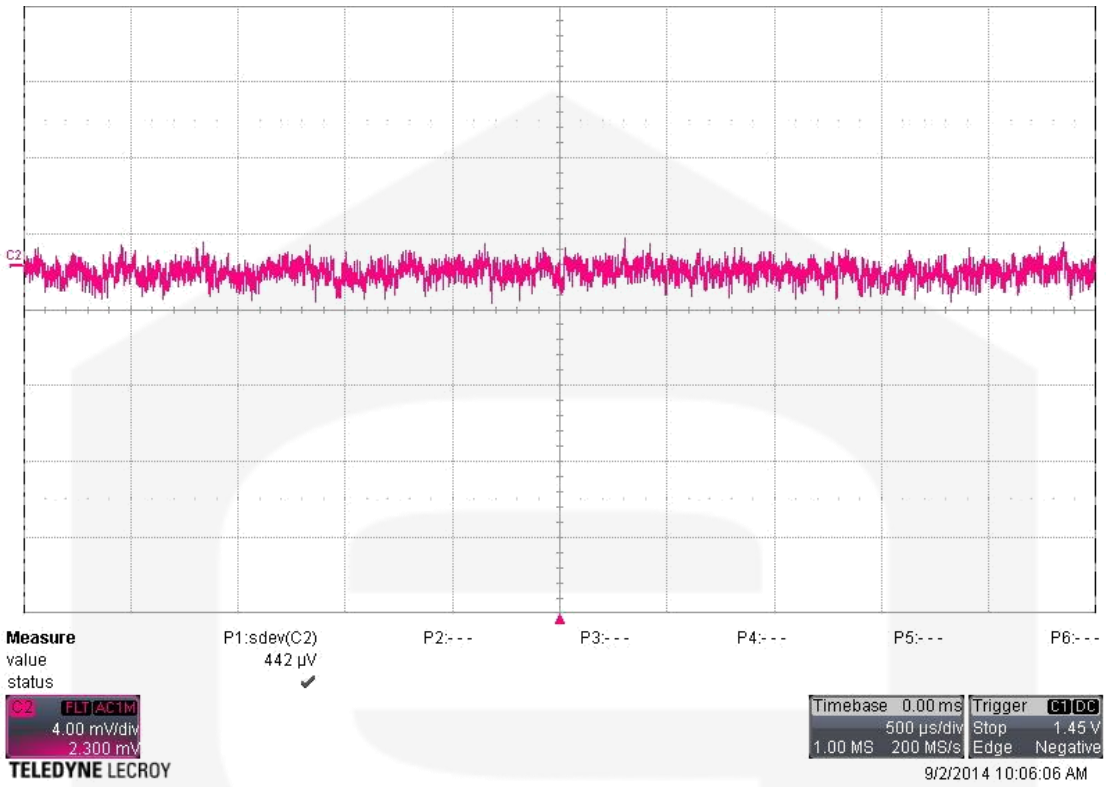


Figure 15: typical output noise - AC coupling

The PS1112S outputs are floating with respect to Earth up to 500V, protected against short-circuit and from over-voltage.

7.4 I/O Connectors

This chapter describes the I/O connectors and switches, their corresponding pinout and their functionality.

7.4.1 AC Line Input Connector

The AC Line Input connector is in a standard IEC Male Socket as shown in **Figure 16**.

The PS1112S power supply is designed for universal AC input voltage range since it can operate with voltage from 90V to 260V and input frequency from 47 to 63 Hz. Under the value of 115V AC Mains input the Power Supply is subject to current (i.e. power) de-rating.

Figure 16: AC Line input connector

7.4.2 Output

Output DC voltage is made available through a 3-pole connector with a screw locking. The pin-out of the connector (frontal view) is shown in **Figure 17**.

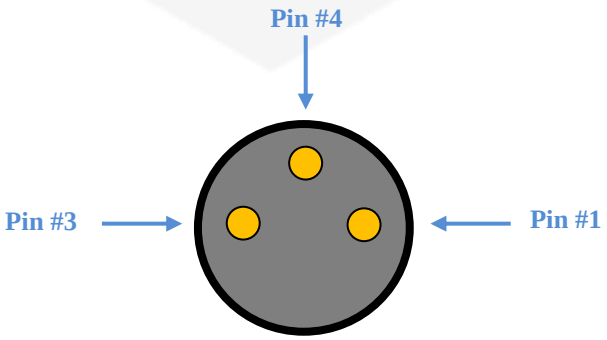


Figure 17: Output DC Connector (TE 1838839-1)

The output connector has the following pin-out:

Pin #	PS1112S
1	+12V
3	nc
4	GND

CAENels also supplies in the same package of all provided power supply PS1112S a mating un-terminated cable that can be terminated with the desired connector.

7.4.3 Status LED

On a lateral side of the power supply, two LEDs turn off whenever the +12V is not correctly regulated on the output cable.

Figure 18: LED indicators for output voltage

7.4.4 Fixations

On the bottom side of the PS1112S four threaded M3×4mm holes can be used to fix the power supply to a support. These are indicated in the following **Figure 19**.

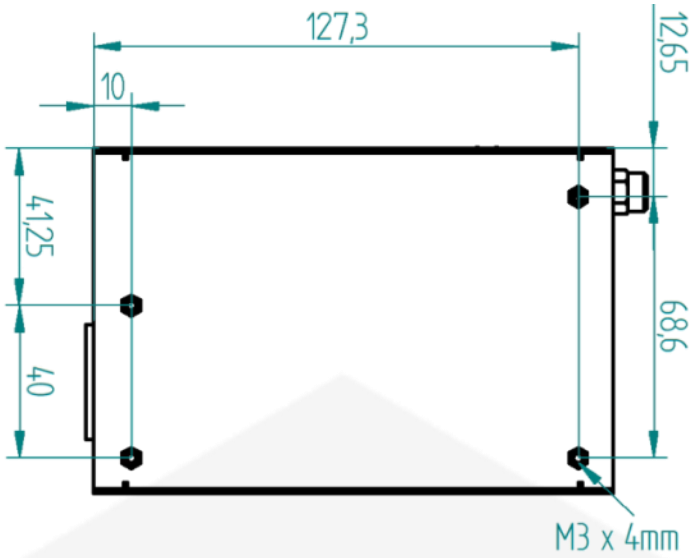


Figure 19: Threaded holes position on the PS1112S bottom

7.5 Mounting position

PS1112S shall **NOT be mounted** in the two following positions:

- bottom side of the box fixed to the ceiling (**Figure 20**);
- lateral side of the box that present ten ventilation holes faced to the top (**Figure 21**).

The RECOMMENDED mounting positions for increasing the heat dissipation and increasing reliability and life-time are:

- bottom side of the box fixed to the floor;
- lateral side of the box that present twenty ventilation holes faced to the top.

Figure 20: Ceiling mounting NOT allowed

Figure 21: Lateral mounting (ten ventilation holes faced to the top) NOT allowed

7.6 Technical Specifications

The technical Specifications for the PS1112S linear power supplies are summarized in the following table:

Technical Specifications	PS1112S
Output Voltage (±3%)	+12 V
Maximum Output Power	27 W
Maximum Output Current	+12V @ 1.2 A
Output Ripple + Noise	0.003% $_{RMS}$ @ DC-1MHz 0.025% $_{P-P}$ @ DC-1MHz
AC Line Voltage Input	90 – 260 V_{AC}
AC Line Frequency	47 - 63 Hz
Input to Output Isolation	3kV
Output to Earth-Case Isolation	500V
Hold-up time	16 ms typ. at 115 V_{AC}
Cooling	Natural convection
Dimensions	136.4 × 41 × 90.7 mm
Weight	600 g
Y-Cable length (CT-I and CT-V)	3m
Indicators	1 LED (Power Good)
Protections	Output short-circuit Output over-voltage
Operating Temperature Range	0°C – 50°C