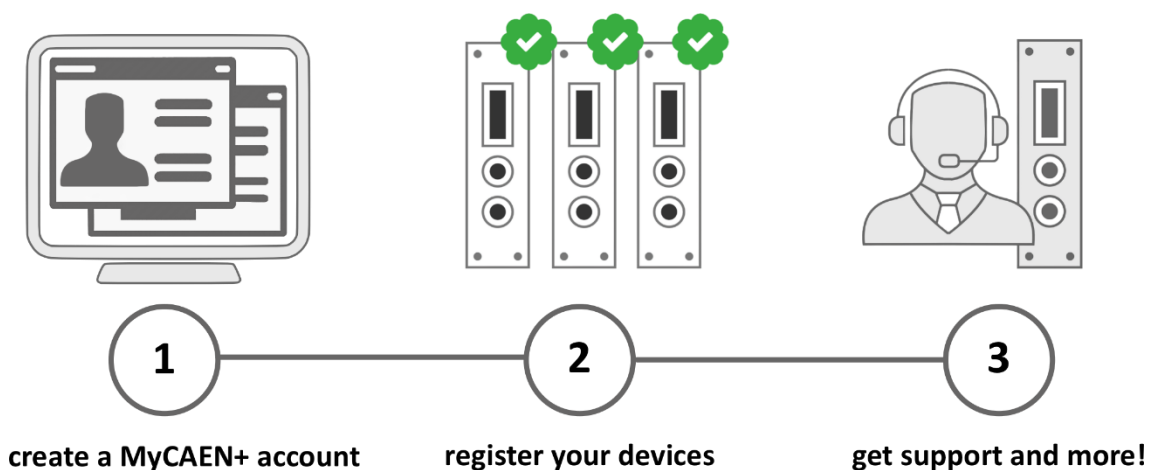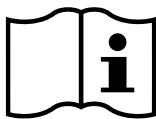# Register your device

Register your device to your **MyCAEN+** account and get access to our customer services, such as notification for new firmware or software upgrade, tracking service procedures or open a ticket for assistance. **MyCAEN+** accounts have a dedicated support service for their registered products. A set of basic information can be shared with the operator, speeding up the troubleshooting process and improving the efficiency of the support interactions.

MyCAEN+ dashboard is designed to offer you a direct access to all our after sales services. Registration is totally free, to create an account go to https://www.caen.it/become-mycaenplus-user and fill the registration form with your data.

1
create a MyCAEN+ account

2
register your devices

3
get support and more!

https://www.caen.it/become-mycaenplus-user/

Purpose of this User Manual

This document is the N1408 User's Manual; it contains information about the installation, the configuration and the use of the device.

Change Document Record

Date	Revision	Changes
12 December 2019	0	Preliminary
18 June 2020	1	Updated Technical specifications table
28 February 2023	2	Updated specs, Updated Layout

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Limitation of Responsibility

If the warnings contained in this manual are not followed, CAEN will not be responsible for damage caused by improper use of the device. The manufacturer declines all responsibility for damage resulting from failure to comply with the instructions for use of the product. The equipment must be used as described in the user manual, with particular regard to the intended use, using only accessories as specified by the manufacturer. No modification or repair can be performed.

Disclaimer

No part of this manual may be reproduced in any form or by any means, electronic, mechanical, recording, or otherwise, without the prior written permission of CAEN spa. The information contained herein has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies. CAEN spa reserves the right to modify its products specifications without giving any notice; for up to date information please visit www.caen.it.

Made in Italy

We remark that all our boards have been designed and assembled in Italy. In a challenging environment where a competitive edge is often obtained at the cost of lower wages and declining working conditions, we proudly acknowledge that all those who participated in the production and distribution process of our devices were reasonably paid and worked in a safe environment (this is true for the boards marked "MADE IN ITALY", while we cannot guarantee for third-party manufactures).

CAEN ⬡ Electronic Instrumentation

Index

CAEN Electronic Instrumentation

1 Safety Notices

N.B. Read carefully the "SAFETY, STORAGE AND SETUP INFORMATION PRODUCT SUPPORT SERVICE AND REPAIR" document provided with the product before starting any operation.

The following HAZARD SYMBOLS may be reported on the unit:

⚠	Caution, refer to product manual
⚡	Caution, risk of electrical shock
⏚	Protective conductor terminal
⏚	Earth (Ground) Terminal
∼	Alternating Current
3∼	Three-Phase Alternating Current

The following symbol may be reported in the present manual:

⚠	General warning statement

The symbol could be followed by the following terms:

- **DANGER**: indicates a hazardous situation which, if not avoided, will result in serious injury or death.
- **WARNING**: indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**: indicates a situation or condition that, if not avoided, could cause physical injury or damage the product and / or its environment.

CAUTION: To avoid potential hazards

USE THE PRODUCT ONLY AS SPECIFIED.
ONLY QUALIFIED PERSONNEL SHOULD PERFORM SERVICE PROCEDURES

CAUTION: Avoid Electric Overload

TO AVOID ELECTRIC SHOCK OR FIRE HAZARD, DO NOT POWER A LOAD OUTSIDE OF ITS SPECIFIED RANGE

CAUTION: Avoid Electric Shock

TO AVOID INJURY OR LOSS OF LIFE, DO NOT CONNECT OR DISCONNECT CABLES WHILE THEY ARE CONNECTED TO A VOLTAGE SOURCE

CAUTION: Do Not Operate without Covers

TO AVOID ELECTRIC SHOCK OR FIRE HAZARD, DO NOT OPERATE THIS PRODUCT WITH COVERS OR PANELS REMOVED

CAUTION: Do Not Operate in Wet/Damp Conditions

TO AVOID ELECTRIC SHOCK, DO NOT OPERATE THIS PRODUCT IN WET OR DAMP CONDITIONS

CAUTION: Do Not Operate in an Explosive Atmosphere

TO AVOID INJURY OR FIRE HAZARD, DO NOT OPERATE THIS PRODUCT IN AN EXPLOSIVE ATMOSPHERE

THIS DEVICE SHOULD BE INSTALLED AND USED BY SKILLED TECHNICIAN ONLY OR UNDER HIS SUPERVISION

DO NOT OPERATE WITH SUSPECTED FAILURES.
IF YOU SUSPECT THIS PRODUCT TO BE DAMAGED, PLEASE CONTACT THE TECHNICAL SUPPORT

CAEN Electronic Instrumentation

2 General description

Overview
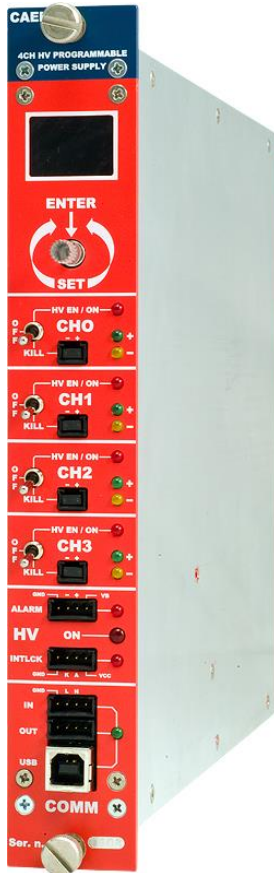
The Mod. N1408 provides 4 independent High Voltage channels in a single width NIM mechanics.

Each channel can provide a ±800V / 20 µA max output.

Channels have common floating return (common return insulated from the crate ground); HV outputs are delivered through BNC HV connectors.

The HV output RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷100 V/s in 1 V/s steps.

Safety features include:

- OVERVOLTAGE and UNDERVOLTAGE warning when the output voltage differs from the programmed value by more than 2% of set value (minimum 1V).

- Programmable VMAX protection limit

- OVERCURRENT detection: if a channel tries to draw a current larger than its programmed limit, it enters TRIP status, keeping the maximum allowed value for a programmable time (TRIP), before being switched off

- Channels can be enabled or disabled individually through the Interlock logic.

Module control can take place either locally, assisted by a Graphic color display or remotely, via USB, RS232 or RS485; the RS485 port allows to build a N1408's daisy chain network (up to 32 modules).

For remote operation, CAEN also provides GECO2020, a graphical application that allows to manage the N14xx HV Power Supplies (as well as all other CAEN Power Supplies).

Moreover, these units can be managed via CAEN HV Wrapper, a set of ANSI C functions bundled in a library, providing the software developer a unified software interface for the control of CAEN Power Supplies. This is a low level application in which the writing of the Control SW is assigned to the user. CAEN HV Wrapper is logically located between an higher level application, such as GECO2020, and the lower layer software libraries. It contains a generic software interface independent by the Power Supply models and by the communication path used to exchange data with them.

For more info please visit: www.caen.it (products>firmware/software section).

3 Technical specifications

Front and back panel

CAEN Electronic Instrumentation
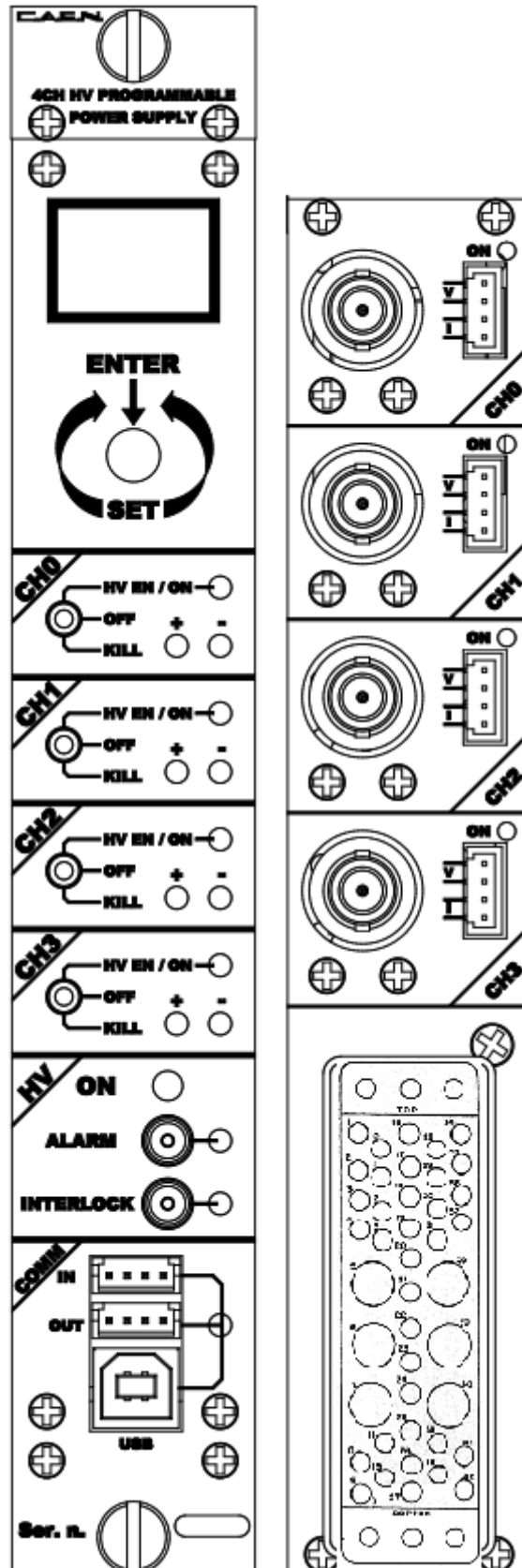
Front panel connections

Local control section
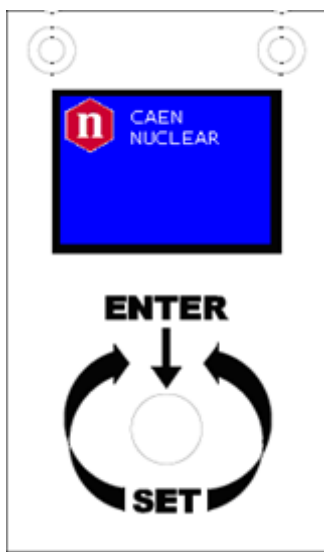
NAME:	TYPE:	FUNCTION:
MONITOR	1" OLED DISPLAY (96x64)	*Local settings monitoring*
TUNE	ROTARY SWITCH	*Parameter and Mode setting*

Channel control section
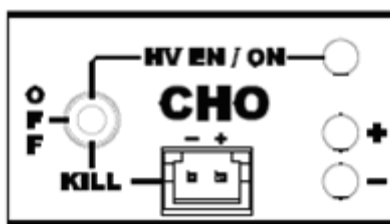
NAME:	TYPE:	FUNCTION:
HV_EN/OFF/KILL	3 POS. SWITCH	*Channel Enable and turning OFF/KILL*
ON	RED LED	*HV On enabled*
REMOTE KILL	AMP 280370-2	*The channel is KILLED either as the +/- contacts are open or as a +4÷6Vdc voltage is fed to pin -*
+	GREEN LED	*Positive polarity*
-	YELLOW LED	*Negative polarity*

HV Status control section
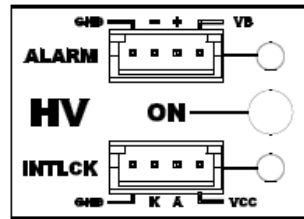
NAME:	TYPE:	SIGNAL:	FUNCTION:
ON	RED LED		*HV On enabled (at least one channel ON)*
ALARM	RED LED/ AMP 280371-2.	Out	*Alarm status signalled (active LOW)*
INTERLOCK	RED LED/ AMP 280371-2	In	*Interlock signal*

Alarm signal
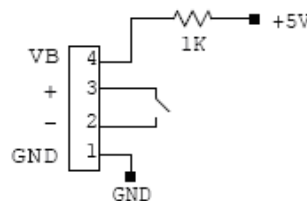
As an Alarm condition is detected (see p. 30 and 31) pins 2 and 3 (- and +) are closed; the contact can be used to switch an external device supplied by an external source, otherwise the VB and GND references can be used to provide a TTL compatible level on pin 2 and 3.

In the first case (externally supplied device) the maximum allowed ratings are:

- Maximum voltage between + and -: 12V

- Maximum sink current across + and -: 100mA

In the latter case, in order to produce a TTL compatible Alarm Out, pin 3 (+) must be connected with pin 4 (VB) and pin 1 (GND) with pin 2 (-); see the diagram below:
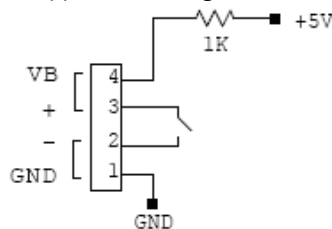
Interlock signal
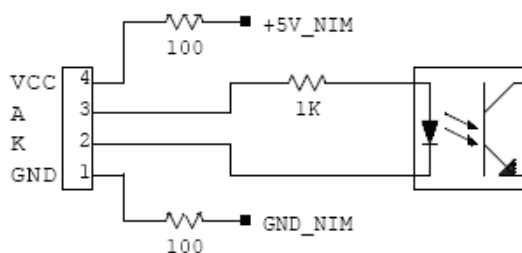
A schematic diagram of the Interlock input is shown in the figure above, where the diode is part of optocoupler stage.

Interlock means that channels are hardware disabled. The interlock operation is explained by the following table:

CONFIGURATION ↓	INTERLOCK MODE (p.15) →	OPEN	CLOSE
leave contact open		INTERLOCK	ENABLED
voltage level (0÷1V, ~5mA current) between pin 2 and pin 3		INTERLOCK	ENABLED
short circuit pin 1 with pin 2, and pin 3 with pin 4		ENABLED	INTERLOCK
voltage level (4÷6V, ~5mA current) between pin 2 and pin 3		ENABLED	INTERLOCK

The front panel Interlock LED is ON when the INTERLOCK is enabled; as INTERLOCK is enabled, channels are <u>turned off</u> at the fastest available rate, regardless the RAMP DOWN setting.

Remote communication control section
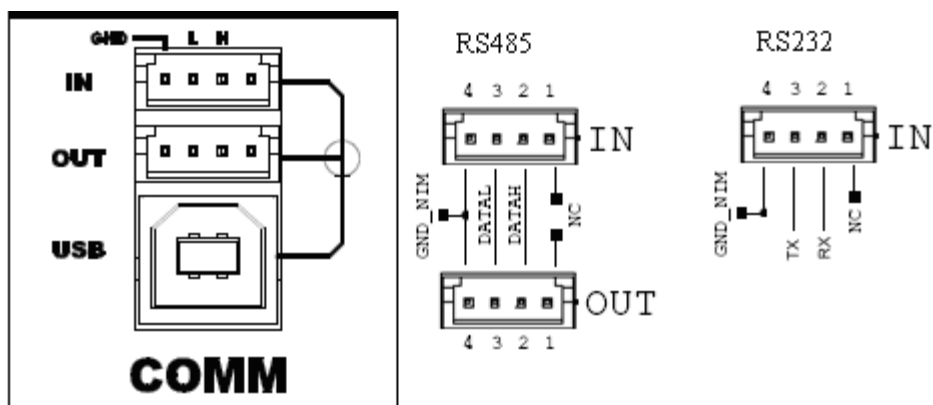
NAME:	TYPE:	FUNCTION:
IN	AMP 280371-2	*RS485 Input[1]; adaptable to RS232 standard*
OUT	AMP 280371-2	*RS485 Output*
USB	B TYPE USB	*USB2.0 compliant realized via USB ↔ RS232 FT232BM converter*

---

[1] RS 485 Serial Port Interface allows to control up to 32 modules connected by a twisted pair cable; the first and last modules must be terminated, see p.36.

Rear panel connections

HV Channel Output
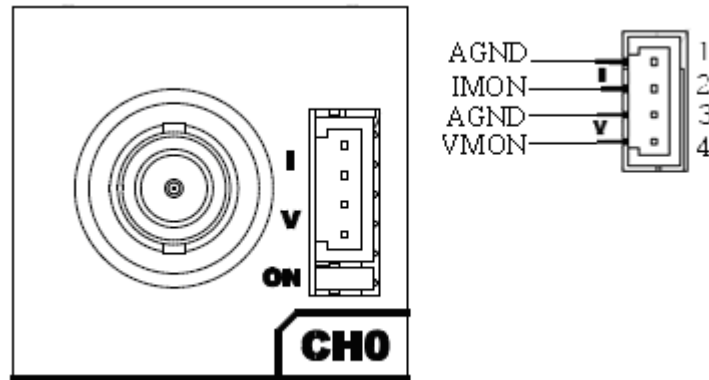
NAME:	TYPE:	FUNCTION:
MON	AMP 280371-2	*Vout/Iout Test point*
OUT	BNC HV (RADIALL R316.553; mate: R316.072)	*HV Channel Output*

The test points allow to monitor the Channel Output Voltage and Current according to the following conversion:

VMON: Voltage level (1V = 206 V ±1% readout; same polarity as channel)

IMON: Voltage level (1V = 4.55 µA ±3% readout; positive, 0÷5 V range)

WARNING! These connectors produce extremely hazardous high voltages at a potentially lethal current level; never connect or disconnect the HV OUT connector with the crate power ON/OFF switch ON; always switch crate power OFF and wait at least 30s before connecting or disconnecting HV cables.

Technical specifications table

Packaging		Single width NIM module
Power requirements		900mA@+12V; 900mA@-12V
Output channels:		Positive or Negative Polarity (requires internal setting, see p.33)
Output range:		800V / 20μA
Max. Ch. Output Power:		16 mW
Vset / Vmon Resolution:		15 mV
Iset / Imon Resolution:		500pA
Vmax:		0 ÷ 850 V Absolute maximum HV level that the channel is allowed to reach, independently from the preset value Vset. Output voltage cannot exceed the preset value Vmax. The accuracy is 0.2 % ± 16mV
Vmax resolution:		0.1 V
Alarm output:		Open collector, 100 mA maximum sink current
Interlock input:		LOW: <1V; current~5mA; HIGH: 4÷6 V
Ramp Up/Down:		1÷100 Volt/s, 1 Volt/s step
Trip:		Max. time an "overcurrent" is allowed to last (seconds). A channel in "overcurrent" works as a current generator; output voltage varies in order to keep the output current lower than the programmed value. "Overcurrent" lasting more than set value (1 to 9999) causes the channel to "trip". Output voltage will drop to zero either at the Ramp-down rate or at the fastest available rate, depending on Power Down setting; in both cases the channel is put in the OFF state. If trip= INFINITE, "overcurrent" lasts indefinitely. TRIP range: 0 ÷ 999.9 s; 1000 s = Infinite. Step = 0.1 s
Accuracy: [2]	Vmon vs. Vout	±0.02% of read value ±16mV
	Vset vs. Vout	±0.02% of read value ±16mV
	Imon vs. Iout	±0.5% of read value ±20nA
	Iset vs. Iout	±0.5% of read value ±100nA
Voltage Ripple:[3]		<5mVpp
Humidity range:		0 ÷ 80%
Operating temperature:		0 ÷ 45°C
Storage temperature:		-10 ÷ 70°C

---

[2] From 10% to 90% of Full Scale Range
[3] Measured with: 1m cable length; 2nF capacitance

4 Operating modes

⚠ **CAUTION: N1408 MUST BE USED ONLY IN CRATES WITH FORCED COOLING AIR FLOW!**
Module control can take place either locally, or remotely, via USB or RS485 (see p. 23).

Hardware installation

Prior to shipment this unit was inspected and found free of mechanical or electrical defects. Upon unpacking of the unit, inspect for any damage, which may have occurred in transport. The inspection should confirm that there is no exterior damage to the unit, such as broken knobs or connectors, and that the panels are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, file a claim with carrier immediately and notify CAEN. Before installing the unit, make sure you have read thoroughly the safety rules and installation requirements, then place the package content onto your bench; you shall find the following parts:

N1408 power supply unit

USB cable

N1408 is housed in a 1-unit NIM mechanics. The unit is an equipment for BUILDING-IN: install it in a NIM crate providing the required power supplies, with forced cooling air flow, then connect the HV Channel Output to the load

Unit control can take place either locally, assisted by a 1" LCD and rotary handle or remotely, via USB, or RS485.

Unit Power ON

After hardware installation (see above), turn on the NIM crate.

Local Control

Insert the unit inside a powered NIM crate and switch it ON. At the power the Display shows for a few seconds the following screen.
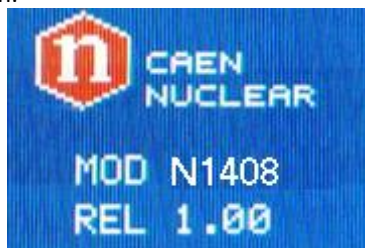
At this point the module is ready to be operated locally. The TUNE ROTARY SWITCH (see p.10) is lit up if Local Control is enabled.

Programmable parameters

With Local Control, the following parameters are available:
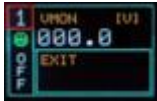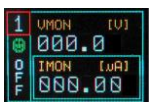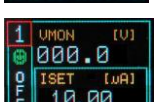
Boards parameters

General board parameters (CONTROL can be operated both in LOCAL and REMOTE mode; other monitor and settings are allowed in LOCAL mode only; see p.15) include:
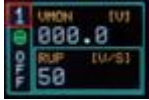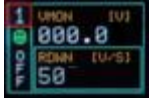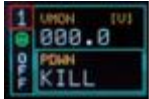
Parameter:	Function:	Display:
Power (Monitor)	Module power supply status	
Termination (Monitor)	Local Bus termination status (ON/OFF)	
HV Clock (Monitor)	Sync clock frequency (200±10 kHz correct value)	
Local Bus Baud Rate (Monitor/Set)	9600, 19200. 38400, 57600, 115200 Baud	
Local Bus Address (Monitor/Set)	Local Bus address for remote communication (0÷31)	
USB Baud Rate (Monitor/Set)	9600, 19200, 38400, 57600, 115200 Baud	
INTERLOCK (Monitor/Set)	CLOSED / OPEN OPERATION (see p.11)	
CONTROL (Monitor/Set)	REMOTE: the module is controlled remotely; local monitor is allowed; *LOCAL/REMOTE* switch is enabled LOCAL: the module is controlled locally; remote monitor is allowed	

Channel settings

For each channel the following parameters can be programmed and monitored either locally or remotely (see p.23):

Parameter:	Function:	Unit:	Display:
Vmon	High Voltage Monitored value	Volt	
Imon	Current Monitored value	µA	
V_{set}	High Voltage programmed value	Volt	
I_{set}	Current Limit programmed value	µA	

MaxV	Absolute maximum High Voltage level that the channel is allowed to reach (see p. 14)	V	
Ramp-Up	Maximum High Voltage increase rate	V/s	
Ramp-Down	Maximum High Voltage decrease rate	V/s	
Power Down	Power Down mode after channel TRIP	KILL or RAMP	
Trip	Maximum time an "overcurrent" is allowed to last expressed in seconds (see p.14)	s	

HV connection

Verify the channels polarity (polarity setting is explained at p.33) checking that the polarity LEDs are switched on according to the programmed configuration (see p.10); verify the HV_EN/OFF/KILL 3 POS. SWITCH of each channel is set to OFF; the Display will show the following message in the left lower row:
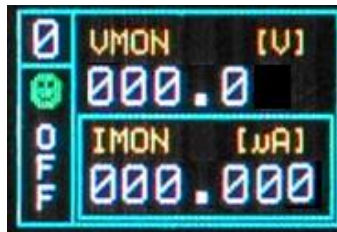
now connect the HV cable linking the outputs to the loads to be supplied and enable the HV outputs switching the HV_EN/OFF/KILL 3 POS. SWITCH in the HV_EN position; the Display will show the following message in the left lower row:
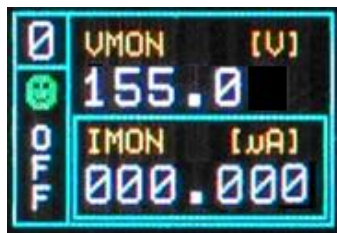
The KILL position of the HV_EN/OFF/KILL 3 POS. SWITCH allows to turn off the module at the fastest available rate; the Display will show the following message in the left lower row:

Module settings

Module settings are general board settings; turn the TUNE ROTARY SWITCH until this screen is shown:
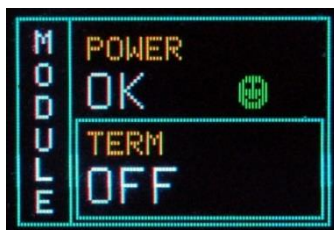
Push the TUNE ROTARY SWITCH in order to access MODULE parameters; the MODULE frame becomes red:
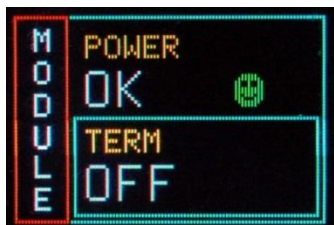
The TUNE ROTARY SWITCH allows to select the parameter to be set; turn the ROTARY SWITCH until such parameter is displayed (for example CONTROL), then select it by pushing the ROTARY SWITCH (the parameter is shown with a red frame as long as it is active):

Select the desired value by turning the TUNE ROTARY SWITCH and confirm it by pushing the switch itself.

Channel settings

In order to operate Output Channel settings:
Turn the TUNE ROTARY SWITCH until the channel number to be set is displayed in the left upper row (for example Channel 0)
Push the TUNE ROTARY SWITCH: at this point the frame of the left upper row (channel number) becomes red and the channel is selected

Turn the TUNE ROTARY SWITCH until the parameter to be set (for example VSET) is displayed in the right lower row
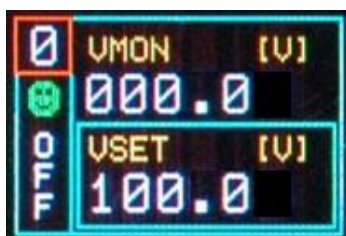
Push the TUNE ROTARY SWITCH: at this point the parameter is selected, its frame is shown in red and its name in blue; it is now possible to change the parameters value

Turn the TUNE ROTARY SWITCH until the value digit to be edited is shown in blue, the parameter name in yellow

Push the TUNE ROTARY SWITCH: at this point the value digit becomes yellow and can be edited

Turn the TUNE ROTARY SWITCH until the digit reaches the desired value

Confirm it by pushing the TUNE ROTARY SWITCH, the edited digit returns blue

Once all the digits are set to the desired value, turn the TUNE ROTARY SWITCH until the parameter name returns blue

Push the TUNE ROTARY SWITCH in order to de-select the parameter, the frame returns to blue
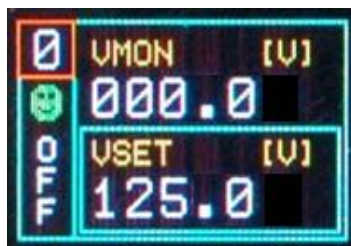
It is now possible to set another parameter; note that the POWER DOWN setting has not digits to be edited, but two options, TRIP/KILL and HIGH/LOW respectively:
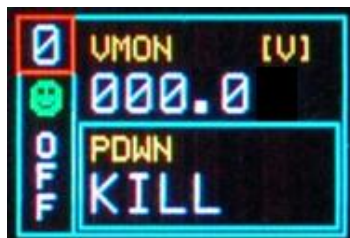
In order to access another channel, the EXIT parameter has to be selected

Now by turning the TUNE ROTARY SWITCH another channel number to be set can be selected.
If CONTROL MODE (see p.23) is set to REMOTE, the left lower row reports DIS (Disabled), since the channel can be accessed only via the serial links (see p.23). If the INTERLOCK MODE is changed while one channel is ON, the channel is turned OFF and the left lower row reports ILK (Interlock); if the channel is OFF, it cannot be turned ON, until it is enabled according to the Interlock logic (see p.11).

Group Settings

Group settings allow to broadcast the same parameter value to all channels.
In order to operate Group settings:
Turn the TUNE ROTARY SWITCH until ALL is displayed in the left column
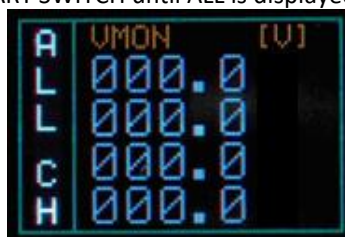
Push the TUNE ROTARY SWITCH: at this point the frame of the left column becomes red and the GROUP is selected. Turn the TUNE ROTARY SWITCH until the parameter to be set (for example VSET) is displayed in the right column (all four channels values).
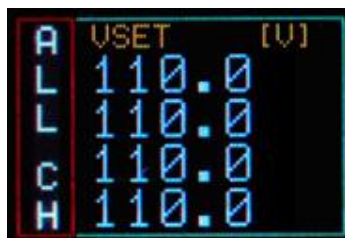
Push the TUNE ROTARY SWITCH: at this point the parameter is selected, its frame is shown in red and its name in blue (only one value common to all channels; pre-set value is picked from Channel 0); it is now possible to change the parameters value.

Turn the TUNE ROTARY SWITCH until the value digit to be edited is shown in blue, the parameter name in yellow

Push the TUNE ROTARY SWITCH: at this point the value digit becomes yellow and can be edited

Turn the TUNE ROTARY SWITCH until the digit reaches the desired value

Confirm it by pushing the TUNE ROTARY SWITCH, the edited digit returns blue

Once all the digits are set to the desired value, turn the TUNE ROTARY SWITCH until the parameter name returns blue. Push the TUNE ROTARY SWITCH in order to de-select the parameter, the frame returns to blue; when the parameter is not active, the parameter status of the four channels is shown.
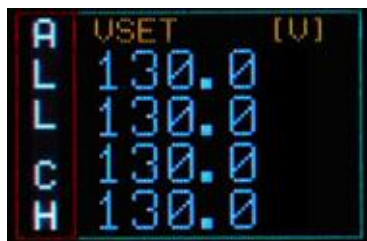
In order to go to individual channel settings, the EXIT parameter has to be selected

CAEN Electronic Instrumentation

Smileys

Three types of Smileys in the display indicate:

Smiley	Meaning
	OK Status
	WARNING Status
	ALARM Status

Zero Current Adjust

This function allows to set the present monitored current value IMON as 0; it works only for monitored values up to 2µA.

ZCDetect: (ON/OFF) If ON, it stores the present IMON value (up to 2µA) into memory for "zero current compensation" purposes

ZCAdjust: (EN/DIS) If enabled, the stored IMON value via ZCDetect option is subtracted from the measured, "non compensated" IMON value. The returned "compensated" IMON value will

be then the difference between measured and stored values; if disabled, the returned IMON value is not compensated

- If, after the ZC Adjust, the monitored current is lower than the stored "zero", a negative current value will be returned.

- If the operation is performed with load disconnected, the "void" current calibration will be obtained.

Remote Control

Module control can take place remotely, via USB or RS485; the latter allows to build a N1408s' daisy chain network. The CAEN NIM8301 7U 12 Slot Smart Fan Unit 300/600 W Crate allows also to communicate with the module via Ethernet.

An external PC is required (supported OS: Windows 10 or later; Linux kernel Rel. 2.4 or later). The connection can be performed via VT emulators (such as Tera Term), or via one of the available tools (see below). The N1408 Power Supply family is identified as **NIM HV** by the available software tools. Control option on the LCD must be set to **REMOTE**.

Software tools

GECO2020

CAEN GECO2020 is a graphical application that allows to control the Power Supply (and all other CAEN Power Supplies). Once the unit is correctly installed, download and install the GECO2020 software package related to your OS; follow the instructions in the GECO2020 User manual and the unit will be ready to be operated. For more info, please visit www.caen.it (products>firmware/software section).

CAEN HV Wrapper

CAEN HV Wrapper is a library, available either as a set of ANSI C functions or LabVIEW™ VI's. Such set provides the software developer a unified software interface for the control of CAEN Power Supplies. This is a low-level application in which the writing of the Control SW is assigned to the user. It contains a generic software interface independent by the Power Supply models and by the communication path used to exchange data with them.

CAEN HV Wrapper is logically located between a higher-level application, such as GECO2020, and the lower layer software libraries. For more info, please visit www.caen.it (products>firmware/software section).

Power Supply Modules LabVIEW Instrument Driver

Power Supply Modules LabVIEW Instrument Driver is a set of VI'S, developed for LabVIEW 2017 and later releases (LabVIEW™ is a Trademark of National Instruments Corp.), that allow to configure and monitor all parameters of remotely controlled CAEN Programmable HV Power Supply modules. Host PC shall run LabVIEW 2017 or later releases and NI-VISA Run-Time Engine 17.

To install the Power Supply Modules LabVIEW Instrument Driver, go to CAEN web site in the "Software" area, download the Power Supply Modules LabVIEW Instrument Driver installation package and follow the Set Up instructions

Serial Links

USB communication

The module is provided with a USB2.0 compliant interface (see p.10). The N1408 can be programmed via PC by connecting the PC USB port with the N1408 USB B-type port; the featured controller, the FT232BM chip requires drivers freely available at www.ftdichip.com (Drivers section); the site also provides installation instructions for all OS's (Documents section)

The connection can be performed via terminal emulator, such as HyperTerminal, configured as follows:

- baud rate 9600 (the same set on the N1408! See p.17)
- Data bits: 8
- Parity: none
- stop bit: 1
- Flow control: Xon Xoff

It is also possible to build a daisy chain of up to 32 N1408's, with the first module connected to the PC USB port and the subsequent ones daisy chained through the COMM IN/OUT, as explained on p.29 ; in this case communication with the chained modules is achieved through the USB - RS485 Communication Protocol, see p.29. All modules must be assigned a LOCAL BUS ADDRESS, different from one another and the last one must be terminated (see p.35).

RS232 communication
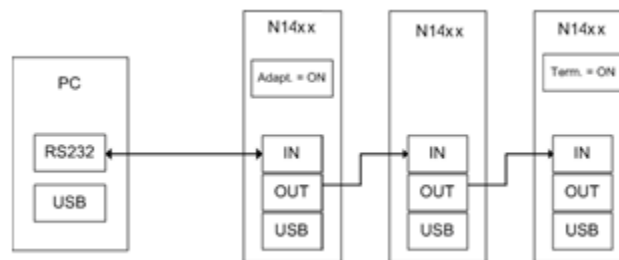
In order to control the module via RS232 it is necessary to use the module's COMM IN port (refer to p.12 for RS232 signals) and to follow adaptation instructions (see p.35).
The connection can be performed via terminal emulator, such as HyperTerminal,
configured as follows:

- baud rate 9600 (the same set on the N1408!)
- Data bits: 8
- Parity: none
- stop bit: 1
- Flow control: Xon Xoff

It is also possible to build a daisy chain of up to 32 N1408's, with the first module connected to the PC RS232 port and the subsequent ones daisy chained through the COMM IN/OUT, as explained on p.12; in this case communication with the chained modules is achieved through the USB - RS485 Communication Protocol . All modules must be assigned a LOCAL BUS ADDRESS, different from one another and the last one must be terminated (see p.35).

RS485 communication
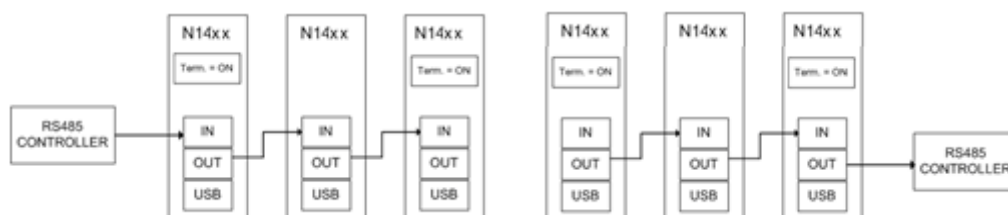
The COMM IN / OUT connectors implement a RS485 type LOCAL BUS which allows to build a 32 modules daisy chain. This can be achieved through the following steps:

- Connect the connector OUT of a module to corresponding the IN connector of the next one

- Assign to each module a different address (LOCAL BUS ADDR);

- Ensure that the LOCAL BUS BIT RATE is the same for all modules;

- Terminate the first and the last module in the chain (see p.35)

The module control can be done in one of the following ways:

- o by connecting a RS485 controller to the first module's COMM IN port

- o by connecting a RS485 controller to the last module's COMM OUT port

Communication with the chained modules is achieved <u>only</u> through the USB - RS485 Communication Protocol, see p.23.

Ethernet communication
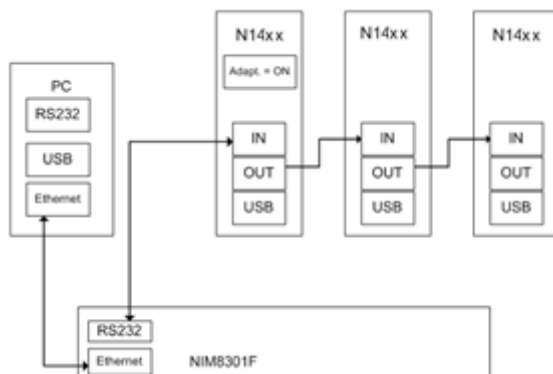
It is possible to communicate via Ethernet with one or more daisy chained N1408 modules through the NIM8301 Fan Unit[4]. Communication via Ethernet is possible only through the USB - RS485 Communication Protocol. The single module or the first module of the daisy chain must be connected to the Fan Unit RS232 port through the cable adapter (see figure below) connected to the N1408 COMM IN port; SW[200, 201] switch placed on the Microcontroller board inside the module must be set to Adaptation ON (see p.33).
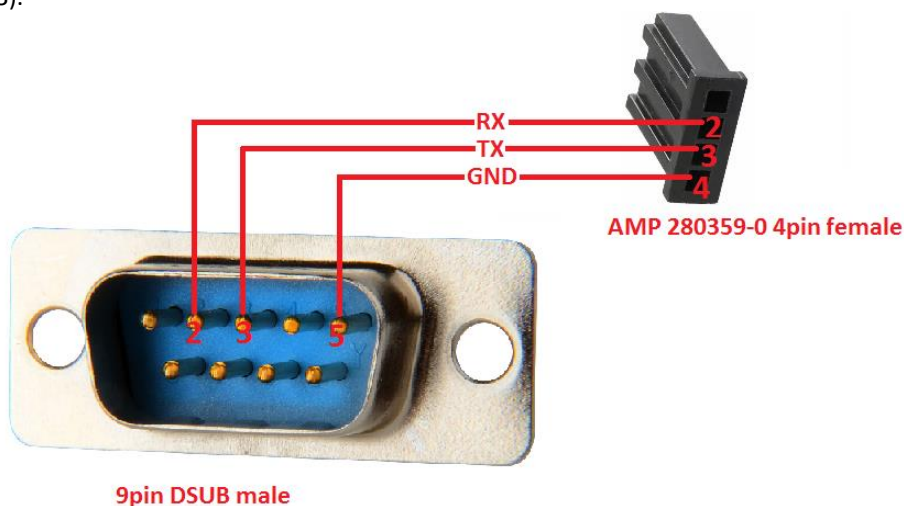
Communication Control

To launch the communication, type *CAEN* and then <Enter>
As the communication is established, the Main Menu will be displayed.

---

[4] The CAEN Mod. NIM8301 is a 7U (5+2) full size NIM crate (19"-12 slot) available with pluggable 300W and 600W power supplies, ventilated by pluggable 2U fan unit. Remote control and monitoring take place through CAN bus, Ethernet, USB and RS232 interfaces.

CAEN Electronic Instrumentation

Remote Control: Main Menu

```
##  ##  ##    ####   #####   #####
### ## ####   ## ##  ##  ## ##  ##
## # ## ##   ####### ##   ##  #####
## ### ##      ##    ##  ## ##  ##
##  ## ####   ####   #####   #####


C.A.E.N.  N1408 4 Ch HV Power Supply   V1.00   Addr 00

B O A R D   M E N U

Display          Display/Modify channels
Format           Reformat EEPROM
General          General board status
Update           Firmware Update

Quit




Select Item █
```

Type **D** to set/monitor channels parameters
Type **F** to format the EEPROM
Type **G** to monitor board status
Type **U** to upgrade the firmware
Type **Q** to exit the program

Remote Control: General Menu

By typing **G** it is possible to access the General Menu which includes the board's general settings.
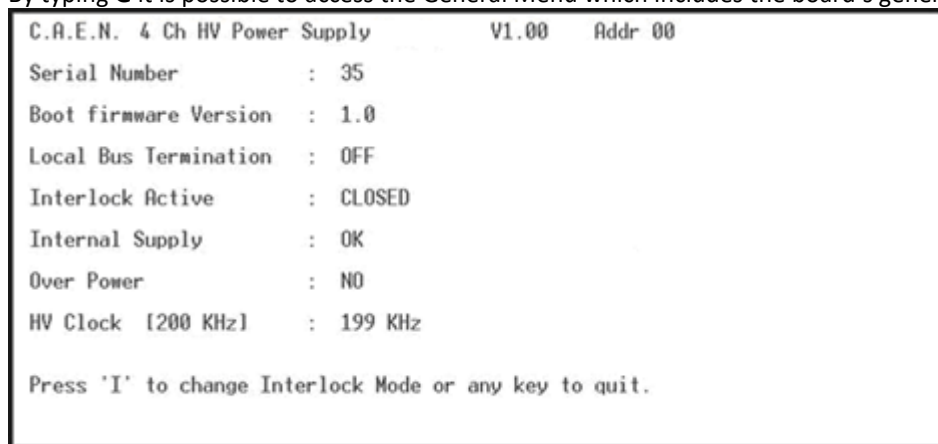
Remote Control: Channels Menu

By typing **D** it is possible to monitor and set all the channels parameters listed at p.15
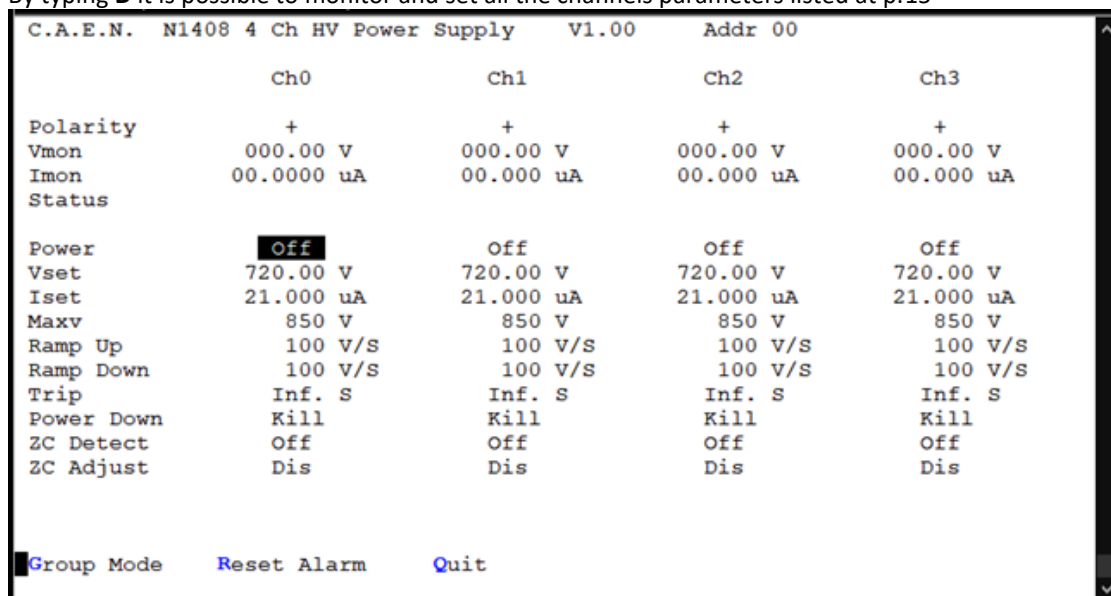
In order to change one parameter: point the parameter with the arrow keys (see figure below), and type the desired value, confirm by pressing <Enter>; Power, Power Down, ZC detect/adjust can be changed using the <Space> bar.
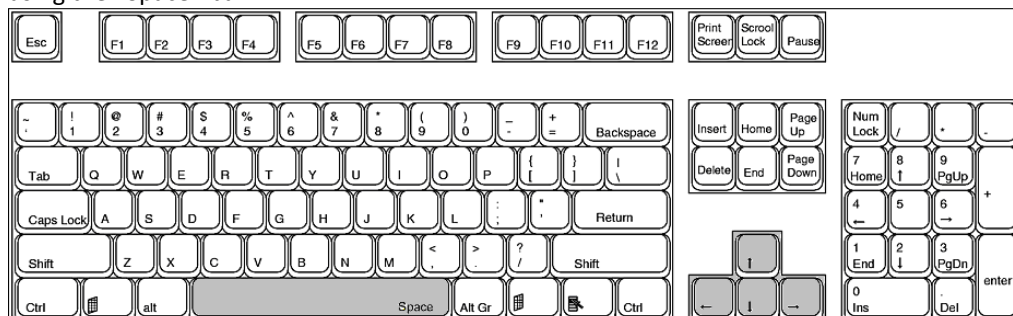
When one parameter is active, by typing G it is possible to make a "group setting", i.e. broadcast the same value to all channels (the parameter becomes active on all channels).
Type **Q** to exit the Menu.

Remote Control: firmware upgrade

N.B.: when firmware upgrade is launched, the resident firmware is ERASED; therefore, make sure the new firmware revision is available before starting the upgrade.

![CAEN Electronic Instrumentation logo]

If TeraTerm is used, set the serial port transmit delay to 1msec/line

By typing **U** it is possible to access the firmware upgrade menu:

```
C.A.E.N.        4 Ch HV Power Supply    V1.00     Addr 00

Firmware Update. Are you sure ? [y/n] _
```

If <y> is typed, then the following menu is shown:

```
C.A.E.N.        4 Ch HV Power Supply    V1.00     Addr 00

Firmware Update. Are you sure ? [y/n]

When the message  'Firmware Updating Complete'  is
displayed, wait few seconds and then press 'caen'.

Resetting ..

Flash Erasing ...

Ready to receive

Please send the new firmware
```

At this point it is necessary to upload the updated firmware.

If "HyperTerminal" is used it is necessary to perform "Transfer" and "Send Text File" operations by selecting the file "N1408.xxx"

Remote Control: format EEPROM

By typing **F** it is possible to access the format EEPROM menu:

```
C.A.E.N.        4 Ch HV Power Supply    V1.00

Format EEPROM. Are you sure ? [y/n]
```

After the FORMAT command, all the channels have the following settings:

Vset = 0 V

Iset = 2.1 µA

Ramp Up / Down = 10 V/s

Trip = 0.1 s

MaxV = 850 V

Power Down = Kill

Module setting:

Interlock Mode = Active CLOSED

USB - RS485 Communication Protocol

The following Protocol allows to communicate with up to 32 daisy chained modules. The Protocol is based on commands made of ASCII characters strings. The protocol requires firmware revision 1.0.1 or greater.

Command Format

The Format of a command string is the following :
$BD:,CMD:***,CH*,PAR:***,VAL:***.**<CR, LF >**
The fields that form the command are :

BD : **0..31** module address (to send the command)
CMD : **MON, SET**
CH : **0..4** (4 for the commands related to all Channels)
PAR : (see parameters tables)
VAL : (numerical value must have a Format compatible with resolution and range)

Format of response string

Format response in case of error

String	Function (Units)
#BD:**,CMD:ERR	Wrong command Format or command not recognized
#BD:**,CH:ERR	Channel Field not present or wrong Channel value
#BD:**,PAR:ERR	Field parameter not present or parameter not recognized
#BD:**,VAL:ERR	Wrong set value (<Min or >Max)
#BD:**,LOC:ERR	Command SET with module in LOCAL mode

Each string is terminated by **< CR, LF >**

Format response in case of correct command

String	Function (Units)
#BD:**,CMD:OK	command Ok
#BD:**,CMD:OK,VAL:***	command Ok *** = value for command to individual Channel
#BD:**,CMD:OK,VAL:*;*;*;*	command Ok *;*;*;* = values Ch0,1,2,3 for command to all Channels

Numerical value Field **'VAL'** has Format compatible (comma and decimal part) with the resolution and the range related to the parameter.
Each string is terminated by **< CR, LF >**

MONITOR commands related to the Channels

The following table contains the strings to be used to handle monitor commands related to the Channels.
The '**X**' in the Field 'Channel' can be set in the '**0..4**' range.
When '**X=4**' the module returns the values of the parameter of all 4 Channels.

String	Function (Units)
$BD:xx,CMD:MON,CH:X,PAR:VSET	Read out VSET value (XXXX.X V)
$BD:xx,CMD:MON,CH:X,PAR:VMIN	Read out VSET minimum value (0 V)
$BD:xx,CMD:MON,CH:X,PAR:VMAX	Read out VSET maximum value (800.0 V)
$BD:xx,CMD:MON,CH:X,PAR:VDEC	Read out VSET number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:VMON	Read out VMON value (XXXX.X V)
$BD:xx,CMD:MON,CH:X,PAR:ISET	Read out ISET value (XXXX.XX µA)

CAEN ⬡ Electronic Instrumentation

String	Function (Units)
$BD:xx,CMD:MON,CH:X,PAR:IMIN	Read out ISET minimum value (0 μA)
$BD:xx,CMD:MON,CH:X,PAR:IMAX	Read out ISET maximum value (20.00 μA)
$BD:xx,CMD:MON,CH:X,PAR:ISDEC	Read out ISET number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:IMON	Read out IMON value (XXXX.XX μA)
$BD:xx,CMD:MON,CH:X,PAR:IMDEC	Read out IMON number of decimal digits (2 HR, 3 LR)
$BD:xx,CMD:MON,CH:X,PAR:MAXV	Read out MAXVSET value (XXXX V)
$BD:xx,CMD:MON,CH:X,PAR:MVMIN	Read out MAXVSET minimum value (0 V)
$BD:xx,CMD:MON,CH:X,PAR:MVMAX	Read out MAXVSET maximum value (850 V)
$BD:xx,CMD:MON,CH:X,PAR:MVDEC	Read out MAXVSET number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:RUP	Read out RAMP UP value (XXX V/S)
$BD:xx,CMD:MON,CH:X,PAR:RUPMIN	Read out RAMP UP minimum value (1 V/S)
$BD:xx,CMD:MON,CH:X,PAR:RUPMAX	Read out RAMP UP maximum value (100 V/S)
$BD:xx,CMD:MON,CH:X,PAR:RUPDEC	Read out RAMP UP number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:RDW	Read out RAMP DOWN value (XXX V/S)
$BD:xx,CMD:MON,CH:X,PAR:RDWMIN	Read out RAMP DOWN minimum value (1 V/S)
$BD:xx,CMD:MON,CH:X,PAR:RDWMAX	Read out RAMP DOWN maximum value (100 V/S)
$BD:xx,CMD:MON,CH:X,PAR:RDWDEC	Read out RAMP DOWN number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:TRIP	Read out TRIP time value (XXXX.X S)
$BD:xx,CMD:MON,CH:X,PAR:TRIPMIN	Read out TRIP time minimum value (0 S)
$BD:xx,CMD:MON,CH:X,PAR:TRIPMAX	Read out TRIP time maximum value (1000.0 S)
$BD:xx,CMD:MON,CH:X,PAR:TRIPDEC	Read out TRIP time number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:PDWN	Read out POWER DOWN value (RAMP / KILL)
$BD:xx,CMD:MON,CH:X,PAR:POL	Read out POLARITY value ('+' / '-')
$BD:xx,CMD:MON,CH:X,PAR:STAT	Read out Channel status value (XXXXX)
$BD:xx,CMD:MON,CH:X,PAR:ZCADJ	Read Out Zero Current Adjust status

Meaning of STATUS bits (value read in decimal Format)

Bit	Function
Bit 0 → ON	1 : ON 0 : OFF
Bit 1 → RUP	1 : Channel Ramp UP
Bit 2 → RDW	1 : Channel Ramp DOWN
Bit 3 → OVC	1 : IMON >= ISET
Bit 4 → OVV	1 : VMON > VSET + 2.5 V
Bit 5 → UNV	1 : VMON < VSET – 2.5 V
Bit 6 → MAXV	1 : VOUT in MAXV protection
Bit 7 → TRIP	1 : Ch OFF via TRIP (Imon >= Iset during TRIP)
Bit 8 → OVP	1 : Power Max; Power Out > 0.11W

Bit 9 → OVT	1: TEMP > 105°C
Bit 10 → DIS	1 : Ch disabled (REMOTE Mode and Switch on OFF position)
Bit 11 → KILL	1 : Ch in KILL via front panel
Bit 12 → ILK	1 : Ch in INTERLOCK via front panel
Bit 13 → NOCAL	1 : Calibration Error
Bit 14, 15 → N.C.	

MONITOR commands related to the module

The following table shows the strings to be used to handle monitor commands related to the module.

String	Function (Units)
$BD:xx,CMD:MON,PAR:BDNAME	Read out module name (N1408)
$BD:xx,CMD:MON,PAR:BDNCH	Read out number of Channels present (4)
$BD:xx,CMD:MON,PAR:BDFREL	Read out Firmware Release (XX.X)
$BD:xx,CMD:MON,PAR:BDSNUM	Read out value serial number (XXXXX)
$BD:xx,CMD:MON,PAR:BDILK	Read out INTERLOCK status (YES/NO)
$BD:xx,CMD:MON,PAR:BDILKM	Read out INTERLOCK mode (OPEN/CLOSED)
$BD:xx,CMD:MON,PAR:BDCTR	Read out Control Mode (LOCAL / REMOTE)
$BD:xx,CMD:MON,PAR:BDTERM	Read out LOCAL BUS Termination status (ON/OFF)
$BD:xx,CMD:MON,PAR:BDALARM	Read out Board Alarm status value (XXXXX)

Meaning of Board Alarm bits

Bit	Function
Bit 0 → CH0	1 : Ch0 in Alarm status
Bit 1 → CH1	1 : Ch1 in Alarm status
Bit 2 → CH2	1 : Ch2 in Alarm status
Bit 3 → CH3	1 : Ch3 in Alarm status
Bit 4 → PWFAIL	1 : Board in POWER FAIL
Bit 5 → OVP	1 : Board in OVER POWER
Bit 6 → HVCKFAIL	1 : Internal HV Clock FAIL ($\neq$ 200±10kHz)

SET commands related to the Channels

The following table contains the strings to be used to handle set commands related to the Channels.
The '**X**' in the Field 'Channel' can be set to the '**0..(N-1)**' values.[5]
When '**X=N**' the command is issued to all Channels.

String	Function (Units)
$BD:xx,CMD:SET,CH:X,PAR:VSET,VAL:XXXX.X	Set VSET value

[5] **N** is the number of channels

$BD:xx,CMD:SET,CH:X,PAR:ISET,VAL:XXXX.XX	Set ISET value
$BD:xx,CMD:SET,CH:X,PAR:MAXV,VAL:XXXX	Set MAXVSET value
$BD:xx,CMD:SET,CH:X,PAR:RUP,VAL:XXX	Set RAMP UP value
$BD:xx,CMD:SET,CH:X,PAR:RDW,VAL:XXX	Set RAMP DOWN value
$BD:xx,CMD:SET,CH:X,PAR:TRIP,VAL:XXXX.X	Set TRIP time value
$BD:xx,CMD:SET,CH:X,PAR:PDWN,VAL:RAMP/KILL	Set POWER DOWN mode value
$BD:xx,CMD:SET,CH:X,PAR:ON	Set Ch ON
$BD:xx,CMD:SET,CH:X,PAR:OFF	Set Ch OFF
$BD:xx,CMD:SET,CH:X,PAR:ZCADJ,VAL:EN/DIS	Enables or disables the Zero Current Adjust
$BD:xx,CMD:SET,CH:X,PAR:ZCDTC	Set the present IMon value as zero current

SET commands related to the module

| String	Function (Units)
$BD:xx,CMD:SET,PAR:BDILKM,VAL:OPEN/CLOSED	Set Interlock Mode
$BD:xx,CMD:SET,PAR:BDCLR	Clear alarm signal

# 5   Internal Settings

Polarity selection

The output polarity is independently selectable for each channel. Note that the polarity is indicated by two LEDs for each channel on the front panel.
In order to change the polarity:

- Wear Antistatic Gloves
- Switch off the unit
- Wait for the complete discharge of the capacitors.
- Lay down the unit, right side up
- Remove screws 1, 2, 3, 4, 5, 6, see figure (red):
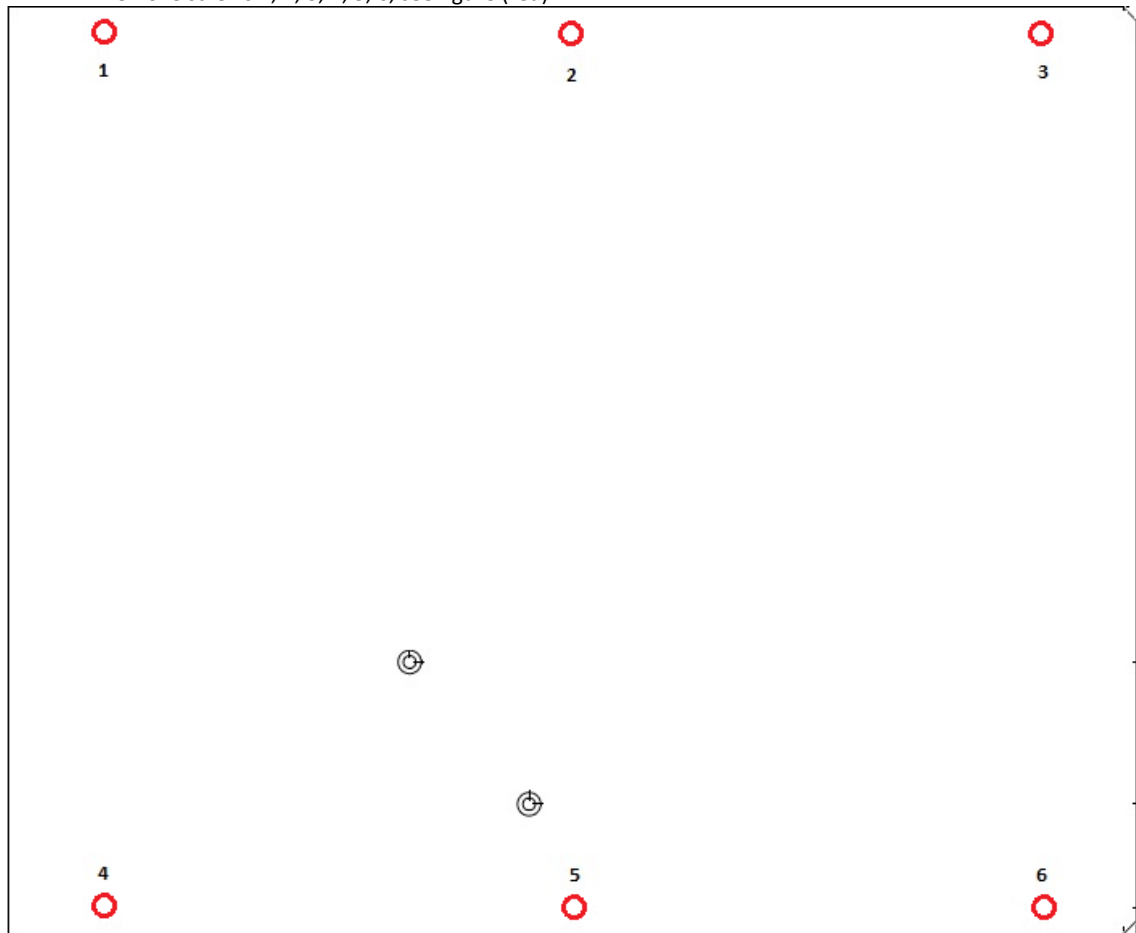
- Lift the side cover gently
- At this point it is possible to change the channel polarity: refer to the following figure (the blue arrow indicates diode bridge box placed to configure channel as POSITIVE).
- During this operation pay attention not to bend the pins, as they are plugged completely in their sockets

↑ POSITIVE POLARITY

CONNECTOR SIDE

↑ NEGATIVE POLARITY
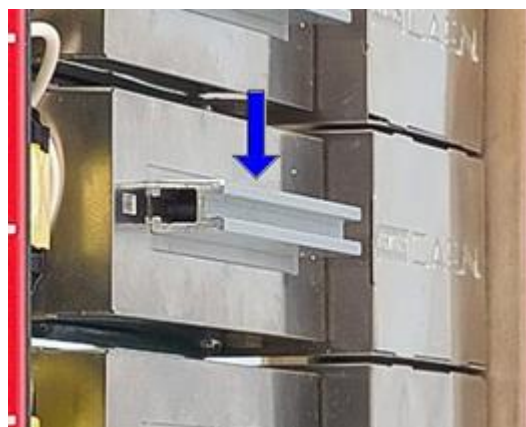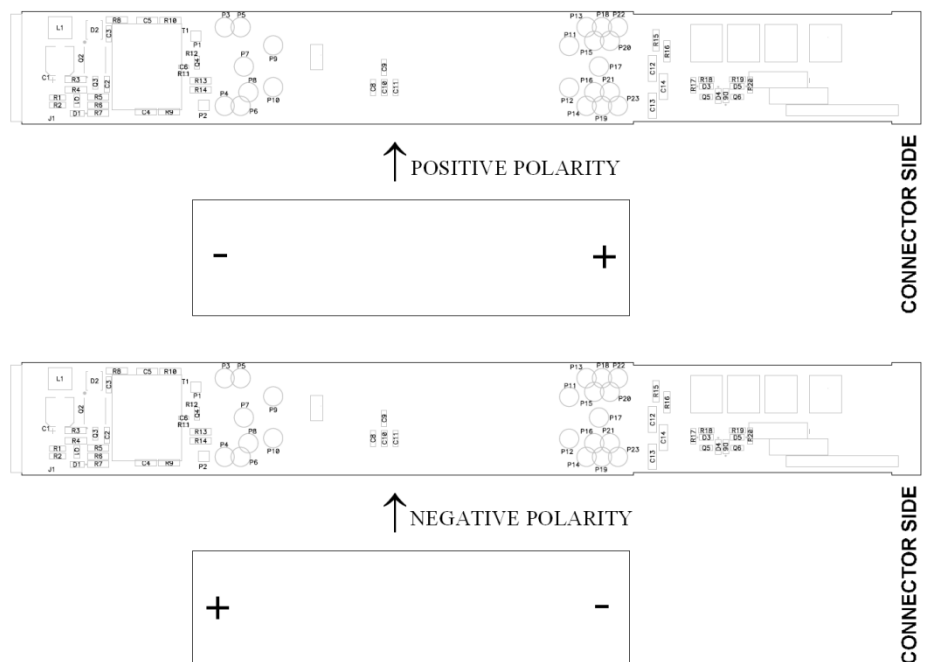
CONNECTOR SIDE

- In order to choose the POSITIVE POLARITY, plug the diode bridge box, with the + symbol towards the connector side.
- In order to choose the NEGATIVE POLARITY, plug the diode bridge box, with the - symbol towards the connector side.
- Always pull and plug the diode bridge box by holding it on the handle pointed by the arrow in Fig. above.

Once settings are done, put the right side cover back in place with screws 1, 2, 3, 4, 5, 6.

Internal switches
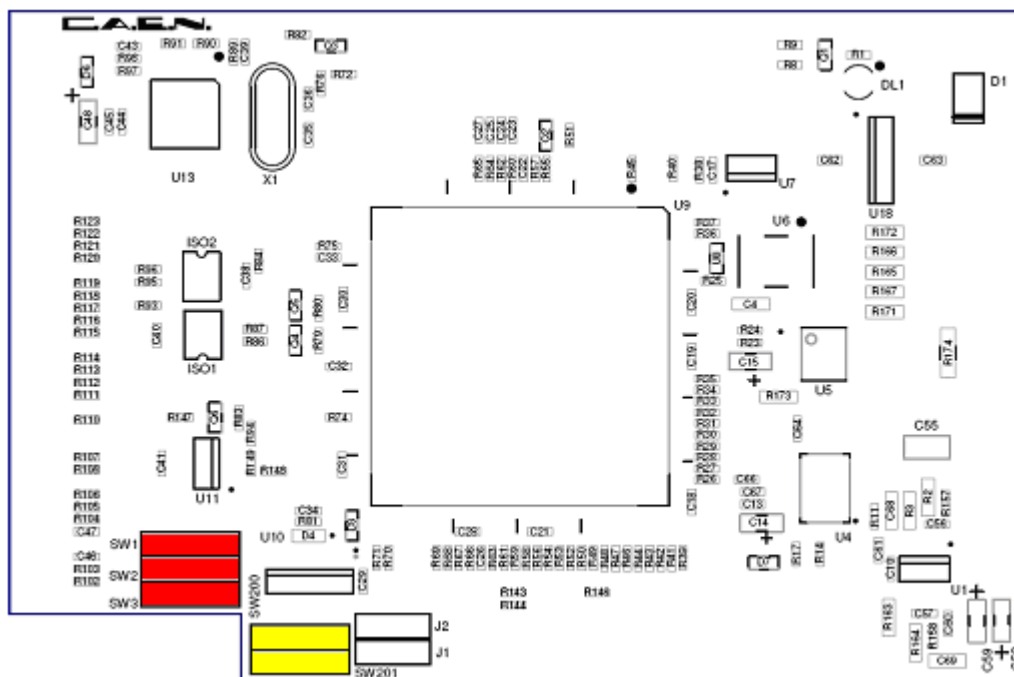
Local Bus termination

The SW[1..3] switch placed on the Microcontroller board inside the module (behind the *Remote communication control section*, see p. 12), allows to terminate the Local Bus for daisy chain purposes (see p. 23); dot NOT visible = Termination ON.

RS485 – RS232 conversion

The SW[200, 201] switch placed on the Microcontroller board inside the module, allows to adapt RS485 signals to RS232; dot visible = Adaptation ON.

Grounding specifications

The Mod. N14xx channels share a common floating return (FAGND), insulated from the crate ground (AGND). This feature allows on-detector grounding, thus avoiding loops which may increase noise level. FAGND and AGND may be connected, by short circuiting C21 jumper pins on the motherboard (see figure below). The protection shield must be screwed off in order to access C21 (see p.33).
Please note that older versions of the N14xx may not have C21 jumper installed; contact info@caen.it for details.
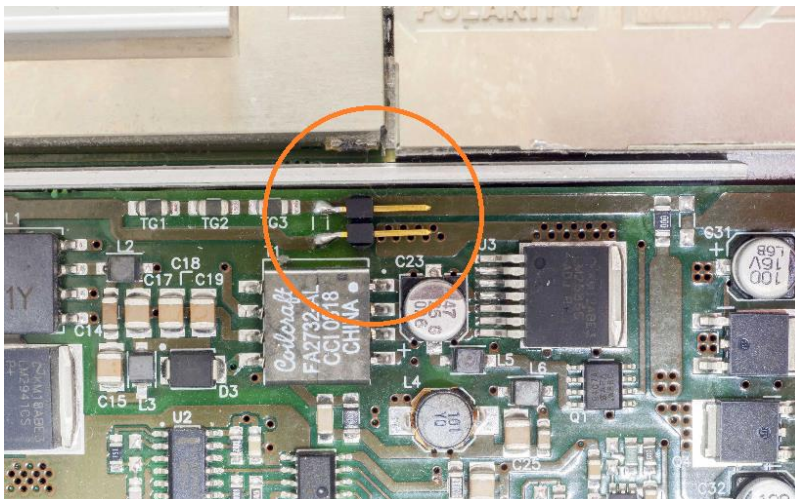
Safety Earth connection

The connection of return to Earth is fundamental for User safety. The connection must always be at the level of detector or power supply system.

Return connection even if not present or performed incorrectly, due to protection circuits implemented on the N14xx are bound to Earth; in this case the voltage difference between return and Earth (System), is limited to approximately 50V. Please note that this is a status of emergency-protection, not a working one. The Connector Configurator allows to optimize the connection of the return and of AGND (Earth). The best configuration must be determined by the user upon application, the optimal connection depends on many characteristics of the related experiment.

The following diagrams show two examples of configuration, namely:

The "closed loop " Earth configuration (C21 contacts closed)

The "open loop" Earth configuration (C21 contacts open)
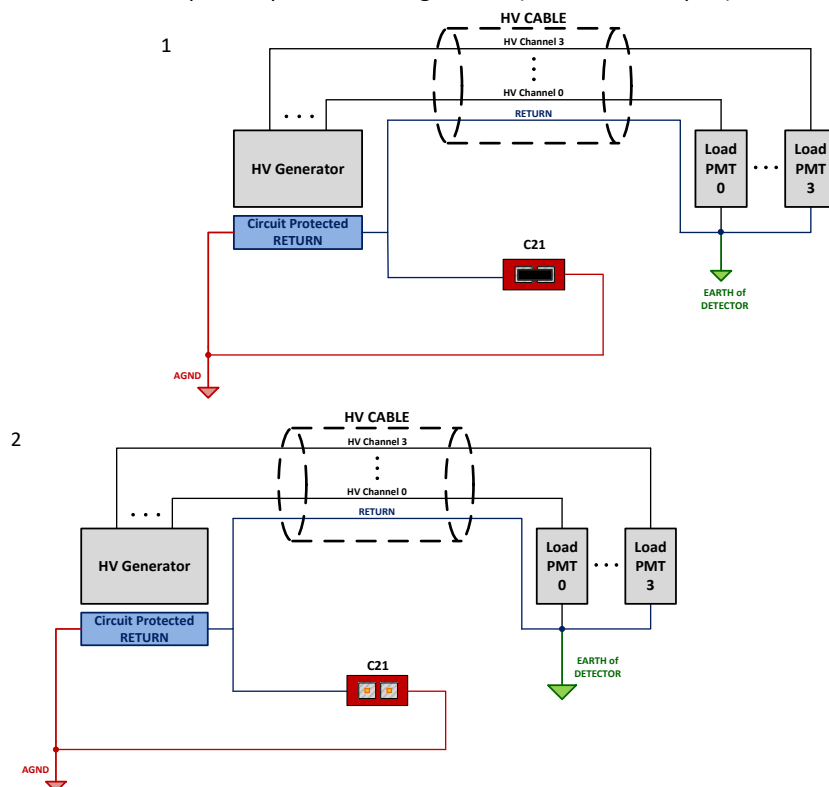
6   Instructions for Cleaning

The equipment may be cleaned with isopropyl alcohol or deionized water and air dried. Clean the exterior of the product only.

Do not apply cleaner directly to the items or allow liquids to enter or spill on the product.

Cleaning the Touchscreen

To clean the touchscreen (if present), wipe the screen with a towelette designed for cleaning monitors or with a clean cloth moistened with water.

Do not use sprays or aerosols directly on the screen; the liquid may seep into the housing and damage a component. Never use solvents or flammable liquids on the screen.

Cleaning the air vents

It is recommended to occasionally clean the air vents (if present) on all vented sides of the board. Lint, dust, and other foreign matter can block the vents and limit the airflow. Be sure to unplug the board before cleaning the air vents and follow the general cleaning safety precautions.

General cleaning safety precautions

CAEN recommends cleaning the device using the following precautions:

- Never use solvents or flammable solutions to clean the board.
- Never immerse any parts in water or cleaning solutions; apply any liquids to a clean cloth and then use the cloth on the component.
- Always unplug the board when cleaning with liquids or damp cloths.
- Always unplug the board before cleaning the air vents.
- Wear safety glasses equipped with side shields when cleaning the board

7   Device decommissioning

After its intended service, it is recommended to perform the following actions:
- Detach all the signal/input/output cable
- Wrap the device in its protective packaging
- Insert the device in its packaging (if present)

THE DEVICE SHALL BE STORED ONLY AT THE ENVIRONMENT CONDITIONS SPECIFIED IN THE MANUAL, OTHERWISE PERFORMANCES AND SAFETY WILL NOT BE GUARANTEED

CAEN **Electronic Instrumentation**

8 Disposal

The disposal of the equipment must be managed in accordance with Directive 2012/19 / EU on waste electrical and electronic equipment (WEEE).

The crossed bin symbol indicates that the device shall not be disposed with regular residual waste.

UM7352 – N1408 4Ch NIM Programmable HV Power Supply (±800V, 20µA) User Manual Rev. 2

CAEN Electronic Instrumentation

9 Technical Support

To contact CAEN specialists for requests on the software, hardware, and board return and repair, it is necessary a MyCAEN+ account on www.caen.it:

https://www.caen.it/support-services/getting-started-with-mycaen-portal/

All the instructions for use the Support platform are in the document:
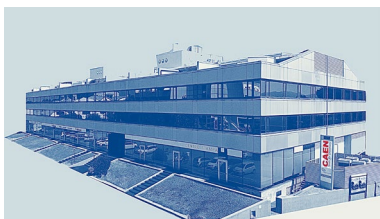
A paper copy of the document is delivered with CAEN boards.

The document is downloadable for free in PDF digital format at:

https://www.caen.it/wp-content/uploads/2022/11/Safety_information_Product_support_W.pdf

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