CAEN
Tools for Discovery

Electronic Instrumentation

N1410 Programmable HV Power Supply
±1kV / 200µA

Rev. 1 - 12 September 2024

Purpose of this Manual

This document is the N1410 User's Manual; it contains information about the installation, the configuration and the use of the unit.

Change Document Record

Date	Revision	Changes
9 May 2022	0	Preliminary
12 September 2024	1	Technical specifications table

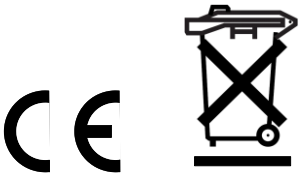
Symbols, abbreviated terms and notation

Not applicable

Reference Documents

CAENGECO2020 Control Software User’s Manual

CAENHVWrapper Software Library User’s Manual



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1. General description

Overview

The Mod. N1410 provides 4 independent High Voltage channels in a single width NIM mechanics.

Each channel can provide a ±1kV / 200µA max output.

Channels have common floating return (common return insulated from the crate ground); HV outputs are delivered through SHV 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 N1410's daisy chain network (up to 32 modules).

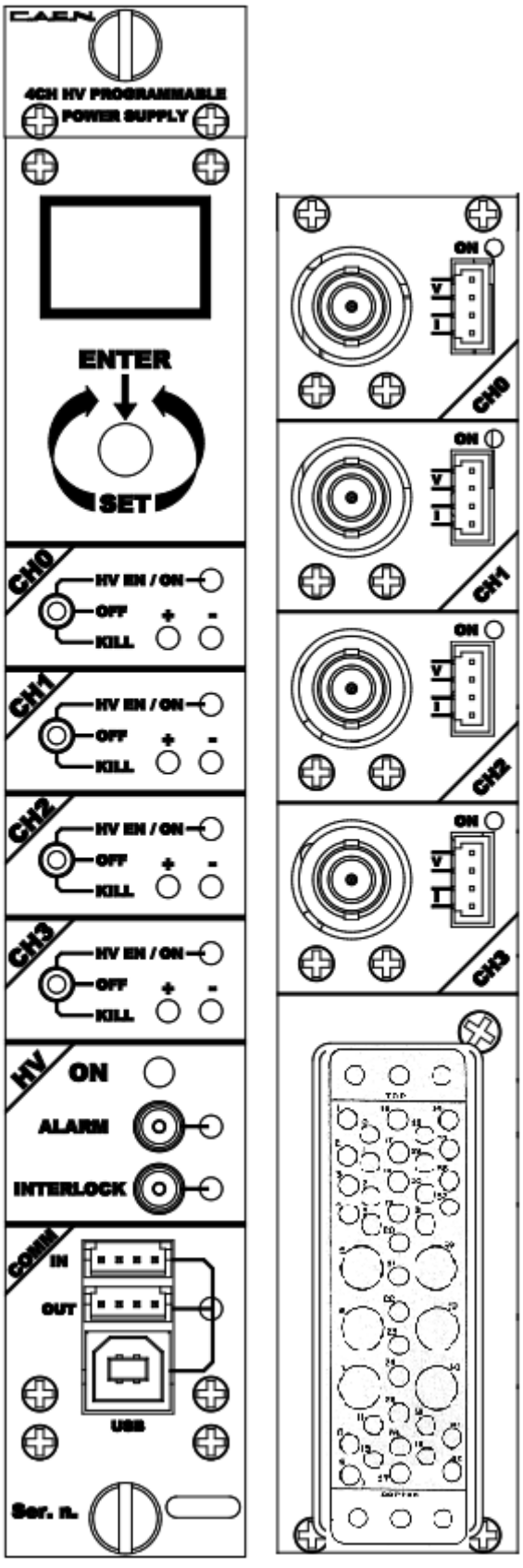
For remote operation, CAEN also provides GECO2020, a graphical application that allows to manage the N14xx HV Power Supplies (as well as all other CAEN Power Supplies).

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).

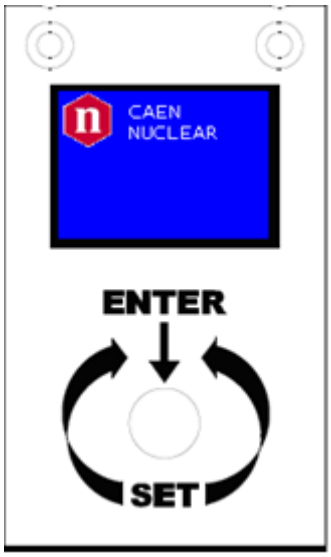
2. Technical specifications

Front and back panel



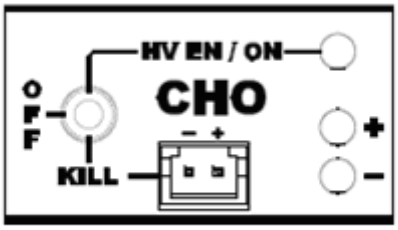
Front panel connections

Local control section



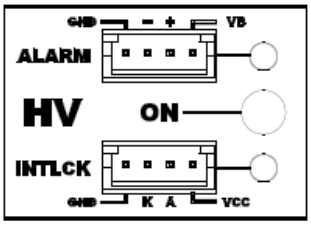
NAME:	TYPE:	FUNCTION:
MONITOR	1" OLED DISPLAY (96x64)	*Local settings monitoring*
TUNE	ROTARY SWITCH	*Parameter and Mode setting*

Channel control section



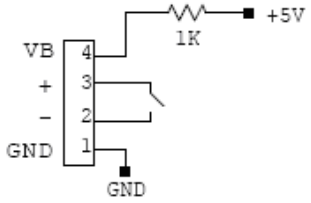
NAME:	TYPE:	FUNCTION:
HV_EN/OFF/KILL	3 POS. SWITCH	*Channel Enable and turning OFF/KILL*
ON	RED LED	*HV On enabled*
REMOTE KILL	AMP 280370-2	*The channel is KILLED either as the +/- contacts are open or as a +4÷6Vdc voltage is fed to pin -*
+	GREEN LED	*Positive polarity*
-	YELLOW LED	*Negative polarity*

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

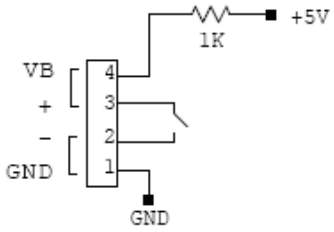


As an Alarm condition is detected (see p. 26 and 27) pins 2 and 3 (- and +) are closed; the contact can be used to switch an external device supplied by an external source, otherwise the VB and GND references can be used to provide a TTL compatible level on pin 2 and 3.

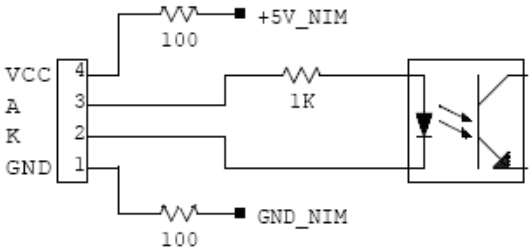
In the first case (externally supplied device) the maximum allowed ratings are:

- Maximum voltage between + and -: 12V
- Maximum sink current across + and -: 100mA

In the latter case, 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



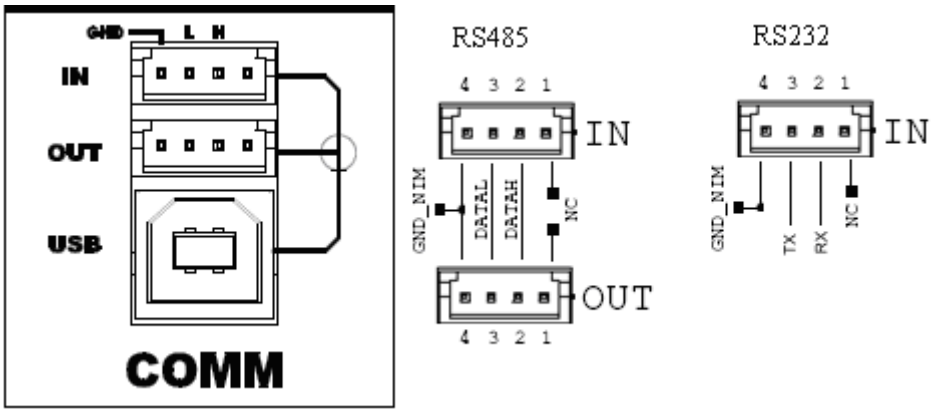
A schematic diagram of the Interlock input is shown in the figure above, where the diode is part of optocoupler stage.

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

CONFIGURATION ↓	INTERLOCK MODE (p.11) →	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 turned off at the fastest available rate, regardless the RAMP DOWN setting.

Remote communication control section

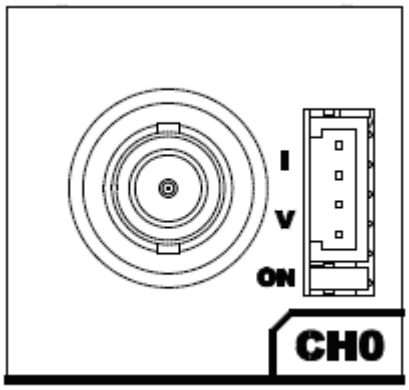


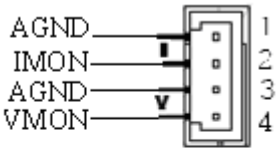
NAME:	TYPE:	FUNCTION:
IN	AMP 280371-2	*RS485 Input[1]; adaptable to RS232 standard*
OUT	AMP 280371-2	*RS485 Output*
USB	B TYPE USB	*USB2.0 compliant realized via USB ↔ RS232 FT232BM converter*

[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	SHV RADIALL R317580; Impedance: 50 Ohm; Frequency range: 0 – 2 GHz; VSWR: <1.20 + 0.3 F (GHz) – (plug and jack); Test voltage: 10kV DC – 1mn (unmated connectors); Ratings: 12kV DC – 1mn (mated pairs); Current rating: 10 A	*HV Channel Output*

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

VMON:	Voltage level (1V = 273 V ±1% readout; same polarity as channel)
IMON Range = High:	Voltage level (1V = 44 µA ±3% readout; positive, 0÷5 V range)
IMON Range = Low:	Voltage level (1V = 4.4 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.29)
Output voltage		0 ÷ 1kV
Max. Output current	**High**	200µA
	Low	20µA
Max. Ch. Output Power		200 mW
Vset Resolution		20 mV
Vmon Resolution		20 mV
Iset Resolution		5nA
Imon Resolution	**High**	5nA
	Low	500pA
Vmax:		0 ÷ 1050 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 % ± 20mV
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 ±0.5V
	Vset vs. Vmon	±0.02% of read value ±0.5V
	Imon vs. Iout **High**	±2% of read value ±20nA
	Low	±2% of read value ±2nA
	Iset vs. Imon **High**	±2% of read value ±30nA
	Low	±2% of read value ±3nA
Voltage Ripple (10Hz ÷ 20MHz)		Typical: 3 mVpp; maximum: 5 mVpp
Humidity range		0 ÷ 80%
Operating temperature		0 ÷ 45°C
Storage temperature		-10 ÷ 70°C
Vout / Temperature coefficient		max. 50ppm / °C
Imon / Temperature coefficient		max 100ppm/C°; max 300ppm/C° with Imon X10 zoom
Long term stability Vout vs. Vset		± 0.02% (after one week @ constant temperature)

[2] From 10% to 90% of Full Scale Range

3. Operating modes

CAUTION: N1410 MUST BE USED ONLY IN NIM CRATES WITH FORCED COOLING AIR FLOW!

Module control can take place either locally, or remotely, via USB or RS485 (see p. 20).

Safety requirements and Initial inspection

N.B. read carefully the "Precautions for Handling, Storage and Installation" document provided with the product before starting any operation!

The following HAZARD SYMBOLS are reported on the unit:

CAUTION: indicates the need to consult the "Precautions for Handling, Storage and Installation" document provided with the product. **A potential risk exists if the operating instructions are not followed**

HIGH VOLTAGE: indicates the presence of electric shock hazards. Enclosures marked with these symbols should only be opened by CAEN authorized personnel.

To avoid risk of injury from electric shock, do not open this enclosure

To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.

Avoid Electric Overload. To avoid electric shock or fire hazard, do not power a load outside of its specified range.

Avoid Electric Shock. To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

Do Not Operate without Covers. To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere. To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Do Not Operate with Suspected Failures. If you suspect this product to be damaged, have it inspected by qualified service personnel.

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.

The kit includes:

- N1410 NIM power supply unit
- USB cable

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.

The N1410 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.

Connect the unit's output to the supplied device, before turning the NIM crate ON, via power supply cables matching the output ratings. Always turn the NIM crate OFF, before disconnecting the power supply cables (wait at least 30s before connecting or disconnecting HV cables).

Programmable parameters

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.14) 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.7)	
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.20):

Parameter:	Function:	Unit:	Display:
Vmon	High Voltage Monitored value	Volt	
Imon	Current Monitored value	µA	
ImRange	Range of monitored current	High or Low	
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. 10)	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.10)	s	
Zero Current Adjust	Enables or disables the Zero Current Adjust	Enable / Disable	
Zero Current Detect	Set the present IMon value as zero current	On / Off	

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.6) is lit up if Local Control is enabled.

HV connection

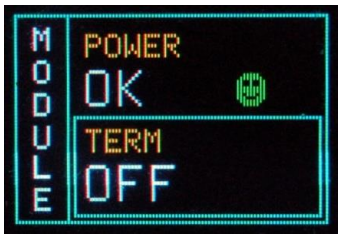
Verify the channels polarity (polarity setting is explained at p.29) checking that the polarity LEDs are switched on according to the programmed configuration (see p.6); verify the HV_EN/OFF/KILL 3 POS. SWITCH of each channel is set to OFF; the Display will show the following message in the left lower 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:

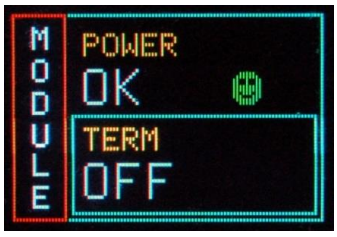
The KILL position of the HV_EN/OFF/KILL 3 POS. SWITCH allows to turn off the module at the fastest available rate; the Display will show the following message in the left lower row:

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

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

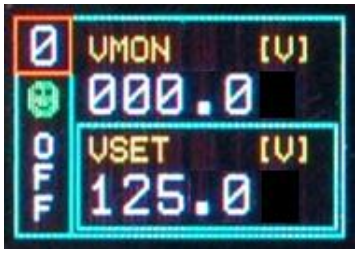
Push the TUNE ROTARY SWITCH: at this point the value digit becomes yellow and can be edited

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, Zero Current Adjust, Zero Current Detect and Imon Range settings have not digits to be edited, but two options, TRIP/KILL, Enable/Disable, On/Off 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.20) is set to REMOTE, the left lower row reports DIS (Disabled), since the channel can be accessed only via the serial links (see p.20). 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.7).

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.

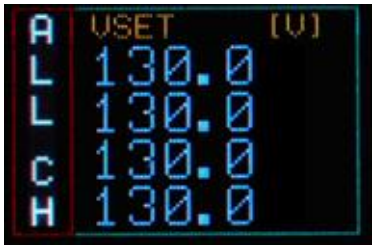
Turn the TUNE ROTARY SWITCH until the value digit to be edited is shown in blue, the parameter name in yellow

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 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.



To go to individual channel settings, the EXIT parameter must be selected

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

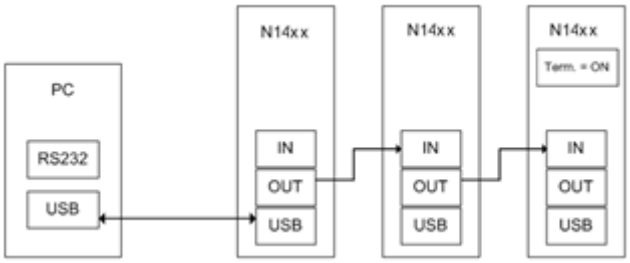
- If, after the ZC Adjust, the monitored current is lower than the stored “zero”, a negative current value will be returned.
- If the operation is performed with load disconnected, the “void” current calibration will be obtained.

Remote Control

Module control can take place remotely, via USB or RS485; the latter allows to build a N1410s’ daisy chain network. The CAEN NIM Smart Fan Unit allows also to communicate with the module via Ethernet.

Serial Links

USB communication



The module is provided with a USB2.0 compliant interface (see p.6). The N1410 can be programmed via PC by connecting the PC USB port with the N1410 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)

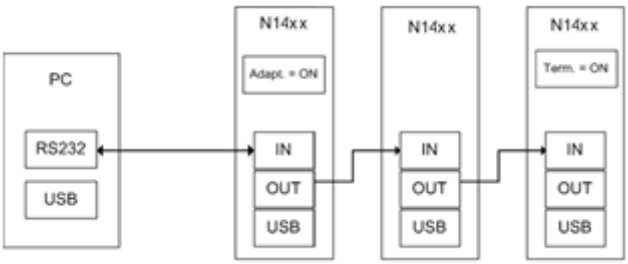
The connection can be performed via terminal emulator, such as HyperTerminal,

configured as follows:

- baud rate 9600 (the same set on the N1410; See p.15)
- 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 N1410’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.25 ; in this case communication with the chained modules is achieved through the USB - RS485 Communication Protocol, see p.25. All modules must be assigned a LOCAL BUS ADDRESS (see p.12) different from one another and the last one must be terminated (see p.31).

RS232 communication



In order to control the module via RS232 it is necessary to use the module’s COMM IN port (refer to p.8 for RS232 signals) and to follow adaptation instructions (see p.31).

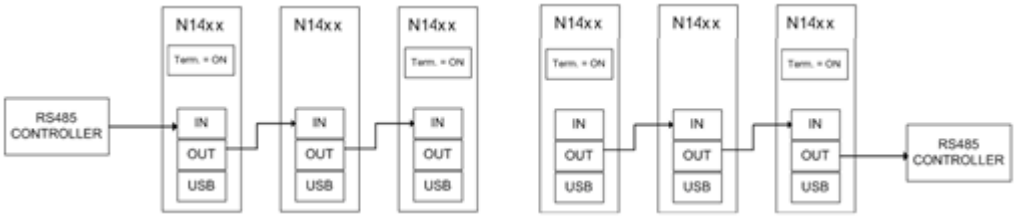
The connection can be performed via terminal emulator, such as HyperTerminal,

configured as follows:

- baud rate 9600 (the same set on the N1410; See p.12)
- 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 N1410'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.8; 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 (see p.12) different from one another and the last one must be terminated (see p.31).

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:

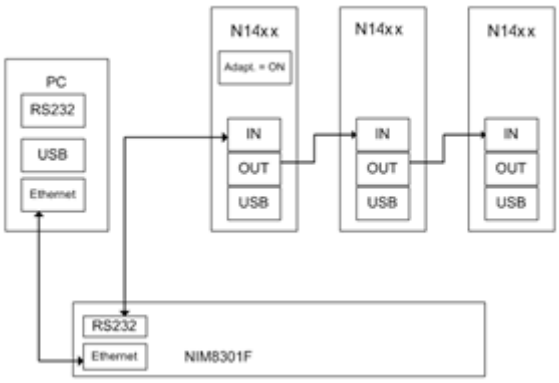
- Connect the connector OUT of a module to corresponding the IN connector of the next one
- Assign to each module a different address (LOCAL BUS ADDR); see p. 12
- Ensure that the LOCAL BUS BIT RATE is the same for all modules; see p. 12
- Terminate the first and the last module in the chain (see p.31)

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

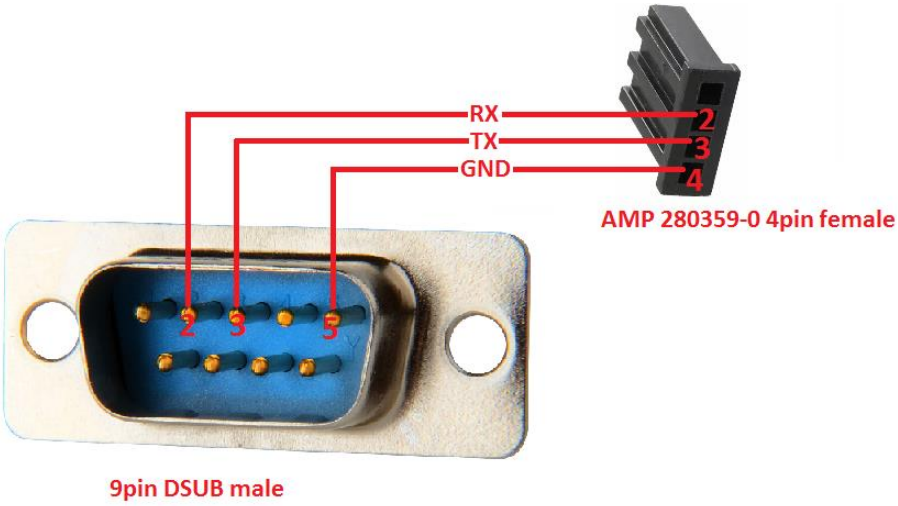
- by connecting a RS485 controller to the first module's COMM IN port
- by connecting a RS485 controller to the last module's COMM OUT port

Communication with the chained modules is achieved only through the USB - RS485 Communication Protocol, see p.20.

Ethernet communication



It is possible to communicate via Ethernet with one or more daisy chained N1410 modules through the CAEN NIM Smart Fan Unit[3]. 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 N1410 COMM IN port; SW[200, 201] switch placed on the Microcontroller board inside the module must be set to Adaptation ON (see p.29).

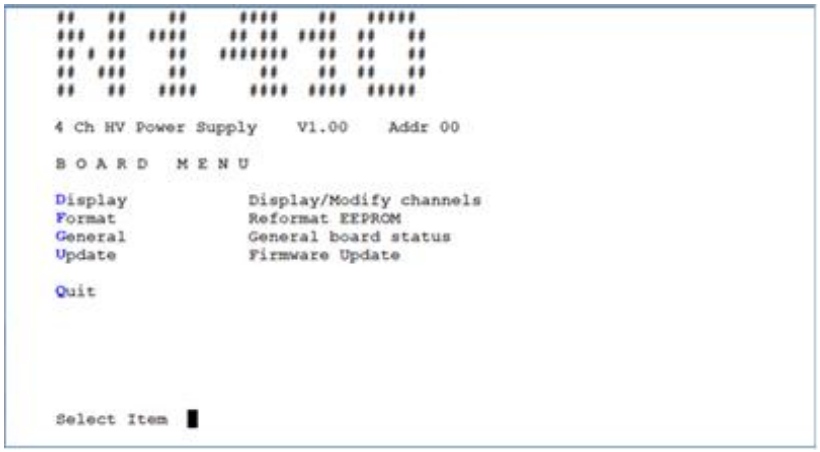


Communication Control

To launch the communication, type *CAEN* and then <Enter>

As the communication is established, the Main Menu will be displayed.

Remote Control: Main Menu



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

[3] CAEN NIM Smart Fan Unit: Remote control and monitoring take place through CAN bus, Ethernet, USB and RS232 interfaces

Remote Control: General Menu

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

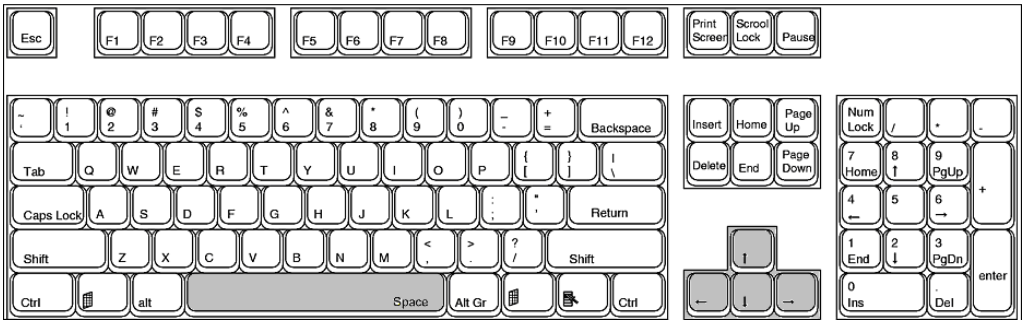
```
C.A.E.N.  4 Ch HV Power Supply          V1.00    Addr 00
Serial Number              :  35
Boot firmware Version      :  1.0
Local Bus Termination      :  OFF
Interlock Active           :  CLOSED
Internal Supply            :  OK
Over Power                 :  NO
HV Clock  [200 KHz]        :  199 KHz

Press 'I' to change Interlock Mode or any key to quit.
```

Remote Control: Channels Menu

By typing **D** it is possible to monitor and set all the channels parameters listed at p.11

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

                  Ch0            Ch1            Ch2            Ch3

Polarity           +              +              +              +
Vmon          000.00 V       000.00 V       000.00 V       000.00 V
Imon          00.0000 uA     00.000 uA      00.000 uA      00.000 uA
Status

Power             Off            Off            Off            Off
Vset          720.00 V       720.00 V       720.00 V       720.00 V
Iset          21.000 uA      21.000 uA      21.000 uA      21.000 uA
Maxv             850 V          850 V          850 V          850 V
Ramp Up          100 V/S        100 V/S        100 V/S        100 V/S
Ramp Down        100 V/S        100 V/S        100 V/S        100 V/S
Trip            Inf. S         Inf. S         Inf. S         Inf. S
Power Down      Kill           Kill           Kill           Kill
ZC Detect       Off            Off            Off            Off
ZC Adjust       Dis            Dis            Dis            Dis
Imon Range      High           High           High           High

Group Mode     Reset Alarm     Quit
```

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.

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 "N1410.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 = 20 µA
Ramp Up / Down = 50 V/s
Trip = 0.1 s
MaxV = 1050 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)

String	Function (Units)
$BD:xx,CMD:MON,CH:X,PAR:VMAX	Read out VSET maximum value (1000.0 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)
$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 (200.00 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:IMRANGE	Read out IMON RANGE value (HIGH / LOW)
$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 (1050 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 > 0.2W
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 (N1410)
$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 (≠ 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.[4]

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
$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:IMRANGE,VAL:HIGH/LOW	Set IMON RANGE
$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

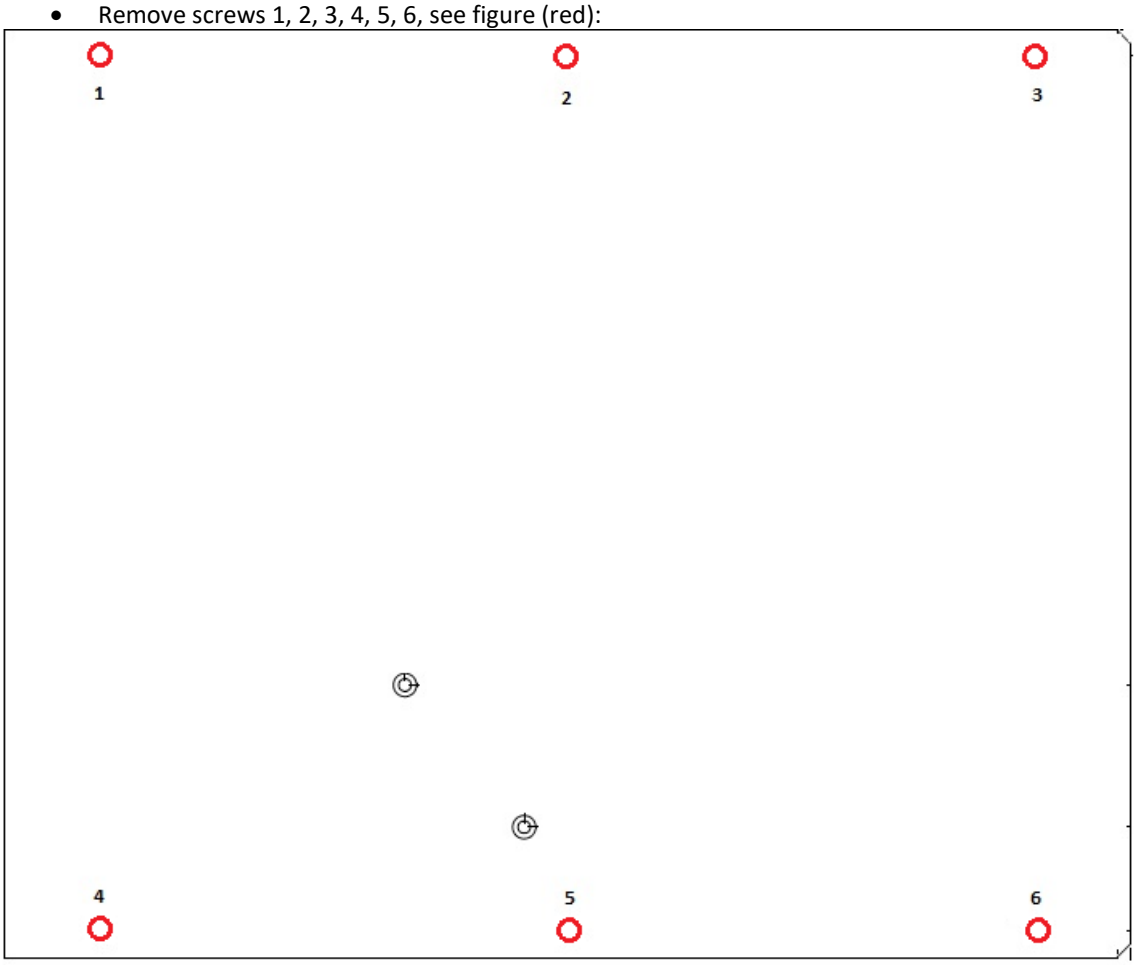
[4] **N** is the number of channels

4. Internal Settings

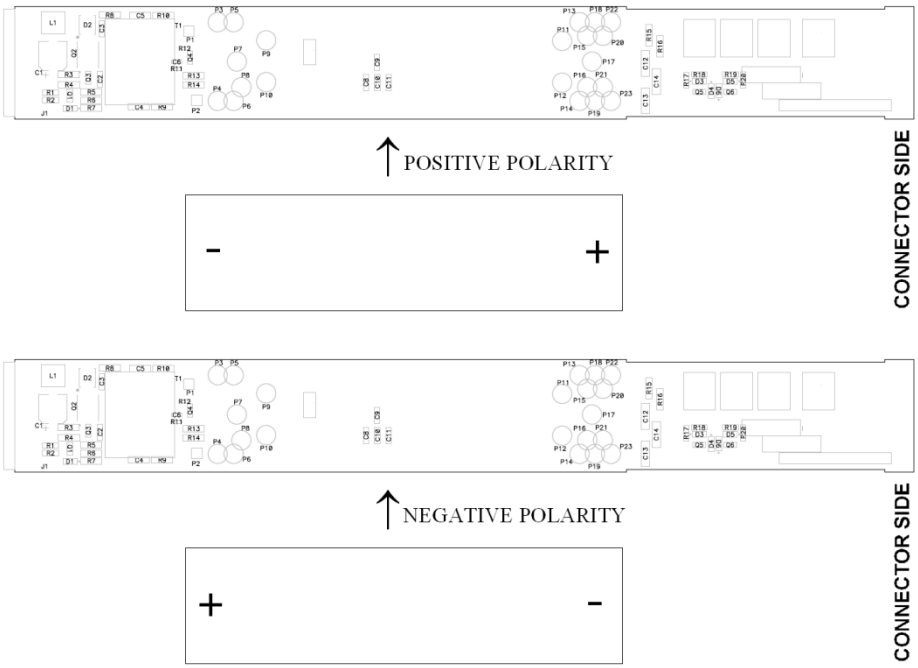
Polarity selection

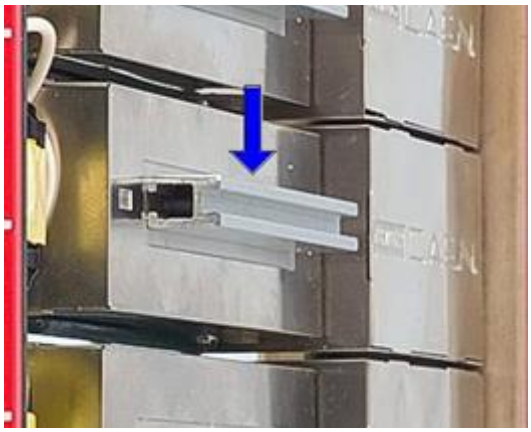
The output polarity is independently selectable for each channel. Note that the polarity is indicated by two LEDs for each channel on the front panel.
To change the polarity:

- 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

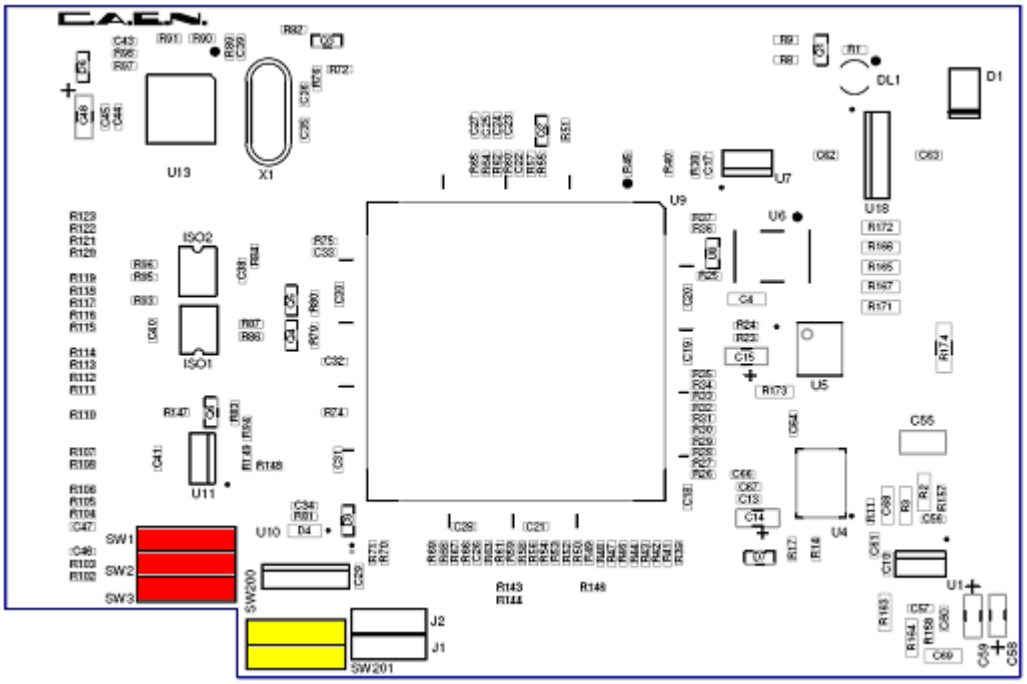




- To choose the POSITIVE POLARITY, plug the diode bridge box, with the + symbol towards the connector side.
- To choose the NEGATIVE POLARITY, plug the diode bridge box, with the - symbol towards the connector side.
- Always pull and plug the diode bridge box by holding it on the handle pointed by the 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

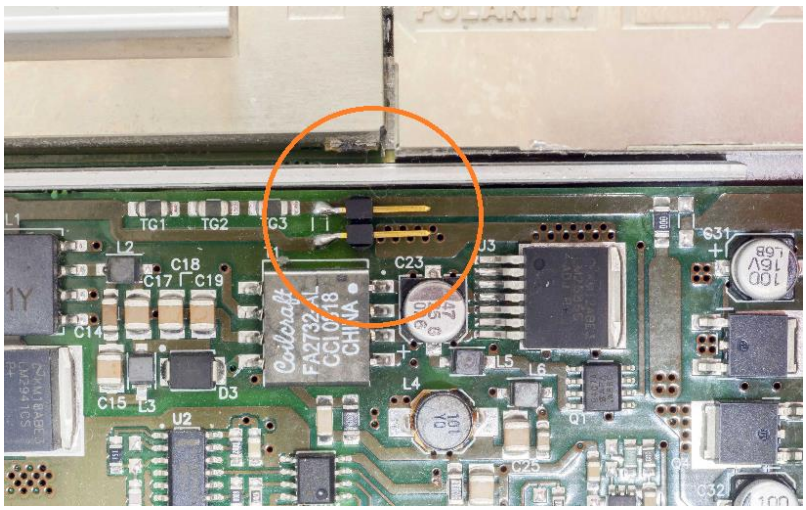
The SW[1..3] switch placed on the Microcontroller board inside the module (behind the *Remote communication control section*, see p. 8), allows to terminate the Local Bus for daisy chain purposes (see p. 20); dot NOT visible = Termination ON.

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 to access C21 (see p.29).



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.

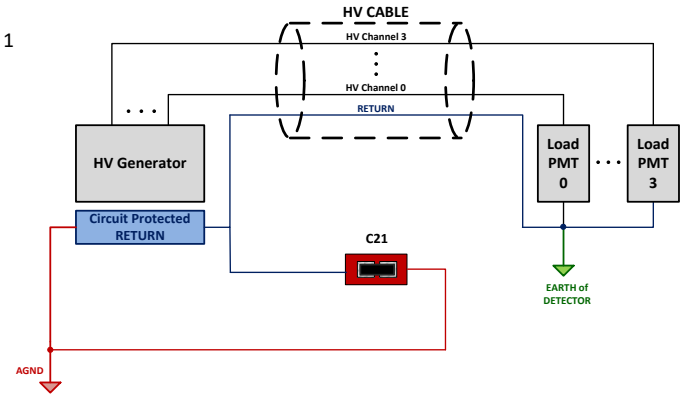
Return connection even if not present or performed incorrectly, due to protection circuits implemented on the N14xx are bound to Earth; in this case the voltage difference between return and Earth (System), is limited to approximately 50V. Please note that this is a status of emergency-protection, not 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:

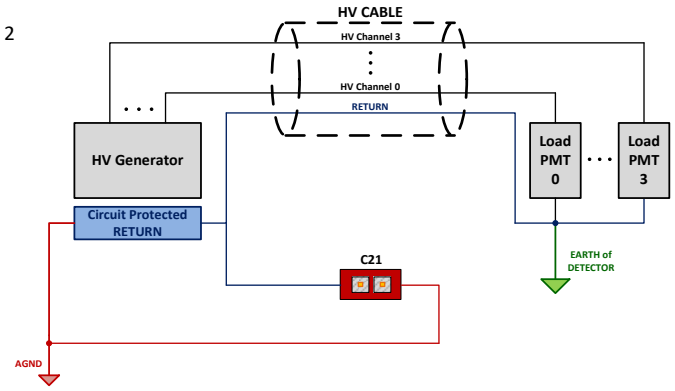
The “closed loop “ Earth configuration (C21 contacts closed)

The “open loop” Earth configuration (C21 contacts open)

1



2



CAEN SpA is acknowledged as the only company in the world providing a complete range of High/Low Voltage Power Supply systems and Front-End/Data Acquisition modules which meet IEEE Standards for Nuclear and Particle Physics. Extensive Research and Development capabilities have allowed CAEN SpA to play an important, long term role in this field. Our activities have always been at the forefront of technology, thanks to years of intensive collaborations with the most important Research Centres of the world. Our products appeal to a wide range of customers including engineers, scientists and technical professionals who all trust them to help achieve their goals faster and more effectively.

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