CAEN
Tools for Discovery

Electronic Instrumentation

UM2027

NDT14xx, N14xxET, N1570 NIM & Desktop HV Power Supplies

Rev. 22 - 29 March 2021

Purpose of this Manual

This document is the NDT14xx / N14xxET NIM & DeskTop HV Power Supplies User's Manual; it contains information about the installation, the configuration and the use of the Power Supply System.

Change Document Record

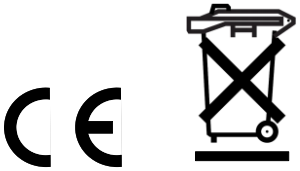
Date	Revision	Changes
29 April 2013	3	Updated Technical specs. Table, Imon Zoom
1 July 2013	4	Added SHV connector features
4 July 2013	5	Added A1480
4 April 2014	6	Added N14xxET series; Grounding specs
11 April 2014	7	Updated table 4
16 May 2014	8	Updated: Ethernet Config.; Fig.2; Tab. 2 & 4; Operating modes; Polarity setting
21 July 2014	9	Updated §1
22 June 2015	10	HV Channel Output updated
2 December 2015	11	EPICS Service description
7 January 2016	12	Added N1570; updated Technical specs. Table
9 May 2016	13	N1570 info updated; Technical specs. Table
16 January 2017	14	Updated hardware KILL description
9 March 2017	15	Updated USB communication
3 April 2019	16	Updated conversion table p.12
21 October 2019	17	Updated table 1
2 March 2020	18	Updated Technical specs. Table
6 August 2020	19	Updated Technical specs. Table
22 October 2020	20	Ethernet settings (DHCP); available with fw release >2.10
12 February 2021	21	Updated ripple specs. Table 6
29 March 2021	22	Updated USB communication, Technical specs. Table, Remote Control

Symbols, abbreviated terms and notation

T.B.D.

Reference Documents

T.B.D.



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1. Overview

Fig. 1: Mod. NDT14xx/N14xxET and N1570

The Mod. NDT14xx/N14xxET series provide 4 independent High Voltage channels in double width NIM mechanics. NDT14xx's support also desktop operation (can be connected directly to 110/220V AC mains, without a NIM crate); four output ranges are available. The more powerful N1570 provides 2 HV channels.

Table 1: Available versions

Model	NDT1419/N1419ET	NDT1470/N1470ET	NDT1471/N1471ET	NDT1471H/ N1471HET	N1570
Number of channels	4	4	4	4	2
V Full Scale (kV)	± 0.5	± 8	± 5.5	± 5.5	±15
I Full Scale (mA)	0.2	3 (@3kV)	0.3	0.02	1
Vset/Vmon res (mV)	10	200	100	100	500
Ramp UP/DWN fsr (V/s)	50	500	500	500	500
Iset/Imon (H) res (nA)	5 Iset/Imon	50 Iset/Imon	5 Iset/Imon	1 Iset/Imon	20 Iset/Imon
Imon (L) resolution (nA)	0.5 Imon	5 Imon	0.5 Imon	0.05 Imon	2Imon
Output connectors	SHV	SHV	SHV	SHV	HV LEMO

Module Control can take place either locally, assisted by a 2.8" Touchscreen Graphic color LCD display or remotely, via USB, or Ethernet, the latter allowing to build a daisy chain network.

For remote operation, CAEN also provides GECO2020, a graphical application that allows to manage the NDT14xx/N14xxET/N1570 HV Power Supplies (and 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 a 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).

The output polarity is independently selectable for each channel. Channels have common floating return (common return insulated from the crate ground); HV outputs are delivered through SHV connectors.
Safety features include:

- OVERVOLTAGE and UNDERVOLTAGE warning when the output voltage differs from the programmed value by more than 2% of set value (minimum 10V).
- 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

Common Interlock logic for channels enable/disable and individual inputs signal for channel Kill function.
The Mod. A1480, a DC Input Power Equalizer which allows to use a different input power distribution (not available on the NDT14xx modules), is optionally available (see Table 2).

2. Technical specifications

Packaging

The Units are housed in double width NIM mechanics. Weight is 2.6kg approximately.

Power requirements

NIM Crate

When operated in a NIM crate, the Power absorption requirements are the following:

Table 2: Power absorption

NDT1419/N1419ET Without A1480				N1419ET With A1480		
Channel output	N° ch ON	Current ± 12V	Current ±6V	Max n° CH ON	Current ± 12V	Current ±6V
500V/200µA	4 CH	500 mA	<10mA	4 CH	T.B.D	T.B.D
NDT1470/N1470ET Without A1480				**N1470ET With A1480**		
Channel output	Max n° CH ON[1]	Current ±12V	Current ±6V	Max n° CH ON	Current ± 12V	Current ± 6V
3kV/3mA	3 CH	2.80 A	<10mA	4 CH	1.85 A	4.30 A
4kV/2mA	4 CH	2.84 A	<10mA	4 CH	1.52 A	3.50 A
8kV/1mA	4 CH	3.16 A	<10mA	4 CH	1.68 A	3.90 A
NDT1471/N1471ET Without A1480				**N1471ET With A1480**		
Channel output	N° ch ON	Current ± 12V	Current ±6V	Max n° CH ON	Current ± 12V	Current ±6V
3kV/300µA	4 CH	860 mA	< 10mA	4 CH	750 mA	800 mA
5.5kV/30µA	4 CH	720 mA	< 10mA	4 CH	630 mA	600 mA
5.5kV/300µA	4 CH	1.02 A	< 10mA	4 CH	800 mA	900 mA
NDT1471H/N1471HET Without A1480				**N1471HET With A1480**		
Channel output	N° ch ON	Current ± 12V	Current ±6V	Max n° CH ON	Current ± 12V	Current ±6V
3kV/20µA	4 CH	720 mA	< 10mA	4 CH	570 mA	700 mA
5.5kV/2µA	4 CH	850 mA	< 10mA	4 CH	630 mA	880 mA
5.5kV/20µA	4 CH	870 mA	< 10mA	4 CH	630 mA	860 mA
N1570 Without A1480				**N1570 With A1480**		
Channel output	N° ch ON	Current ± 12V	Current ±6V	Max n° CH ON	Current ± 12V	Current ±6V
10kV/1mA	2 CH	3750mA	< 10mA	2 CH	2070mA	3860mA
7.5kV/250µA	2 CH	1780mA	<10mA	2 CH	1110mA	1580mA
14kV/450µA	2 CH	3180mA	<10mA	2 CH	1710mA	3380mA

AC Powered Desktop Operation (NDT14xx only)

If NDT14xx is connected to the Mains, through the provided power cord, the Unit is powered by 100 - 240 Vac (50 - 60 Hz).

[1] The maximum number is considered with channels at FULL LOAD

PIN	FUNCTION
1	+3 Volts
2	-3 Volts
3	SPARE
4	RESERVED
5	COAXIAL
6	COAXIAL
7	COAXIAL
8	+200 Volts D.C.
9	SPARE
10	+6 Volts
11	-6 Volts
12	RESERVED
13	CARRY NO. 1
14	SPARE
15	RESERVED
16	+12 Volts
17	-12 Volts
18	SPARE
19	RESERVED
20	SPARE
21	SPARE
22	RESERVED
23	RESERVED
24	RESERVED
25	RESERVED
26	SPARE
27	SPARE
28	+24 Volts
29	-24 Volts
30	SPARE
31	CARRY NO. 2
32	SPARE
33	117 V A.C. (HOT)
34	POWER RET. GND
35	RESET
36	GATE
37	SPARE
38	COAXIAL
39	COAXIAL
40	COAXIAL
41	117 V A.C (NEUT.)
42	HIGH QUAL. GND
G	GROUND GUIDE PIN

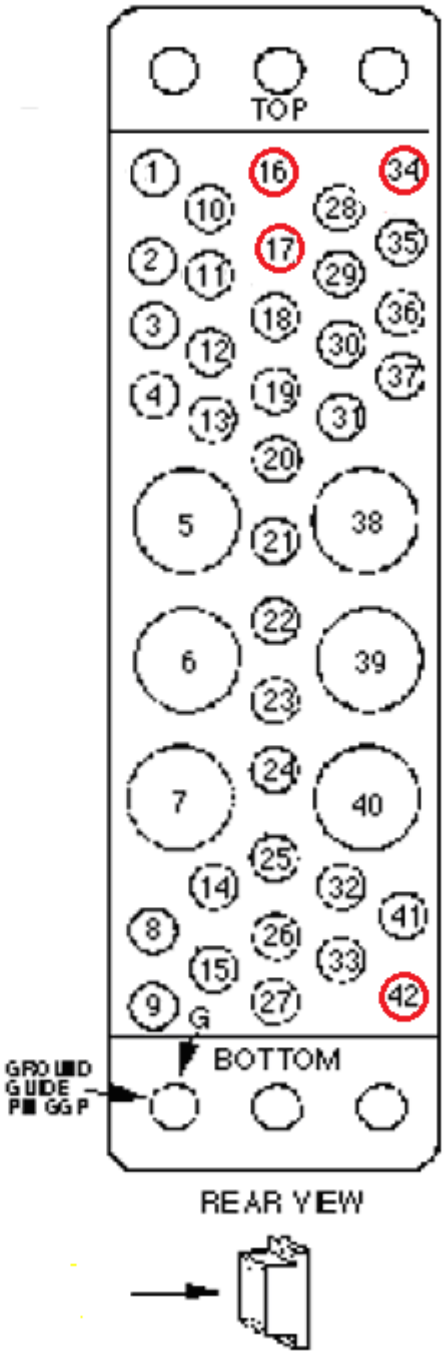


Fig. 2: Backplane NIM connector

Front panel

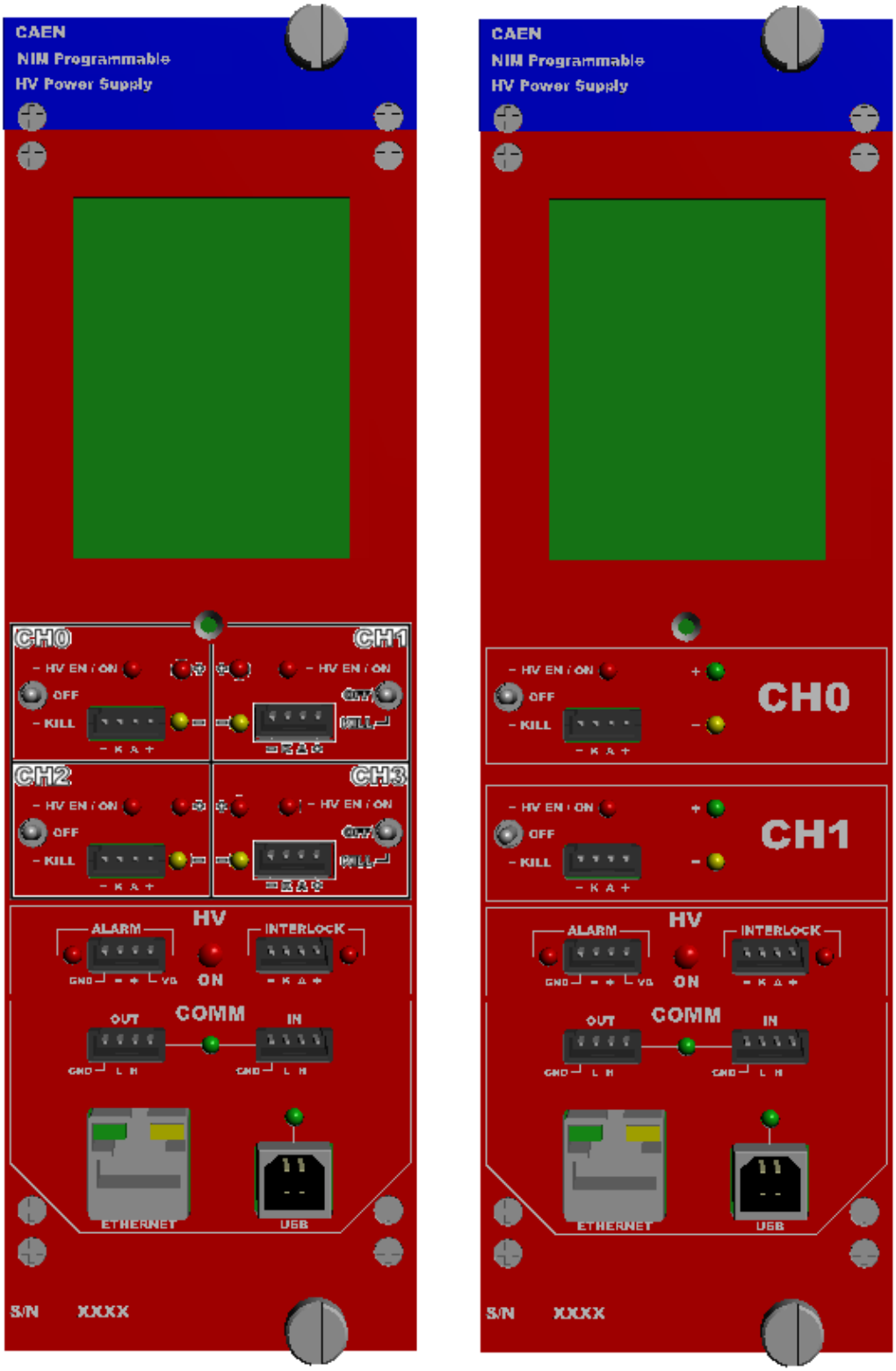


Fig. 3: Front panel

Front panel connections

Local control section

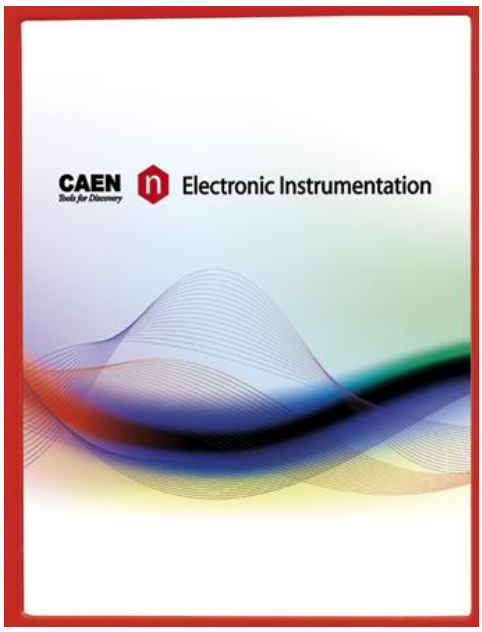


Fig. 4: Local control panel

NAME:	TYPE:	FUNCTION:
MONITOR	2.8" LED Touch Screen	*Parameter and Mode setting; Local settings monitoring*

Channel control section

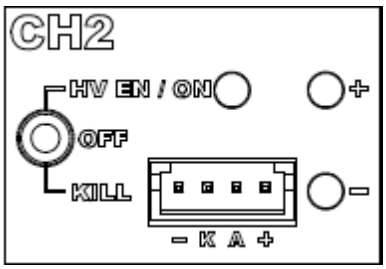


Fig. 5: Channel control panel and Kill scheme

NAME:	TYPE:	FUNCTION:
HV_EN/OFF/KILL	3 POS. SWITCH	*Channel Enable and turning OFF/KILL*
ON	RED LED	*HV On enabled*
+	GREEN LED	*Positive polarity*
-	YELLOW LED	*Negative polarity*
REMOTE KILL	AMP 280371-2	*See below*

Kill signal

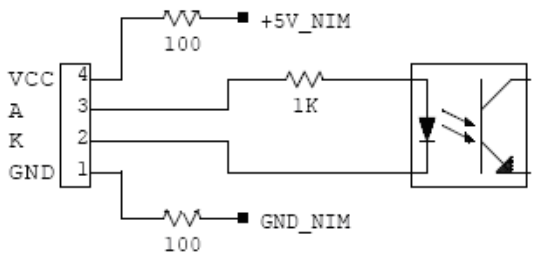


Fig. 6: KILL electrical scheme

A schematic diagram of the Kill input is shown in the figure above, where the diode is part of opto-coupler stage. Kill means that channels are hardware turned off. The following table explains the Kill operation:

Table 3: Kill operation

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

HV Status control section

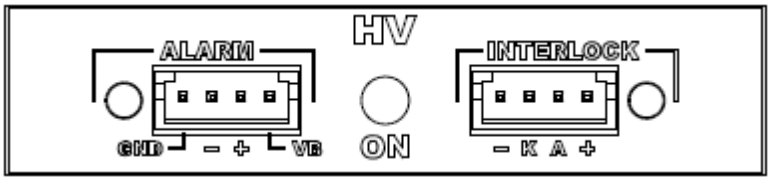


Fig. 7: HV Status control panel

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

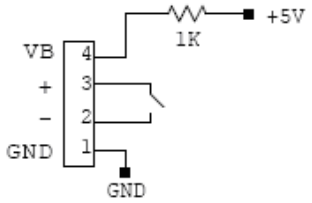


Fig. 8: ALARM electrical scheme

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:

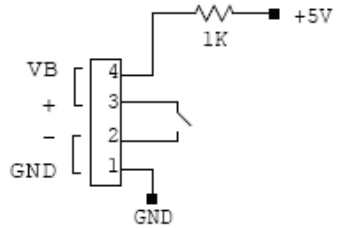


Fig. 9: ALARM TTL configured

Interlock signal

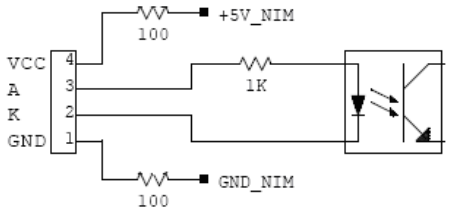


Fig. 10: INTERLOCK electrical scheme

A schematic diagram of the Interlock input is shown in the figure above, where the diode is part of opto-coupler stage.
Interlock means that channels are hardware disabled. The following table explains the interlock operation:

Table 4: Interlock operation

CONFIGURATION ↓	INTERLOCK MODE →	*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 active; as INTERLOCK is active, channels are turned off at the fastest available rate, regardless the RAMP DOWN setting.

Remote communication control section

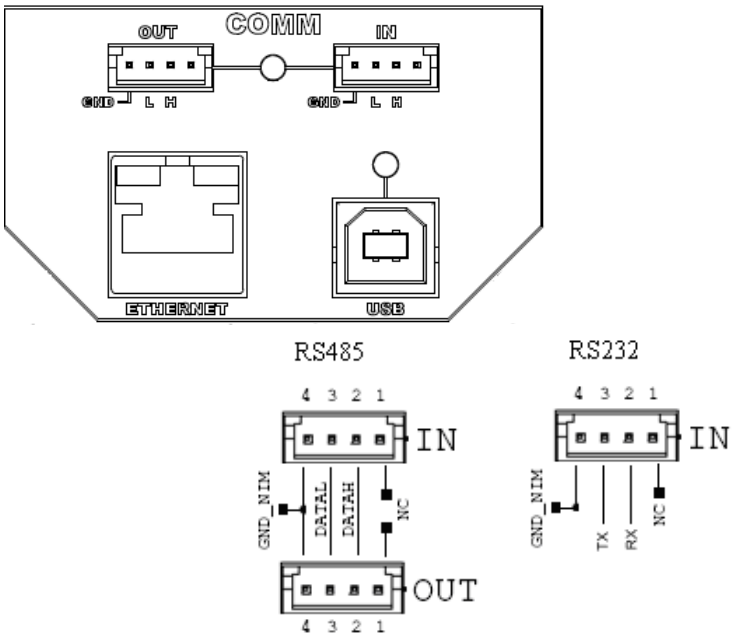


Fig. 11: Remote communication control and RS485 I/O – RS232 IN electrical scheme

NAME:	TYPE:	FUNCTION:
IN	AMP 280371-2	*RS485 Input*[2]*;*
OUT	AMP 280371-2	*RS485 Output*
USB	B TYPE USB	*USB2.0 compliant*
ETH	10Base-T female connector	TTL signals (TCP/IP)

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

Rear panel connections

HV Channel Output

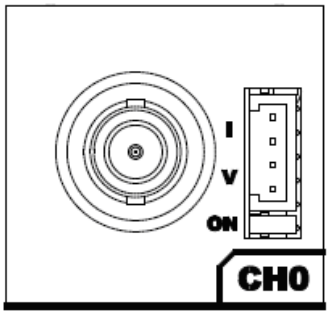
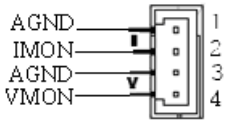
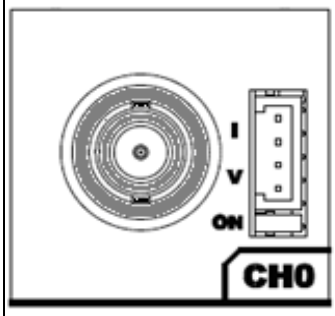
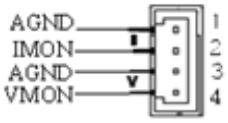
NDT14xx/N14xxET			N1570		
 			 		
NAME	**TYPE**	**FUNCTION**	**NAME**	**TYPE**	**FUNCTION**
OUT	SHV RADIALL R317580 Impedance: 50 Ohm Frequency range: 0 – 2 GHz VSWR: <1.20 + 0.3 F (GHz) – (plug and jack) Test voltage: 10kV DC – 1mn (unmated connectors) 12kV DC – 1mn (mated pairs) Current rating: 10 A	*HV Channel Output*	*OUT*	LEMO HV ERA3S415CTL	*HV Channel Output*
MON	AMP 280371-2	*Vout/Iout Test point*	MON	AMP 280371-2	*Vout/Iout Test point*

Fig. 12: HV Channel panel and test point electrical scheme

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

VMON	NDT1419/N1419ET	Voltage level	1V = 118 V ±1% readout; same polarity as channel
	NDT1470/N1470ET		1V = 1.8kV ±1% readout; same polarity as channel
	NDT1471/N1471ET		1V = 1.5 kV ±1% readout; same polarity as channel
	NDT1471H/N1471HET		1V = 1.5 kV ±1% readout; same polarity as channel
	N1570		1V = 4 kV ±1% readout; same polarity as channel
IMON HI RANGE	NDT1419/N1419ET		1V = 67 µA ±3% readout; positive, 0÷5 V range
	NDT1470/N1470ET		1V = 660 µA ±3% readout; positive, 0÷5 V range
	NDT1471/N1471ET		1V = 66 µA ±3% readout; positive, 0÷5 V range
	NDT1471H/N1471HET		1V = 4.55 µA ±3% readout; positive, 0÷5 V range
	N1570		1V = 260 µA ±3% readout; positive, 0÷5 V range
IMON LOW RANGE	NDT1419/N1419ET		1V = 6.7 µA ±3% readout; positive, 0÷5 V range
	NDT1470/N1470ET		1V = 66 µA ±3% readout; positive, 0÷5 V range
	NDT1471/N1471ET		1V = 6.6 µA ±3% readout; positive, 0÷5 V range
	NDT1471H/N1471HET		1V = 455 nA ±3% readout; positive, 0÷5 V range
	N1570		1V = 26 µA ±3% readout; positive, 0÷5 V range

AC Input (NDT14xx only)

IEC 60 320 Socket with switch; to be connected to Mains 100 - 240 Vac (50 - 60 Hz) via provided power cord.
Fuse: 6.3x32 1A Retarded 500V

Technical specifications table

Table 5: Mod. NDT14xx/N14xxET/N1570 Series technical specifications

Series			1419	1471H	1471	1470	1570
Packaging			Double width NIM mechanics. Weight: ~2.6kg				
Number of channels			4				2
Output channels			Positive or Negative Polarity (requires internal setting, see p. 29); Common Floating Return				
Output connectors			SHV				HV LEMO
Output ranges			500 V / 200µA	5.5kV / 20µA	5.5kV / 300µA	8 kV / 3 mA	15 kV / 1mA
Max. Ch. Output Power			0.1W	0.11W	1.65W	9W (≤ 3 kV); 8 W (> 3 kV)	10W (<10kV); 7W (>10kV)
Vset / Vmon Resolution			10 mV	100 mV		200 mV	500 mV
Iset Resolution			5 nA	1 nA	5 nA	50 nA	20 nA
Imon Resolution		IMON RNG H	5 nA	1 nA	5nA	50 nA	20 nA
		IMON RNG L	500pA	50pA	500pA	5 nA	2 nA
Vmax			0 ÷ 510 V	0 ÷ 5600 V		0 ÷ 8100 V	0 ÷ 15100 V
			Absolute maximum HV level that the channel can reach, independently from the preset value Vset. Output voltage cannot exceed the preset value Vmax. The accuracy is 1 % ± 5 V				
Vmax resolution			± 0.1 V	± 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÷50 Volt/s, 1 Volt/s step	1÷500 Volt/s, 1 Volt/s step			
Trip			Max. time "overcurrent" can last (seconds). Channel in "overcurrent" works as a current generator; output voltage varies 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				
"Zero" current			Zero Current Detect channel parameter allows to sample the present IMon value; this value (IMonZero) can be then subtracted via the Zero Current Adjust parameter ENABLE, from the monitored current (IMon), to compensate the current offset; if ZCAdjust = Enabled, then the IMon value is compensated. After the IMonZero value is sampled, Zero Current Detect, returns to Off. Allowed IMonZero values are from 0 to full scale. If Zero Current Adjust is DISABLED, the IMonZero compensation is neglected. (Available only on 1471H series)				
Accuracy[3]	Vmon vs. Vout		±0.02% of read value ±0.2V	±0.02% of read value ±2V			
	Vset vs. Vout		±0.02% of set value ±0.2V	±0.02% of set value ±2V			
	Imon vs. Iout	IMON RNG H	±2% of read ±20nA	±2% of read ±2nA	±2% of read ±20nA	±2% of read ±2µA	±2% of read ±1µA
		IMON RNG L	±2% of read ±2nA	±2% of read ±200pA	±2% of read ±2nA	±2% of read ±200nA	±2% of read ±100nA
	Iset vs. Imon	IMON RNG H	±2% of read ±30nA	±2% of read ±3nA	±2% of read ±30nA	±2% of read ±2µA	±2% of read ±1µA
		IMON RNG L	±2% of read ±3nA	±2% of read ±300pA	±2% of read ±3nA	±2% of read ±200nA	±2% of read ±100nA
Voltage Ripple			See p.14				
Cooling Fan (NDT14xx only)			2 Sunon 60x60x15 12V KDE1206PHV1 and 2 Mouser 40x40x20 12V 1608KL-04W-B50-L00				
Humidity range			0 ÷ 80%				
Operating temperature			0 ÷ 45°C				
Storage temperature			-10 ÷ 70°C				
Altitude			Not designed for high altitude (2000mt max.)				
Vout / Temperature coeff.			max. 50ppm / °C				
Imon / Temperature coeff.			max 100ppm/C°; max 300ppm/C° with Imon zoom[4]				
Longterm stab. Vout vs. Vset			± 0.02% (after one week @ constant temperature)				
Mean time between failures			~12 years				
EMC qualification			CEI EN 61326				

[3] Accuracy values are measured from 10% to 90% of Full Scale Range

[4] Typical data (for NDT1470/N1470ET) IMON: Imon-Zoom Offset = ±100nA; ppm/C° Imon-Zoom <300ppm/°C; Imon leakage +5nA/2Kv

Voltage Ripple

Table 6: Mod. NDT14xx/N14xxET/N1570 ripple specifications

Series			1419	1470			1471	1471H	1570		
Range			Full scale	3kV/200µA	3kv/3mA	8kV/800µA	Full scale	Full scale	7 kV/250µA	10 kV/350µA	14 kV/500µA
Bandwidth	20 ÷ 1000 Hz	Typ	5 mVpp	20 mVpp	20 mVpp	25 mVpp	10 mVpp	12 mVpp	7 mVpp	12 mVpp	20 mVpp
		Max	10 mVpp	25 mVpp	30 mVpp	30 mVpp	15 mVpp	20 mVpp	10 mVpp	15 mVpp	25 mVpp
	1 ÷ 20000 kHz	Typ	3 mVpp	5 mVpp	5 mVpp	10 mVpp	3 mVpp	2 mVpp	4 mVpp	6 mVpp	20 mVpp
		Max	5 mVpp	10 mVpp	10 mVpp	15 mVpp	8 mVpp	5 mVpp	10 mVpp	15 mVpp	25 mVpp

Imon Zoom

Imon Zoom is a feature that allows to monitor the channel current with an increased resolution in the following ranges:

1419	0 – 20 µA
1470	0 – 300 µA
1471	0 – 30 µA
1471H	0 - 2 µA
1570	0 – 100 µA

range; by selecting Imon Range = LOW, the output current is monitored with

1419	500 pA resolution (instead of 5 nA), in the 0 – 20 µA range
1470	5 nA resolution (instead of 50 nA), in the 0 – 300 µA range
1471	500 pA resolution (instead of 5 nA), in the 0 – 30 µA range
1471H	50 pA resolution (instead of 1 nA), in the 0 - 2 µA range
1570	2 nA resolution (instead of 20 nA), in the 0 – 100 µA range

It is important to notice that, if Imon Range = LOW is selected, and the channel draws a current larger than

20 µA	1419
300 µA	1470
30 µA	1471
2 µA	1471H
100 µA	1570

then Overcurrent is signalled.

3. Operating modes

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

Module control can take place either locally, assisted by a 2.8" Touchscreen Graphic color LCD display or remotely, via USB, or Ethernet (see p. 21). The module can be used in NIM Crates; NDT14xx can be used also in Desktop standalone operation

- NIM Crate operation: insert the module into a crate providing the required power supplies and ventilation
- Desktop standalone operation (NDT14xx only):
    - place the module on hard horizontal surface and connect it to the Mains
    - the module can be used either vertically or horizontally “right side up” (vents upward)

Local Control

The Units can be turned ON in one of the following ways:

- Insert the unit inside a powered NIM crate, and switch it ON
- Connect the unit to the Mains through the power cord, provided with the kit, and switch it ON

At power ON the Display shows the Main Menu (example of NDT1470):

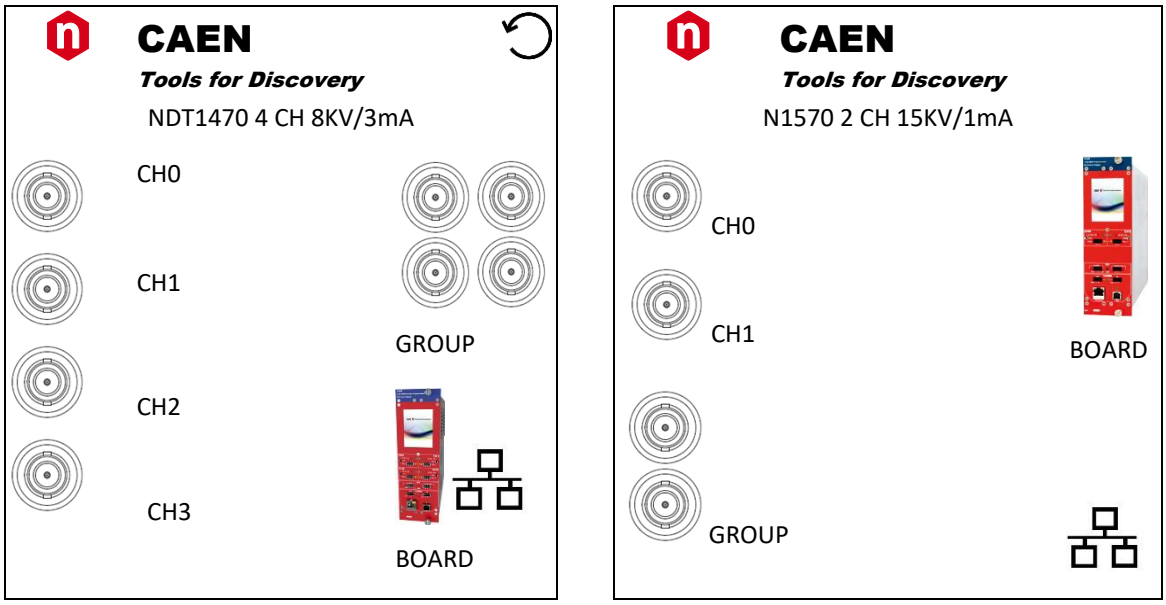


Fig. 13: Main Menu (N-NDT14xx and N1570)

At this point the module is ready to be operated locally. Tap on:

- BOARD icon to access BOARD parameters
- CHx icon to access CHANNELS parameters
- GROUP icon to access CHANNEL GROUP parameters

N.B.: during desktop operation (NDT14xx only) the module can be used either vertically or horizontally “right side up” (ventilation fans upward) and the display visualization can be rotated by tapping the “rotation symbol”

Desktop Operation

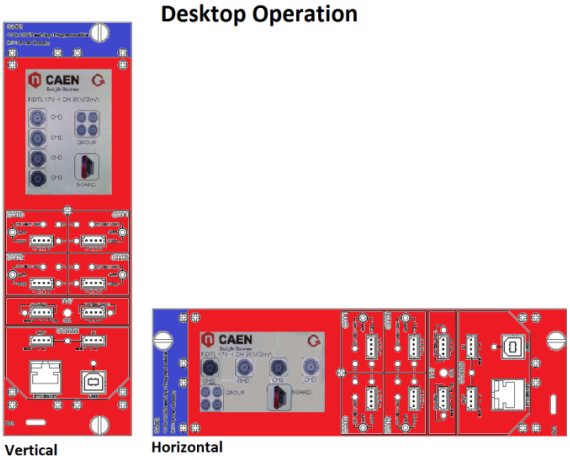


Fig. 14: Desktop operation (NDT14xx)

BOARD Settings

Board Parameters	
Power	**√**
RTerm	**Off**
HV Clock	**√**
LBusBaud	**9600**
LBusAddr	**0**
Interlock	**Closed**
Control	**Remote**
←	

Fig. 15: Board Parameters

General board parameters (CONTROL can be operated both in LOCAL and REMOTE mode; other settings are allowed in LOCAL mode only; monitor are available also with remote control) include:

Parameter:	Type:	Function:
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)
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

In order to set one parameter, set Control to “Local”, then tap on the relevant name, and change and/or enter the desired value; confirm with “Enter”. Tap the red arrow to go back to Main Menu.

Ethernet settings

Ethernet Config. Menu <
IPAddress
010.000.007.061
Mask
255.000.000.000
Gateway
255.255.255.255
√ >

MAC Address
010.000.000.000
DHCP
Disabled
√ >

Tap on the "Network" symbol to access this option, that allows to configure the Ethernet settings; once they are done, tap Mark icon to Save, but changes will only become effective at next power ON. Tap the red arrows to go forward and back.
If a DHCP Server is available, then the module can be enabled or disabled as DHCP client; tap green button to save the new setting and go back to Main Menu: the DHCP server will automatically assign a new IP to the module at next Power On. Tap the backward red arrow to go back without changes.

Channel settings

(-) CH1 MENU ←	
VMon	0000.0
IMon	0000.00
Status	Kill !
VSet	2000.0
ISet	3100.00
Chan	1/2

(-) CH1 MENU ←	
MaxV	8100
RampUp	500
RampDown	400
Trip	INF
PowerDown	Kill
IMonRange	High
Chan	2/2

Fig. 16: Channel Parameters

For each channel the following parameters can be programmed and monitored either locally or remotely (see p.21):

Parameter:	Function:	Unit:
(±)	Channel polarity	
Vmon	High Voltage Monitored value	Volt
Imon	Current Monitored value	µA
Status	ON/OFF; Ramp UP/DOWN; OVV; UNV; OVC; OVP; MAXV; TRIP; OVT; OFF; KILL; ILK; CAL_ERR	
Vset	High Voltage programmed value	Volt
Iset	Current Limit programmed value	µA
MaxV	Absolute maximum High Voltage level that the channel can reach (see p. 13)	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	Max time "overcurrent" allowed to last (1000= ∞)	s
Imon Range	Current Monitor Zoom	H or L
ZC Detect	Stores IMOn value (IMonZero) into memory for “zero current compensation” [1471H only]	ON/OFF
ZC Adjust	Subtracts IMonZero from “non compensated” current value [1471H only]	EN/DIS

To set one parameter, tap on the relevant name, and change and/or enter the desired value through the “virtual keypad” (see below); confirm with “Enter”. Tap the red arrow to go back to Main Menu.

1	**2**	**3**
4	**5**	**6**
7	**8**	**9**
.	**0**	**Del**
Enter		

Fig. 17: Virtual keypad

Group Settings

N-NDT14xx

GROUP MENU ←			
Ch	**VMon**	**IMon**	**Status**
0(-)	**1500.0**	**0000.00**	**On √**
1(-)	**0000.0**	**0000.00**	**Off √**
2(-)	**0000.0**	**0000.00**	**Off √**
3(-)	**0000.0**	**0000.00**	**Off √**
Zoom			
VSet			
ISet			
Chan	**1/2**		

GROUP MENU ←	
MaxV	**8100**
RampUp	**500**
RampDown	**400**
Trip	**INF**
RampDown	**400**
PowerDown	**Kill**
IMonRange	**High**
Chan	**2/2**

N1570

GROUP MENU ←			
Ch	**VMon**	**IMon**	**Status**
0(-)	**9500.0**	**0000.00**	**On √**
1(-)	**0000.0**	**0000.00**	**Off √**
Zoom			
VSet			
ISet			
Chan	**1/2**		

GROUP MENU ←	
MaxV	**15100**
RampUp	**500**
RampDown	**400**
Trip	**INF**
RampDown	**400**
PowerDown	**Kill**
IMonRange	**High**
Chan	**2/2**

Fig. 18: Group Parameters

For the Group of all channels, the following parameters can be programmed and monitored either locally or remotely (see p.21):

Parameter:	Function:	Unit:
Vmon	High Voltage Monitored value single channels	Volt
Imon	Current Monitored value single channels	µA
Status	ON/OFF; Ramp UP/DOWN; OVV; UNV; OVC; OVP; MAXV; TRIP; OVT; OFF; KILL; ILK; CAL_ERR single channels	
Vset	High Voltage programmed value	Volt
Iset	Current Limit programmed value	µA
MaxV	Absolute maximum High Voltage level that the channel is allowed to reach	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	s
Imon Range	Current Monitor Zoom	H or L
ZC Detect	Stores IMOn value (IMonZero) into memory for “zero current compensation” [1471H only]	ON/OFF
ZC Adjust	Subtracts IMonZero from “non compensated” current value [1471H only]	EN/DIS

To set one parameter, tap on the relevant name, and change and/or enter the desired value through the “virtual keypad”; confirm with “Enter”. Tap the red arrow to go back to Main Menu. “Zoom” option allows to display large sized Vmon and Imon values.

ZOOM MODE ←		
Ch0 √	5499.2 0000.00	V µA
Ch0 √	0000.0 0000.00	V µA
Ch0 √	0000.0 0000.00	V µA
Ch0 √	0000.0 0000.00	V µA

Fig. 19: Zoom Mode

Status Icon

Three types of Icon in the display status area indicate:

√ OK status

! WARNING status

! ALARM status

Current monitor offset calibration

The Units are calibrated by introducing a positive offset on the current monitor. This type of calibration allows to monitor very low current thus removing possible issues due to components and working temperatures related negative offsets. The absolute value of delivered current can be quantified by following the steps below:

1) Turn on the module, after a warm-up of about 30 minutes with operating voltage and load disconnected (no link between the unit and detectors) then read the monitored current value Imon = I1 (offset)
2) Turn off the channel and connect the load

3) Turn on the channel with the same voltage set as point 1)
4) Wait a few minutes and read again the current value monitor Imon = I2 (offset + Iout)
5) The value of current output is equal to the difference between I2 and I1 (Iout = I2 – I1)

Leakage currents equal to:

NDT1419/N1419ET	1nA/100 V	Shall be tolerated; e.g.	Vout=400V, Imon=+6nA (2nA Offset +4nA current leakage/400V)
NDT1470/N1470ET	5nA/1kV		Vout=4kV, Imon=+30nA (10nA Offset +20nA current leakage/4kV)
NDT1471/N1471ET	1nA/500V		Vout=2kV, Imon=+6nA (2nA Offset +4nA current leakage/2kV)
NDT1471H/N1471HET	0.1nA/500V		Vout=2kV, Imon=+0.6nA (0.2nA Offset +0.4nA current leakage/2kV)
N1570			

The offset introduced is equal to:

NDT1419/N1419ET	20nA for high range; 2nA for low range
NDT1470/N1470ET	100nA for high range; 10nA for low range
NDT1471/N1471ET	20nA for high range; 2nA for low range
NDT1471H/N1471HET	2nA for high range; 0.2nA for low range
N1570	

with output voltage at 10% of full scale and 20 °C temperature.

Remote Control

Module control can take place remotely, via USB or Ethernet; the latter allows, using the RS485 Communication Port I/O's, to build a NDT14xx/N14xxET s' daisy chain network.

USB communication

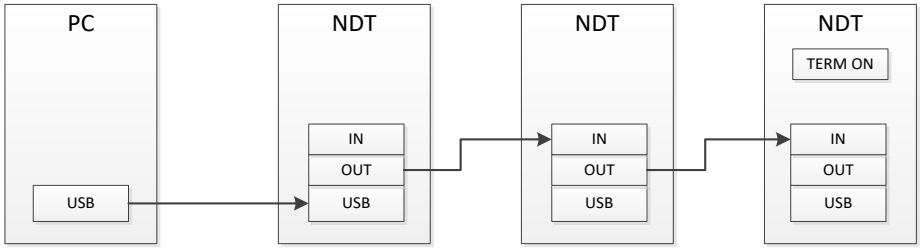


Fig. 20: USB communication diagram

The module is provided with a USB2.0 compliant interface (see p.9). The Unit can be programmed via PC by connecting the PC USB port with the Unit USB B-type port; the relevant drivers, are available from www.caen.it NDT14xx/N14xxET page.
N.B. for Linux OS Users: the Unit is automatically recognised by Kernel Linux 2.6.9 and higher; NDT is assigned to serial port with name /dev/ttyACM[x], where [x] is device number; for example 1st module connected is /dev/ttyACM0, 2nd module is /dev/ttyACM1 etc.
CAEN provides the CAEN GECO2020 Control Software that allows a friendly remote management of all Unit's functional parameters (see www.caen.it software support page); anyway the connection can be performed also via terminal emulator, we suggest to use Tera Term, configured as follows:

- baud rate 9600
- Data bits: 8
- Parity: none
- stop bit: 1
- Flow control: none

As the communication is running, type CAEN, and the main menu will be accessed (see p. 22)

It is also possible to build a daisy chain of up to 32 units, 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.22 ; in this case communication with the chained modules is achieved through the USB - RS485 Communication Protocol, see p.22. All modules must be assigned a LOCAL BUS ADDRESS different from one another and the last one must be terminated (see p.31). Daisy chain can be achieved by using SW1470 Control Software for NIM Power Supply Modules, freely available from www.caen.it

Ethernet communication

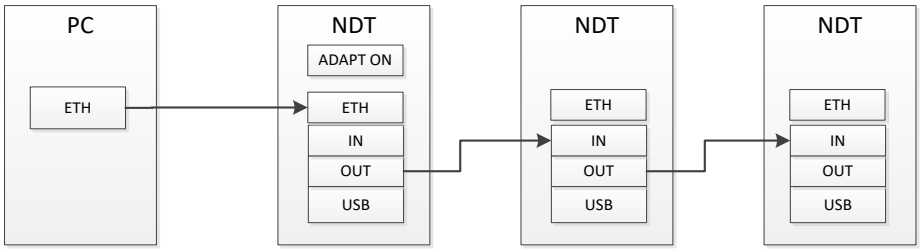


Fig. 21: Ethernet communication diagram

It is possible to communicate via Ethernet with one or more daisy chained NDT14xx/N14xxET/N1570 modules. Communication via Ethernet is possible only through the USB - RS485 Communication Protocol. It is necessary to connect the 1st module to the PC via Ethernet, then the 1st module to the following using COMM IN/OUT.

Ethernet configuration

In order to configure the Ethernet Port:

- connect to the module via USB as explained in the previous sections
- launch a terminal emulator, such as Tera Term, configured as explained at p.21
- type CAEN
- the following screen will open:

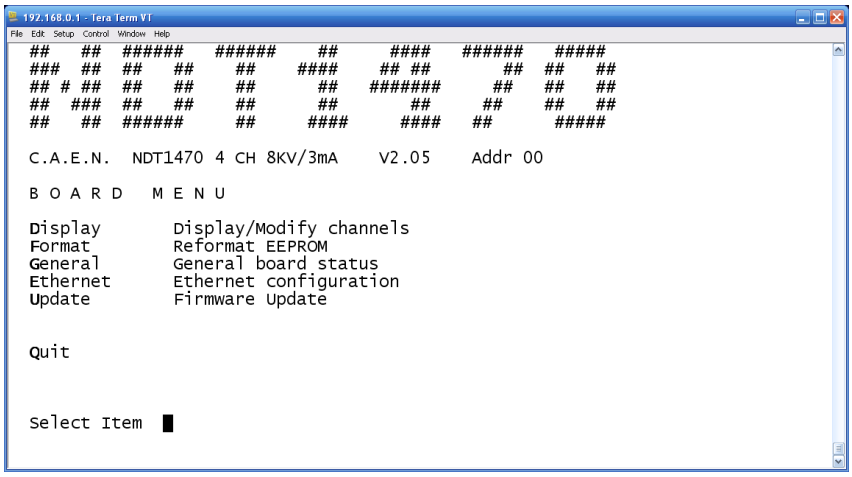


Fig. 22: Terminal Board Menu

Type E; the following screen will open:

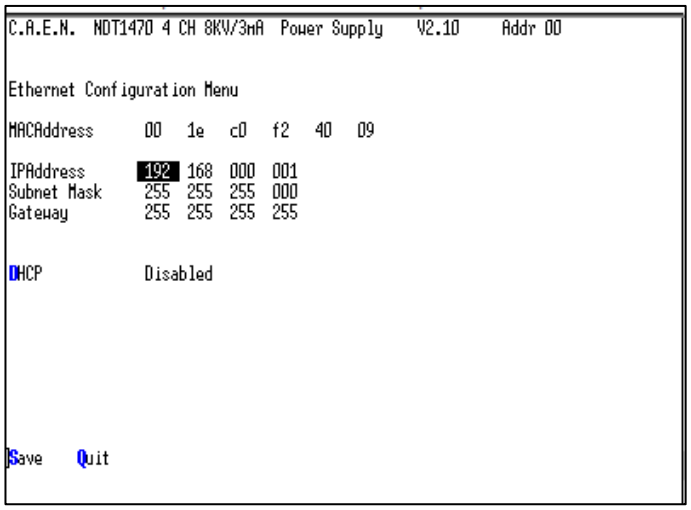


Fig. 23: Terminal Ethernet settings

At first Power On the module is configured with default static IP (factory setting); such IP can be updated using the I(PAddress), M(ask) or G(ate) to select the fields, typing the new values and confirming with <Enter>.

Type S to save the new setting in the EEPROM and go back to Main Menu, Q to go back without changes. When accessing via Ethernet select port number 1470; refer to figure:

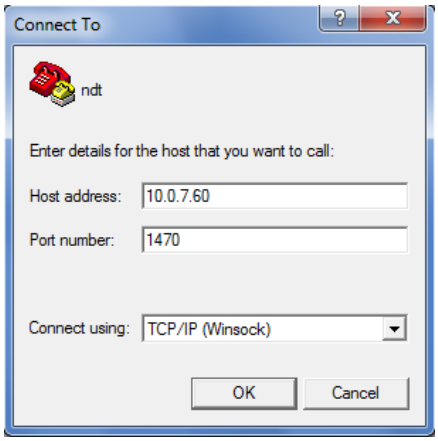


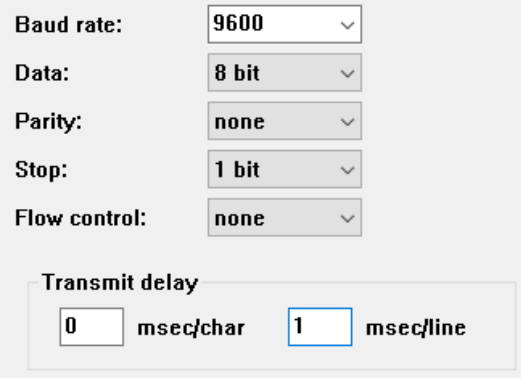
Fig. 24: Terminal Ethernet connection

The new setting will become active at next Power On; if a DHCP Server is available, then the module can be enabled or disabled as DHCP client; type S to save the new setting in the EEPROM and go back to Main Menu: the DHCP server will automatically assign a new IP to the module at next Power On.

Firmware upgrade

In order to upgrade the firmware:

- download from www.caen.it NDT14XX/N14xxET/N1570 page the most recent firmware revision for your module
- connect to the module via USB using Tera Term VT Emulator
- in the Tera Term options, select “set up” > “serial port” and enter the following settings



- click OK to confirm
- go to Terminal Board Menu (Fig. 22)
- type U in order to upgrade the firmware:

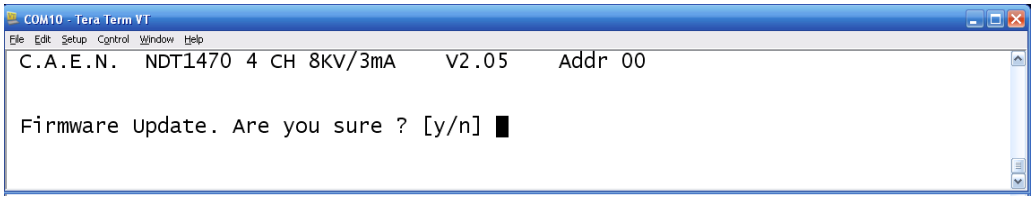


Fig. 25: Firmware Upgrade Menu

- Type y
- the following message will be shown:

```
!!! Checksum Error
Firmware Update...press any key to start
```

- Press any key
- Wait until the following message is shown:

```
Flash Erased!!!

Send file to upload
```

- Select “File” > send file
- Browse the image file
- Select “open”
- Wait the upload to complete
- turn OFF and then ON the module
- now the unit is ready to operate running the upgraded firmware

Format EEPROM

By typing F on Terminal Board Menu (Fig. 22) it is possible to access the format EEPROM menu.

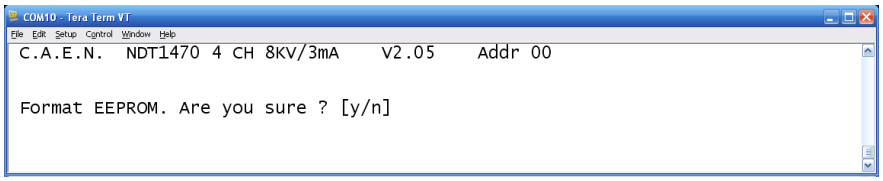


Fig. 26: Format EEPROM Menu

Channels settings

By typing D on Terminal Board Menu (Fig. 22) it is possible to access channels settings

In order to change one parameter: point the parameter with the “arrow keys”, and type the desired value, confirm by pressing <Enter>; Power and Power Down can be changed using the <Space> bar.

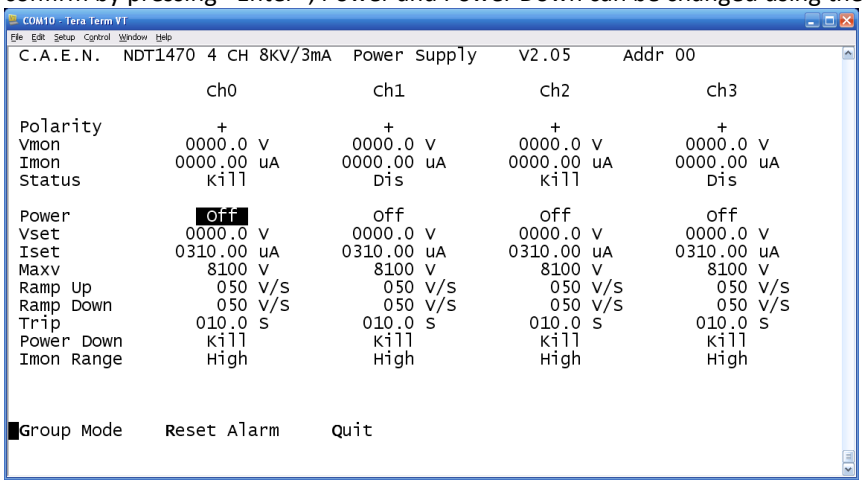


Fig. 27: Channels Menu

Board Status

By typing G on Terminal Board Menu (Fig. 22) it is possible to monitor the General Board Status

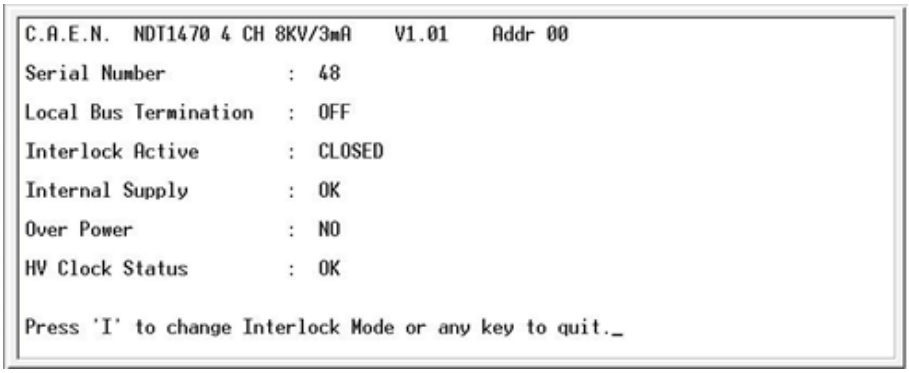


Fig. 28: General Board Status

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.

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..NUMCH** (NUMCH=2 for N1570, NUMCH=4 for the other modules)
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..NUMCH 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..NUMCH**' range.
When '**X=NUMCH**' the module returns the values of the parameter of all Channels.

String	Function (Units)
$BD:xx,CMD:MON,CH:X,PAR:VSET	Read out VSET value
$BD:xx,CMD:MON,CH:X,PAR:VMIN	Read out VSET minimum value
$BD:xx,CMD:MON,CH:X,PAR:VMAX	Read out VSET maximum value
$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
$BD:xx,CMD:MON,CH:X,PAR:ISET	Read out ISET value (µA)
$BD:xx,CMD:MON,CH:X,PAR:IMIN	Read out ISET minimum value (µA)
$BD:xx,CMD:MON,CH:X,PAR:IMAX	Read out ISET max value
$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 (µA)
$BD:xx,CMD:MON,CH:X,PAR:IMRANGE	Read out IMON RANGE value (HIGH / LOW)
$BD:xx,CMD:MON,CH:X,PAR:IMDEC	Read out IMON number of decimal digits
$BD:xx,CMD:MON,CH:X,PAR:MAXV	Read out MAXVSET value
$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
$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 (V/S)
$BD:xx,CMD:MON,CH:X,PAR:RUPMIN	Read out RAMP UP minimum value (V/S)
$BD:xx,CMD:MON,CH:X,PAR:RUPMAX	Read out RAMP UP maximum value
$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 (V/S)
$BD:xx,CMD:MON,CH:X,PAR:RDWMIN	Read out RAMP DOWN minimum value (V/S)
$BD:xx,CMD:MON,CH:X,PAR:RDWMAX	Read out RAMP DOWN maximum value
$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 (S)
$BD:xx,CMD:MON,CH:X,PAR:TRIPMIN	Read out TRIP time minimum value (S)
$BD:xx,CMD:MON,CH:X,PAR:TRIPMAX	Read out TRIP time maximum value (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:ZCDTC	Status of ZC Detect; ON = offset current is getting stored; OFF = ready to store offset current (Available only on 1471H series)
$BD:xx,CMD:MON,CH:X,PAR:ZCADJ	Status of ZC Adjust (EN/DIS) (Available only on 1471H series)

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 : Output Power > Max
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
$BD:xx,CMD:MON,PAR:BDNCH	Read out module Channels number
$BD:xx,CMD:MON,PAR:BDFREL	Read out Firmware Release
$BD:xx,CMD:MON,PAR:BDSNUM	Read out module serial number
$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..NUMCH**' range.
When '**X=NUMCH**' the command is issued to all Channels.

String	Function (Units)
$BD:xx,CMD:SET,CH:X,PAR:VSET,VAL:value	Set VSET value
$BD:xx,CMD:SET,CH:X,PAR:ISET,VAL:value	Set ISET value
$BD:xx,CMD:SET,CH:X,PAR:MAXV,VAL:value	Set MAXVSET value
$BD:xx,CMD:SET,CH:X,PAR:RUP,VAL:value	Set RAMP UP value
$BD:xx,CMD:SET,CH:X,PAR:RDW,VAL:value	Set RAMP DOWN value
$BD:xx,CMD:SET,CH:X,PAR:TRIP,VAL:value	Set TRIP time value
$BD:xx,CMD:SET,CH:X,PAR:PDWN,VAL:RAMP/KILL	Set POWER DOWN mode
$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	The stored IMonZero 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; (Available only on 1471H series)
$BD:xx,CMD:SET,CH:X,PAR:ZCADJ,VAL:DIS	The returned IMON value is not compensated (Available only on 1471H series)

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

EPICS Service

EPICS (Experimental Physics and Industrial Control System) is a set of software tools and applications which provide a software infrastructure for use in building distributed control systems, widely used to control experimental Physics and industrial electronics.
CAEN provides EPICS Input/Output Controller (IOC) for NIM-Desktop HV Power Supplies units, that allows access to a Process Variable using the Channel Access Protocol. Process Variable is a named piece of data associated with the module (e.g. status, readback, setpoint, parameter).
Client software (EPICS Channel Access Client), which requests access to a Process Variable, runs on the Host PC and is connected to the modules via either TCP/IP or USB.
The EPICS IOC is available for free download on www.caen.it website (Power Supply Software section)
More information about EPICS and a list of available client applications can be found at:
http://www.aps.anl.gov/epics/.

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 (see p. 10).
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); figure shows NDT14xx side cover with ventilation grids; N14xxET-N1570 have a flat cover

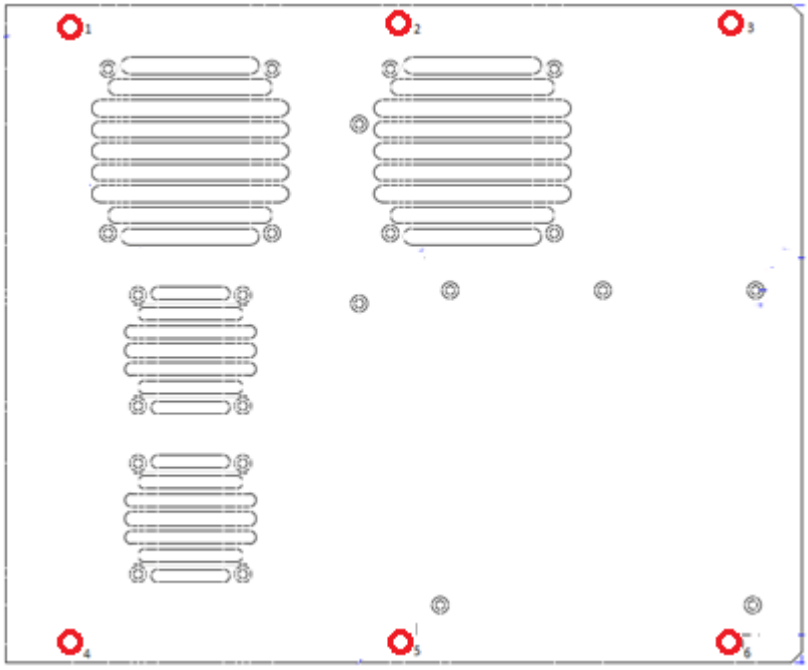
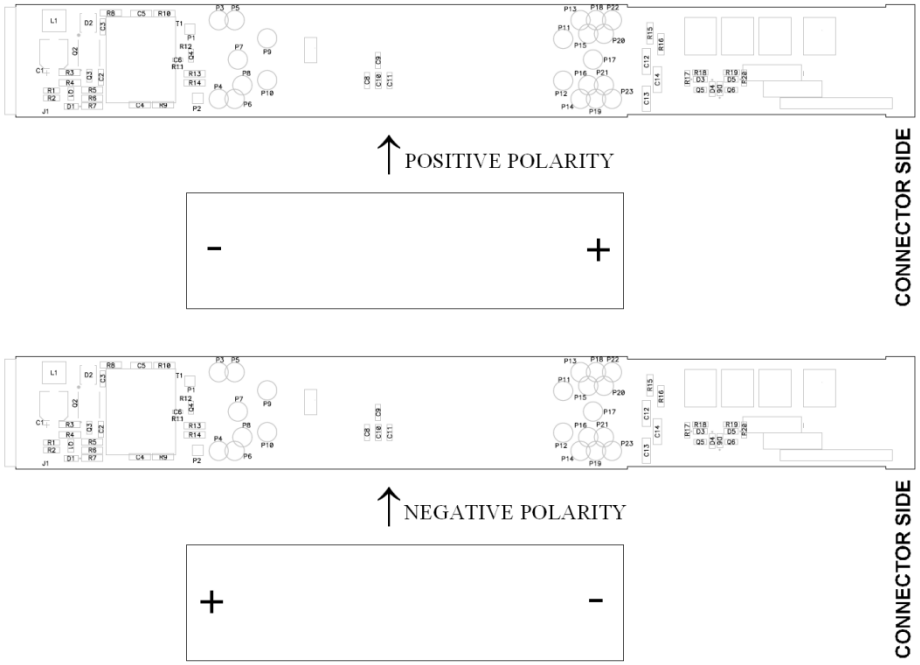


Fig. 29: Side cover removal instructions

- Lift the side cover gently, paying attention, if the module is a NDT14xx, not to strain ventilation fans power supply and control cords
- 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, when plugging them completely in their sockets



NDT14xx-N14xxET **N1570**

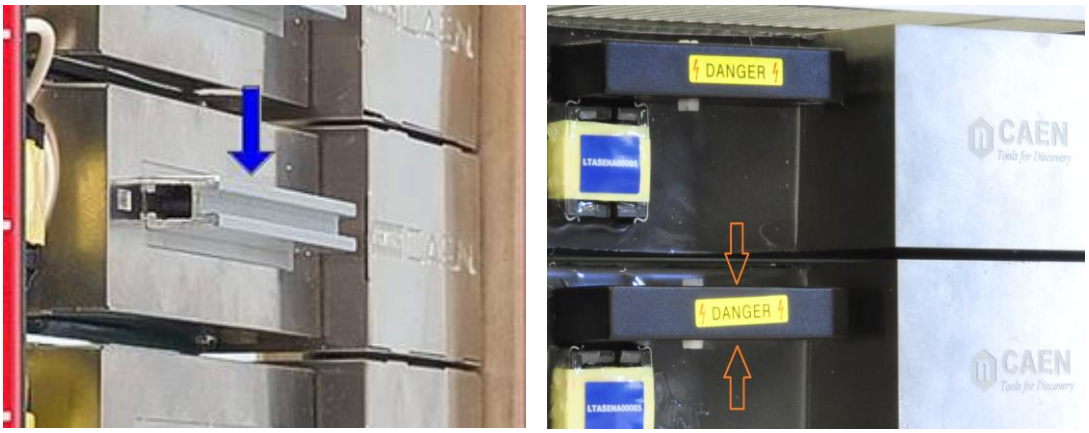


Fig. 30: Polarity selection instructions

- 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.
    - NDT14xx-N14xxET: Always pull and plug the diode bridge box by holding it on the handle pointed by the arrow in Fig. above.
    - N1570: Always pull and plug the diode bridge box by holding it on its sides (Fig. above).
- Once settings are done, put the right side cover back in place with screws 1, 2, 3, 4, 5, 6.

Internal switches

To access internal switches:

- Wear Antistatic Gloves
- Switch off the unit
- Wait for the complete discharge of the capacitors
- Lay down the unit, right side up (ventilation fans upward)
- Remove screws 1, 2, 3, 4, 5, 6, see Fig. 29
- Lift the side cover gently, paying attention not to strain ventilation fans power supply and control cords

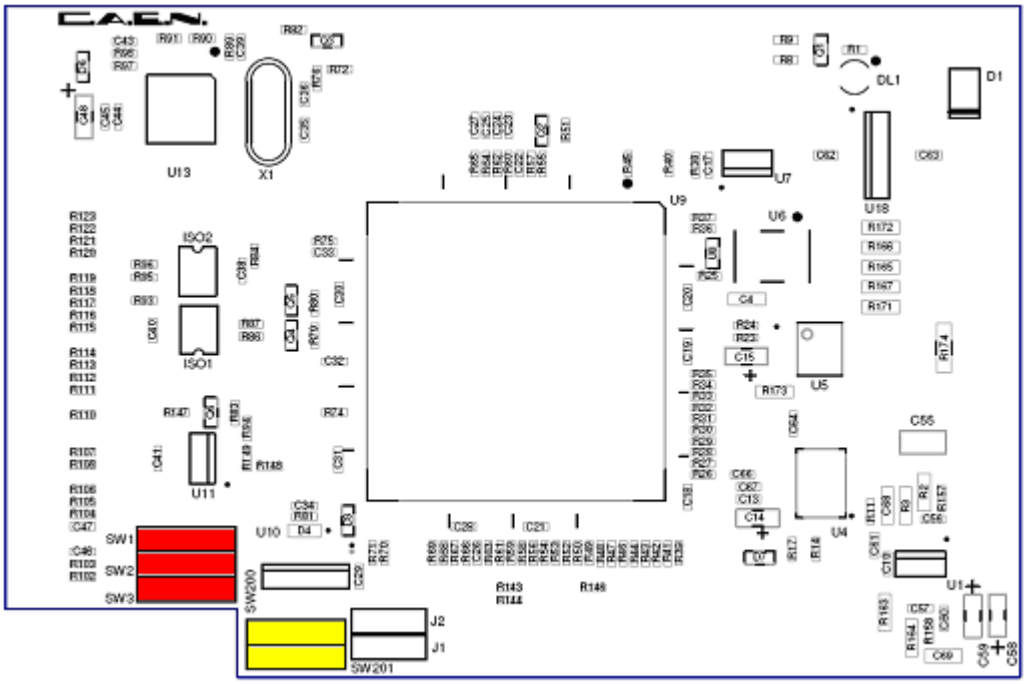


Fig. 31: Dip switch position

Local Bus termination

The SW[1..3] switch placed on the Microcontroller board inside the module (behind the *Remote communication control section*, see p. 11), allows to terminate the Local Bus for daisy chain purposes (see p. 21); dot NOT visible = Termination ON.

Grounding specifications

The Units 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 Polarity selection).
Please note that older versions of the Units may not have C21 jumper installed; contact info@caen.it for details.

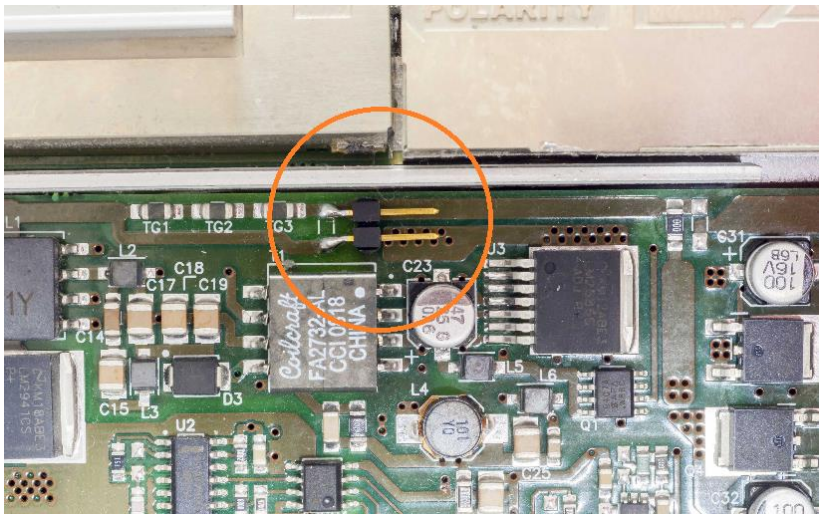


Fig. 32: C21 jumper location

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 Units 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:

1. The “closed loop “ Earth configuration (C21 contacts closed)
2. The “open loop” Earth configuration (C21 contacts open)

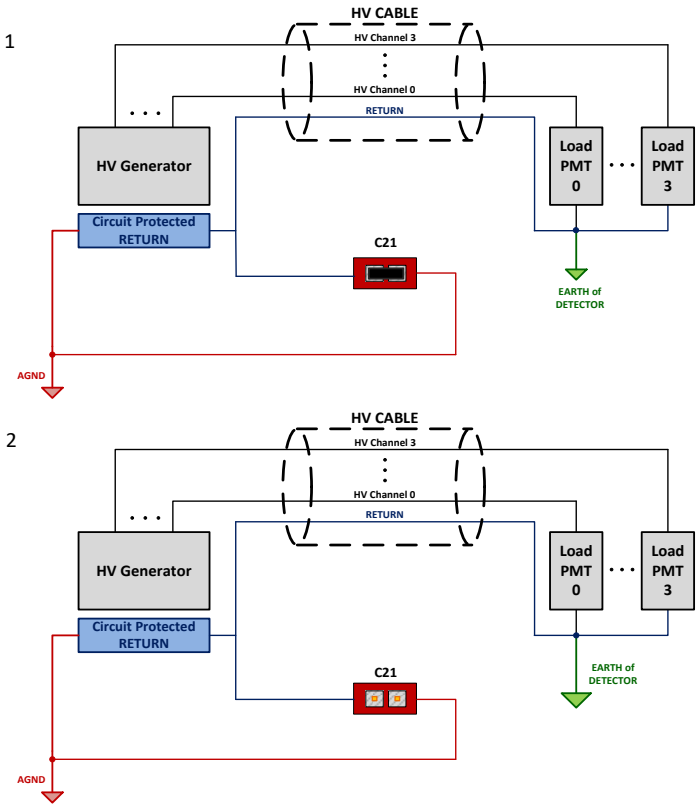


Fig. 33: Earth configuration connection examples

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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