Rev. 4 - May 4th, 2023

A161x

A161x 250/500V 1mA HV 16 Ch. Floating Boards

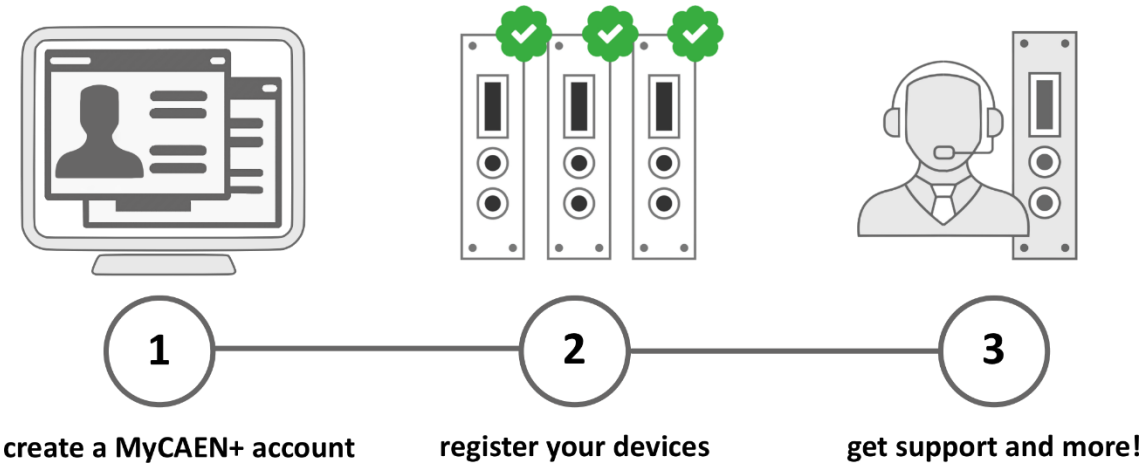
CAEN
Tools for Discovery

User Manual

Register your device

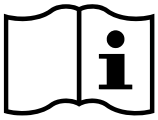
Register your device to your **MyCAEN+** account and get access to our customer services, such as notification for new firmware or software upgrade, tracking service procedures or open a ticket for assistance. **MyCAEN+** accounts have a dedicated support service for their registered products. A set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

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



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

Purpose of this User Manual



This document is the A161x 250/500V 1mA HV 16 Ch. Floating Boards User's Manual; it contains information about the installation, the configuration and the use of the devices.

Change Document Record

Date	Revision	Changes
20 January 2021	0	PRELIMINARY Release
10 March 2021	1	Updated Channel Characteristic Table
13 April 2022	2	Updated: Overview, Channel Characteristic Table, Output control and monitoring
18 April 2023	3	Updated Technical specifications table
4 May 2023	4	Updated Output control and monitoring

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Limitation of Responsibility

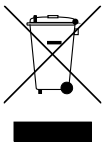
If the warnings contained in this manual are not followed, CAEN will not be responsible for damage caused by improper use of the device. The manufacturer declines all responsibility for damage resulting from failure to comply with the instructions for use of the product. The equipment must be used as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

Disclaimer

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

Made in Italy

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



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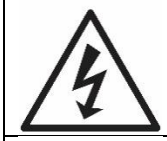
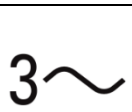
1 Safety Notices

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

The following HAZARD SYMBOLS may be reported on the unit:

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

The following symbol may be reported in the present manual:

	General warning statement

The symbol could be followed by the following terms:

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

CAUTION: To avoid potential hazards

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

CAUTION: Avoid Electric Overload

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

CAUTION: Avoid Electric Shock

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

CAUTION: Do Not Operate without Covers

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

CAUTION: Do Not Operate in Wet/Damp Conditions

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

CAUTION: Do Not Operate in an Explosive Atmosphere

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

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

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

2 Overview

The Mod. A 161x single width boards house 16 HV floating channels (i.e. the channels do not share any ground reference). Two versions are available: A1612 and A1619; the output voltage can be programmed and monitored in the range 0÷500 V and 0÷250 V respectively, with 10 mV resolution. The floating channels allow on detector grounding, thus avoiding ground-loops which may increase noise level.
The units offer dual 100 µA / 1 mA current Full Scale Range (selectable via display Menu. The boards are compatible with the CAEN Universal Multichannel Power Supply System (SYx527)
If the output voltage differs from the programmed value by more than 1% of voltage full scale range, the channel is signalled to be either in OVERVOLTAGE or UNDERVOLTAGE condition. Moreover, for each channel, a voltage protection limit SVMAX can be fixed via software with 1 V resolution and the output voltage can not be programmed beyond this value.
The HV RAMP-UP / DOWN rates may be selected independently for each channel in the range 1÷ 100 V/s (A1612) and 1 ÷ 50 V/s (A1619) in 1 V/s steps.
The output current is monitored with 100 pA / 1 nA resolution depending on current range; if a channel tries to draw a current larger than its programmed limit it is signalled to be in OVERCURRENT condition; the SYX527 system detects this state as a fault and reacts according to the setting of the TRIP parameter, namely:
1) TRIP=infinite (= 1000 s)
When the set output current value is reached the channel behaves like a constant current generator.
2) TRIP=finite (< 1000 s)
The output current keeps the set value only for programmed time interval and then is switched off.
The TRIP time (i.e. the maximum time an OVERCURRENT condition is allowed to last) can be programmed in 0.1 s steps.
The maximum output voltage (VMAX Hardware) can be fixed, through a potentiometer located on the front panel, at the same common value for all the board channels and this value can be read out via software.
The output channels can be enabled or disabled according to the interlock logic.

Channel Characteristic Table[1]

Version				A1619	A1612
Output Voltage				0÷250 V	0÷500 V
Polarity				Individual Floating Channels; ±500V isolation	
Max. Output Current		**low range**		100 µA	
		high range		1mA	
Voltage Set Resolution				10 mV	
Voltage Monitor Resolution				10 mV	
Current Set Resolution				20 nA	
Current Monitor Resolution		**low range**		100 pA	
		high range		1 nA	
VMAX hardware				0÷250 V common to all channels	0÷500 V common to all channels
VMAX hardware accuracy				± 2% of FSR	
VMAX software				0÷250 V individual	0÷500 V individual
VMAX software resolution				1V	
Ramp Down				1÷50 Volt/sec, 1 Volt/sec step	1÷100 Volt/sec, 1 Volt/sec step
Ramp Up				1÷50 Volt/sec, 1 Volt/sec step	1÷100 Volt/sec, 1 Volt/sec step
Voltage Ripple (max load with 10nF)		**1 KHz ÷ 20 MHz**	**typical**	<3 mVpp	<5 mVpp
			maximum	<5 mVpp	<7 mVpp
		10 Hz ÷ 1KHz	**typical**	<4 mVpp	<6 mVpp
			maximum	<6 mVpp	<8 mVpp
Accuracy[2]	**Voltage Monitor vs. Output Voltage**		**typical**	± 0.03% ± 0.05 V	± 0.03% ± 0.1 V
			maximum	± 0.05% ± 0.1 V	± 0.05% ± 0.2 V
	Voltage Set vs. Output Voltage		**typical**	± 0.03% ± 0.05 V	± 0.03% ± 0.1 V
			maximum	± 0.05% ± 0.1 V	± 0.05% ± 0.2 V
	Current Mon. vs. Output Current		**high range typ.**	± 0.5% ± 0.5 µA	
			high range max	± 1% ± 1 µA	
			low range typ.	± 0.5% ± 0.05 µA	
			low range max	± 1% ± 0.1 µA	
	Current Set vs. Output Current		**high range typ.**	± 0.5% ± 0.5 µA	
			high range max	± 1% ± 1 µA	
			low range typ.	± 0.5% ± 0.5 µA	
			low range max	± 1% ± 0.1 µA	
Temperature Coefficient		**Voltage**		50ppm/C°	
		Current		100ppm/C°	

[1] A1612: minimum load is 1nA @ 10V
[2] From 10% to 100% of Full Scale Range

Front Panel


CAEN
Mod. A1612
ON
VMAX
J1
A
J2
B
CFG CONNECTOR
1-2 SHIELD-AGND
2
1
INTERLOCK
PAS
AGND
SIG
SHIELD
16 CH
500V 1mA

Packaging

Single width (5 TE); height is 6U.

Displays

ON LED lights up as at least one channel is on

INTERLOCK LED *Function:* Red LED. Lights up as the board is in INTERLOCK (channel are disabled).

External connections

The function and electro-mechanical specifications of the external connectors are listed in the following subsections.

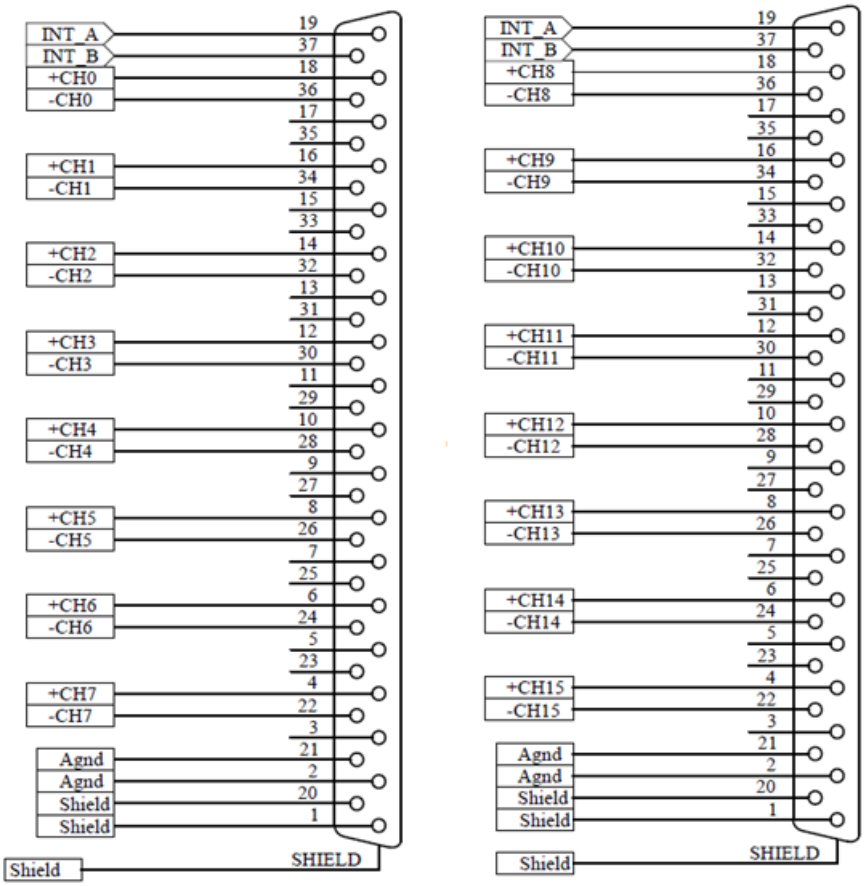
Output Channels	2 x DB37 Amphenol FCI 865637SLT	Ch 0..7 and Ch 8..15
ILK Signal/Passive	No.2 00-type LEMO connector	See p.14
Shield	Radiall R921921 socket, Ø 2mm	Output connector shield reference
AGND	Radiall R921921 socket, Ø 2mm	Ground of the crate reference
CFG	2pin jumper	Connects Shield to AGND

Trimmers

VMAX: it allows to adjust the hardware maximum voltage VMAX common to all the channels. Its value can be read out via software.

Multipin connectors pin assignment

Connector used Amphenol FCI 865637SLT Wiring with high insulation cable above 500V as working voltage.



3 Safety and installation requirements

General safety information

N.B. read carefully the "Precautions for Handling, Storage and Installation" document provided with the product before starting any operation!
This section contains the fundamental safety rules for the installation and operation of the board. Carefully read this section before starting any procedure of installation or operation of the product.

Injury Precautions

Review the following precautions to avoid injury and prevent damage to this product or any products connected to it. 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.

Safety Terms and Symbols on the Product

These terms may appear on the product:
DANGER indicates an injury hazard immediately accessible as you read the marking.
WARNING indicates an injury hazard not immediately accessible as you read the marking.
CAUTION indicates a hazard to property including the product.
The following symbols may appear on the product:

DANGER

High Voltage

WARNING

Refer to Manual

Installation

The Mod. A161x are SYx527 boards. At power ON the SYx527 SYSTEM, the processor will scan all the slots in the crate to find out where the module is plugged and what kind of module it is.

N.B.: the ventilation fan speed must be set to HIGH or MEDIUM.

4 Operating modes

The Mod. A161x boards can be controlled, either locally or remotely, through the SYx527 SYSTEM software interface. For details on SYx527 SYSTEM operation, please refer to the User's Manual of this product. The following sections contain a description of commands available for the board control and status monitoring.

Output control and monitoring

The following board parameters are monitorable:

Model	the board model
Description	the board synthetic description
Fmw Release	the board firmware release.
SerNum	the board serial number
NrOfCh	the number of board's channels
BdStatus	the status of generic board's parameters, namely: bit 0: PowerFail; if 1, it indicates a failure in the channels local power supply bit 1: Firwmare Checksum Error; if 1, it indicates an error in the board firmware checksum bit 2: HVMax Calibration Error; if 1, it indicates that the board HVMax parameter is not calibrated bit 3: Temperature Calibration Error; if 1, it indicates that the board temperature sensor is not calibrated bit 4: Under Temperature; if 1, it indicates that the board temperature sensor signals a board temperature < 5 °C bit 5: Over Temperature; if 1, it indicates that the board temperature sensor signals a board temperature > 65 °C bits 6..31: Reserved for future use
HVMax	the voltage hardware limit set by trimmer on the board
Temp	the board's temperature.

For each output channel, it is possible, through the system, to access the following parameters:

CHANNEL NAME (settable)	descriptive name for the relevant channel
V0Set (settable)	the first of the two allowed voltage programmable values.
I0Set (settable)	the first of the two allowed current limit programmable values
V1Set (settable)	the second of the two allowed voltage programmable values
I1SET (settable)	the second of the two allowed current limit programmable values
RUp (settable)	the Ramp-Up parameter value, i.e. the maximum voltage programmable increase rate.
RDWn (settable)	the Ramp-Down parameter value, i.e. the maximum voltage programmable decrease rate.
Trip (settable)	the TRIP parameter value, i.e. the maximum time an Over Current condition is allowed to last.
SVMax (settable)	the maximum voltage value programmable for the channel. If the value set as SVMAX is less than the current value of the V0SET/ V1SET parameter, the latter will automatically decrease to the SVMAX value.
VMon(monitor)	monitored voltage value
IMon (monitor)	monitored current value
ImRange (settable):	Sets current range (high or low)
Status (monitor)	it displays the channel status: Bit 0: ON/OFF Bit 1: Ramp Up Bit 2: Ramp Down Bit 3: OverCurrent Bit 4: OverVoltage Bit 5: UnderVoltage Bit 6: External Trip Bit 7: Over HVmax Bit 8: External Disable Bit 9: Internal Trip Bit 10: Calibration Error Bit 11: Unplugged ("remote" boards only) Bit12: UnderCurrent Bit13: OverVoltage Protection Bit14: Power Fail Bit15: Temperature Error
Pw (ON/OFF)	the Power parameter shows the ON/OFF channel status. As this parameter is set ON, the channel is switched on (if the INTERLOCK is not active and if the channel is enabled either locally or remotely) highlighted in green when channel ON; onstate = ON; offstate = OFF

ZCDetect (settable)	On: enable the detection of leakage currents Off: disable the detection of leakage currents
ZCAdjust (settable)	En: the current offset due to leakage currents on cascaded channels is compensated Dis: the current offset due to leakage currents on cascaded channels is not compensated
POn (EN/DIS):	Power-On option, which can be enabled or disabled. If this option is enabled, at Power-On or after a Restart each channel is restored in the same condition (defined by the Power parameter) it was before the Power-Off or Reset. If this option is disabled, at Power-On or after a Restart all the channels are off, independently from the condition in which they were before the Power-Off or Reset ; onstate = Enabled; offstate = Disabled
PDwn (Kill/Ramp):	Power-Down option, which can be set as KILL or RAMP. It affects the way the channels react at a Power-Off command caused by a TRIP condition. If the KILL option is selected, the relevant channel will be switched off at the maximum rate available. If the RAMP option is selected, the voltage will drop to zero at a rate determined by the value of the Ramp-Down parameter programmed for that channel; onstate = Ramp; offstate = Kill
TripInt:	2N-bit word (hexadecimal) maximum 16 lines, where N is the number of the board's Internal Trip Bus lines. Bits [0;N-1] allow the channel to sense the trip status from the corresponding lines when set to one; in the same way, bits [N;2N-1] allow the channel to propagate the trip status over the Trip Bus: bit N on line 0 and so on (see SY4527 User's manual).
TripExt:	Must be set in the 0÷255 range (hexadecimal). Bits [0;3] allow the channel to sense the trip status from the corresponding lines when set to one; in the same way, bits [4;7] allow the channel to propagate the trip status over the trip bus: bit 4 on line 0 and so on (see SY4527 User's manual).

The following messages may be returned by the SYx527 SYSTEM when monitoring the channel status:

OFF	(channel turned OFF)
ON	(channel turned ON)
ETRIP	(channel in external trip)
ITRIP	(channel in internal trip)
HVMAX	(channel exceeding hardware max voltage)
CAL-ERR	(channel with calibration data loss; contact manufacturer!)
UNPLUGGED	(channel with communication loss; contact manufacturer!)
RUP	(channel ramping up)
RDWN	(channel ramping down)
OVC	(channel in OVERCURRENT condition)
OVV	(channel in OVERVOLTAGE condition)
UNV	(channel in UNDERVOLTAGE condition)
EXT_DIS	(channel disabled by board or mainframe INTERLOCK protection)
UNDER_TEMP	(channel temperature < 5°C)
OVER_TEMP	(channel temperature > 65°C)

Output Enable

To enable the HV output channels, first it is necessary that INT_A, INT_B pins on the output connectors are short circuited; Then the enable procedure is completed in one of the following ways:

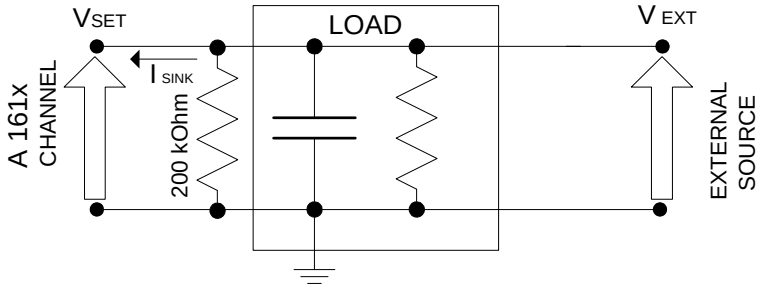
- terminating the PASSIVE INTERLOCK [P] connector on 50 Ohm.
- supplying the SIGNAL INTERLOCK [S] connector with a +5 V (3-4mA) signal.

The INTERLOCK LED (red) is turned off as one of the actions above is performed.
When the channels are disabled the voltage outputs drop to zero at the maximum rate available; when the output disable cause is removed (see above), the channels remain OFF until the User turns them ON via software.

Grounding specifications

The output channels feature reversible polarity and independent floating return. This feature allows on-detector grounding, thus avoiding loops which may increase noise level. The connection of shield and return to Earth is fundamental for User safety; the connection must always be at the level of detector or power supply system.
The best configuration must be determined by the user upon application, the optimal connection depends on many characteristics of the related experiment.
Please note that SHIELD is a shielding reference for the HV channels; it can be used as reference for external filters and it is available on the output connector. If it is not used, it must be wired to AGND via front panel jumper.

Sink mode



The 161x output channels can absorb current; if the detector input load is powered with an external voltage VEXT greater than VSET, the channel draws current. This feature makes it possible to maintain programmed descent ramps even if high filter capacities are present on the load. With the channel in OFF status, the output is maintained with a low impedance value (some kOhm's).

5 Instructions for Cleaning

The equipment may be cleaned with isopropyl alcohol or deionized water and air dried. Clean the exterior of the product only.
Do not apply cleaner directly to the items or allow liquids to enter or spill on the product.

Cleaning the Touchscreen

To clean the touchscreen (if present), wipe the screen with a towelette designed for cleaning monitors or with a clean cloth moistened with water.
Do not use sprays or aerosols directly on the screen; the liquid may seep into the housing and damage a component. Never use solvents or flammable liquids on the screen.

Cleaning the air vents

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

General cleaning safety precautions

CAEN recommends cleaning the device using the following precautions:

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

6 Device decommissioning

After its intended service, it is recommended to perform the following actions:

- Detach all the signal/input/output cable
- Wrap the device in its protective packaging
- Insert the device in its packaging (if present)

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

7 Disposal

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

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

8 Technical Support

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

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

All the instructions for use the Support platform are in the document:

A paper copy of the document is delivered with CAEN boards.

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

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

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