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A162x 1kV 20-10mA HV 8-16 Ch. Floating Boards

CAEN
Tools for Discovery

User Manual 8950

Purpose of this Manual

This document is the **A162x 1kV 20-10mA HV 8-16 Ch. Floating Boards** User's Manual; it contains information about the installation, the configuration and the use of the units.

Change Document Record

Date	Revision	Changes
13 June 2022	0	Preliminary Release
13 January 2023	1	Updated Technical specifications table
10 April 2024	2	Updated Output control and monitoring
22 January 2025	3	Updated Technical specifications table
24 September 2025	4	Updated Technical specifications table

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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

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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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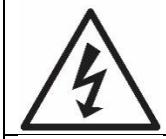
1. Safety Notices

N.B. Read carefully the "Precautions for Handling, Storage and Installation" 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

Two versions are available: A1625 and A1626; the output voltage can be programmed and monitored in the 0 ÷ 1000 V range, with 20 mV resolution. Floating channels allow the detector to be grounded, thus avoiding ground loops that can increase the noise level.

The units offer a double current full scale of 1mA / 10mA (A1626), 2mA / 20mA (A1625), the full scale ranges are independent for each channel and can be selected via the display menu. The cards are compatible with the CAEN Universal Multi-Channel Power System (SYx527).

The channels have independent ground but polarized, i.e. the hot pole can assume values from 0 to 1000V (positive or negative) with respect to earth, the cold pole cannot exceed 50 V with respect to earth.

If the output voltage differs from the programmed value by more than 1% of the full scale of the voltage, the channel is signalled as in an OVER VOLTAGE or UNDER VOLTAGE condition. Furthermore, for each channel, an SVMAX voltage protection limit with a resolution of 1 V can be set via software and the output voltage cannot be programmed beyond this value.

The HV RAMP-UP / DOWN speeds can be selected independently for each channel in the range 1 ÷ 100 V/s

The output current is monitored with a resolution of either 100nA / 10nA (A1625) or 50nA / 5nA (A1626) depending on the current range; if a channel tries to draw a current greater than its programmed limit, it is signalled that it is in an OVERCURRENT condition; the SYx527 system detects this status as a fault and reacts according to the setting of the TRIP parameter, that is:

1) TRAVEL = infinite (= 1000 s)

When the set output current value is reached, the channel behaves like a constant current generator.

2) TRIP = finished (<1000 s)

The output current maintains the set value only for the programmed time interval and is then deactivated.

The TRIP time (i.e. the maximum time that an OVERCURRENT condition can last) can be programmed in steps of 0.1 s.

The maximum output voltage (VMAX Hardware) can be set, by means of a potentiometer on the front panel, to the same common value for all the card channels and this value can be read via software.

The output channels can be enabled or disabled according to the interlocking logic.

Channel Characteristic Table

Output Voltage				0÷1000 V			
Polarity				Individual Floating Channels; ±50V isolation (internal Clamp)			
Max. Output Current	**low range**	**A1626**		1 mA			
		A1625		2 mA			
	high range	**A1626**		10 mA			
		A1625		20 mA			
Voltage Set Resolution				20 mV			
Voltage Monitor Resolution				20 mV			
Current Set Resolution				500 nA			
Current Monitor Resolution	**low range**	**A1626**		5 nA			
		A1625		10 nA			
	high range	**A1626**		50 nA			
		A1625		100 nA			
VMAX hardware				0÷1000 V common to all channels			
VMAX hardware accuracy				± 2% of FSR			
VMAX software				0÷1000 V individual			
VMAX software resolution				1V			
Ramp Down				1÷100 Volt/sec, 1 Volt/sec step			
Ramp Up				1÷100 Volt/sec, 1 Volt/sec step			
Voltage Ripple[1] (max load with 20nF)	**1 KHz ÷ 20 MHz**	**typical**		Differential:	<10 mVpp	Common:	<10 mVpp
		maximum			<15 mVpp		<25 mVpp
	10 Hz ÷ 1KHz	**typical**			<10 mVpp		<15 mVpp
		maximum			<15 mVpp		<30 mVpp
Accuracy[2][3]	**Voltage Monitor vs. Output Voltage**		**typical**	± 0.1% ± 0.1 V			
			maximum	± 0.2% ± 0.2 V			
	Voltage Set vs. Output Voltage		**typical**	± 0.1% ± 0.1 V			
			maximum	± 0.2% ± 0.2 V			
	Current Mon. vs. Output Current		**high range typ.**	± 0.5% ± 50 µA			
			high range max	± 1% ± 100 µA			
			low range typ.	± 0.5% ± 5 µA			
			low range max	± 1% ± 10 µA			
	Current Set vs. Output Current		**high range typ.**	± 1% ± 50 nA			
			high range max	± 1% ± 100 nA			
			low range typ.	± 1% ± 5 nA			
			low range max	± 1% ± 10 nA			
Temperature Coefficient	**Voltage**			50ppm/C°			
	Current			100ppm/C°			
Power requirement				280W max			

[1] Higher ripple values could be expected when the HV cards are used in SY4527's, SY4527LC's and SY5527's with PID<10000 and in SY5527LC's with PID<20000

[2] From 10% to 100% of Full Scale Range

[3] Minimum load: 5 µA

Front Panel

CAEN
A1625M
ON
VMAX
CH0-3
POS
CH4-7
NEG
B
CFG CONNECTOR
1-2 SHIELD-AGND
INTERLOCK
8 CH P/N
1kV 20mA

CAEN
A1626M
ON
VMAX
POS
A
B
NEG
CFG CONNECTOR
1-2 SHIELD-AGND
INTERLOCK
16 CH P/N
1kV 10mA

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).

A1626 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.15
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

A1625 External connections

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

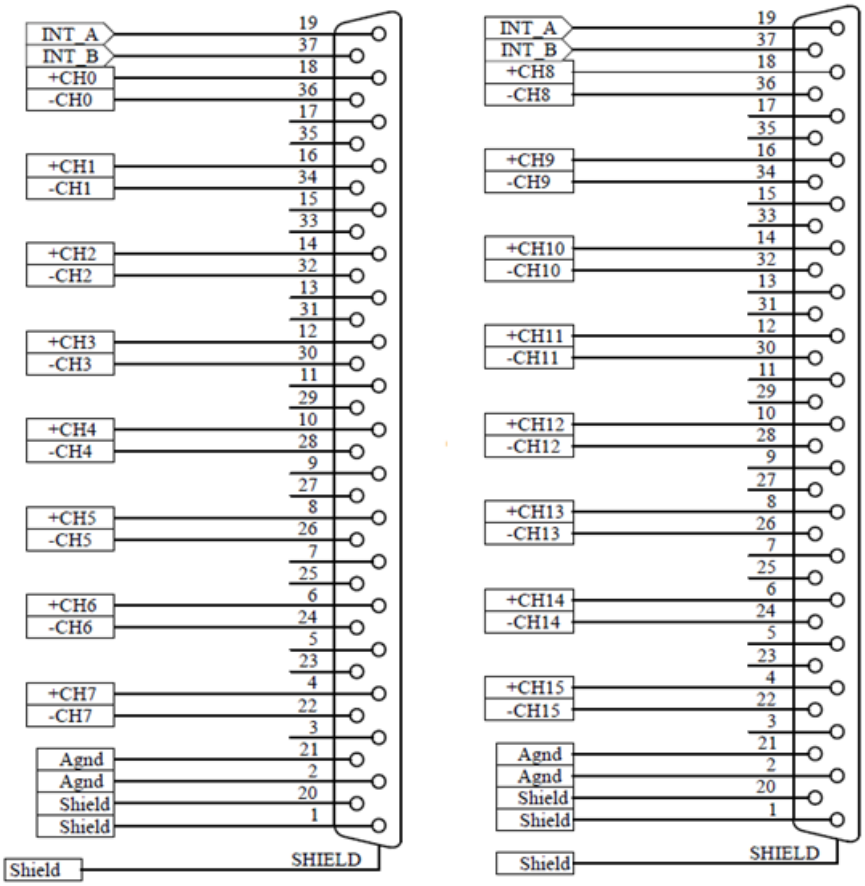
Enable Channels	1x DB25 Amphenol FCI	Ch 0..7
Output Channels	1 x DB37 Amphenol FCI 865637SLT	Ch 0..7
ILK Signal/Passive	No.2 00-type LEMO connector	See p.15
Shield	Radiall R921921 socket, Ø 2mm	Output connector shield reference
AGND	Radiall R921921 socket, Ø 2mm	Ground of the crate reference
CFG	2pin 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.

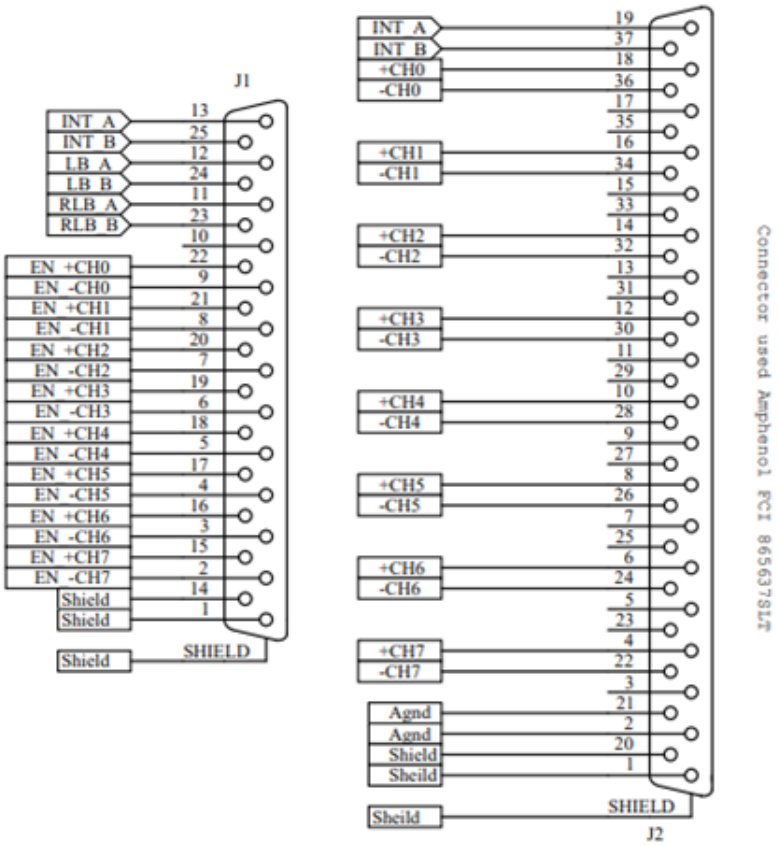
A1626 Multipin connectors pin assignment

Connector used Amphenol FCI 865637SLT ; Wiring with high insulation cable above 1000V as working voltage.



A1625 Multipin connectors pin assignment

Connector used Amphenol FCI 865637SLT ; Wiring with high insulation cable above 1000V as working voltage.



Logic enable for single channel

For each channel it is possible to use a double logic to enable it.

The behaviour of the channels is associated with either a Drive or Undrive software setting to either a local or remote polarization (Power internal module or Ext.source). In the following tables, depending on the settings (jumpers inside the male cable connector), the status of the channel is evident.

N.B. Ext.source = +5V

Mode Drive **Power internal module**	Pin J1	Pin J1	Jump	Status
IntA-IntB	13	25	Not used	Not used
LB_A – LB_B	12	24	Close	Active internal power
RLB_A – RLB_B	11	23	Close	Active internal power
Channel 0	9	22	Close	Channel Disable
	9	22	Open	Channel Enable
Channel 1	8	21	Close	Channel Disable
	8	21	Open	Channel Enable
Channel 2	7	20	Close	Channel Disable
	7	20	Open	Channel Enable
Channel 3	6	19	Close	Channel Disable
	6	19	Open	Channel Enable
Channel 4	5	18	Close	Channel Disable
	5	18	Open	Channel Enable
Channel 5	4	17	Close	Channel Disable
	4	17	Open	Channel Enable
Channel 6	3	16	Close	Channel Disable
	3	16	Open	Channel Enable
Channel 7	2	15	Close	Channel Disable
	2	15	Open	Channel Enable

Mode Drive **NO Power internal module**	Pin J1	Pin J1	Jump	Status
IntA-IntB	13	25	Not used	Not used
LB_A – LB_B	12	24	Open	No Active internal power
RLB_A – RLB_B	11	23	Open	No Active internal power
Channel 0	-9	+22	No Ext.source	Channel Disable
	-9	+22	Yes Ext.source	Channel Enable
Channel 1	-8	+21	No Ext.source	Channel Disable
	-8	+21	Yes Ext.source	Channel Enable
Channel 2	-7	+20	No Ext.source	Channel Disable
	-7	+20	Yes Ext.source	Channel Enable
Channel 3	-6	+19	No Ext.source	Channel Disable
	-6	+19	Yes Ext.source	Channel Enable
Channel 4	-5	+18	No Ext.source	Channel Disable
	-5	+18	Yes Ext.source	Channel Enable
Channel 5	-4	+17	No Ext.source	Channel Disable
	-4	+17	Yes Ext.source	Channel Enable
Channel 6	-3	+16	No Ext.source	Channel Disable
	-3	+16	Yes Ext.source	Channel Enable
Channel 7	-2	+15	No Ext.source	Channel Disable
	-2	+15	Yes Ext.source	Channel Enable

N.B: please pay attention to respect the indicated polarity when the external source is used

Mode UnDrive Power internal module	Pin J1	Pin J1	Jump	Status
IntA-IntB	13	25	Not used	Not used
LB_A – LB_B	12	24	Close	Active internal power
RLB_A – RLB_B	11	23	Close	Active internal power
Channel 0	9	22	Open	Channel Disable
	9	22	Close	Channel Enable
Channel 1	8	21	Open	Channel Disable
	8	21	Close	Channel Enable
Channel 2	7	20	Open	Channel Disable
	7	20	Close	Channel Enable
Channel 3	6	19	Open	Channel Disable
	6	19	Close	Channel Enable
Channel 4	5	18	Open	Channel Disable
	5	18	Close	Channel Enable
Channel 5	4	17	Open	Channel Disable
	4	17	Close	Channel Enable
Channel 6	3	16	Open	Channel Disable
	3	16	Close	Channel Enable
Channel 7	2	15	Open	Channel Disable
	2	15	Close	Channel Enable

Mode UnDrive NO Power internal module	Pin J1	Pin J1	Jump	Status
IntA-IntB	13	25	Not used	Not used
LB_A – LB_B	12	24	Open	No Active internal power
RLB_A – RLB_B	11	23	Open	No Active internal power
Channel 0	-9	+22	Yes Ext.source	Channel Disable
	-9	+22	No Ext.source	Channel Enable
Channel 1	-8	+21	Yes Ext.source	Channel Disable
	-8	+21	No Ext.source	Channel Enable
Channel 2	-7	+20	Yes Ext.source	Channel Disable
	-7	+20	No Ext.source	Channel Enable
Channel 3	-6	+19	Yes Ext.source	Channel Disable
	-6	+19	No Ext.source	Channel Enable
Channel 4	-5	+18	Yes Ext.source	Channel Disable
	-5	+18	No Ext.source	Channel Enable
Channel 5	-4	+17	Yes Ext.source	Channel Disable
	-4	+17	No Ext.source	Channel Enable
Channel 6	-3	+16	Yes Ext.source	Channel Disable
	-3	+16	No Ext.source	Channel Enable
Channel 7	-2	+15	Yes Ext.source	Channel Disable
	-2	+15	No Ext.source	Channel Enable

N.B: please pay attention to respect the indicated polarity when the external source is used

3. Operating modes

The Mod. A162x 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.

Installation

The Mod. A162x are SYx527 boards. At power ON, the SYx527 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.

Output control and monitoring

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.
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).
EnCtr (Drive / Undrive)	On A1625, allows to select the channel enable mode; see p. 12

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

OFF	(channel turned OFF)
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 INTERLOCK protection)

Moreover, it is possible to monitor board temperature and to check board status; the following messages may be returned by the SYSTEM when monitoring the board status:

UNDER_TEMP	(board temperature < 5°C)
OVER_TEMP	(board 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 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.

4. 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

5. 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

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