

PRELIMINARY

A1592 9kV 200 μ A HV 8 Ch. Floating Board



Register your device

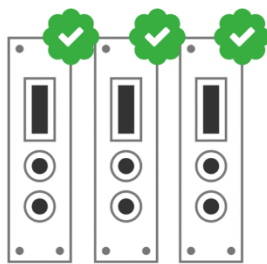
Register your device to your **MyCAEN+** account and get access to our customer services, such as notification for new firmware or software upgrade, tracking service procedures or open a ticket for assistance. **MyCAEN+** accounts have a dedicated support service for their registered products. A set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

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



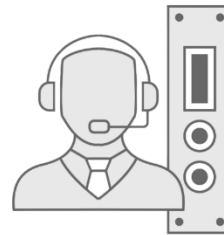
1

create a MyCAEN+ account



2

register your devices



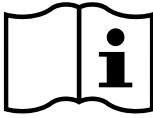
3

get support and more!



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

Purpose of this User Manual



This document is the A1592 9kV 200µA HV 8 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
November 26th, 2024	0	PRELIMINARY Release

Manufacturer Contacts



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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

A1592 is a single width board (5TE wide) that houses 8 individual floating channels, delivered through SHV connectors. The output voltage is $0 \div 9000$ V with 100mV set/monitor resolution. The maximum current value is 200 μ A with a 4nA setting resolution.

The channels share a Individual Floating Channels, which allows on-detector grounding, reducing the noise level. The channels have independent ground but polarized, i.e. the hot pole can assume values from 0 to 9000V (positive or negative) with respect to earth, the cold pole cannot exceed 50 V with respect to earth.

A global enable/disable connector allows to disable the channels. The voltage ramp rates may be set independently for each channel and offer dual current ranges (software selectable).

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 $1 \div 500$ V/s

The output current is monitored with a resolution of 1nA / 50pA 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) TRIP = 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÷9000 V				
Polarity		Positive or negative (depending on version); Individual Floating Channels; ±50V isolation (internal Clamp)				
Max. Output Current	low range	20 µA				
	high range	200 µA				
Voltage Set Resolution		200 mV				
Voltage Monitor Resolution		200 mV				
Current Set Resolution		4 nA				
Current Monitor Resolution	low range	50 pA				
	high range	1 nA				
VMAX hardware		0÷9000 V common to all channels				
VMAX hardware accuracy		± 2% of FSR				
VMAX software		0÷9000 V individual				
VMAX software resolution		1V				
Ramp Up / Down		1÷500 Volt/sec, 1 Volt/sec step				
Trip		Max. time an "overcurrent" (OVC) is allowed to last (seconds). A channel in OVC works as a current generator; voltage varies to keep the output current lower than the programmed value. OVC lasting more than set value (1 to 9999) causes the channel "trip". Voltage will drop to zero either at Ramp-down rate or at the fastest available rate, depending on Power Down setting; in both cases the channel is turned OFF. If trip= INFINITE, "overcurrent" lasts indefinitely. TRIP range: 0 ÷ 999.9 s; 1000 s = Infinite. Step = 0.1 s				
Voltage Ripple (max load 1nF on the load)	1 KHz ÷ 20 MHz	typical	Differential:	<3 mVpp	Common:	<5 mVpp
		maximum		<5 mVpp		<15 mVpp
	10 Hz ÷ 1KHz	typical		<5 mVpp		<5 mVpp
		maximum		<10 mVpp		<15 mVpp
Accuracy ¹	Voltage Monitor vs. Output Voltage		typical	± 0.05% ± 2 V		
			maximum	± 0.05% ± 2 V		
	Voltage Set vs. Output Voltage		typical	± 0.05% ± 2 V		
			maximum	± 0.05% ± 2 V		
	Current Mon. vs. Output Current		high range typ.	±1% ±20nA		
			high range max	±1% ±50nA		
			low range typ.	±1% ±200pA		
			low range max	±1% ±500pA		
Current Set vs. Output Current		typical	±1% ±20nA			
		maximum	±1% ±50nA			
Temperature Coefficient	Voltage		50ppm/C°			
	Current		100ppm/C°			
Power requirement		70W max				
Operating temperature		0 ÷ 45°C				
Storage temperature		-10 ÷ 70°C				
Humidity		0 – 80% non condensing				
Altitude		2000m				
Stability (24h; 1 hour warm up)		±0.001% / full scale				
Safety Standard – ROHS – Halogen free		ROHS				
EMC qualification		CE Standards				

¹ From 10% to 100% of Full Scale Range; for good regulation in the range < 5% of the f.s., a minimum current delivered on the load > 1µA is required

Front Panel



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	CPE 23.100.151-046 type male panel connector. Working voltage: 15kV DC mated; test voltage: 20kV DC mated; working current: 1mA; operating cycles: 500 insertions. Mating connector: CAEN A997	Ch 0..7
ILK Signal/Passive	No.2 00-type LEMO connector	See p.13
AGND	Radiall R921921 socket, \varnothing 2mm	Ground of the crate reference

Trimmers

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

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. A1592 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. A1592 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: Firmware 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:

<i>CHANNEL NAME (settable)</i>	descriptive name for the relevant channel
<i>V0Set (settable)</i>	the first of the two allowed voltage programmable values.
<i>I0Set (settable)</i>	the first of the two allowed current limit programmable values
<i>V1Set (settable)</i>	the second of the two allowed voltage programmable values
<i>I1SET (settable)</i>	the second of the two allowed current limit programmable values
<i>RUp (settable)</i>	the Ramp-Up parameter value, i.e. the maximum voltage programmable increase rate.
<i>RDWn (settable)</i>	the Ramp-Down parameter value, i.e. the maximum voltage programmable decrease rate.
<i>Trip (settable)</i>	the TRIP parameter value, i.e. the maximum time an Over Current condition is allowed to last.
<i>SVMax (settable)</i>	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.
<i>VMon (monitor)</i>	monitored voltage value
<i>IMon (monitor)</i>	monitored current value
<i>ImRange (settable):</i>	Sets current range (high or low)
<i>Status (monitor)</i>	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
<i>Pw (ON/OFF)</i>	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

<i>ZCDetect (settable)</i>	On: enable the detection of leakage currents Off: disable the detection of leakage currents
<i>ZCAjust (settable)</i>	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
<i>POn (EN/DIS):</i>	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
<i>PDwn (Kill/Ramp):</i>	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
<i>TripInt:</i>	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).
<i>TripExt:</i>	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.

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 of 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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