Rev. 0 - 13rd Sept 2022

PRELIMINARY

A1632H

6kV 100µA HV 8 Ch. Floating Board

CAEN
Tools for Discovery

User Manual

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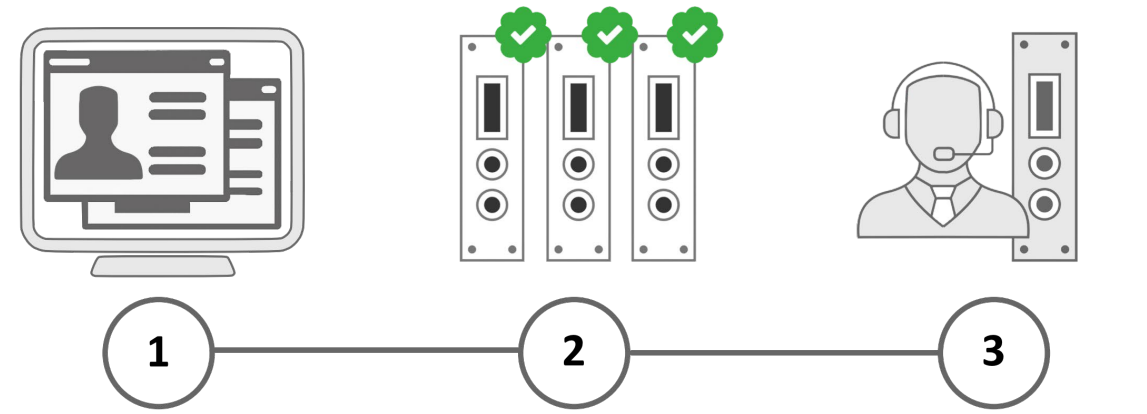

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Purpose of this Manual

This document is the A1632H 6kV 100µA HV 8 Ch. Floating Board user manual; it contains information about the installation, the configuration and the use of the board.

Change Document Record

Date	Revision	Changes
13 September 2022	0	PRELIMINARY Release

Symbols, abbreviated terms and notation

N.A.

Reference Documents

SY4527 Universal Multichannel Power Supply System User's Manual

GECO2020 GEneral COntrol Software for CAEN HV Power Supplies User's Manual

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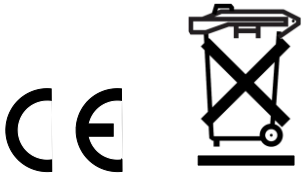

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1. Overview

A1632H is a single width board (5TE wide) that houses 8 individual floating channels, delivered through SHV connectors. The output voltage is 0 ÷ 6000 V with 100mV set/monitor resolution. The maximum current value is 100µA with a 2nA 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 6000V (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 ÷ 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) 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÷6000 V
Polarity							Individual Floating Channels; ±50V isolation (internal Clamp)
Max. Output Current	**low range**						20 µA
	high range						100 µA
Voltage Set Resolution							100 mV
Voltage Monitor Resolution							100 mV
Current Set Resolution							2 nA
Current Monitor Resolution	**low range**						50 pA
	high range						1 nA
VMAX hardware							0÷6000 V common to all channels
VMAX hardware accuracy							± 2% of FSR
VMAX software							0÷6000 V individual
VMAX software resolution							1V
Ramp Down							1÷500 Volt/sec, 1 Volt/sec step
Ramp Up							1÷500 Volt/sec, 1 Volt/sec step
Trip							Max. time an “overcurrent" is allowed to last (seconds). A 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
Voltage Ripple (max load with 1nF)	**1 KHz ÷ 20 MHz**	**typical**	Differential:	<3 mVpp	Common:	T.B.D.	
		maximum		<5 mVpp		T.B.D.	
	10 Hz ÷ 1KHz	**typical**		<5 mVpp		T.B.D.	
		maximum		<10 mVpp		T.B.D.	
Accuracy[1]	**Voltage Monitor vs. Output Voltage**		**typical**				± 0.05% ± 0.2 V
			maximum				± 0.05% ± 0.5 V
	Voltage Set vs. Output Voltage		**typical**				± 0.05% ± 0.2 V
			maximum				± 0.05% ± 0.5 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							40W max

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

Front Panel


CAEN
A1632HN
ON
VMAX
CH
0
1
2
3
4
5
6
7
CFG
CONF
INTERLOCK
FAS
SIG
AGND
SHIELD
8 CH NEG
6kV 100µA

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.

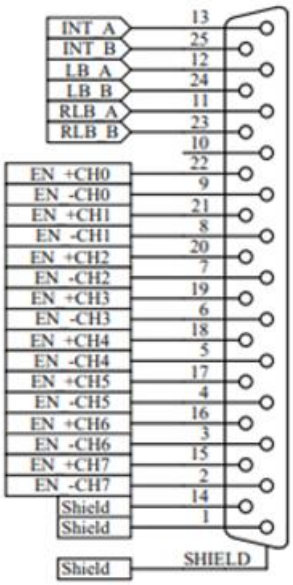
Enable Channels	1x DB25 Amphenol FCI	Ch 0..7
Output Channels	SHV RADIALL R317580; Impedance: 50 Ohm; Frequency range: 0 – 2 GHz; VSWR: <1.20 + 0.3 F (GHz) – (plug and jack); Test voltage: 10kV DC – 1mn (unmated connectors); Ratings: 12kV DC – 1mn (mated pairs); Current rating: 10 A	Ch 0..7
ILK Signal/Passive	No.2 00-type LEMO connector	See p.12
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.

Enable connector J1 pin assignment

J1 Connector: Amphenol FCI



Logic enable for single channel

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

The behavior 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
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 3	-2	+15	Close	Channel Disable
	-2	+15	Open	Channel Enable

Mode Drive **NO Power internal module**	Pin J1	Pin J1	Jump	Status
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

Mode UnDrive Power internal module	Pin J1	Pin J1	Jump	Status
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	Close	Enable connector
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

2. 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. A1632H's 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.

3. Operating modes

The Mod. A1632H 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

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).

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.

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