Rev. 7 - 5 Sept 2024

A1561H-AG561H

12 Channel 6 kV/20 µA Power Supply Boards

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User Manual
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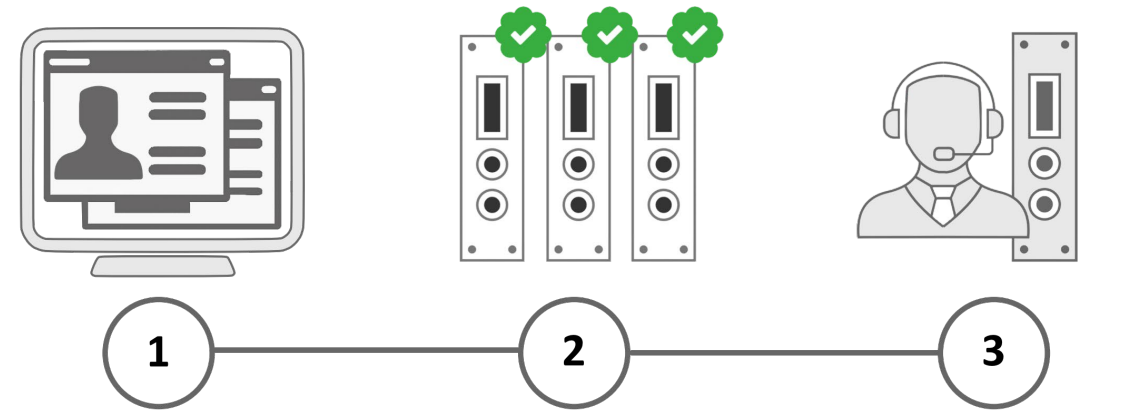

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Purpose of this Manual

This document is the A1561H-AG561H 12 Channel 6 kV/20 µA Power Supply Boards user manual; it contains information about the installation, the configuration and the use of the board.

Change Document Record

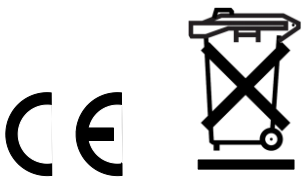
Date	Revision	Changes
30 September 2014	0	PRELIMINARY Release
1 April 2016	1	Updated with AG561H
06 February 2018	2	Updated technical specification
28 May 2019	3	Updated technical specification
10 July 2019	4	Updated Output control and monitoring
14 April 2020	5	Updated Overview
14 February 2022	6	Updated technical specification
5 September 2024	7	Updated technical specification

Symbols, abbreviated terms and notation

T.B.D.

Reference Documents

SY4527 User's Manual



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1. Overview

Functional description

The Mod. A1561H is a 12 channel HV board, available with either positive or negative polarity, compatible with the CAEN Universal Multichannel Power Supply System[1] (SY1527, SY2527, SY4527, SY5527).

The HV channels share a common floating return, which allows on-detector grounding reducing the noise level; the floating return is insulated from the crate earth up to ±50 V (with a 65 V hardware limit).

The AG561H is the “common ground” version of the board: the return of the HV channels is wired to the crate Earth reference.

The output voltage range is 0 ÷ 6 kV, with 20 µA maximum output current.

The board is provided with both current and voltage protections. If overcurrent occurs, the relevant channel can be programmed either to turn off after a programmable trip time or to keep on providing the maximum allowed current: this particular feature allows the modules to work as current generator. The maximum output voltage 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 HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the 1 ÷ 500 V/s range (1 V/s step).

The HV output is delivered by SHV connectors. The boards have also the safety board interlock: this protection allows to disable the primary HV generation when the HV outputs are not connected to their loads. The unit is available with either positive, negative or “mixed” (half of the channels positive and half negative) polarity.

[1] SYx527 shall run the latest available firmware release

Channel Characteristic Table

Table 1 – Channel characteristics of the Mod. Ax561H HV Board

Polarity			Positive, Negative or Mixed depending on purchased version; on "Mixed" version: CH0..5 positive, CH6..11 negative
Output Voltage			0÷6 kV
Max. Output Current			20 µA
Voltage Set Resolution			100 mV
Voltage Monitor Resolution			10 mV
Current Set Resolution			500 pA
Current Monitor Resolution			50 pA
VMAX hardware			0÷6 kV common for all the board channels
VMAX hardware accuracy			± 2% of FSR
VMAX software			0÷6 kV settable for each channel
VMAX software resolution			1 V
Ramp Up/Down			1÷500 Volt/sec, 1 Volt/sec step
Voltage Ripple [2]	**10 ÷ 1000 Hz**	**Typ**	5mVpp
		Max	10mVpp
	1 ÷ 20000 kHz	**Typ**	3mVpp
		Max	5mVpp
Accuracy [3,4]	**VMon vs. VOut**		± 0.02% ± 1.2 V
	VSet vs. VOut		± 0.02% ± 1.2 V
	IMoN vs. IOut		± 0.2% ± 40 nA
	ISet vs. IOut		± 0.2% ± 40 nA

[2] Ripple may exceed such limits whenever OVC and UNV occur (see Output control and monitoring)
[3] From 1% to 100% of Full Scale Range
[4] During operation in Overcurrent or when VMAX Hardware is reached (and/or exceeded), VMON values have to be assumed as "indication"; possible monitor drifts are caused by the different regulation mode.

Front Panel

Fig. 1 – Ax561H front panel

Technical Specifications

Packaging

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

External connections

WARNING! HV output connectors produce extremely hazardous voltages at a potentially lethal current level; never connect or disconnect the HV OUT connector with the SYx527 power ON/OFF switch ON; always switch SYx527 power OFF and wait at least 30s before connecting or disconnecting HV cables.

The function and electro-mechanical specifications of the external connectors are as follows:

Output Channels (0…11): HV coaxial connectors; 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),12kV DC – 1mn (mated pairs); Current rating: 10 A

INTERLOCK: AMP 280371-2 connector

Displays:

- HV ON LED: Function: lights up as at least one channel is on.
  Type: red LEDs for positive polarity; yellow LEDs for negative polarity
- INTERLOCK LED: Function: lights up as the board is in INTERLOCK (channel are disabled).
  Type: red LED

Other components:

- VMAX trimmer: allows to adjust the hardware maximum voltage VMAX common to all channels.
  Its value can be read out via software.
- JA: Jumper connector; short circuit: connect FAGND and AGND; see p.10

2. Safety and installation requirements

General safety information

This section contains the fundamental safety rules for the installation and operation of the board. Read thoroughly 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. Ax561H is a SYx527 board. At power ON the 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.

3. Operating modes

The HV board can be controlled, either locally or remotely, through the SYSTEM software interface. For details on 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
ZCDetect (settable):	(ON/OFF) If ON, it stores the present IMON value into memory for "zero current compensation" purposes, see ZCAdjust parameter (this parameter is available only for some versions, please contact CAEN)
ZCAdjust (settable):	(EN/DIS) If enabled, the stored IMON 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; if disabled, the returned IMON value is not compensated (this parameter is available only for some versions, please contact CAEN)
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
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).

If the POWER ON option is enabled, as the module is turned ON, the channel is restored to the same condition it was before the POWER OFF or RESET; if this option is disabled, at POWER ON or after a RESET, the channel is kept OFF independently from its previous condition.
The following messages may be returned by the 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)5
E-TRIPPED	(channel OFF due to external TRIP line signal)6
I-TRIPPED	(channel OFF due to internal OVERCURRENT condition)
EXT_DIS	(channel disabled by board INTERLOCK protection)

Moreover it is possible to monitor board parameters, such as measured Temperature and HVMax, and to check board status; the following messages may be returned by the POWER SUPPLY SYSTEM when monitoring the board status:

UNDER_TEMP	(board temperature < 5°C)
OVER_TEMP	(board temperature > 65°C)

Output Enable

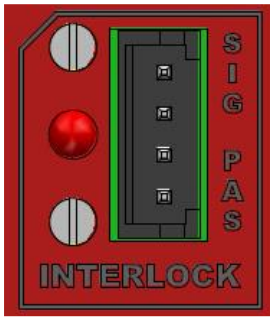

Fig. 2 – INTERLOCK connector

The enable procedure is completed in one of the following ways:

- short the PASSIVE INTERLOCK (see also p. 7) pins (lower couple).
- supply the SIGNAL INTERLOCK (see also p. 7) pins (higher couple) with a +5 V (3-4mA) differential 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 (A1561H)

The HV 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 JA jumper pins on the motherboard (see figure below). The protection shield must be screwed off in order to access JA.

[5] UNV is also reported when Hvmax limit is reached, it is up to the User to verify that VMON value does not exceed HVMAX.

[6] EXTTRIP and INTTRIP parameters are expressed in Hexadecimal format

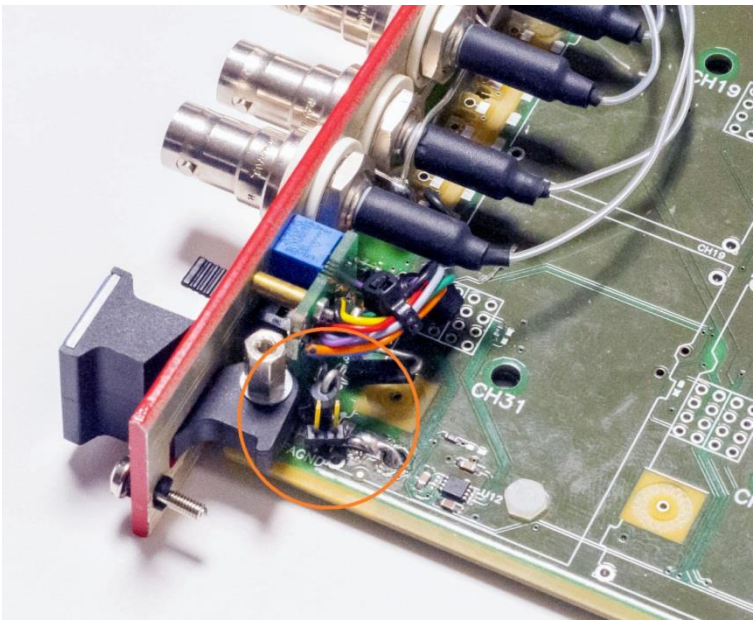

Fig. 3 – JA jumper location

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 board, 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 JA jumper 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:

- The “closed loop “ Earth configuration (JA contacts closed)
- The “open loop” Earth configuration (JA contacts open)

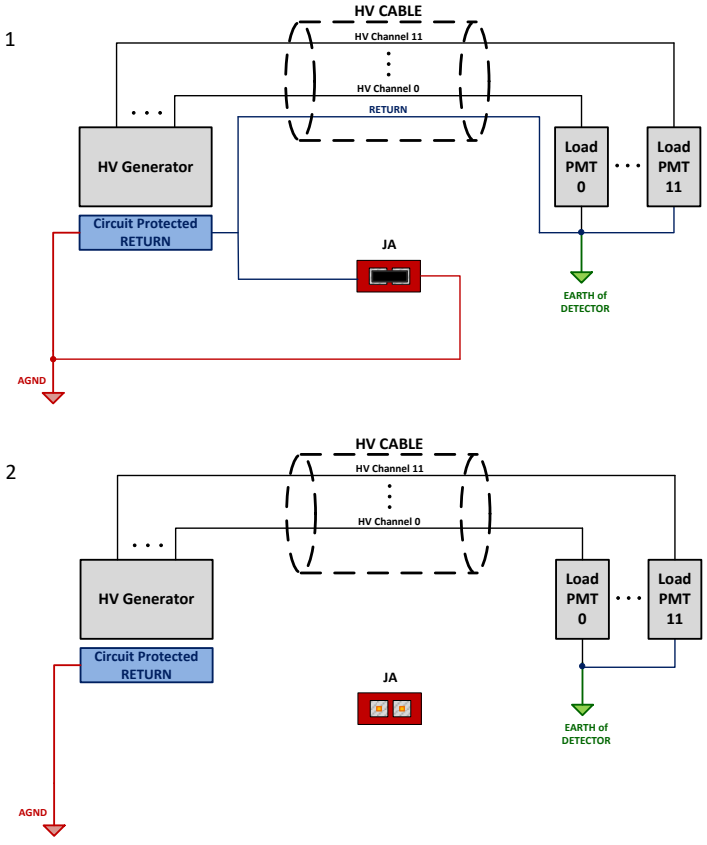

Fig. 4 – Earth configuration connection examples

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