Rev. 03 - September 9th, 2020

A1538D/AG538D

12 Channel 1.5 kV/10 mA (12W) High Voltage Boards

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User Manual
UM4549

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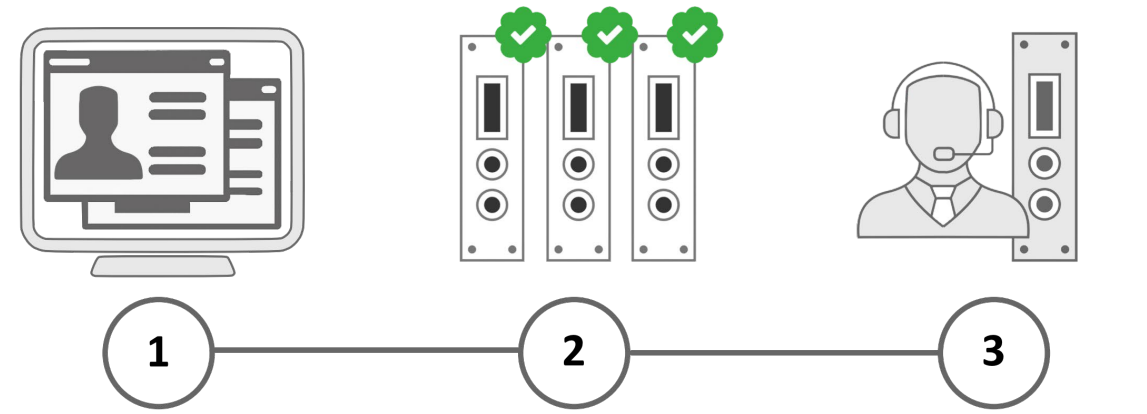

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Purpose of this Manual

This document is the A1538D - AG538D 12 Channel 1.5 kV/10 mA 12W Boards User's manual; it contains information about the installation, the configuration and the use of the board.

Change Document Record

Date	Revision	Changes
19 June 2013	1	Added AG538D
3 February 2014	2	Updated: Table 2, Grounding specs
9 September 2020	3	Updated: Table 1

Symbols, abbreviated terms and notation

Not available

Reference Documents

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1. Introduction

Functional description

The Mod. A1538D is a single width (5TE wide) Board housing 12 HV channels, available with either positive or negative polarity; it is compatible with the CAEN Universal Multichannel Power Supply System (SYx527). The 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 65V hardware limit).

The Mod. AG538D is the "ground return" version of the board: the channels return is wired to the crate Earth reference.

The output voltage range is 0 ÷ 1.5 kV, with 10 mA maximum output current (max power: 12W per channel) and 50 mV set and monitor resolution.

The board is provided with both current and voltage protections. If over-current 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 (TRIP range: 0 ÷ 999 s; 1000 s = Infinite, current generator mode. Step = 1 s). 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 board channels can be enabled according to the interlock logic (see p. 10)

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).

Table 1 – Available Items

Code	Description
WA1538DXAAAA	A1538DN - SYx527 H.V. channels -1.5 KV 10 mA SHV common floating (12 ch)
WA1538DXPAAA	A1538DP - SYx527 H.V. channels +1.5 KV 10 mA SHV common floating (12 ch)
WAG538DXAAAA	AG538DN - SYx527 negative H.V. -1.5 KV 10 mA -SHV Connector common ground (12 ch)
WAG538DXPAAA	AG538DP - SYx527 positive H.V. +1.5 KV 10 mA -SHV Connector common ground (12 ch)

2. Technical Specifications

Channel Characteristic Table

Table 1 – Channel characteristics of the Mod. A1538D - AG538D HV Board

Polarity:		Negative or Positive
Output Voltage:		0 ÷ 1.5 kV
Max. Output Current:		10 mA
Max. Output Power:		12 W
Voltage Set/Monitor Resolution:		50 mV
Current Set/Monitor Resolution:		200 nA
VMAX hardware:		0 ÷ 1.5 kV common for all the board channels
VMAX hardware accuracy:		± 2% of FSR
VMAX software:		0 ÷ 1.5 kV settable for each channel
VMAX software resolution:		1 V
Ramp Up / Down:		1÷ 500 Volt/sec, 1 Volt/sec step
Voltage Ripple:	**20 ÷ 1000 Hz**	<23mVpp (typ); <30mVpp (max)
	1 ÷ 20000 kHz	<15mVpp (typ); <20mVpp (max)
Accuracy: [1,2]	**Voltage Monitor vs. Output Voltage**	typical: ± 0.3% ± 0.2 V max: ± 0.3% ± 1 V
	Voltage Set vs. Voltage Monitor	typical: ± 0.3% ± 0.2 V max: ± 0.3% ± 1 V
	Current Monitor vs. Output Current	typical: ± 2% ± 3 µA max: ± 2% ± 15 µA
	Current Set vs. Current Monitor	typical: ± 3% ± 3 µA max: ± 3% ± 15 µA
Power consumption:		240 W @ full power

[1] From 10% to 90% of Full Scale Range

[2] 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

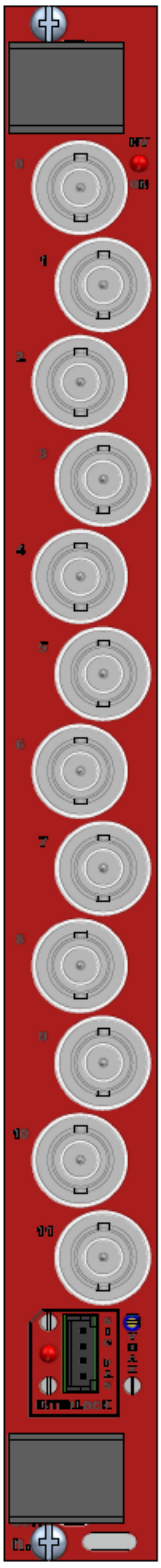

Fig. 1 – Mod. A1538D front panel

Packaging

The module is housed in a 1 unit wide, 6U-high mechanics.

External connections

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

Output Channels (0…11):	HV coaxial connectors Radiall SHVR317580-type
INTERLOCK:	AMP 280371-2

Displays

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

Other components

VMAX trimmer:	Function: it allows to adjust the hardware maximum voltage VMAX common to all the channels. Its value can be read out via software.
JA (A1538D only):	Jumper connector; short circuit: connect FAGND and AGND. See p. 10 for JA location.

3. 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. A1538D / AG538D is a single-width board. At power ON the POWER SUPPLY SYSTEM processor will scan all the slots in the crate to find out where the module is plugged and what kind of module it is.

4. Operating modes

The Mod. A1538D / AG538D board can be controlled, either locally or remotely, through the POWER SUPPLY SYSTEM software interface. For details on POWER SUPPLY 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.

WARNING

A1538D / AG538D REQUIRE POWER SUPPLY SYSTEM "HIGH" OR "MID" FAN SPEED FOR ADEQUATE COOLING

A1538D / AG538D REQUIRE POWER SUPPLY SYSTEM FIRMWARE VERSION 2.00.01 OR LATER

Output control and monitoring

For each output channel, it is possible, through the POWER SUPPLY SYSTEM, to perform the following operations:

- Assign to channel a symbolic name
- Set output voltage (VSET)
- Set max. output current (ISET)
- Set output voltage software limit (SVMAX)
- Set voltage ramp-up rate (RAMP-UP)
- Set voltage ramp-down rate (RAMP-DOWN)
- Set TRIP parameter configuration (see SYx527 User's manual)
- Enable/disable POWER ON option
- Power Down (KILL/RAMP)
- Switch channel ON/OFF
- Monitor output voltage (VMON)
- Monitor output current (IMON)
- Monitor channel status

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 POWER SUPPLY 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)[3]
- E-TRIPPED (channel OFF due to external TRIP line signal)
- 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)

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

Output Enable

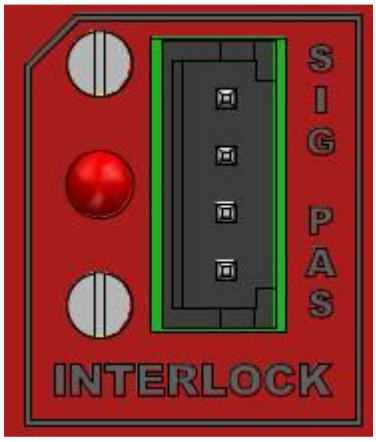

Fig. 2 – INTERLOCK connector

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

The Mod. A1538D 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.

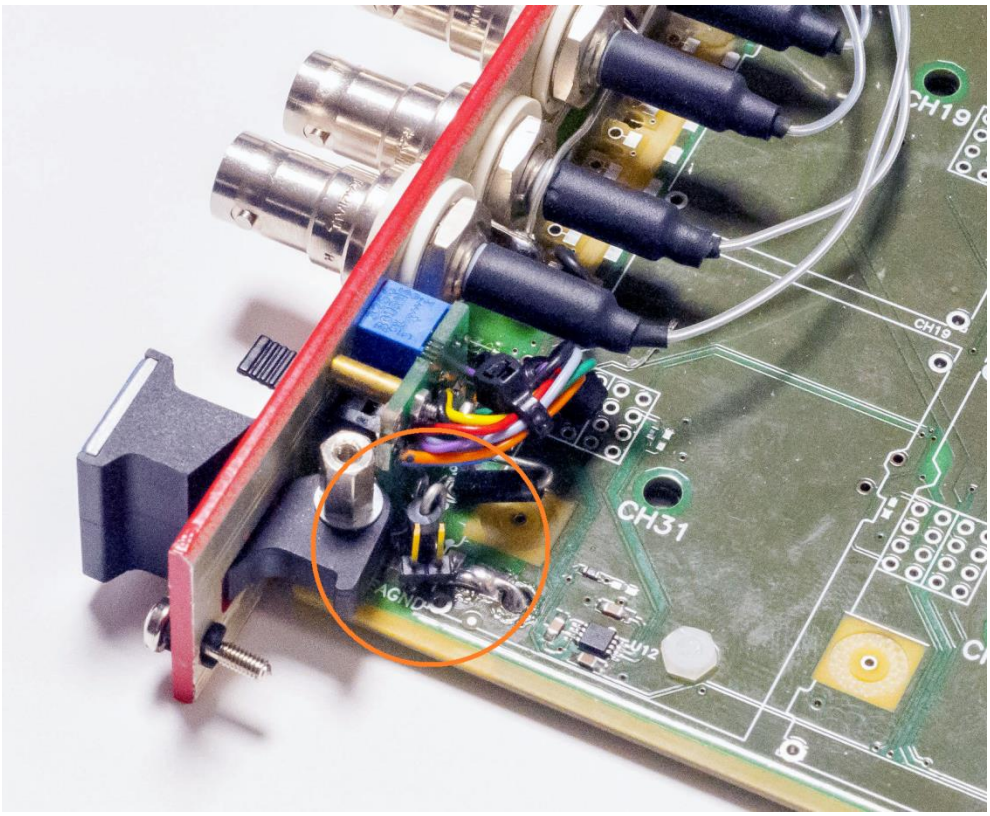

Fig. 3 – JA jumper location

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 A1538D 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 Connector Configurator 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)

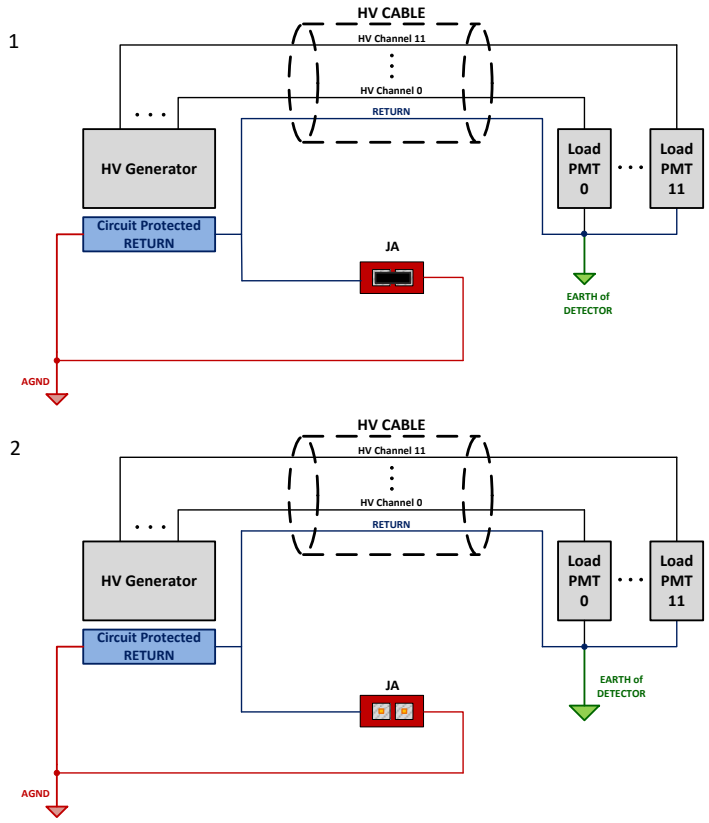

Fig. 4 – Earth configuration connection examples

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