

# **Technical Information Manual**

Revision n.6  
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**MOD. A1535S - AG535S**  
*24 CH 3.5KV/3 mA  
POWER SUPPLY  
BOARD*

**NPO:**  
**00119/07:1535S.MUTx/06**

CAEN will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

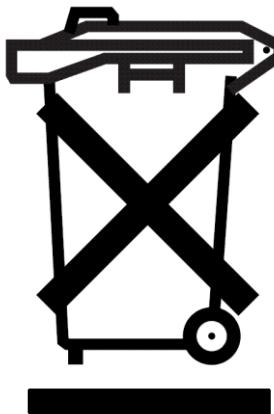
**CAEN declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly the CAEN User's Manual before any kind of operation.**



*CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.*

## **Disposal of the Product**

*The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.*



**MADE IN ITALY** : We stress the fact that all the boards are made in Italy because in this globalized world, where getting the lowest possible price for products sometimes translates into poor pay and working conditions for the people who make them, at least you know that who made your board was reasonably paid and worked in a safe environment. (this obviously applies only to the boards marked "MADE IN ITALY", we cannot attest to the manufacturing process of "third party" boards).

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# 1. Functional description

## 1.1 Overview

The Mod. A1535S is a double width (10TE wide) board housing 24 HV channels, available with either positive or negative polarity; Mod. A1535SM has 12 HV negative and 12 HV positive channels; 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  $\pm 50$  V (with a 65 V hardware limit).

The Mod. AG535S is the “ground return” version of the board: the channels return is wired to the crate Earth reference.

The output voltage range is 0  $\div$  3.5 kV, with 3 mA maximum output current and 0.5 V set and monitor resolution. The boards 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. 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 § 2.2)

The HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the 1  $\div$  500 V/s range (1 V/s step).

**Table 1.1 – Available Items**

| Code         | Description                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------|
| WA1535SMXAAA | A1535SM - SYx527 H.V. 12 ch. +3.5 KV 3 mA and 12 ch. -3.5 KV 3 mA SHV floating                       |
| WA1535SXAAAA | A1535SN - SYx527 H.V. channels -3.5 KV 3 mA SHV common floating (24 ch)                              |
| WA1535SXPAAA | A1535SP - SYx527 H.V. channels +3.5 KV 3 mA SHV common floating (24 ch)                              |
| WAG535SMXAAA | AG535SM - SYx527 H.V. channels +3.5 KV 3 mA (6W)(12ch) and -3.5 KV 3 mA (6W)(12 ch) - SHV common GND |
| WAG535SXAAAA | AG535SN - SYx527 H.V. channels -3.5 KV 3mA (6W) -SHV common ground (24 ch)                           |
| WAG535SXPAAA | AG535SP - SYx527 H.V. channels +3.5 KV 3 mA (6W) - SHV common ground (24 ch)                         |

## 1.2 Channel Characteristic Table

Table 1.2 – Channel characteristics of the Mod. A1535S / AG535S HV Board

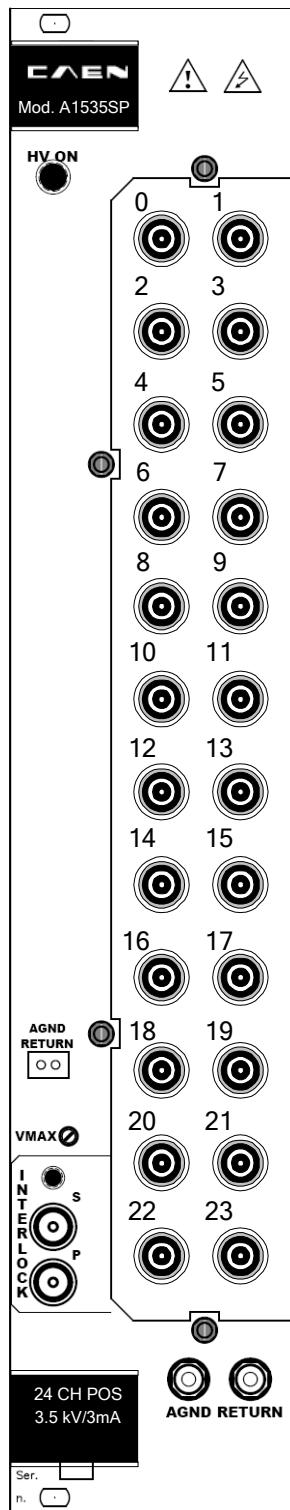
|                                                                    |                                                                                                                     |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Polarity:</b>                                                   | A1535SM, AG535SM: CH0..11: Positive, CH12..23: Negative<br>A1535SN, AG535SN: Negative<br>A1535SP, AG535SP: Positive |
| <b>Output Voltage:</b>                                             | 0 ÷ 3.5 kV                                                                                                          |
| <b>Max. Output Current:</b>                                        | 3 mA                                                                                                                |
| <b>Voltage Set/Monitor Resolution:</b>                             | 0.5 V                                                                                                               |
| <b>Current Set/Monitor Resolution:</b>                             | 500 nA                                                                                                              |
| <b>VMAX hardware:</b>                                              | 0 ÷ 3.5 kV common for all the board channels                                                                        |
| <b>VMAX hardware accuracy:</b>                                     | ± 2% of FSR                                                                                                         |
| <b>VMAX software:</b>                                              | 0 ÷ 3.5 kV settable for each channel                                                                                |
| <b>VMAX software resolution:</b>                                   | 1 V                                                                                                                 |
| <b>Ramp Down:</b>                                                  | 1 ÷ 500 Volt/sec, 1 Volt/sec step                                                                                   |
| <b>Ramp Up:</b>                                                    | 1 ÷ 500 Volt/sec, 1 Volt/sec step                                                                                   |
| <b>Voltage Ripple:</b> <sup>1</sup>                                | <20 mV typical; 30mV max                                                                                            |
| <b>Voltage Monitor vs. Output Voltage Accuracy:</b> <sup>2,3</sup> | typical: ± 0.3% ± 0.5 V<br>max: ± 0.3% ± 2 V                                                                        |
| <b>Voltage Set vs. Voltage Monitor Accuracy:</b> <sup>2</sup>      | typical: ± 0.3% ± 0.5 V<br>max: ± 0.3% ± 2 V                                                                        |
| <b>Current Monitor vs. Output Current Accuracy:</b> <sup>2</sup>   | typical: ± 2% ± 1 µA<br>max: ± 2% ± 5 µA                                                                            |
| <b>Current Set vs. Current Monitor Accuracy:</b> <sup>2</sup>      | typical: ± 3% ± 1 µA<br>max: ± 3% ± 5 µA                                                                            |
| <b>Maximum output power:</b>                                       | A1535S: 8 W; AG535S: 6 W (per channel, software limit)                                                              |
| <b>Power consumption:</b>                                          | A1535S: 310 W; AG535S: 230 W @ full power                                                                           |

<sup>1</sup> From 10 Hz to 15 MHz at full load; ripple may exceed such limits whenever OVC and UNV occur (see § 2.1)

<sup>2</sup> From 10% to 90% of Full Scale Range

<sup>3</sup> 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.

## 1.3 Front Panel



**Fig. 1.1 – Mod. A1535S front panel**

## 1.4 Technical Specifications

### 1.4.1 Packaging

The module is housed in a 2 unit wide, 6U-high mechanics.

### 1.4.2 External connections

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

**Output Channels (0...23):** HV coaxial connectors Radiall SHVR317580-type

**Return:** Radiall R921921 socket, Ø 2mm (A1535S only)

**AGND:** Radiall R921921 socket, Ø 2mm (A1535S only)

**PASSIVE INTERLOCK:** 00-type LEMO connector

**SIGNAL INTERLOCK:** 00-type LEMO connector

### 1.4.3 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

### 1.4.4 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.

**Agnd - Return jumper:** Function: Connects Agnd (Earth) to HV channels return (A1535S only)

**Internal switch (SW1):** Function: SW1 (if installed) shall be used only for test purposes; keep on OFF position during normal use, otherwise TEMPERATURE sensor might not work properly.

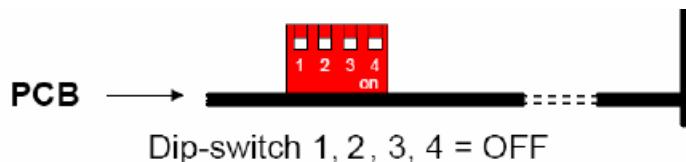


Fig. 1.2 – SW1 Internal dip switches

## 1.5 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.

### 1.5.1 *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.

## 1.6 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

## 1.7 Installation

The Mod. A1535S – AG535S is a double-width board. At power ON the SY x527 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.

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## 2. Operating modes

The Mod. A1535S – AG535S board can be controlled, either locally or remotely, through the SY x527 software interface. For details on SY x527 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

**IF USED WITH SY 1527, THE MOD. A1535S – AG535S BOARDS REQUIRE  
SY 1527 SYSTEMS RUNNING FIRMWARE VERSION 2.00.01 OR LATER**

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### 2.1 Output control and monitoring

For each output channel, it is possible, through the SY x527 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
- Enable/disable POWER ON option
- Switch channel ON/OFF
- Monitor output voltage (VMON)
- Monitor output current (IMON)
- Monitor channel status

If the POWER ON option is enabled, the channel, at POWER ON, is restored in 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 SY x527 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)<sup>4</sup>
- EXTTRIP (channel OFF due to external TRIP line signal)<sup>5</sup>
- INTTRIP (channel OFF due to internal OVERCURRENT 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 SY x527 when monitoring the board status:

- UNDER\_TEMP (board temperature < 5°C )
- OVER\_TEMP (board temperature > 65°C)

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## 2.2 Output Enable

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

- terminate the PASSIVE INTERLOCK (see § 1.4.2) connector on 50 Ohm.
- supply the SIGNAL INTERLOCK (see § 1.4.2) connector 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.

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## 2.3 Grounding specifications

The Mod. A1535S channels share a common floating return (FAGND, see § 1.4.2), available on the RTN 2mm socket connector, insulated from the crate ground (AGND, see § 1.4.2), which is available as front panel 2mm socket connector. This feature allows on-detector grounding, thus avoiding loops which may increase noise level. FAGND and AGND may be coupled in several ways, according to the environment requirements.

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<sup>4</sup> UNV is also reported when Hvmax limit is reached, it is up to the User to verify that VMON value does not exceed HVMAX.

<sup>5</sup> EXTTRIP and INTTRIP parameters are expressed in Hexadecimal format