Rev. 12 - 25/06/2015

A1520P

12 Channel 500 V/15 mA Individual Floating Channel Board

CAEN
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User Manual

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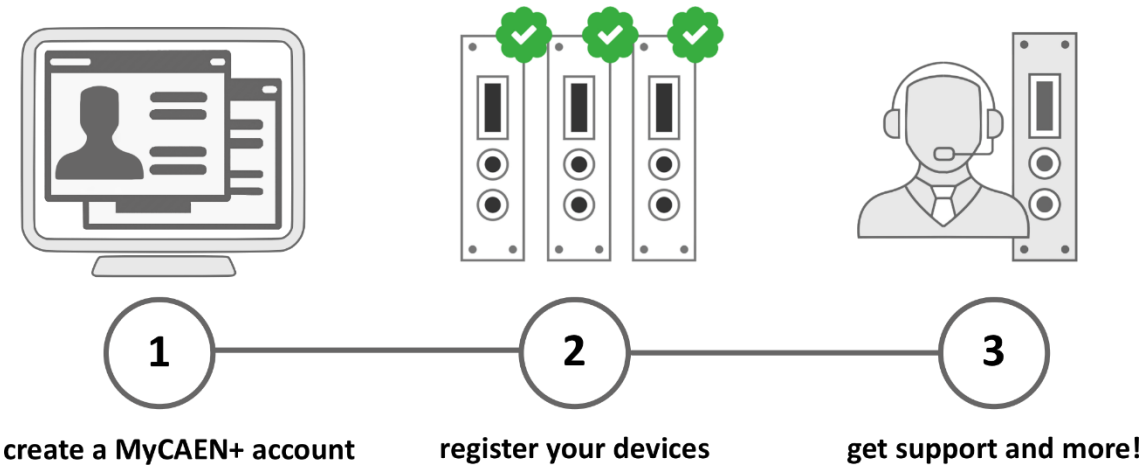

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Purpose of this Manual

This document is the WaveDump User Manual, aligned to the **rel. 3.10.3** of the software. It contains information for the installation, the complete command list explained and the syntax of the configuration file.

Change Document Record

Date	Revision	Changes
Apr 14th, 2011	04	Revised all chapters, new document format.
Mar 1st, 2012	05	Revised Chap. **1**.
Jun 7th, 2012	06	Updated Sec. System requirements & installation setup.
Apr 3rd, 2014	07	Updated sections: Chap. **4**.
Feb 2nd, 2015	08	Revised all chapters, new document format. Major updates in Chap. **2** and **4**. Added Chap. **5** and **7**.
Nov 9th, 2015	09	Updated Chap. **1**, **3**, **5**; added Chap. **6**.
Apr 28th, 2016	10	Updated Chap. **2**, **4** and **6**.
Jan 13th, 2017	11	Updated Chap. **3** and **4**.
May 31st, 2017	12	Updated Chap**. 2, 3** and **4**.
Dec 22nd, 2017	13	Updated Sec. **Block Diagram**. Extended the Decimation support to the 724 family in Chap. **4**. Added note on software compatibility with A3818 driver in Chap. **2**.
Dec 5th, 2018	14	Revised Sec. **Overview,** Sec. **Installation,** Chap. **3** and Chap. **4**. Added Sec. **Configuration File Management** and Sec. **Other Permitted Settings**.
Jan 24th, 2019	15	Modified note in Sec. **OUTPUT_FILE_FORMAT** `option`. Added note in Sec. **OUTPUT_FILE_HEADER** `option`.
Nov 8th, 2019	16	Added notes on 725S and 730S digitizers. Updated Chap. **6** and Chap. **7**.
Apr 26th , 2021	17	Added support to V3718 Bridge and A4818 Adapter. Updated **Reference Document**, Sec. **Drivers**, **Figure 2.4**, Sec. **Common Settings**.
Sep 3rd, 2021	18	Added support to V4718 Bridge. Updated Sec. **OUTPUT_FILE_FORMAT** `option` and Sec. **OUTPUT_FILE_HEADER** `option` for 742 digitizers family. Updated information about data saving path in Chap. **3**.

Symbols, Abbreviated Terms, and Notation

ADC	Analog to Digital Converter
DPP	Digital Pulse Processing
FFT	Fast Fourier Transform
FSR	Full Scale Range
PCB	Printed Circuit Board

Reference Document

[RD1] GD2483 - WaveDump QuickStart Guide

[RD2] GD2783 – First Installation Guide to Desktop Digitizers & MCA

[RD3] Technical Information Manual of V1718 and VX1718 VME – USB2.0 Bridge

[RD4] Technical Information Manual of A3818 PCI Express Optical Link Controller

[RD5] Technical Information Manual of A2818 PCI Optical Link Controller

[RD6] UM1934 - CAENComm User & Reference Manual

[RD7] UM1935 – CAENDigitizer User and Reference Manual

[RD8] AN2472 - CONET1 to CONET2 migration

[RD9] GD2512 - CAENUpgrader QuickStart Guide

[RD10] GD5695 - 742 Quick Start Guide

[RD11] UM7685 – V3718 Bridge User Manual

Technical Information Manual

Revision n. 12

25 June 2015

MOD. A1520P series

CMS ECAL

PWS BOARD

MANUAL REV. 12

NPO:

00110/99:ECAL.MUTx/12

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.

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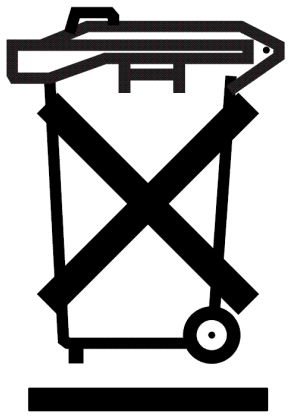

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Mod. A 1520P High Voltage Board

1.1 Overview

The Mod. A1520 P has been specially designed to meet the strict performance requirements for powering the APDs of CMS ECAL; thanks to a careful layout and the use of selected components, ±20 mV voltage regulation stability, less than 20 mV pp noise and ±1 ppm/°C thermal stability has been achieved.

1.2 Functional description

The Model A1520 P[1] is a SY1527 System double-width board which houses 12 positive HV channels; each output channel has an independent floating ground. The output voltage can be programmed and monitored in the range 0 ÷ +500 V with 1 mV steps.

The board is compatible with the CAEN Universal Multichannel Power Supply System (SYx527).

If the output voltage differs from the programmed value by more than 15 V, the channel is signalled to be either in OVERVOLTAGE or UNDERVOLTAGE condition. Moreover, for each channel, a voltage protection limit SVMAX can be fixed via software with 1 V resolution and the output voltage can not be programmed beyond this value.

All output channels are provided with Remote Sensing Lines to compensate for the voltage drop over the cables.

The HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷ 50 V/s in 1 V/s steps.

For each channel, it is also possible to set an output current limit in the range 0 ÷ 15 mA (25 nA steps). The output current is monitored with 25 nA resolution; if a channel tries to draw a current larger than its programmed limit it is signalled to be in OVERCURRENT condition; the SYX527 system detects this state as a fault and reacts according to the setting of the TRIP parameter[2], namely:

1) TRIP=infinite (= 1000 s)

   If the maximum output current value is reached the channel behaves like a constant current generator.

2) TRIP=finite (< 1000 s)

The output current is permitted to equal the limit value only for programmed time interval and then is switched off at the selected RAMP-DOWN speed.

The TRIP time (i.e. the maximum time an OVERCURRENT condition is allowed to last) can be programmed in 0.1 s steps. If a RESET, INTERLOCK or KILL command is issued to the board, all channels are switched off at the selected RAMP-DOWN speed.

[1] The board version which actually supplies the APDs of CMS ECAL features 9 channels instead of 12 and is encoded as A1520 PE. Such issue shares all the other functional characteristics with the standard A1520 P.

[2] Refer to the SYx527 User's Manuals for details about the TRIP Handling.

1.3 Channel Characteristics Table

Table 1.1 – Channel characteristics of the Mod. A 1520P HV PWS Board

Polarity:	Positive
Output Voltage:	0 ÷ 500 V
Max. Output Current:	15 mA
Voltage Set/Monitor resolution:	1 mV
Current Set:	250 nA
Current Monitor resolution:	25 nA
SVMAX limit:	0÷500 V, 1 V steps
Ramp Up / Ramp Down rate:	1÷50 Volt/sec, 1 Volt/sec steps
Temperature Monitor resolution:	1 °C
Temperature range:	+15 ÷ +40°C

Table 1.2 – Measured ratings of the Mod. A 1520P HV PWS Board

Low frequency noise (f < 100 kHz):	20 mV pp
High frequency noise (f ≥ 100 kHz)	4 mV pp
Voltage Monitor vs. Output Voltage accuracy: (*)	±40 ppm
Voltage Set vs. Output Voltage accuracy: (*)	±40 ppm
Current Monitor vs. Output Current accuracy: (*)	±(250 nA + 0.01%)
Current Set vs. Output Current accuracy: (*)	±(1 µA + 1%)
Short term reproducibility:	±40 ppm
Thermal stability:	±3 ppm/°C

N.B.: Most boards can operate indifferently whether the SY1527 mainframe is supplied with 50 Hz or 60 Hz AC power supply; the A1520P series, instead, requires a factory calibration, so the User should check if the board is calibrated for operation at the right frequency (50 Hz or 60 Hz).

(*) in the 200÷500 V output voltage range.

1.4 Front Panel

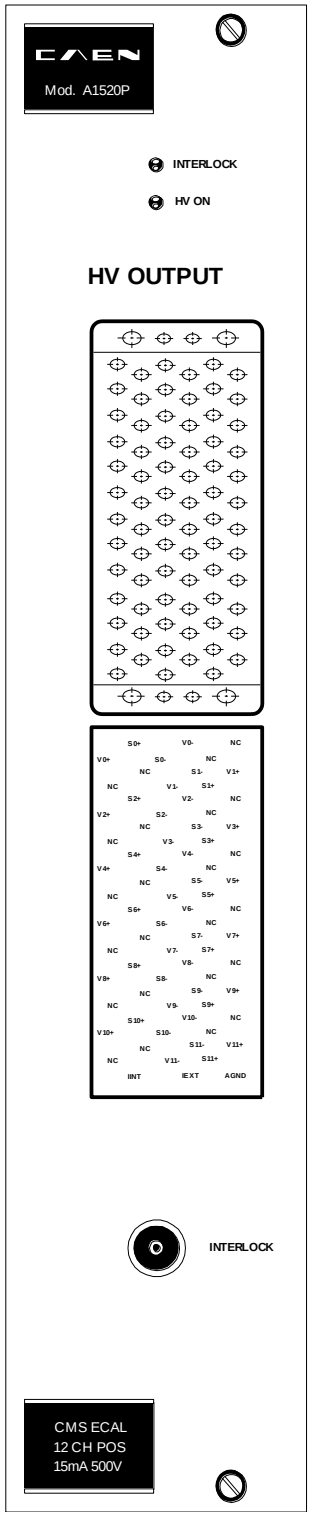

Fig. 1.1 – Mod. A1520 P front panel

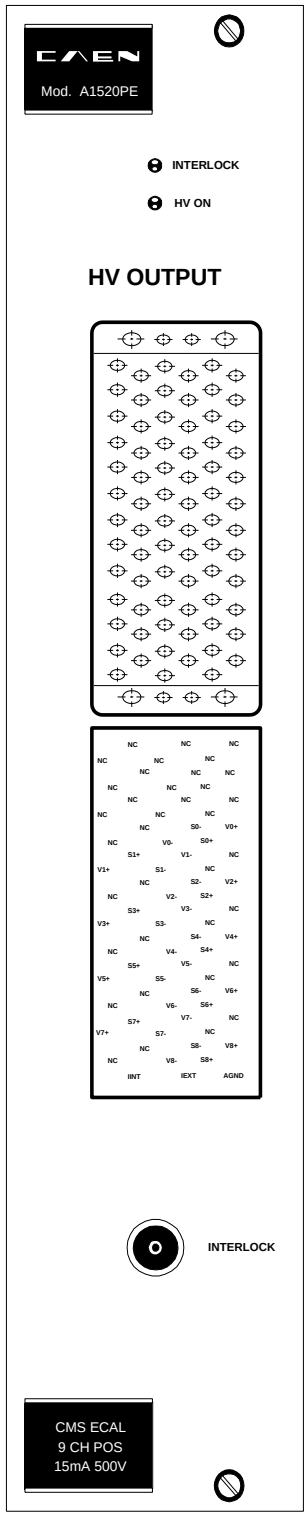

Fig. 1.2 – Mod. A1520 PE front panel

1.5 Technical Specifications

1.5.1 Packaging

The module is housed in a 10TE-wide, 6U-high mechanics.

1.5.2 External connections

The location of all components of the front panel is shown in Fig. 1.1, p.7.
The function and electro-mechanical specifications of the external connectors are listed in the following subsections.
HV OUTPUT:
Mechanical specifications:
75position DialylPhthalate receptacle housing AMP Part No. 201311-3
Electrical specifications: see table below

Table 1.3 – Mod. A1520 P HVOUTPUT connector pin-out

Name	Pin number	Function
V0+	4	ch. 0 positive output
S0+	1	ch. 0 positive sensing line
S0-	5	ch. 0 negative sensing line
V0-	2	ch. 0 negative output
V1+	11	ch. 1 positive output
S1+	14	ch. 1 positive sensing line
S1-	10	ch. 1 negative sensing line
V1-	13	ch. 1 negative output
V2+	18	ch. 2 positive output
S2+	15	ch. 2 positive sensing line
S2-	20	ch. 2 negative sensing line
V2-	16	ch. 2 negative output
V3+	24	ch. 3 positive output
S3+	27	ch. 3 positive sensing line
S3-	23	ch. 3 negative sensing line
V3-	26	ch. 3 negative output
V4+	31	ch. 4 positive output
S4+	28	ch. 4 positive sensing line
S4-	32	ch. 4 negative sensing line
V4-	29	ch. 4 negative output
V5+	36	ch. 5 positive output

Name	Pin number	Function
S5+	39	ch. 5 positive sensing line
S5-	35	ch. 5 negative sensing line
V5-	38	ch. 5 negative output
V6+	43	ch. 6 positive output
S6+	40	ch. 6 positive sensing line
S6-	44	ch. 6 negative sensing line
V6-	41	ch. 6 negative output
V7+	48	ch. 7 positive output
S7+	51	ch. 7 positive sensing line
S7-	47	ch. 7 negative sensing line
V7-	50	ch. 7 negative output
V8+	55	ch. 8 positive output
S8+	52	ch. 8 positive sensing line
S8-	56	ch. 8 negative sensing line
V8-	53	ch. 8 negative output
V9+	60	ch. 9 positive output
S9+	64	ch. 9 positive sensing line
S9-	59	ch. 9 negative sensing line
V9-	63	ch. 9 negative output
V10+	70	ch. 10 positive output
S10+	65	ch. 10 positive sensing line
S10-	71	ch. 10 negative sensing line
V10-	66	ch. 10 negative output
V11+	75	ch. 11 positive output
S11+	78	ch. 11 positive sensing line
S11-	74	ch. 11 negative sensing line
V11-	77	ch. 11 negative output
IINT	79	INTERLOCK connection
IEXT	80	INTERLOCK connection
AGND0	82	Analog ground

Table 1.4 – Mod. A1520 PE HVOUTPUT connector pin-out

Name	Pin number	Function
V0+	24	ch. 0 positive output
S0+	27	ch. 0 positive sensing line
S0-	23	ch. 0 negative sensing line
V0-	26	ch. 0 negative output
V1+	31	ch. 1 positive output
S1+	28	ch. 1 positive sensing line
S1-	32	ch. 1 negative sensing line
V1-	29	ch. 1 negative output
V2+	36	ch. 2 positive output
S2+	39	ch. 2 positive sensing line
S2-	35	ch. 2 negative sensing line
V2-	38	ch. 2 negative output
V3+	43	ch. 3 positive output
S3+	40	ch. 3 positive sensing line
S3-	44	ch. 3 negative sensing line
V3-	41	ch. 3 negative output
V4+	48	ch. 4 positive output
S4+	51	ch. 4 positive sensing line
S4-	47	ch. 4 negative sensing line
V4-	50	ch. 4 negative output
V5+	55	ch. 5 positive output
S5+	52	ch. 5 positive sensing line
S5-	56	ch. 5 negative sensing line
V5-	53	ch. 5 negative output
V6+	60	ch. 6 positive output
S6+	64	ch. 6 positive sensing line
S6-	59	ch. 6 negative sensing line
V6-	63	ch. 6 negative output
V7+	70	ch. 7 positive output
S7+	65	ch. 7 positive sensing line
S7-	71	ch. 7 negative sensing line
V7-	66	ch. 7 negative output
V8+	75	ch. 8 positive output
S8+	78	ch. 8 positive sensing line

Name	Pin number	Function
S8-	74	ch. 8 negative sensing line
V8-	77	ch. 8 negative output
IINT	79	INTERLOCK connection
IEXT	80	INTERLOCK connection
AGND0	82	Analog ground

INTERLOCK:

Mechanical specifications**:**
female LEMO-00 connector
Electrical specifications: open/closed contact

1.5.3 Cabling

Fig. 2.2 and 2.3 show, respectively, details about the parts constituting the front panel channel connectors and the connector to be mounted on the cable in order to match with the channel connector.
These parts are available from AMP INCORPORATED, Harrisburg Pennsylvania 17105, U.S.A..

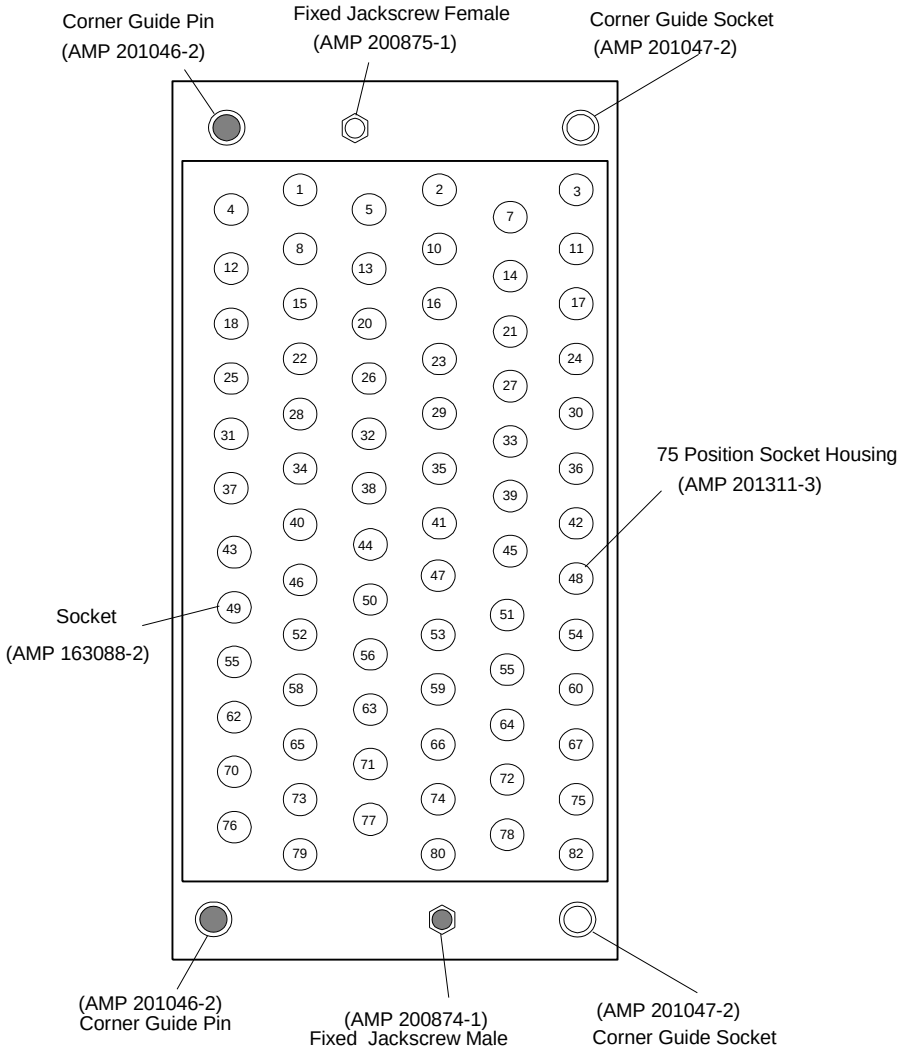

Fig. 1.3 – Panel connector parts

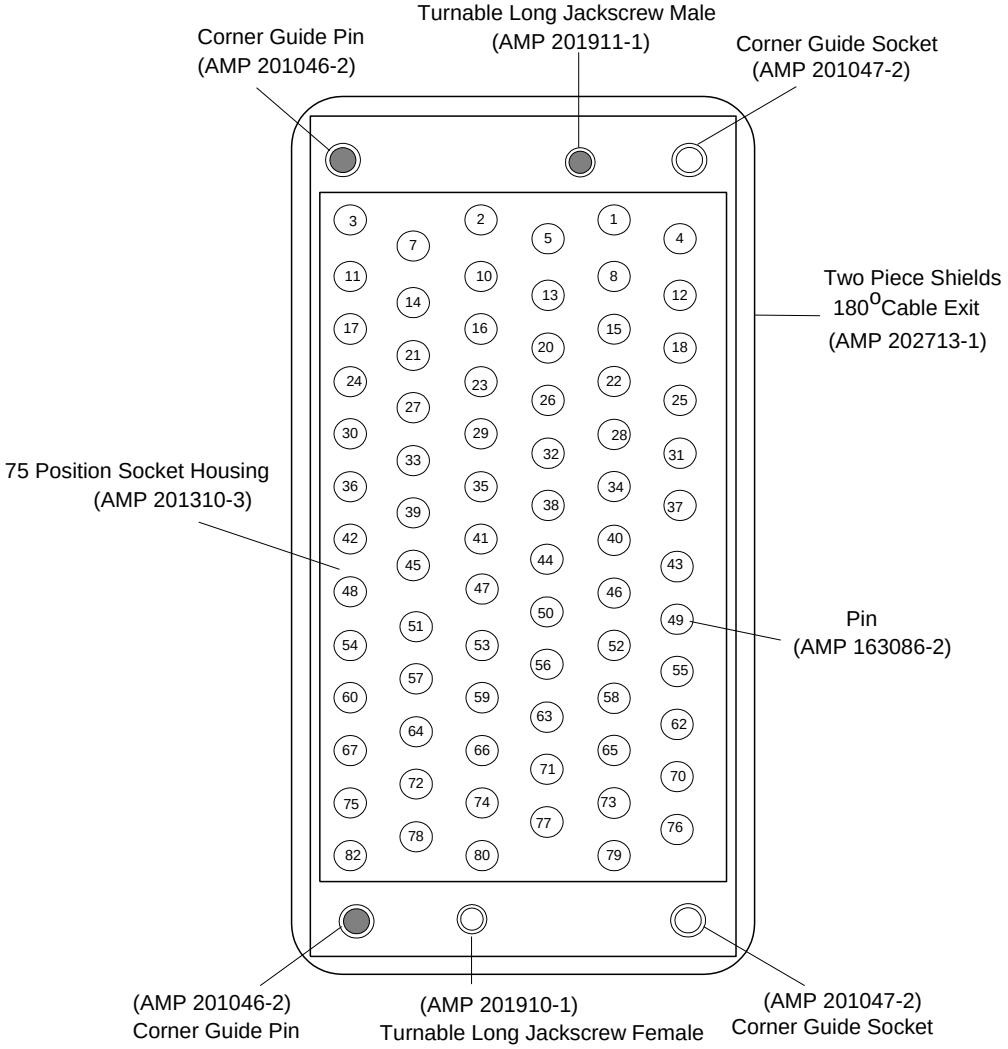

Fig. 1.4 – Cable connector parts

1.5.4 Displays

HV ON (red LED)

INTERLOCK (green LED, refer to § 3.3 for further details)

1.5.5 Other components

J1, J2 jumpers for INTERLOCK options selection. Please refer to Fig. 2.5 for jumpers location.

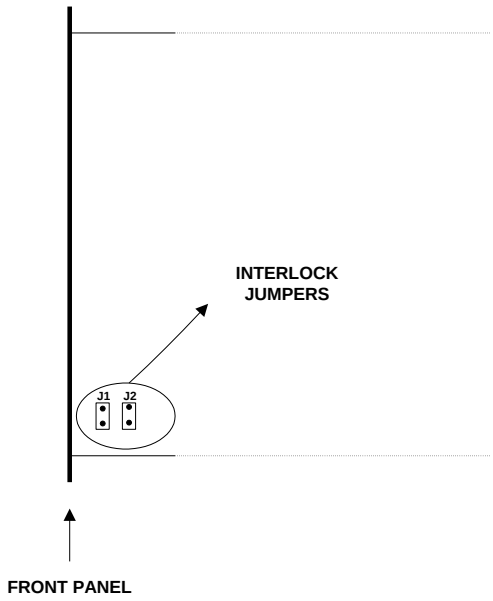

Fig. 1.5 – INTERLOCK jumpers location

2. Safety information and installation requirements

2.1 General safety information

This section contains the fundamental safety rules for the installation and operation of the A 1520P board. Read thoroughly this section before starting any procedure of installation or operation of the product.

2.1.1 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 apply a voltage to a load that is outside the range specified for that load.

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 there is damage to this product, have it inspected by qualified service personnel.

2.2 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

ATTENTION

Refer to Manual

2.3 Installation

The Mod. A 1520P is a double-width board (10 TE-wide) which can be inserted in any slot of the SYX527 crate. At power ON the SYX527 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.
For correct operation it is recommended to turn off the SY1527 crate before the board's insertion/extraction, although insertion/extraction in/from a powered crate does not damage the board's circuitry.
N.B.: the board does not allow "live extraction"; the system must be turned off before removing the board.

3. Operating modes

The Mod. A 1520P can be controlled, either locally or remotely, through the SYX527 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.

ATTENTION

THE MOD. A 1520P BOARD REQUIRES

SYX527 FIRMWARE VERSION 1.09.04 OR LATER

3.1 Output control and monitoring

For each output channel, it is possible, through the SYX527 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 speed (RAMP-UP)
- Set voltage ramp-down speed (RAMP-DOWN)
- Set TRIP parameter
- ON/OFF POWER ENABLE option
- Switch channel ON/OFF
- Monitor output voltage (VMON)
- Monitor output current (IMON)
- Monitor channel status
- Null the IMON offset (IMONOFFSET), see § 3.5
- Compensate for drift due to Temeprature variations (T_DRIFT), see § 3.4

If the POWER ENABLE option is ON (default setting), the channel is intrinsically ON (it is supplied): by switching it ON/OFF (ON/OFF parameter), the output voltage can be either provided or not. If the POWER ENABLE option is OFF, the channel is intrinsically OFF (it is not supplied): the output voltage cannot be provided in any case (whatever the ON/OFF parameter setting); this option can be useful to cut-off one channel from the rest of the board, while the other ones keep on working.

The following messages may be returned by the SYX527 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)
- EXTTRIP (channel OFF due to external TRIP line signal)
- 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 SYX527 when monitoring the board status:

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

3.2 Voltage sensing

All output channels have a Remote Sensing Line to compensate for the voltage drop over the cable. Voltage is monitored directly at the load by an high input impedance differential amplifier; the voltage sensing circuit is schematically illustrated in the figure below.

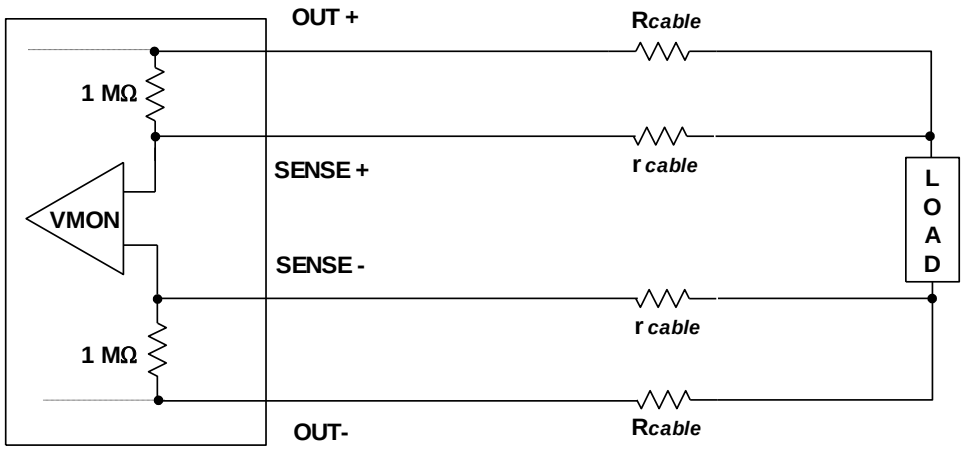

Fig. 3.1 – Remote voltage sensing scheme

3.3 Interlock

The board is provided with an INTERLOCK system which switches OFF simultaneously all the channels if the INTERLOCK contact is removed; there are various INTERLOCK options which can be selected by means of two PCB jumpers (see Fig. 1.5):

a) if J2 is inserted (J1 not inserted), INTERLOCK is disabled and the green front panel LED is always lit.

b) if J1 is inserted (J2 not inserted), the IINT and IEXT pin of the HV OUTPUT cable connector should be short-circuited; in this case if the cable connector is unplugged the output channels are immediately turned OFF and the green LED is switched off.

c) If no jumper is inserted, the green LED doesn't light on and the board is disabled until the LEMO INTERLOCK input is shorted to ground.

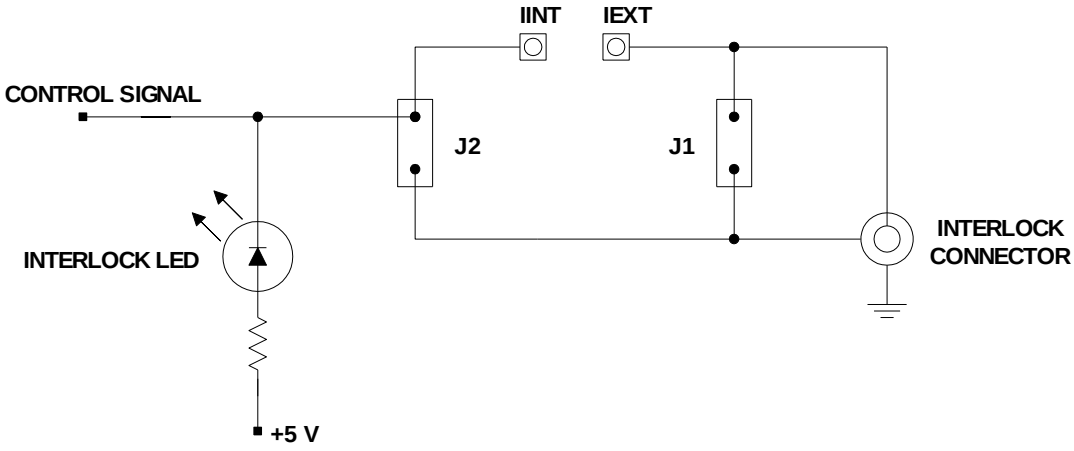

Fig. 3.2 – INTERLOCK connections scheme

3.4 Temperature drift compensation

The channels are provided with an automatic compensation function for voltage drift due to temperature variations. The User must set the T_DRIFT parameter with the expected drift[3] (mV/°C), eventually obtained from thermal chamber tests (default value is 0).

3.5 IMON offset nulling

The IMONOFFSET parameter can be set either to ABS (absolute) or to REL (relative). The default setting is ABS, which means that IMON=0 is considered as the IMON baseline. When the User switches to REL, the IMON value present on the channel is taken as baseline from that moment on.

3.6 Transparent Mode access

The communication with the board can take place in “Transparent Mode” (from the System’s Main menu), which is password protected; this allows to access the “Calibration Mode”, which can be either “Manual” or “Automatic”. A mostly self-explanatory menu will guide the User through the calibration procedure.

[3] Valid T_DRIFT values can be either positive or negative

4. T1520 P voltmeter board

The Mod. T1520 P 12-channel board has been issued for calibration purposes. It is provided with three 2 mm sockets (two for the voltage and one for the current) to be connected with the multimeter and two serial links (to be connected with the oscilloscope and with the multimeter respectively) on 9-pin DB connectors. Settings on the channels can be performed via 9 groups of jumpers placed on the board side (the group closest to the front panel is related to channel 0 and so on). The jumpers description is shown in Fig. 5.1.

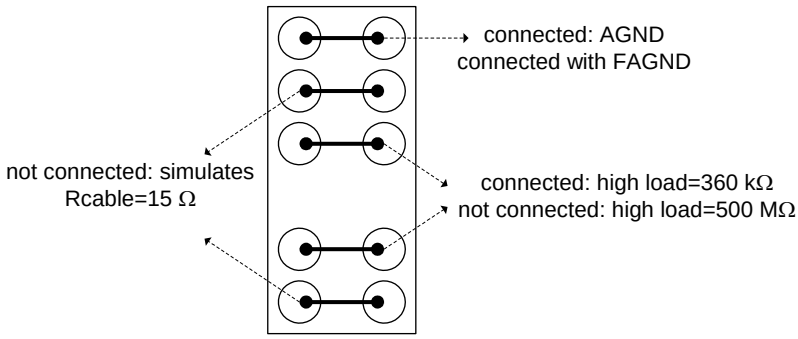

Fig. 4.1 – Mod. T1520 P jumpers group (1 channel)

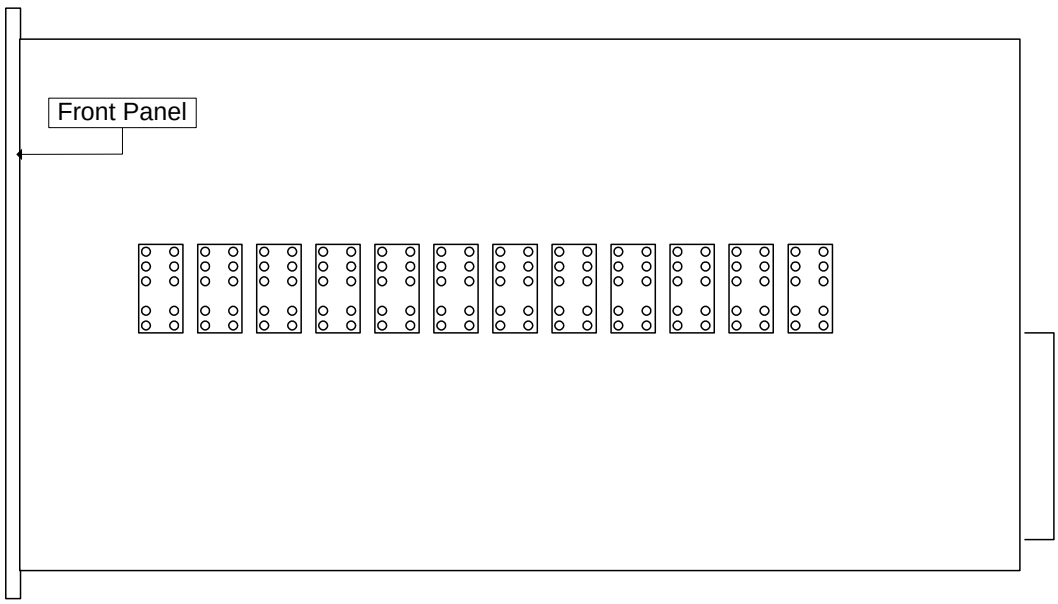

Fig. 4.2 – Mod. T1520 P jumpers position

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