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# **Technical Information Manual**

Revision n. 9  
24 March 2014

**MOD. A 1516 B**

*6 CH FLOATING  
LOW VOLTAGE BOARD*  
**MANUAL REV. 9**

**NPO:  
0000/01:A1516B.MUTx/09**

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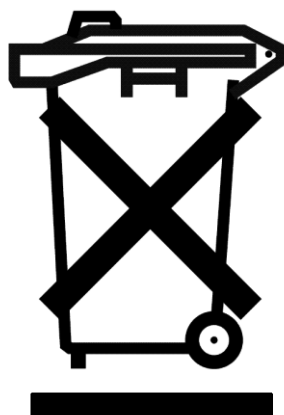
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*CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.*

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*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 can not attest to the manufacturing process of "third party" boards).

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# 1. Mod. A1516 B Low Voltage Board

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## 1.1 Functional description

The Model A1516 B is a single width (5 TE wide) board housing 6 LV floating (reversible polarity) channels. The connector<sup>1</sup> output voltage range is 0÷15 V (1.5 A maximum output current) with 10 mV monitor resolution.

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

The board is provided with Remote Sensing Lines to compensate for the voltage drop over the connection cables.

If the output voltage differs from the programmed value by more than 3% of voltage full scale range, 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 10 mV resolution and the output voltage can not be programmed beyond this value.

The LV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷ 29 V/s in 1 V/s steps. By programming this parameter at 30 V/s, the channel ramps actually at the maximum available rate.

The output current is monitored with 10 mA 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<sup>2</sup>, namely:

1) TRIP=infinite ( = 1000 s)

When the set output current value is reached the channel behaves like a constant current generator.

2) TRIP=finite (< 1000 s)

The output current keeps the set value only for programmed time interval and then is switched off.

The TRIP time (i.e. the maximum time an OVERCURRENT condition is allowed to last) can be programmed in 0.1 s steps.

The maximum output voltage (VMAX Hardware) 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 boards host also a temperature sensor located on the PCB near the LV channels: the temperature values measured by this sensor are used to signal Over Temperature condition on the SYX527.

The boards are provided with an "EN" input that disables the channels when it is not terminated.

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<sup>1</sup> A modest voltage drop along the connection lines, depending on the cables' length, must be expected

<sup>2</sup> Refer to the SYx527 User's Manuals for details about the TRIP Handling.



## 1.2 Channel Characteristics Table

**Table 1.1 - Channel characteristics of the Mod. A 1516 B LV Board**

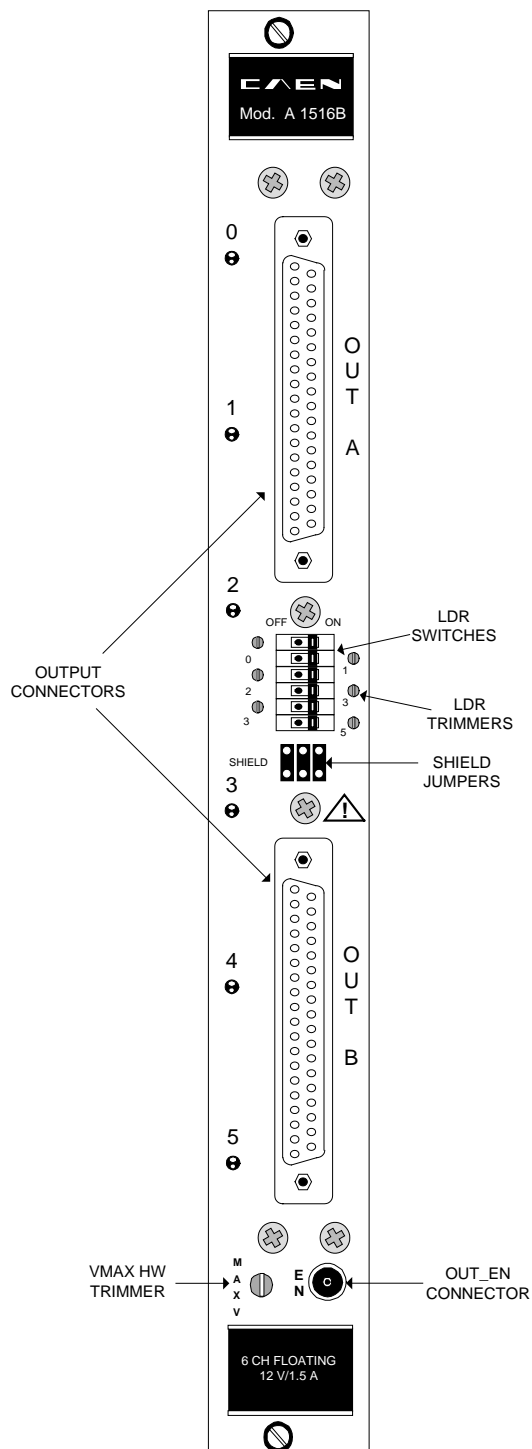
<b>Polarity:</b>	Floating
<b>Output Voltage<sup>3</sup>:</b>	0÷15 V (connector output)
<b>Max. Output Current:</b>	1.5 A
<b>Voltage Set/Monitor Resolution:</b>	10 mV
<b>Current Set/Monitor Resolution:</b>	1 mA
<b>VMAX hardware:</b>	0÷15 V common for all the board channels
<b>VMAX hardware accuracy:</b>	± 2% of FSR
<b>VMAX software:</b>	0÷15 V settable for each channel
<b>VMAX software resolution:</b>	10 mV
<b>Ramp Up/Down:</b>	1÷29 Volt/sec, 1 Volt/sec step
<b>Voltage Ripple: <sup>4</sup></b>	< 5 mV pp
<b>Voltage Monitor vs. Output Voltage Accuracy: <sup>5</sup></b>	typical: ± 0.3% ± 30 mV maximum: ± 0.3% ± 50 mV
<b>Voltage Set vs. Output Voltage Accuracy: <sup>4</sup></b>	typical: ± 0.3% ± 30 mV maximum: ± 0.3% ± 50 mV
<b>Current Monitor vs. Output Current Accuracy: <sup>4</sup></b>	typical: ± 2% ± 2 mA maximum: ± 2% ± 5 mA
<b>Current Set vs. Output Current Accuracy: <sup>4</sup></b>	typical: ± 2% ± 2 mA maximum: ± 2% ± 5 mA
<b>Load Regulation: <sup>4</sup></b>	± 0.3 % (with sense wires) ± 2 % (without sense wires/LDR ON/SENSE OFF)
<b>Power consumption</b>	275 W

<sup>3</sup> The board works properly with a Vset larger than 1.25 V and a current on the load larger than 0.1 A

<sup>4</sup> From 10 Hz to 15 MHz at full load; measure with the line terminated on a 10 µF capacitance and a 100 nF ceramic capacitance in parallel to the load

<sup>5</sup> From 10% to 90% of Full Scale Range

## 1.3 Front Panel



**Fig. 1.1 - Mod. A 1516 B front panel**

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## 1.4 Technical Specifications

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### 1.4.1 Packaging

The Mod. A 1516 B is housed in a 5TE-wide, 6U-high mechanics.

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### 1.4.2 External connections

The location of all components of the front panel is shown in Fig. 2.1, p. 8. The function and electro-mechanical specifications of the external connectors are listed in the following subsections.

#### OUT A, OUT B CONNECTORS:

##### Mechanical specifications:

two DB37 type female connectors

Electrical specification: LV outputs according to specifications given in Table 1.1, p.6 and Sense wires.

#### EN CONNECTOR

##### Mechanical specifications:

00-type LEMO connector.

Electrical specifications: board ENABLE input, if it is connected to ground, the channels are enabled. Refer to § 3.4.1 for further details.

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### 1.4.3 Displays

#### 0...5 LEDs:

*Function:* they light up as the relevant channel is on.

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### 1.4.4 Switches

#### SENSE 0...5

*Function :* they allow to enable/disable the automatic Line Drop Recovery system

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### 1.4.5 Front Panel Jumpers

#### JP1, JP2, JP3 :

*Type:* two pin jumpers

*Function:* grounding of the front panel connectors' shield (see also § 3.5)

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## **1.4.6      *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.

**LDR trimmers:**

*Function:* 6 calibration trimmers for the automatic Line Drop recovery system

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## 2. Safety information and installation requirements

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### 2.1 General safety information

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

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#### 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.

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## 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 1516 B is a single-width (5 TE wide) board 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.

**N.B.: the board does not allow “live extraction”; the board must be disabled (see § 3.4.1) before it is removed from the system.**

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## 3. Operating modes

The Mod. A 1516 B board 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 1516 B BOARD REQUIRE  
SYX527 FIRMWARE VERSION 1.09.04 OR LATER**

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### 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
- Enable/disable POWER ON option
- Switch channel ON/OFF
- Monitor output voltage (VMON) [measured on the load by the sense wires, see § 3.3]
- 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 SYX527 when monitoring the channel status:

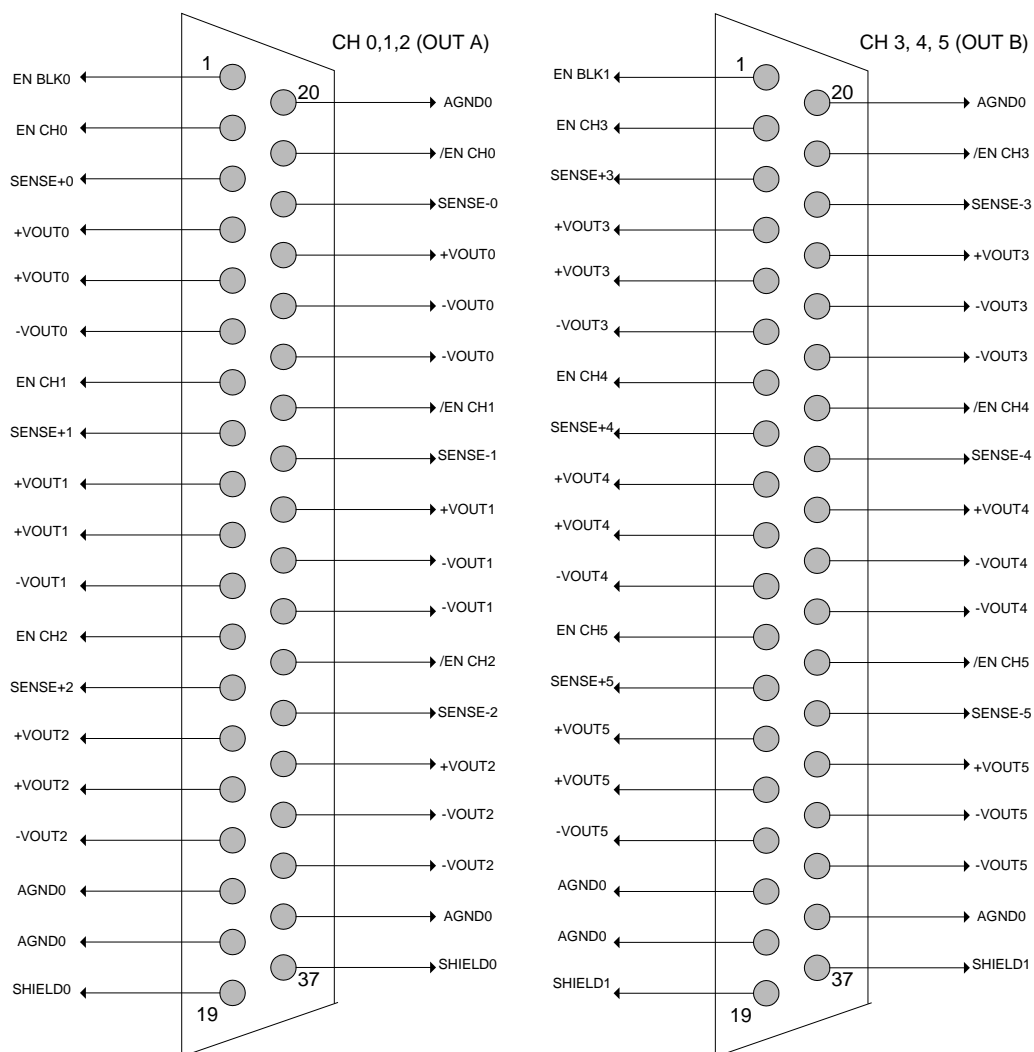
- OFF (channel turned OFF)
- RUP (channel ramping up)
- RDWN (channel ramping down)
- OVC (channel in OVERCURRENT condition)
- OVV (channel in OVERVOLTAGE condition)
- INTTRIP (channel OFF due to internal OVERCURRENT condition)
- EXT\_DIS (channel disabled by board INTERLOCK protection)

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 Pin assignment

The following figure shows the pin assignment of the front panel connectors:



**Fig. 3.1 - Mod. A 1516 B Pin assignment**



### 3.2.1 Front panel connectors pin assignment description

- $+VOUTx$  and  $-VOUTx$ : they are the x channel's LV outputs (x ranging from 0 to 5)
- $SENSE_{\pm x}$ : they are the sensing lines to be connected to the load in order to compensate the voltage drop (see § 3.3)
- $ENCHx$  and  $/ENCHx$ : ENMODE0: short circuiting these pins, x channel is disabled (default); ENMODE1: x channel is enabled when a +5 V d.c. voltage difference is applied between  $ENCHx$  and  $/ENCHx$  pins (see § 3.4.2)
- $ENBLK0/1$ : grounding these pins channels 0, 1, 2 ( $ENBLK0$ ) and 3, 4, 5 ( $ENBLK1$ ) are enabled
- $AGND0$ : these pins are connected to the crate ground
- $SHIELD0/1$ : these pins are connected to the connector's external shield

## 3.3 Voltage drop compensation

The voltage drop along the cables can be recovered in the two following ways:

### 3.3.1 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 through the sense wires; the voltage sensing circuit is schematically illustrated in the figure below.

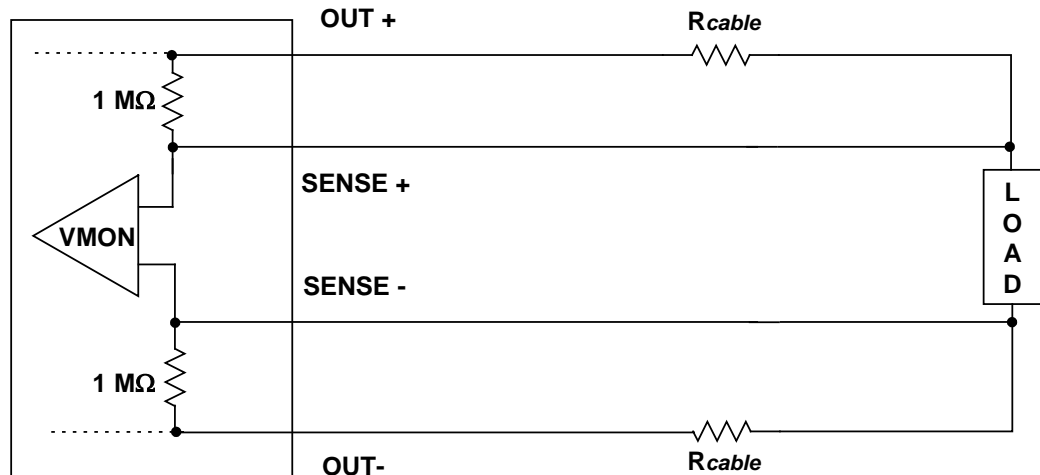


Fig. 3.2 - Remote voltage sensing scheme

When the sense switches (see Fig. 2.1) are set ON and the sense wires are connected to the load, the  $V_{set}$  value equals the voltage on the load; if the sense wires are not connected (to the load),  $V_{set}$  will equal the voltage on the connector.

### 3.3.2 Line Drop Recovery (LDR) system

The Mod. A 1516 B also features a Line Drop Recovery system which can compensate for the voltage drop over the connection cables. If the User wishes to employ the LDR system a short calibration procedure is required:

- Set the sense switch (see Fig. 2.1) on the OFF position
- Set the output voltage (Vset) so that the voltage drop over the cable is near to the maximum drop expected during operation
- Measure the voltage over the load by a voltmeter (the measured value will be, in general, different from the Vset value)
- Turn the relevant LDR trimmer (see Fig. 2.1) so that the measured voltage equals Vset.

**N.B. The LDR system works properly with a Vset larger than 1.25 V and a current on the load larger than 0.1 A.**

A third way consists of using the sense wires over the first cable segment (point A and A', sense switches = OFF); then, the remaining loss (voltage drop over  $r_{cable}$ ) can be compensated with the LDR, as illustrated in the following scheme:

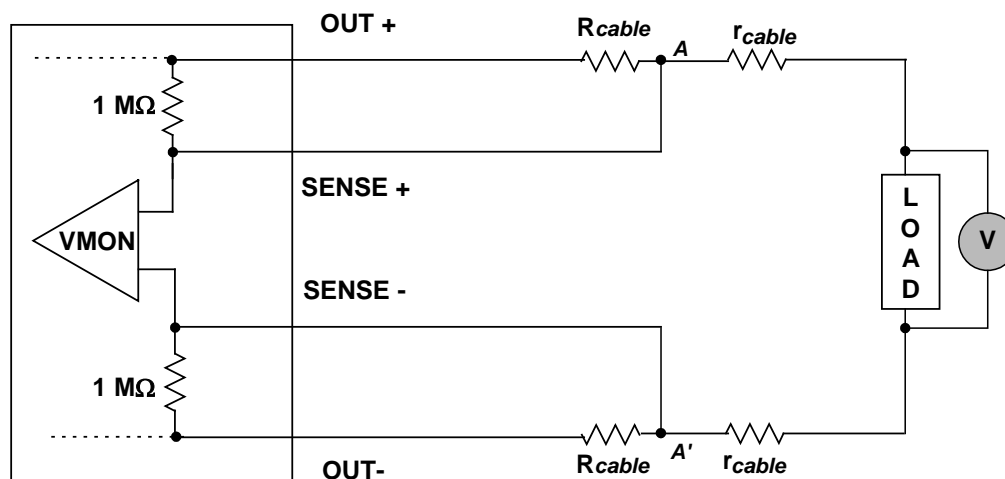


Fig. 3.3 – LDR system + remote voltage sensing scheme

## 3.4 Output Enable

It is possible to enable the board's channels in the following ways.

### 3.4.1 Board Enable

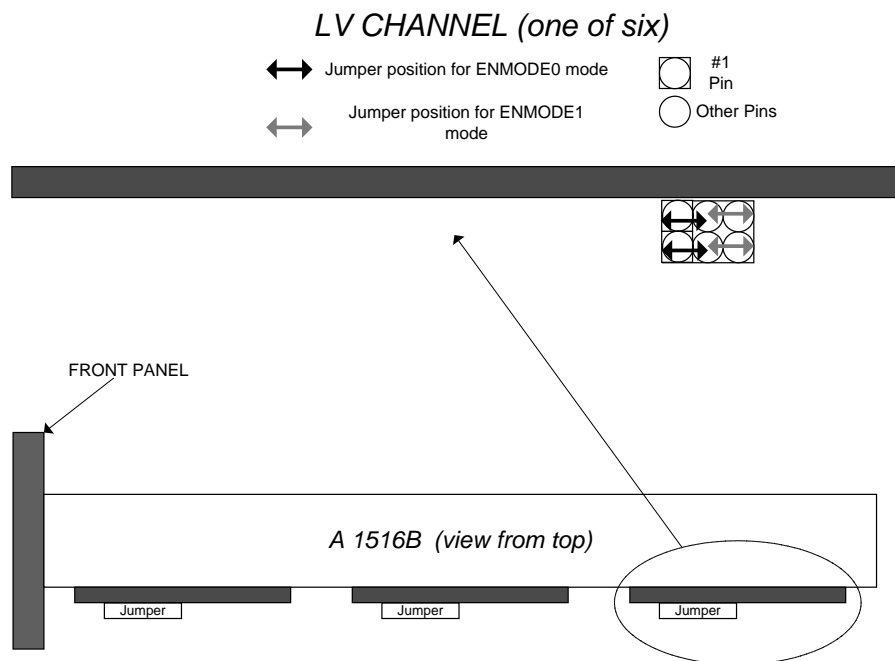
The board is provided with an "EN" input that enables the channels when it is terminated on 50 Ohm. When the channels are disabled (the 50 Ohm termination is removed), the voltage outputs drop to zero at the maximum rate available; when the output disable cause is removed, i.e. the "EN" connector is connected to ground, the channels remain OFF until the User turns them ON via software.

### 3.4.2 Channel Enable

Each channel can be either enabled or disabled singularly. This operation can be performed in two ways, according to the mode, selected via jumpers (see § 3.4.2):

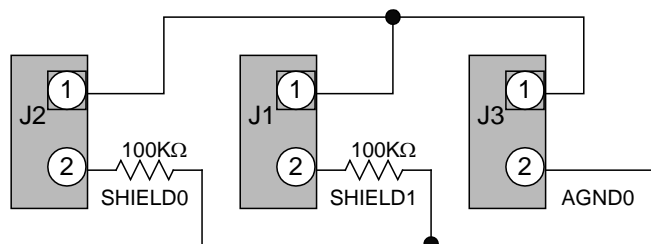
- *ENMODE0*: if ENCHx and /ENCHx front connector pins (see § 3.2.1) are not connected, x channel is enabled; if ENCHx and /ENCHx pins are short circuited, channel x is disabled
- *ENMODE1*: a +5 V d.c. voltage difference between ENCHx and /ENCHx pins must be applied in order to enable x channel

ENMODE0 is the default setting. Mode selection is shown in the following figure:



**Fig. 3.4 - Enable mode jumpers setting**

## 3.5 Front panel jumpers



**Fig. 3.5 - Front panel jumpers**

The front panel jumpers J1, J2 and J3 allow to connect the two DB37 connectors shields (SHIELD0 and SHIELD1) with the ground reference of the crate (AGND0).

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