

# **Technical Information Manual**

Revision n. 10  
12 December 2006

**MOD. EASY3000/4000**  
*EMBEDDED ASSEMBLY*  
*POWER SUPPLY SYSTEM*  
**MANUAL REV.10**

**NPO:**  
**00105/03:A1676A.MUTx/10**

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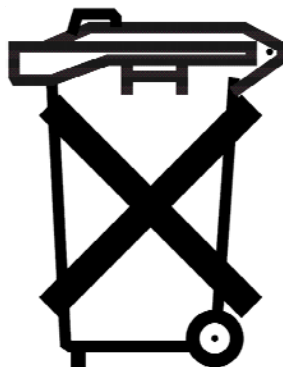
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# 1. EASY3000 Embedded Assembly System

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## 1.1 Functional description

EASY3000 (Embedded Assembly SYstem) is the new CAEN power supply solution for operation in magnetic field and radioactive environment. CAEN has been involved for more than a decade in developing different solutions for the main LHC experiments, where the electronic equipment of the experiment is dealing with high dose radiation and intense magnetic field. In order to provide safe and reliable operations in such hostile areas, CAEN started tests with rad-tolerant components and magnetic field resistant solutions, patenting the new technology that is now used in this new line of products. Moreover, though designed for harsh environment, the EASY3000 modules can work also in normal condition with excellent performance. In the new architecture, the power supply can be located directly in the hostile area (see Table 1.1), where the EASY3000 modules provide a wide variety of output voltages to satisfy the requirements of most detectors and front-end electronics. The control of the EASY3000 power supply system is done remotely using a Branch Controller (Mod. A1676A) plugged in a SY1527 or SY2527 mainframe located in the control room. Each A1676A branch controller can handle up to 6 EASY3000 crates. The EASY3000 crate can house up to 10 boards, depending on the boards' width. The branch controller is the interface between the mainframe (SY1527 or SY2527) and the remote boards in the EASY3000 crate: its role is to configure the EASY3000 channels as if they belong to the supply unit slot in which the branch controller is located. All the channels of the EASY3000 boards will be considered as channels of the branch controller, thus hugely increasing the number of channels the system can handle. Through the mainframe, the provided and fully reliable OPC server permits an immediate and "automatic" interfacing with the custom control software; moreover, a C-library for Windows and Linux is available as well. The EASY3000 crate can be used with an air and/or water intercooler and its standard width fit the rack mounting. Optional fan trays are available for the stand-alone operation of the EASY3000 crate when no magnetic field is present. EASY3000 is powered by external 48 V DC. The EASY architecture foresees two independent 48 V power supplies: the first (48 V Power) to power the channels regulators, the other (48 V Service) to power the control logic. The use of CAEN 48 V power sources (Mod. A3484 and A3485), allows to integrate into the channels control also the management of the 48 V power supplies. Fig. 1.1 shows the system's block diagram.

The EASY4000 crate is designed to house some custom PS boards that do not fit into the EASY3000 crates; it supports mechanically up to 9 PS boards and distributes control signals and power supplies.

**Table 1.1 – EASY3000/4000 Crates and Boards hostile areas tolerances**

<b>Magnetic field:</b>	2 kGauss
<b>Radiation:</b>	$1 \cdot 10^{11}$ p/cm <sup>2</sup> TD
	$2 \cdot 10^{12}$ n/cm <sup>2</sup> TD
	15 kRad TID

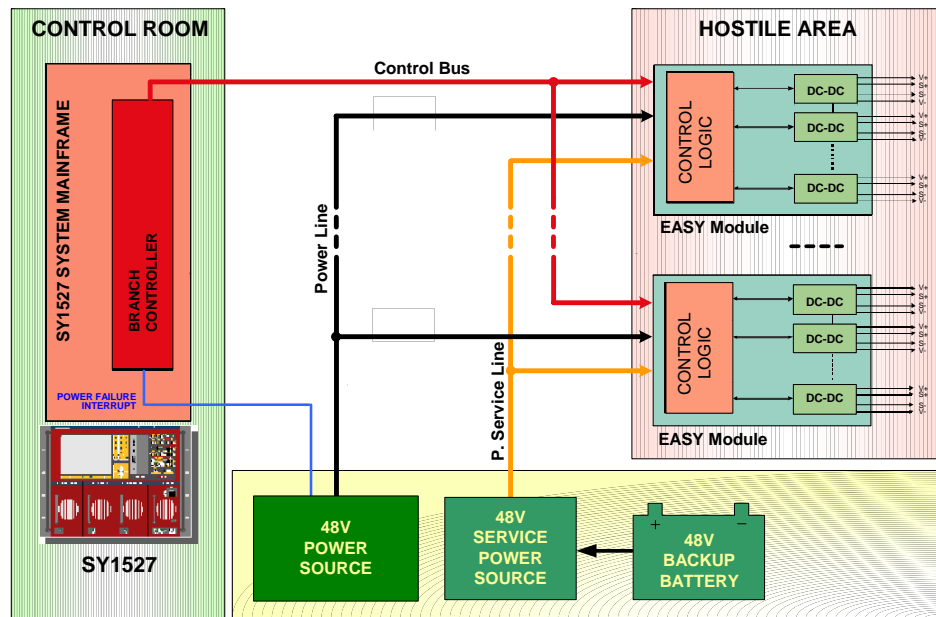


Fig. 1.1 – System's block diagram

## 1.2 The CAEN Multichannel Power Supply System Overview

The SY1527 system is the fully equipped experiment version of a new line of power supply systems which represent CAEN's latest proposal in the matter of High Voltage and Low Voltage Power Supplying. This system outlines a completely new approach to power generation and distribution by allowing the housing, in the same mainframe, of a wide range of boards with different functions, such as High/Low Voltage boards, generic I/O boards (temperature, pressure monitors, etc.) and branch controllers, where the latter are used to control other remote generators and distributors. Modularity, flexibility and reliability are the key-points of its design, enabling this module to meet the requirements needed in a wide range of experimental conditions, which range from those of LHC experiments, where the features of this model find prior application, to those of other less challenging, but still demanding, High Energy Physics experiments.

The mainframe is housed in a 19"-wide, 8U-high euro-mechanics rack and hosts four main sections:

- the Board Section, with 16 slots to house boards, distributors and branch controllers;
- the Fan Tray Section, housing 6 fans arranged on two rows;
- the Power Supply Section, which consists of the primary power supply and up to 3 power supply units;
- the CPU and Front Panel Section which includes all interface facilities.

The User Software Interface features the usual friendliness of the previous CAEN systems which now also includes a 7.7" colour LCD. A wide choice of interface facilities provides full communication compatibility with the previous systems and the feasibility of controlling heterogeneous external devices. Modularity has been one of the leading criteria in the design and development of the system: both the Power Supply Section and the Board Section are completely modular. The Power Supply Section allows different configurations with up to 3 power supply units per mainframe (up to 2250 W), while the Board Section can house up to 16 boards able to fulfil different functions. A complete line of power supply boards and distributors has been specially developed for this new system. The minimum system configuration consists of the primary power supply, one

Power Supply Unit and one board. The system allows also to deal with power supply solutions composed by "branch controllers" (housed in the system main frame) and on-detector "remote boards" (manufactured in order to be magnetic field and radiation tolerant). Channel trip control on other crates is performed via four external differential trip lines. A sophisticated trip handling via software allows to control and correlate trip conditions on the channels of the crate as well as of other crates connected to it. Live insertion and extraction of the boards, which reduces the down time of the global system, and easy access to the computing core and peripherals of the system complete the system flexibility. Easy interfacing is another key-point of the SY1527 system, which can be connected to SY127 and SY527 systems. The Ethernet interface (TCP/IP) allows both an easy Telnet access and the connection via OPC Server to a SCADA control system. Enhanced software programming features a unified command set independent from the interface used to communicate with the system. The Power Supply Section and Board Section can be externally synchronised via front panel connectors. Multi-layered access to the system via Intranet is foreseen through the management of several custom user profiles. In particular, three different access levels have been implemented: Guest, User and Administrator, each of which with password protection. Handy maintenance and upgrading, which constitute a major issue in the reliability of a system, are further guaranteed by the possibility of accessing and servicing the system via network facilities. Actually, the Telnet access facility allows remote debugging and technical support of the system, including future firmware upgrading. For a detailed description of the SY 1527 Universal Multichannel Power Supply System please refer to the *SY 1527 User's Manual*.

**Table 1.2 – Technical specifications of the SY 1527 mainframe**

<b>Packaging</b>	- 19"-wide, 8U-high Euro-mechanics rack; - Depth: 720 mm.
<b>Weight</b>	-Mainframe (*): 24 kg -Mod. A1532: 3.2 kg
<b>Power requirements</b>	<i>Voltage range:</i> 100/230 V <i>Frequency:</i> 50/60 Hz <i>Power:</i> 3400 W
<b>Max. number of boards per crate</b>	16
<b>Max. number of power supply units per crate</b>	3
<b>Primary power supply output (Mod. A 1531)</b>	± 12 V, 8 A +5 V, 20 A
<b>Power supply unit output (Mod. A 1532)</b>	+48 V, 15.6 A
<b>Max. output power</b>	2250 W
<b>Operating temperature</b>	From 0°C (dry atmosphere) to +40°C
<b>Storage temperature</b>	From -20°C (dry atmosphere) to +50°C

(\* ) One Primary Power Supply (Mod. A 1531) and one Power Supply Unit (Mod. A 1532) are included; boards are not included.



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## 2. The Mod. A1676A Branch Controller

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### 2.1 A1676A Branch Controller overview

The Mod. A1676A EASY Branch Controller is implemented in a single width SY1527/SY2527 board. Once plugged in, the Branch Controller must be linked to the EASY3000 and EASY4000 crates (which can work in the "hostile area"), via front panel connectors (Control and Power Supply). The A1676A is the interface between the mainframe and the remote boards in the EASY3000/4000 crate. It configures the EASY3000/4000 channels as if they belong to the slot in which the branch controller is located: the channels of the EASY3000/4000 boards operate as channels of the A1676A. Up to six EASY3000/4000 crates can be controlled by one A1676A.

The User has to configure the A1676A to operate with His EASY crate layout by using the provided software tool (see details in § 2.4).

The A1676A branch controller is a single width board and will be housed in one SY1527 system, while the remote sections will operate in the "hostile area".

## 2.2 A1676A Front Panel

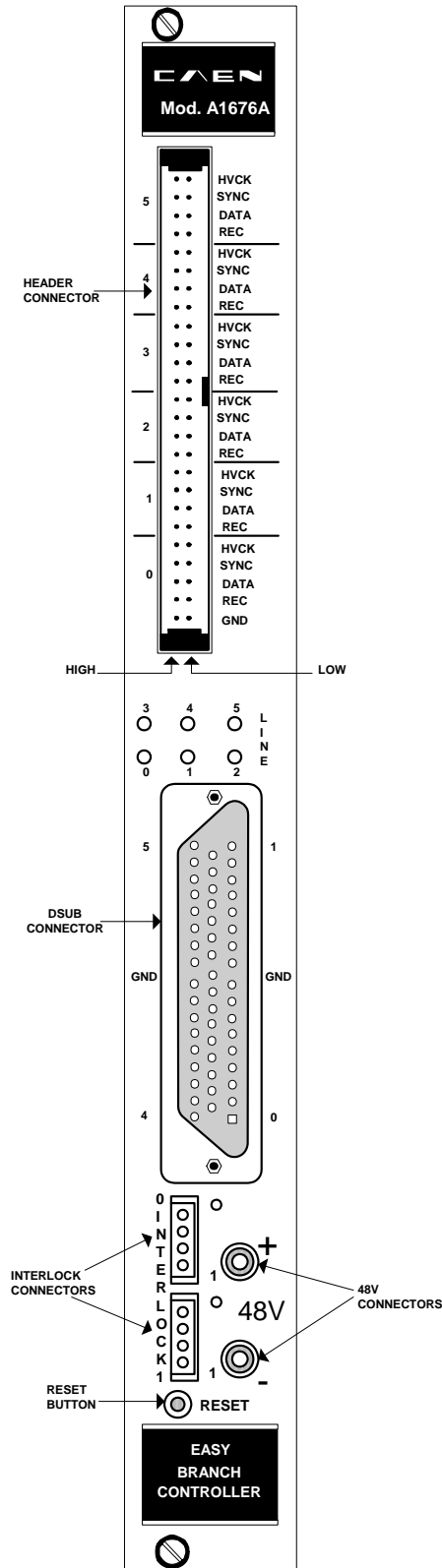


Fig. 2.1 – Mod. A1676A Branch Controller front panel

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## 2.3 A1676A Technical specifications

The A1676A Branch Controller board can control up to six remote crates through the CANbus protocol (250 kbit/sec).

Remote crates controlled by the A1676A can house different sets of EASY3000/4000 boards, then it is necessary to configure the Branch Controller firmware through a set up file containing all the information about number, type and position of the boards in remote crates. After the configuration it is not possible to change the crate layout unless the A1676A configuration file is updated. The Branch Controller, in fact, scans the crates expecting to find the sets of boards corresponding to its configuration file; if any board is misplaced (or absent) with respect to the configuration file, then it is ignored and its channels are signalled as "unplugged" by the SY1527: in this case it is necessary to insert correctly the misplaced board, and then its channels will be accessed.

The User can build his crate configuration using the software tool described in § 2.4.

Control of remote crates is performed through 2 alternative output connectors (50-pin Header male or 50-pin DSUB female) placed on the front panel of the A1676A board (see fig. 2.1); maximum suggested cable length between A1676A and EASY crate is 150 m.

The front panel houses also six green LEDs (one per branch = remote crate); each LED lights up / blink as the branch communications take place.

The Reset button allows to reset the internal A1676A controller; during this operation all the remote channels continue operating with old settings. It is necessary to wait 15 seconds at least before monitoring or setting once more the remote channels.

The Interlock signal allows to shut down all the remote channels, keeping active the communications between remote boards and SY1527.

The A1676A provides also a 48 V / 2 A supply voltage (to be used for powering the crates) that can be enabled via the A1676A 48V parameter.

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### 2.3.1 A1676A Packaging

The Mod. A1676A module is housed in a 5 TE-wide, 6U-high mechanics. The board requires one SY1527 slots (single-width).

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### 2.3.2 A1676A Front panel connections

<b>CONTROL Connectors:</b>	50-pin Header male / 50-pin DSUB female
<b>48 V OUT Connector:</b>	2 x 4 mm connectors female
<b>INTERLOCK Connectors:</b>	2 x 4 pin Amp connectors



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### 2.3.5 **Control signals**

The Branch Controller Control signals are described in the following table.

**Table 2.1 – A1676A Control Signals**

SIGNAL	DESCRIPTION
HVCK	625 kHz synchronisation signal (one per branch) for switching parts of remote PS channel boards; however, if this signal fails, remote boards run properly (a synchronisation signal is generated by their controller), though lose synchronisation between each other, and an error message ("Fail") is returned by the SY1527. The HVCK presence is signalled by the remote board parameter "HVSynC" (Ok or Fail)
SYNC	50 Hz clock (one per branch) for the board controllers synchronisation; if this signal fails, remote boards do not operate and an error message ("Fail") is returned by the SY1527. In order to remove the Fail message, it is necessary to send the "Clear Alarm" command
DATA	Communication data line
REC	Recovery / Reset lines, one for each remote EASY3000 crate; through the SY1527 it is possible to send a command to the controllers of a remote crate either switching off all the channels in the crate (HW Reset) or eventually leaving them on, if they were (Recovery)

The A1676A Branch Controller allows also to use the SY1527 System front panel signals (Kill, Interlock, Enable) on the remote channels.

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## 2.4 **A1676A Communication timing**

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### 2.4.1 **Foreword**

The A1676A board can handle, via the CANBUS protocol, up to 6 remote crates in parallel (EASY bus).

The remote crates, which can be of two different kinds developed so far, EASY3000 and EASY4000, can house respectively up to 23 and 20 nodes (EASY power supply boards, optional Fan Units and A34xx AC/DC Converters).

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### 2.4.2 **Communication mode**

A remote board is defined by its number of channels along with the type and number of associated parameters.

Such parameters allow both to control the channel and to monitor constantly its status.

The A1676A asks in sequence all the functional parameters of each channel of each board. Each parameter foresees the transmission and the reception of a single CANBUS data packet.

The parameters request takes place through cycles, from the first channel of the first board until the last channel of the last board in the crate.

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### 2.4.3 Requested parameters present on EASY3000 LV and HV boards

It is possible to distinguish between channel 0 parameters and other channel parameters:

Channel	Parameters
0	Temp, MainPwS, 12VPwS, 48VPwS, Sync, HVSync, Remllk
1..n	V0Set, Vmon, Vcon (LV boards only), lmon, Status, Pw

Such parameters are continuously requested by the A1676A from the remote boards channels.

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### 2.4.4 Timing

The average time necessary in order to update one parameter is 1.5 ms. Since the request of the parameters takes place through cycles, the time necessary to update a board depends thus on both the number of channels and the number of channels parameters.

If one channel has six parameters, then  $6 \times 1.5 \text{ ms} = 9 \text{ ms}$  are necessary for the complete refresh of its parameters.

Beyond the time necessary for the parameters request, a 10 ms latency between one node's scanning end and the beginning of the subsequent is introduced.

If more remote crates are added to the EASY bus, the time necessary for one board's scanning and for the parameters request, does not grows significantly, since communications take place in parallel.

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### 2.4.5 Timing examples

#### 2.4.5.1 A4601H

For example we consider the A4601H board (which is housed inside the EASY4000 crate); such board is composed by two Power Supply Units (1 Unit = 1 Node) with 5 channels each. The number of parameters per channel is as follows:

ch0 7 parameters

ch1 7 parameters

ch2 7 parameters

ch3 6 parameters

ch4 6 parameters

the total number of parameters per node is thus 33; the time necessary for scanning the A4601H is then  $33 \times 1.5\text{ms} \times 2 = 99\text{ms}$

If we have an EASY4000 crate completely filled with A4601H boards, the time necessary for the upgrade is:

99ms x 9 (max number of A4601H per crate) = 891 ms

plus the 10 ms latency per node: 10 ms x 9 x 2 = 180 ms

the total time is then 180 ms + 891 ms = **1071 ms**

Such time does not depend on the number of active EASY bus (from 1 to 6)

#### 2.4.5.2 A3009

For example we consider the A3009 board (which is housed inside the EASY3000 crate); such board (1 Board = 1 Node) has 13 channels. The number of parameters per channel is as follows:

ch0 7 parameters

ch1..12 6 parameters

the total number of parameters per node is thus 79; the time necessary for scanning the A3009 is then 79 x 1.5 ms = 118.5 ms

If we have an EASY3000 crate completely filled with A3009 boards, the time necessary for the upgrade is:

118.5 ms x 5 (max number of A3009 per crate) = 592.5 ms

plus the 10 ms latency per board: 10 ms x 5 = 50 ms

the total time is then 50 ms + 592.5 ms = **642.5 ms**

Such time does not depend on the number of active EASY bus (from 1 to 6)

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## 2.5 EASY Crate Configuration

**CAEN EASY Rack Builder** is a Java(TM) application which allows EASY Users to create their customised EASY Crate configurations.

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### 2.5.1 *Installation and set up*

First of all it is necessary to connect the PC, which must run a Java(TM) 2 Platform Standard Edition, and must be connected to the Internet.

Now it is necessary to download the software tool from the web page:

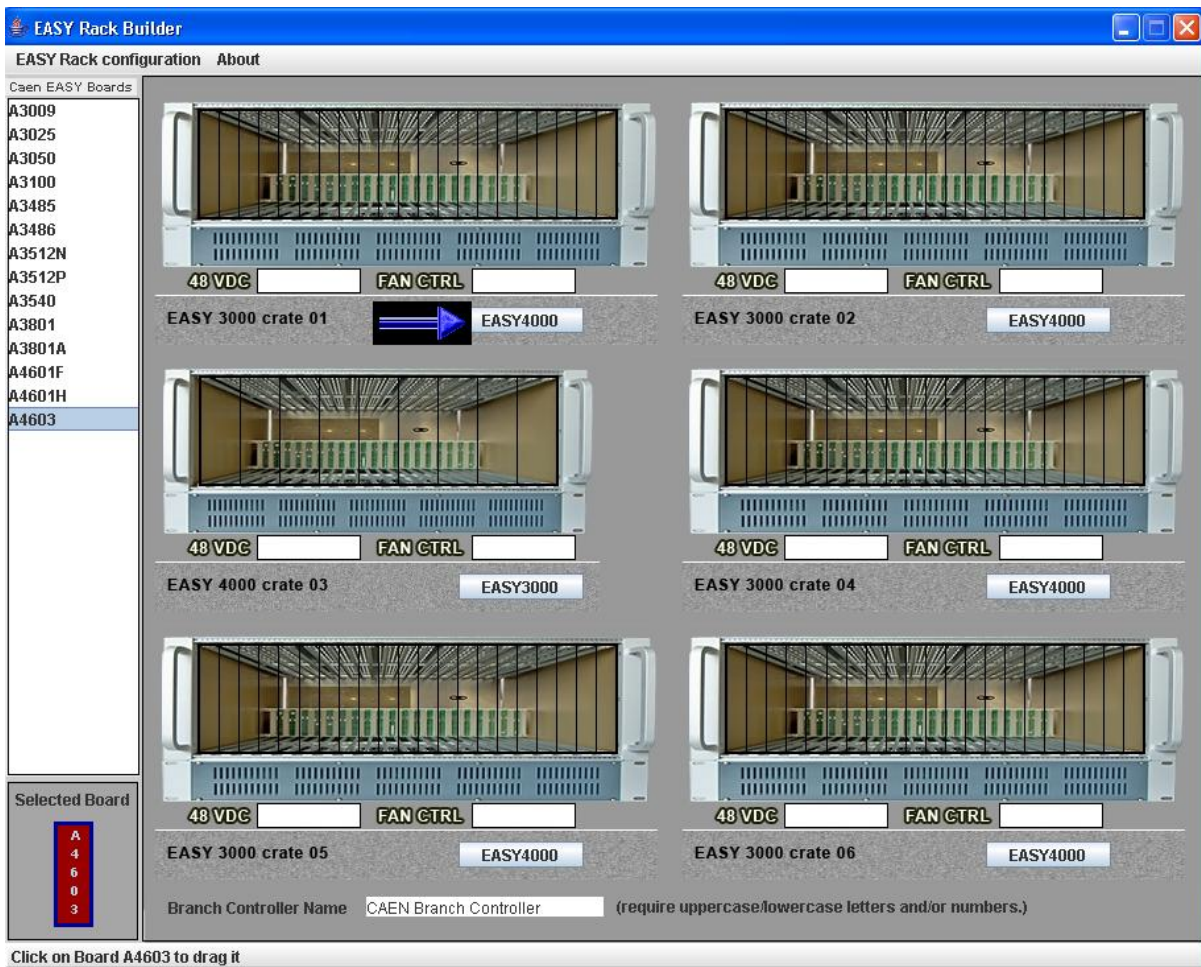
<http://www.caen.it/nuclear/product.php?mod=A1676A>

Click on the *Software* menu and download the *CaenEASYSRackBuilder-x.y.zip* file  
Unzip the file then launch the *CaenEASYSRackBuilder.jar* Java(TM) application

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### 2.5.2 *Configuring the crates*

Now the following EASY Rack Builder window will open:



**Fig. 2.3 – EASY Rack Builder main menu**

The EASY Rack Builder shows six empty EASY crates, by clicking on the “Crate button” (see the arrow in fig. 2.3) it is possible to choose between EASY3000 and EASY4000 crates (according to the crates connected to the A1676A to be configured).

The menu on the white box on the left lists the EASY boards (including optional AC/DC converters and Fan units) available to fill the crates.

The operating parameters of such boards are stored in the *board.xml* files included in the folder:

`\CaenEASYPackBuilder\Boards`

Each time CAEN EASY Rack Builder is launched, such xml files are compared to those present in the CAEN data base and, if the comparison is successful, the corresponding boards are added in the white box list.

The updated xml files of each board can be downloaded in the software section at:

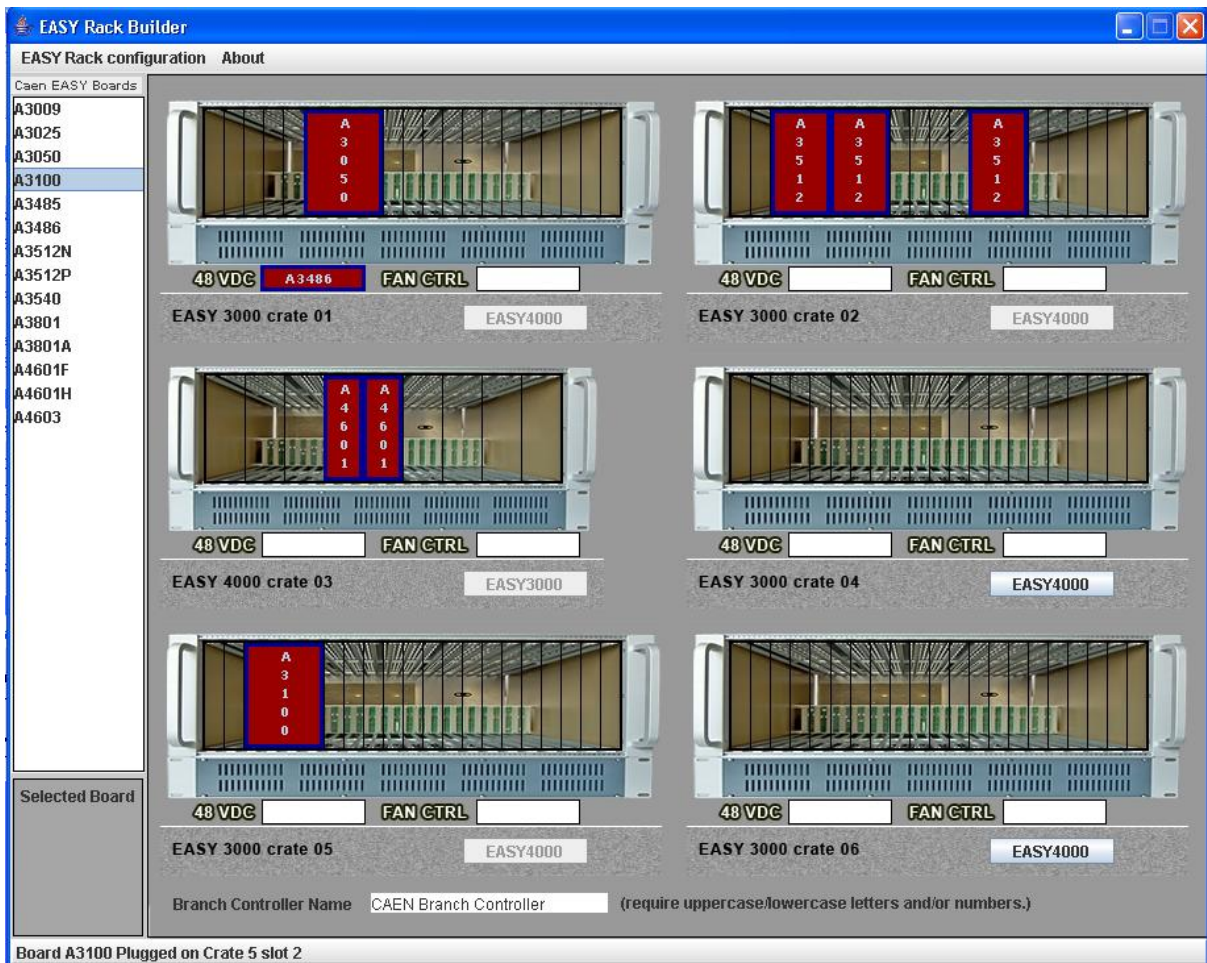
<http://www.caen.it/nuclear/product.php?mod=XXXXX>

where “XXXXX” stands for the board name (for example: A3009).

In order to configure the crates it is necessary to select the desired board by left clicking on its name and dragging it on the selected crate slot. Left click again to drop.

Boards can be removed from the crates left clicking on them and dragging and dropping them on the white box.





**Fig. 2.4 – EASY Rack Builder with populated racks**

When the crate configuration is complete, it is necessary to save the file; go to:

*EASY Rack Configuration > Save as...*

This allow to create an xml file which can be used for future purposes (modify, update etc.).

In order to configure the A1676A it is necessary to select:

*EASY Rack Configuration > Generate Branch Controller update file*

This allow to create a binary file that must be used to configure the A1676A via SY1527; now it is necessary to connect the PC to the SY1527 System which hosts the A1676A to be configured. The configuration procedure is described in the SY1527 User Manual, section 7.1.19 (*The UTILITY Menu: Board Upgrade*; please follow the same procedure of the firmware upgrade).

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## 3. EASY3000 and EASY4000 crates

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### 3.1 EASY3000 crate overview

The EASY3000 crate is designed to house Power Supply and ADC boards of EASY3000 family; it supports mechanically EASY boards and distributes control signals and power supplies. It is handled by one of six branches of the A1676A – Branch Controller.

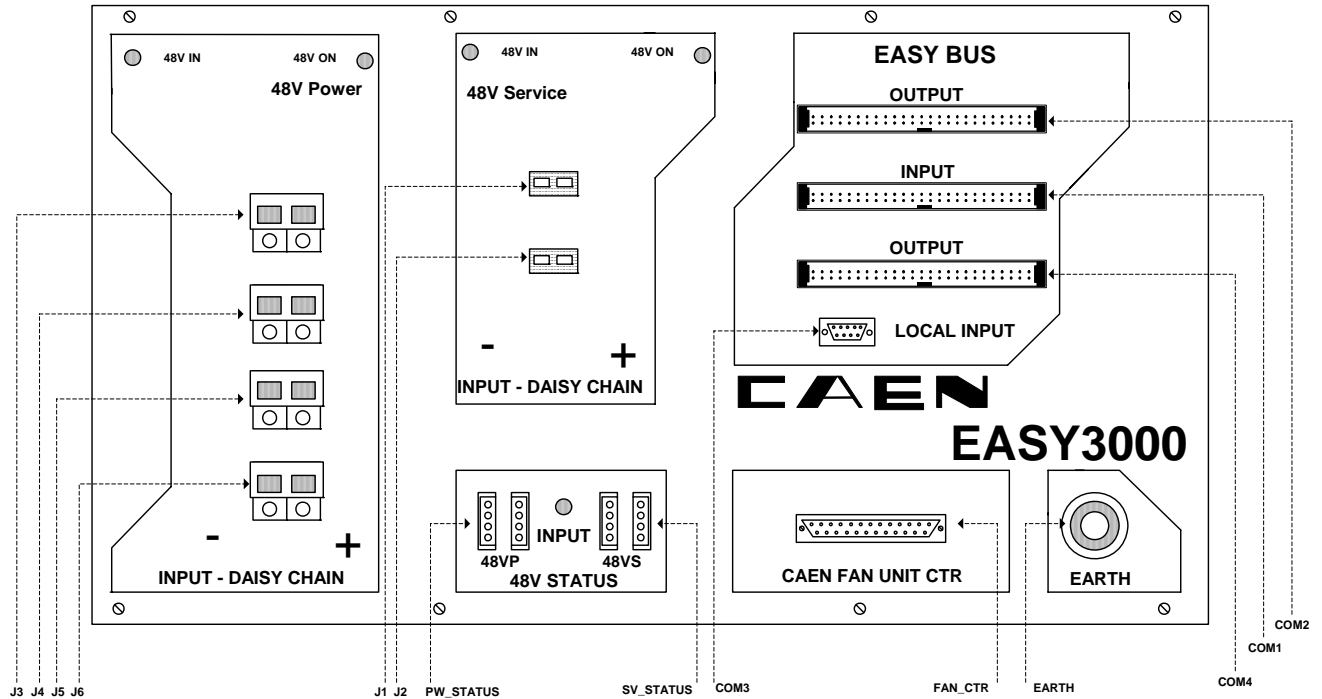
It is necessary to provide the crates the proper ventilation by using for example the CAEN Mod. A3000F Fan Unit; (A34FU Fan Unit must be used with EASY 3000 crate first issue).



Fig. 3.1 – Ventilation-warning Label

## 3.2 EASY 3000 crate panel connections and displays

### 3.2.1 EASY 3000 crate panel second issue



**Fig. 3.2 – EASY 3000 crate panel second issue**

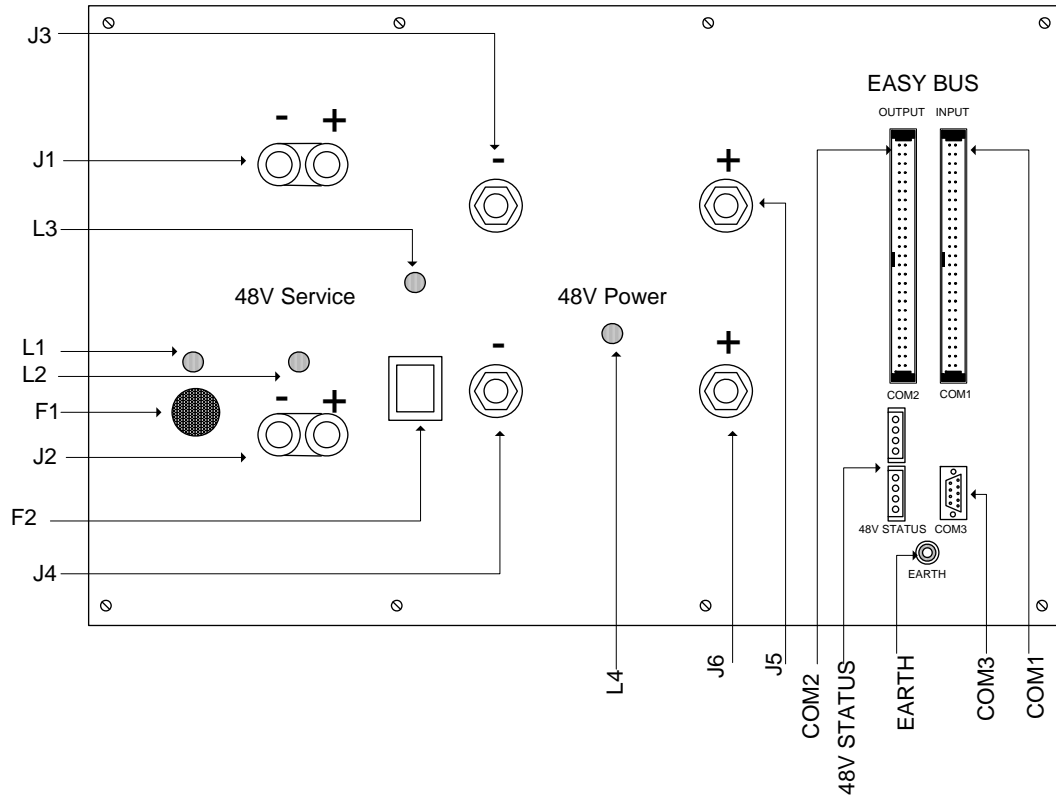
The figure above shows the EASY 3000 crate panel second issue and subsequents; for this model the optional A3000F Fan Unit is available. The connections are explained in the following table:

**Table 3.1 – EASY 3000 crate connections second issue**

Name	Description
J1,J2	48V SERVICE connectors (in parallel); input of 48 V supply for auxiliary low voltages in boards
J3..6	48V POWER connectors (in parallel); input of 48 V supply for DC/DC converters
F2	100 Amps fuse on 48 V POWER line
Com1..4	I/O of EASY bus for remote control
48V power/service status <sup>1</sup> :	Connectors for inputs from 48V supplies. Through this input the remote EASY board microcontroller can detect failures in supply voltages and consequently enables PS channels ramping down, while service supply voltage is provided by a back up battery
FAN_CTR	Control link for fan unit (Mod. A3000F)
EARTH	Earth link for the crate

<sup>1</sup> This feature is not yet implemented

### 3.2.2 EASY 3000 crate panel first issue



**Fig. 3.3 – EASY 3000 crate panel first issue**

The figure above shows the EASY 3000 crate panel first issue; for this model the optional A34FU Fan Unit is available. The connections are explained in the following table:

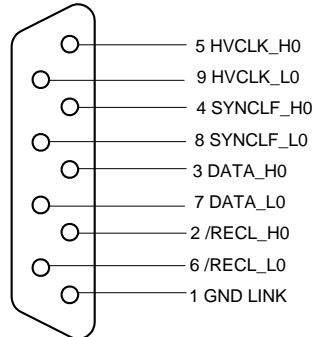
**Table 3.2 – EASY 3000 crate first issue connections**

Name	Description
J1,J2	48V SERVICE connectors (in parallel); input of 48 V supply for auxiliary low voltages in boards
F1	20 Amps fuse on 48 V SERVICE line
L1	Red LED that lights up when F1 is interrupted
L2	Red LED that lights up when 48 V SERVICE is present
J3, J4, J5, J6	48V POWER connectors (in parallel); input of 48 V supply for DC/DC converters
F2	100 Amps fuse on 48 V POWER line
L3	Red LED that lights up when F2 is interrupted
L4	Red LED that lights up when 48 V POWER is present
Com1, Com2, Com3	I/O of EASY bus for remote control
48V status <sup>2</sup> :	Connectors for inputs from 48V supplies. Through this input the remote EASY board microcontroller can detect failures in supply voltages and consequently enables PS channels ramping down, while service supply voltage is provided by a back up battery
EARTH	Earth link for the crate

<sup>2</sup> This feature is not yet implemented

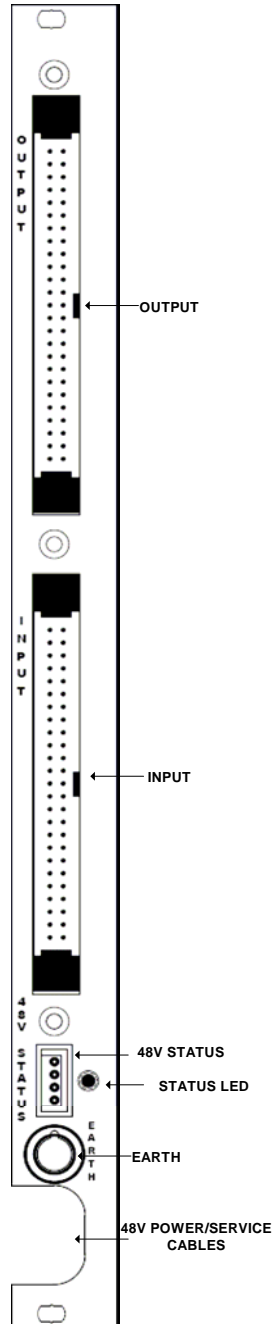
### 3.2.2.1 COM3 Port

9 Pin DB-type male connector



**Fig. 3.4 –9 Pin DB-type male connector signals**

### 3.2.3 EASY 3000S crate panel



**Fig. 3.5 – EASY 3000S crate panel**

The figure above shows the EASY 3000S crate front panel; for this model the optional A3000F Fan Unit is available. The connections are explained in the following table:

**Table 3.3 – EASY 3000S crate connections**

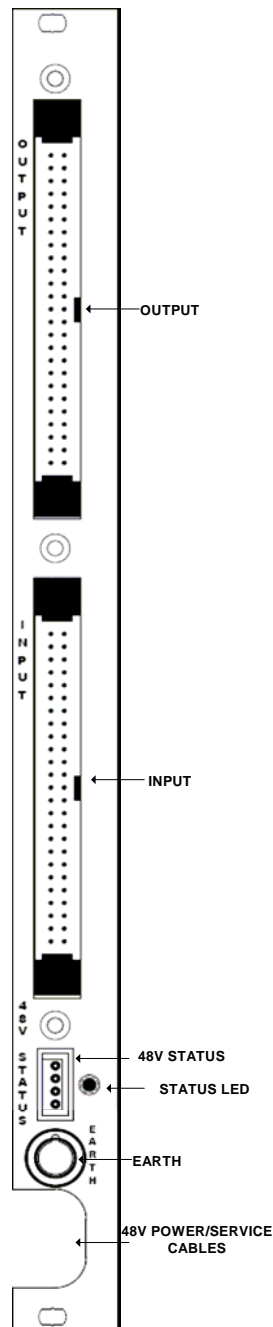
Name	Description
Input	Input of EASY bus for remote control, 50-pin Header male
Output	Output of EASY bus for remote control, 50-pin Header male
48V status:	Connectors for inputs from 48V supplies. Through this input the remote

	EASY board microcontroller can detect failures in supply voltages and consequently enables PS channels ramping down, while service supply voltage is provided by a back up battery. This feature can be disabled via a dip switch (SW1) on the EASY3000S controller PCB; AMP 280372-2 type connector
EARTH	Earth link for the crate; RADIALL R921921 type connector

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### 3.2.4 *EASY4000 crate overview*

The EASY4000 crate is designed to house some custom PS boards that do not fit into the EASY3000 crates; it supports mechanically up to 9 PS boards and distributes control signals and power supplies. The crate has ten slots: slot 0 (the leftmost) is available for test purposes, while slot 1..9 are suitable to host PS boards. The EASY4000 crate is handled by one of six branches of the A1676A – Branch Controller. The crate panel is provided with I/O 50 pin flat connectors of the EASY bus remote control and the 48V Status input connector which allows the PS boards microcontrollers to detect failures in supply voltages and consequently to enable PS channels ramping down, while service supply voltage is provided by a back up battery; a green led signals the 48V activity. An Earth link for the crate is available as well. It is necessary to provide the crates the proper ventilation by using, for example, the A34FU Fan Unit.



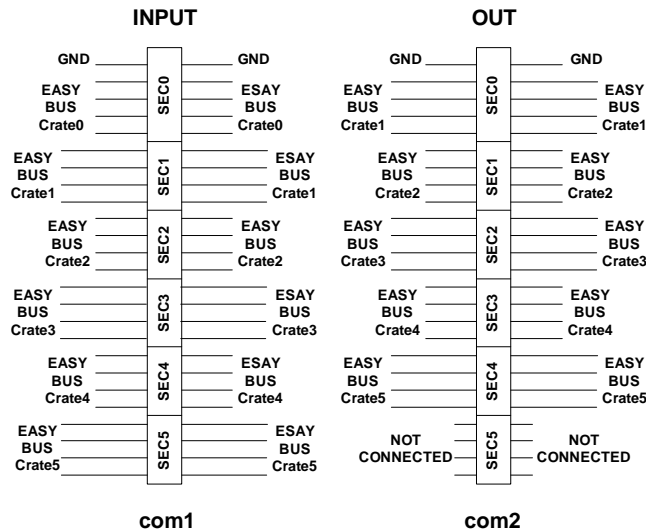
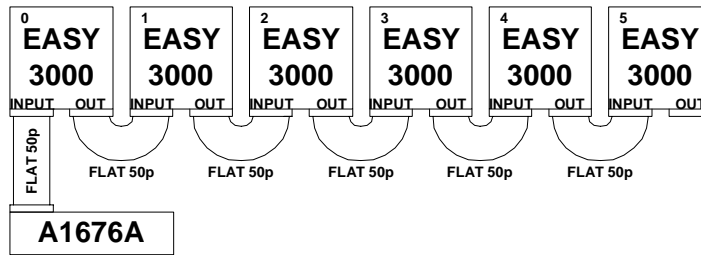
**Fig. 3.6 – EASY4000 Connectors**

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### **3.2.5 A1676A – EASY3000/4000 CRATE connection**

There are two different ways for connecting the A1676A Branch controller with up to six EASY3000/4000 crates; the first type of connection uses a 50-wires flat cable between the A1676A and the first crate as well as between the subsequent crates, as shown in the following figure:



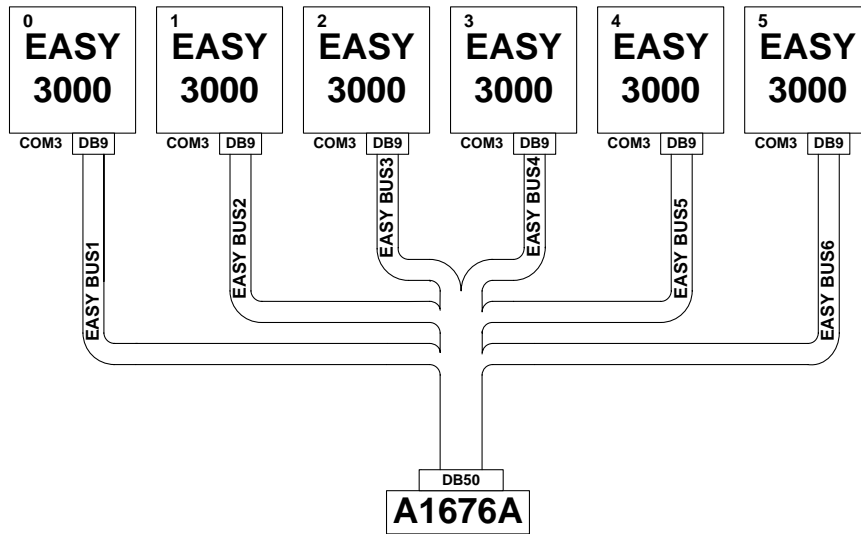


**Fig. 3.7 – Connecting A1676A and the crates with 50 wires cable**

The A1676A provides the signals for all the crates; the first crate uses only “Section 0” (see § 2.2) of such control signals arriving into the input connector and passes the other sections to its output connector. Each EASY 3000/4000 crate is connected in series to the subsequent other ones.

The main advantage of this way of connection is the easy manufacturing of cables. The most evident disadvantage is the unnecessary connection of each crate with 50 wires, while only 4 couples and return would be required.

The second way of connection uses the DSUB50 control connector of the A1676A, which, via a split cable, is connected with each section of the EASY BUS through the crates DB9 connectors, as shown in the following figure:



**Fig. 3.8 – Connecting A1676A and the crates with split cable**

The main advantage of this solution is the lower number of wires (9 for crates).  
The most evident disadvantage is the more difficult manufacturing of split cables.  
Note that cables must be shorter than 150 m; the Bus line does not require a termination.

### 3.3 48 V Power Sources

#### 3.3.1 Mod. A3486 AC/DC Converter for Hostile Areas

The CAEN Mod. A3486 is a two channel 220/400 Vac – 48 Vdc converter, which allows to integrate into the EASY channels control also the management of the 48 V power supplies. Each channel provides a 2 kW output and can be tracked in order to obtain one 4 kW output. This module is designed to work as main converter in LHC hostile areas, thus completing the EASY system. Features include local or remote control, overload protection and local or remote inhibit function.

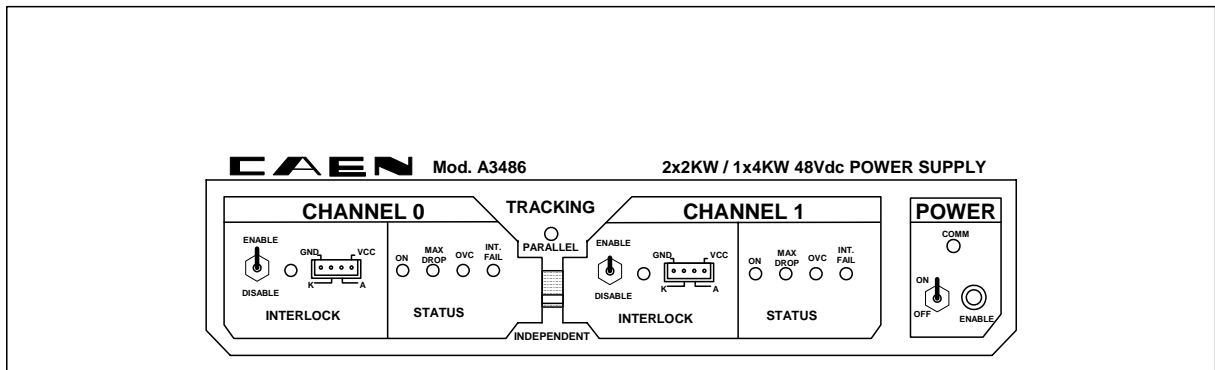
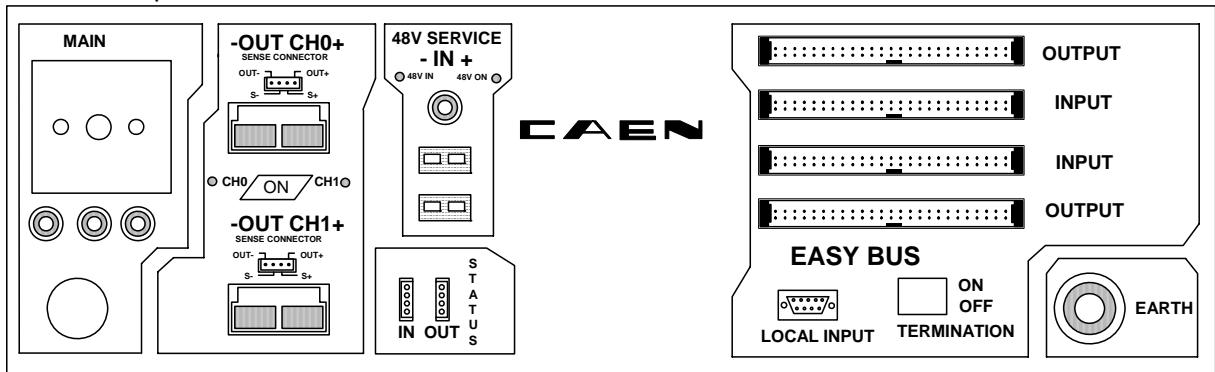


Fig. 3.9 – A3486 48 V Power Source for Hostile Areas front panel

Table 3.4 – Technical specifications of the A3486 48 V Power Source

<b>Model:</b>	A3486
<b>Polarity:</b>	positive
<b>AC input:</b>	3-phase 220/400 V 50/400 Hz
<b>Output Voltage:</b>	44 ÷ 52 V software adjustable
<b>Max. Output Power:</b>	4000 W
<b>Voltage Ripple:</b>	< 100 mV pp

### 3.3.2 Mod. A3484 and A3485 AC/DC Converters

CAEN can provide 2 types of 48 V power sources (Mod. A3484 and A3485), which allow to integrate into the channels control also the management of the 48 V power supplies. The modules are implemented in a 3U / 19" Euro Rack and have Single (A3484) or Dual (A3485) 48V output. Features include local or remote control, overload protection and local or remote inhibit function. The A3484 and the A3485 are designed to work in "friendly" environment (no magnetic field and radiation).

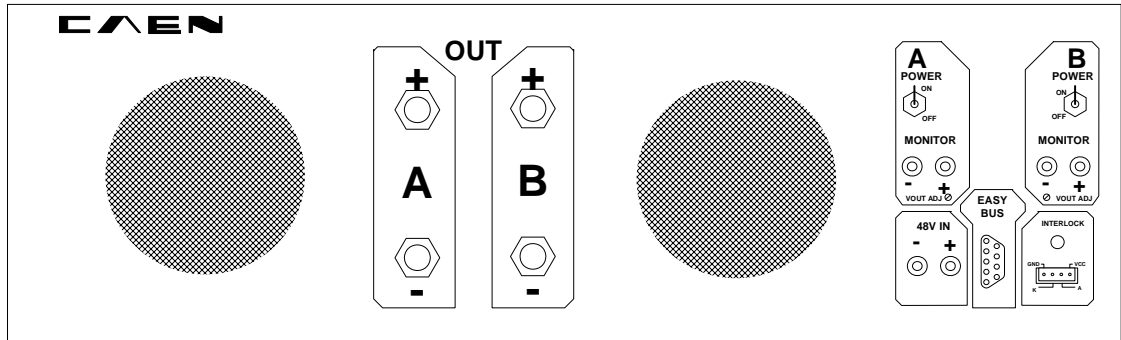


Fig. 3.10 – A3485 48 V Power Source front panel

Table 3.5 – Technical specifications of the A3484 and A3485 48 V Power Sources

Model:	A3484	A3485
Polarity:	positive	positive
AC input:	3-phase 400 V / 400 Hz	3-phase 400 V / 400 Hz
Output Voltage:	48 V ± 5% trimmer adjustable	48 V ± 5% trimmer adjustable
Max. Output Power:	2500 W	5000 W
Voltage Ripple:	< 100 mV pp	< 100 mV pp

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## 4. Safety information and installation requirements

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### 4.1 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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#### 4.1.1 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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### 4.2 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

## 4.3 Installation

The Mod. A1676A is a single-width board for the SY1527/2527/3527 systems. At power ON the SY1527 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.

The A1676A must be connected to the EASY3000 remote crates through the control lines. The control connectors are placed on the A1676A front panel and on the EASY3000 front panel.

## 4.4 Operating modes

The Mod. A1676A board can be controlled, either locally or remotely, through the SY1527 software interface. For details on SY1527 system operation, please refer to the User's Manual of this product.



**ATTENTION**  
 THE MOD. A1676A BOARD REQUIRES  
 SY1527 FIRMWARE VERSION 2.00.01 OR LATER

## 4.5 Output control and monitoring

The A1676A handles up to 6 remote crates and ac/dc converters connected to the EASY BUS lines. In order to communicate with the power supply boards inside the crates, it is necessary to load the configuration file into the A1676A (see § 2.5). It is possible, through the SY1527 system, to perform the following operations:

**Table 4.1 – A1676A board items**

Name	Dir	Sign	ValType	Min	Max	Res	UM	OnStr	OffStr
Name	SET	UNSIGNED	STRING						
Hw Reset0..5	SET	UNSIGNED	ON_OFF					On	Off
Recovery0..5	SET	UNSIGNED	ON_OFF					On	Off
48VA1676A	SET	UNSIGNED	ON_OFF					On	Off
GlobalOn	SET	UNSIGNED	ON_OFF					On	Off
GlobalOff	SET	UNSIGNED	ON_OFF					On	Off
A1676Ilk	Mon	UNSIGNED	NUMERIC	0	3	1	NONE	Yes	No

**Name:** allows to assign a symbolic name to the board

**HwReset0..5:** allows to Reset the relevant EASY BUS line. This command allows to reset all the boards connected to such line and all the channels are turned off.

**Recovery0..5:** allows to Recover the relevant EASY BUS line. This command allows to reset all the boards connected to such line, but the channels status does not change.

**48VA1676A:** allows to turn ON/OFF the 48V output available on the front panel connectors.

**GlobalOn:** allows to enable the Global ON command, which acts on all the modules connected on EASY BUS lines. All the channels whose parameter '**GlbOnEn = En**' are turned ON.

**GlobalOff:** allows to enable the Global OFF command, which acts on all the modules connected on EASY BUS lines. All the channels whose parameter '**GlbOffEn = En**' are turned OFF.

**A1676Ilk:** allows to readout the status of the 'INTERLOCK0/1' signals on the front panel. If one INTERLOCK lines becomes active, all the channels of all the modules connected on the EASY BUS lines are turned OFF.

---

#### 4.5.1 **A1676A OPC Items**

This chapter describes the items which are available for the board control.

The **Name** item allows to assign to the channel a symbolic name.

The **HwReset0..5** allows to Reset the relevant EASY BUS line.

A read access to the **HwReset0..5#CoOpen** returns back the label "Off" associated to HwReset0..5=0.

A read access to the **HwReset0..5#CoClose** item back the label "On" associated to HwReset0..5=1.

The **Recovery0..5** allows to Recover the relevant EASY BUS line.

A read access to the **Recovery0..5#CoOpen** returns back the label "Off" associated to Recovery0..5=0.

A read access to the **Recovery0..5#CoClose** item back the label "On" associated to Recovery0..5=1.

The **48VA1676A** allows to turn ON/OFF the 48V output available on the front panel connectors.

A read access to the **48VA1676A#CoOpen** returns back the label "Off" associated to 48VA1676A=0.

A read access to the **48VA1676A#CoClose** item back the label "On" associated to 48VA1676A=1.

The **GlbOn** item enables the Global On command.

A read access to **GlbOn#CoOpen** returns back the label "Off" associated to GlbOn=0.

A read access to **GlbOn#CoClose** returns back the label "On" associated to GlbOn=1.

The **GlbOff** item enables the Global Off command.

A read access to **GlbOff#CoOpen** returns back the label "On" associated to GlbOff=0.

A read access to **GlbOff#CoClose** returns back the label "Off" associated to GlbOff=1.

A read access to the **A1676Ilk** allows to readout the status of the 'INTERLOCK0/1' signals on the front panel.

A read access to the **A1676Ilk#CoOpen** item returns back the label "Off" associated to A1676Ilk=0.

A read access to the **A1676Ilk#CoClose** item returns back the label "On" associated to A1676Ilk =1.

**Table 4.2 – A1676A Board OPC items**

ItemID	Data Type	Access Rights	Description
PowerSupplyName.BoardXX.Name	String	R/W	Channel name
PowerSupplyName.BoardXX.HwReset0..5	boolean	R/W	HwReset0..5 status
PowerSupplyName.BoardXX.HwReset0..5#CoOpen	string	R	HwReset0..5 open label
PowerSupplyName.BoardXX.HwReset0..5#CoClose	string	R	HwReset0..5 close label
PowerSupplyName.BoardXX.Recovery0..5	boolean	R/W	Recovery0..5 status
PowerSupplyName.BoardXX.Recovery 0..5#CoOpen	string	R	Recovery0..5 open label
PowerSupplyName.BoardXX.Recovery0..5#CoClose	string	R	Recovery0..5 close label
PowerSupplyName.BoardXX.48VA1676A	boolean	R/W	48VA1676A status
PowerSupplyName.BoardXX.48VA1676A#CoOpen	string	R	48VA1676A open label
PowerSupplyName.BoardXX.48VA1676A#CoClose	string	R	48VA1676A close label
PowerSupplyName.BoardXX.GlbOn	boolean	R/W	GlbOn status
PowerSupplyName.BoardXX.GlbOn#CoOpen	string	R	GlbOn open label
PowerSupplyName.BoardXX.GlbOn#CoClose	string	R	GlbOn close label
PowerSupplyName.BoardXX.GlbOff	boolean	R/W	GlbOff status
PowerSupplyName.BoardXX.GlbOff#CoOpen	string	R	GlbOff open label
PowerSupplyName.BoardXX.GlbOff#CoClose	string	R	GlbOff close label
PowerSupplyName.BoardXX.A1676Ilk	boolean	R/W	A1676Ilk status
PowerSupplyName.BoardXX.A1676Ilk#CoOpen	string	R	A1676Ilk open label
PowerSupplyName.BoardXX.A1676Ilk#CoClose	string	R	A1676Ilk close label

#### 4.5.2 **SY1527 and SY2527 parameters**

Some of the general parameters directly handled by the SY1527 and SY2527 system are used in the EASY system management.

**ClearAlarm:** allows to Clear a possible Fail situation. Once removed the channel OFF cause, it is necessary to send a 'ClearAlarm' before turning the channel ON.

**FrontPanIn:** allows to readout the status of the SY1527/2527 system front panel lines. The A1676A broadcasts to all the modules connected on the EASY BUS lines the status of the KILL, INTERLOCK and ENABLE (LOC/REM) front panel signals of SY1527/2527.

It is important to remember:

If KILL and INTERLOCK signals are active, all the channels are turned OFF

If ENABLE signal is not active, the output voltages are = 0

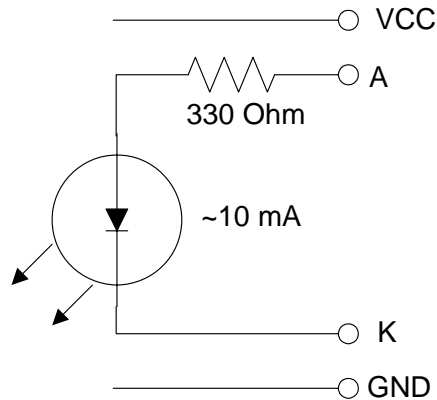
#### 4.6 **Interlock operation**

This section allows to enable/disable the module output and can work in two ways:



**PASSIVE INTERLOCK:** it is necessary to short circuit pin 1 ("GND", the first from left to right) with pin 2 ("K=katode"), and pin 3 ("A=anode") with pin 4 ("VCC"), or put a 50 Ohm termination between pin 3 and pin 4.

**ACTIVE INTERLOCK:** it is necessary to send a voltage level (for example a TTL) between pin 2 = katode and pin 3 = anode (high = interlock disabled, the channel can be turned on; low = interlock enabled, the channel cannot be turned on), leaving pin 1 and pin 4 disconnected.



**Fig. 4.1 – Interlock diagram**