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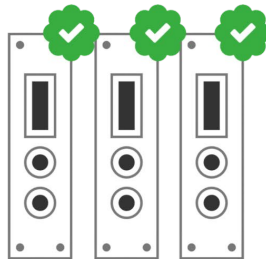
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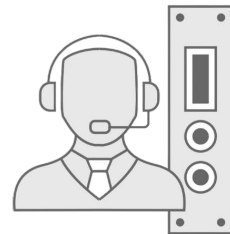
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Technical Information Manual

Revision n.2
2 November 2009

MOD. A3802
128 CHANNEL
EASY DAC
MANUAL REV. 2

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1. EASY3000 Embedded Assembly System

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, 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: in this way, one SY1527 power supply system, for example, housing up to 16 A1676A boards, can handle up to 96 EASY3000 systems. 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 control board, 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. An optional fan tray (A34FU -EASY3000 Fan Unit) can be used 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.

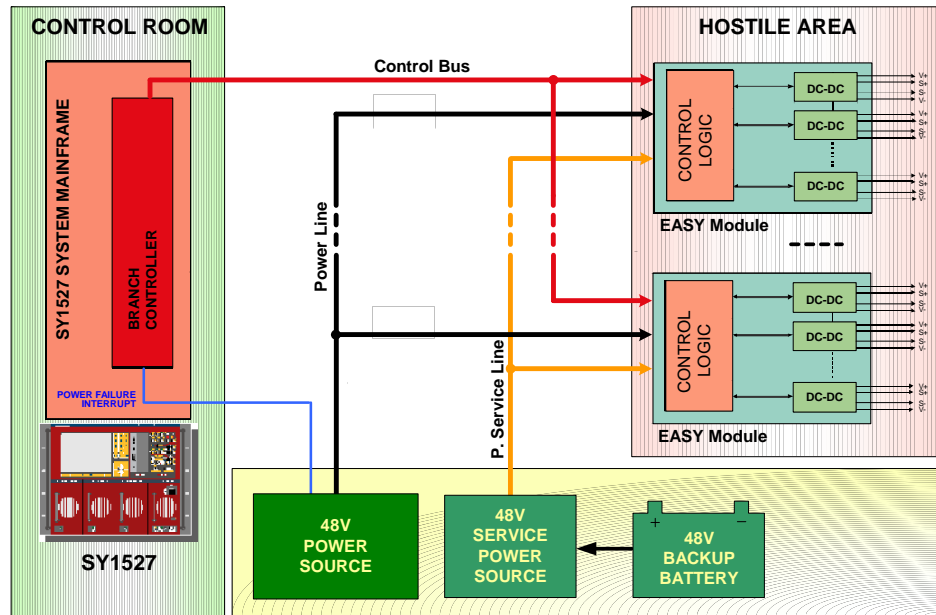


Fig. 1.1 – System's block diagram

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 1.1 – Technical specifications of the SY 1527 mainframe

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

1.3 The Mod. 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 crates (placed 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 crate. It configures the EASY3000 channels as if they belong to the slot in which the branch controller is located: the channels of the EASY3000 boards operate as channels of the A1676A. Up to six EASY3000 crates can be controlled by one A1676A. The provided software tool allows the User to configure the A1676A to operate with any EASY crate layout.

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. A3802 128 Channel DAC

2.1 A3802 Overview

The CAEN A3802 128 Channel DAC Board is developed for operation in magnetic field and radioactive environment. One A3802 houses 128 -4 V / 4 mA channels, suitable for applications such as discriminator thresholds generation. Voltage set/Voltage monitor resolution is 12 bit; the module features flat cable connectors. Channels can be enabled by groups (1 group = 8 channels); one group is turned off if $|V_{sum} - \Sigma V_{0set}| > 0.5V$ (see § 4.1).

2.2 A3802 Channel Characteristic Table

Table 2.1 – Channel characteristics of the Mod. A3802 128 Channel DAC Board

Polarity	Negative
Output Voltage	0 ÷ -4 V
Max. Output Current	4 mA
Voltage Set/ Vsum Mon Resolution	12 bit
Vset Accuracy	0.1% of Vset ± 2mV
Settling time	1ms
Ripple	<5mVpp measured on 10Hz to 15MHz frequency band

2.3 A3802 Front panel components

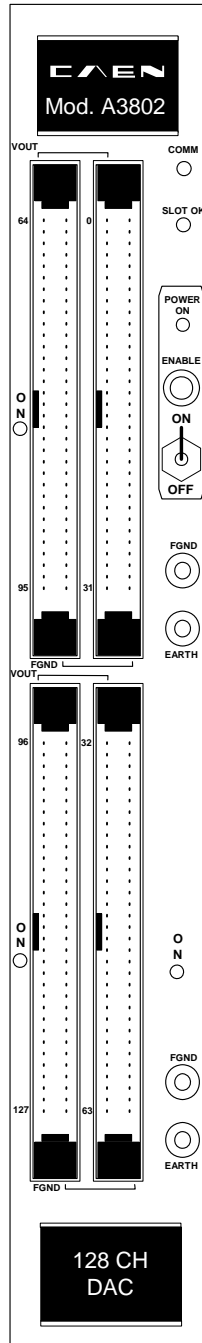


Fig. 2.1 – A3802 Front Panel

2.4 A3802 Technical Specifications

2.4.1 A3802 Packaging

The module is housed in a 8 TE wide, 6U-high mechanics.

2.4.2 A3802 Front panel connections

The board front panel houses the following components:

VOOUT/FAGND 0..127: DAC output and Floating return;
Type: Four 64 Pin Header Connectors

EARTH: Function: earth auxiliary reference
Type: 2mm plastic dial connector

FGND: Function: floating return
Type: 2mm plastic dial connector

48V ENABLE: Function: to be shorted (or terminated on 50 Ohm) in order to
enable the 48 V power supply (general ON/OFF of the
module)
Type: LEMO00 type connector

2.4.3 A3802 Front panel switches

POWER ON: Allows to enable/disable the the 48 V power supply (general
ON/OFF of the module)

2.4.4 A3802 Front Panel Displays

PWGOOD LED: *Function:* lights up as $\pm 12V$ supplies are
present.
Type: green LED

COMM LED: *Function:* lights up as the communications
take place.
Type: green LED

SLOT OK LED: *Function:* lights up as the board is correctly
inserted into the assigned slot.
Type: green LED

ON LED: *Function:* lights up as at least one channel in
a 32ch-group (0÷31, 32÷63, 64÷95, 96÷127)
is enabled.
Type: four yellow LEDs

3. Safety information and installation requirements

3.1 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.

3.1.1 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.

3.2 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

3.3 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 panel.

3.4 Ventilation

It is necessary to provide the unit the proper ventilation by using for example the CAEN Mod. A3000F Fan Unit; (A34FU Fan Unit must be used when the board is operated with EASY 3000 crate first issue). Ventilation is necessary even when channels and 12VPwS are off (see § 4.1).



Fig. 3.1 – Ventilation-warning Label

4. Operating modes

The Mod. A1676A board can be controlled, either locally or remotely, through the SY 1527 software interface. For details on SY 1527 system operation, please refer to the User's Manual of this product.



ATTENTION

THE MOD. A1676A and A3802 BOARDS REQUIRE SY 1527 FIRMWARE VERSION 2.01.00 OR LATER

4.1 Output control and monitoring

The control software handles 3 types of parameters:

the *board parameters* are referred to **Channel 0** (which is actually a “virtual” internal channel); they are common to all 128 DAC channels.

the *group parameters* which are referred to **Channel 1, 9, 17..121**; they are common to all channels in a group (1÷8; 9÷16..121÷128)

the *channel parameters* which are referred to **Channel 1..128**; they are individually defined for each channel

A1676A Branch Controller parameters are listed in the relevant User's Manual.

Table 4.1 – Board parameters

Name	Dir	Sign	ValType	Min	Max	Res	UM	OnStr	OffStr
UNVCtr	SET	UNSIGNED	ON_OFF					En	Dis
SerNum	MON	UNSIGNED	NUMERIC	1	65535	1	NONE		
Rel	MON	UNSIGNED	NUMERIC	1.00	99.99	0.01	NONE		
Status	MON	UNSIGNED	STATUS	---	---	---	---		
I2VPwS	MON	UNSIGNED	ON_OFF					Fail	Ok
Sync	MON	UNSIGNED	ON_OFF					Fail	Ok
HVSync	MON	UNSIGNED	ON_OFF					Fail	Ok
RemBdName	MON	UNSIGNED	ON_OFF					A3802	A3802

UNVCtr allows to Enable/Disable the control over all the channel groups in Under/Over voltage (group turned off if $|V_{sum} - \Sigma V_{0set}| > 0.5V$)

SerNum allows to readout the module serial number.

Rel allows to readout the module firmware release.

Status allows to monitor the board status

Bit11: 0 = plugged
1 = unplugged

- other bits: don't care
- 12VPwS** allows to readout the status of the +/-12V voltages generated inside the module.
- Sync** allows to readout the status of the 50Hz synchronisation signal (EASY BUS) provided by the A1676A Branch Controller.
- HVSync** allows to readout the status of the 625KHz EASY BUS clock signal provided by the A1676A
- RemBdName** allows to readout the module name.

Table 4.2 – Group parameters

Name	Dir	Sign	ValType	Min	Max	Res	UM	OnStr	OffStr
Pw	SET	UNSIGNED	ON_OFF					On	Off
Status	MON	UNSIGNED	STATUS	---	---	---	---		
VSum	MON	UNSIGNED	NUMERIC	00.00	32.00	0.01	VOLT		

- Pw** allows to send the ON/OFF command to the group
- VSum** allows to readout the sum of the voltage values related to the corresponding 8 channel group. If the difference between the VSum and the sum of the V0Set's in the group is larger than 0.5V, the relevant group is signalled to be in UNV/OVV and, if **UNVctr = En**, all the channel in the group are turned off (output voltage = 0).
- Status** allows to readout the channel status value.

Status	Name	Meaning
Bit 0	ON/OFF	
Bit 4	OVV	Over Voltage : $VSum - \sum V0set > 0.5V$
Bit 5	UNV	Under Voltage : $\sum V0set - VSum > 0.5V$
Bit 11	UNPLUGGED	Fail in communication with A1676A Branch Controller

Before turning one channel group ON, UNV/OVV must be removed via the 'Clear Alarm' command, sent by the Sy1527/Sy2527 system.

Table 4.3 – Channel parameters

Name	Dir	Sign	ValType	Min	Max	Res	UM	OnStr	OffStr
V0Set	SET	UNSIGNED	NUMERIC	0.000	4.000	0.001	VOLT		

- V0Set** allows to set the output voltage

N.B.: the A3802 Board parameters are actually referred to the first channel (CH0); the A3802 Channel parameters are referred to Channels [1..128], which correspond to Channels [0..127] on front panel.

4.1.1 A3802 Board OPC Items

This chapter describes the items which are available for the A3802 board control.

The **UNVctr** item allows to Enable/Disable all the channels in Undervoltage

A read access to the **UNVctr#CoOpen** item returns back the label "En" associated to UNVctr = 1.

A read access to the **UNVctr# CoClose** item returns back the label "Dis" associated to UNVctr = 0.

A read access to the **SerNum** item returns the board serial number.

A read access to the **SerNum#EU** item returns a string with the serial number Engineering Units.

A read access to the **SerNum#HighEU** item returns the highest possible serial number value.

A read access to the **SerNum#LowEU** item returns the lowest possible serial number value.

A read access to the **Rel** item returns a string with the board firmware release.

A read access to the **Rel#EU** item returns a string with the firmware release Engineering Units.

A read access to the **Rel#HighEU** item returns the highest possible firmware release value.

A read access to the **Rel#LowEU** item returns the lowest possible firmware release value

A read access to the **Status** item returns back a 16 bit pattern indicating channel status.

A read access to the **12VPwS** item returns the internal ± 12 V status.

A read access to the **12VPwS#CoOpen** item returns back the label "Off" associated to 12VPS=FAIL.

A read access to the **12VPwS#CoClose** item returns back the label "On" associated to 12VPS=OK.

A read access to the **Sync** item returns the external 50 Hz status.

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

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

A read access to the **HVSync** item returns the external 625 Hz status.

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

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

A read access to the **RemBdName** item returns a string with the board name.

Table 4.4 – A3802 board items

ItemID	Data Type	Access Rights	Description
PowerSupplyName.BoardXX.Chan0.UNVctr	boolean	R/W	UNVctr status
PowerSupplyName.BoardXX.Chan0.UNVctr#HighEU	string	R	UNVctr open label
PowerSupplyName.BoardXX.Chan0.UNVctr#LowEU	string	R	UNVctr close label
PowerSupplyName.BoardXX.Chan0.SerNum	4-byte real	R	Board serial number
PowerSupplyName.BoardXX.Chan0.SerNum#EU	String	R	SerNum EU
PowerSupplyName.BoardXX.Chan0.SerNum #HighEU	8-byte real	R	SerNum upper limit

ItemID	Data Type	Access Rights	Description
PowerSupplyName.BoardXX.Chan0.SerNum #LowEU	8-byte real	R	SerNum lower limit
PowerSupplyName.BoardXX.Chan0.Status	2-byte integer	R	Status
PowerSupplyName.BoardXX.Chan0.Rel	4-byte real	R	Board firmware release
PowerSupplyName.BoardXX.Chan0.Rel#EU	String	R	Rel EU
PowerSupplyName.BoardXX.Chan0.Rel#HighEU	8-byte real	R	Rel upper limit
PowerSupplyName.BoardXX.Chan0.Rel#LowEU	8-byte real	R	Rel lower limit
PowerSupplyName.BoardXX.Chan0.12VPwS	boolean	R	12V PwS status
PowerSupplyName.BoardXX.Chan0.12VPwS#CoOpen	string	R	12V PwS open label
PowerSupplyName.BoardXX.Chan0.12VPwS#CoClose	string	R	12V PwS close label
PowerSupplyName.BoardXX.Chan0.Sync	boolean	R	Sync status
PowerSupplyName.BoardXX.Chan0.Sync#CoOpen	string	R	Sync open label
PowerSupplyName.BoardXX.Chan0.Sync#CoClose	string	R	Sync close label
PowerSupplyName.BoardXX.Chan0.HVSync	boolean	R	HVSync status
PowerSupplyName.BoardXX.Chan0.HVSync#CoOpen	string	R	HVSync open label
PowerSupplyName.BoardXX.Chan0.HVSync#CoClose	string	R	HVSync close label
PowerSupplyName.BoardXX.Chan0.RemBdName	String	R	Board name

4.1.2 A3802 Group OPC Items

This chapter describes the items available for the control of the channel groups. A read access to the **Status** item returns back a 16 bit pattern indicating channel status, as follows (only meaningful bits reported):

Status	Name	Meaning
Bit 0	ON/OFF	
Bit 4	OVV	Over Voltage : $V_{Sum} - \Sigma V_{0set} > 0.5V$
Bit 5	UNV	Under Voltage : $\Sigma V_{0set} - V_{Sum} > 0.5V$
Bit 11	UNPLUGGED	Fail in communication with A1676A Branch Controller

The **Pw** item allows to switch ON/OFF the channel group.

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

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

The **VSum** item allows to monitor VSum (channels group voltage sum).

A read access to the **VSum#EU** item returns a string with the VSum Engineering Units.

A read access to the **VSum#HighEU** item returns the highest possible VSum value.

A read access to the **VSum#LowEU** item returns the lowest possible VSum value.

Table 4.5 – A3802 Group items

ItemID	Data Type	Access Rights	Description
PowerSupplyName.BoardXX.ChanYYY.Status	2-byte integer	R	Channel status
PowerSupplyName.BoardXX.ChanYYY.Pw	boolean	R/W	Power ON/OFF
PowerSupplyName.BoardXX.ChanYYY.Pw#CoClose	string	R	Pw close label
PowerSupplyName.BoardXX.ChanYYY.Pw#CoOpen	string	R	Pw open label
PowerSupplyName.BoardXX.ChanYYY.VSum	4-byte real	R	VSum
PowerSupplyName.BoardXX.ChanYYY.VSum#EU	string	R	VSum EU
PowerSupplyName.BoardXX.ChanYYY.VSum#HighU	8-byte real	R	VSum upper limit
PowerSupplyName.BoardXX.ChanYYY.VSum#LowEU	8-byte real	R	VSum lower limit

4.1.3 A3802 Output Channel OPC Items

This chapter describes the items which are available for the control of the DAC channel. The **V0set** item allows to set V0 output voltage. A read access to the **V0set#EU** item returns a string with the V0set Engineering Units. A read access to the **V0set#HighEU** item returns the highest possible V0set value. A read access to the **V0set#LowEU** item returns the lowest possible V0set value.

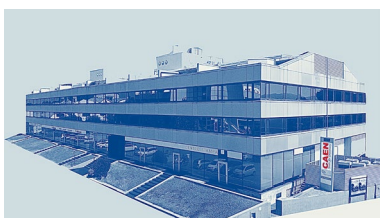
Table 4.6 – A3802 Channel items

ItemID	Data Type	Access Rights	Description
PowerSupplyName.BoardXX.ChanYYY.V0Set	4-byte real	R/W	Set V0 voltage limit
PowerSupplyName.BoardXX.ChanYYY.V0Set#EU	String	R	V0set EU
PowerSupplyName.BoardXX.ChanYYY.V0Set#HighEU	8-byte real	R	V0set upper limit
PowerSupplyName.BoardXX.ChanYYY.V0Set#LowEU	8-byte real	R	V0set lower limit



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