Rev.14 - 6 December 2021

DT55xxE

4 Channel Desktop HV Power Supply Family with Ethernet & USB

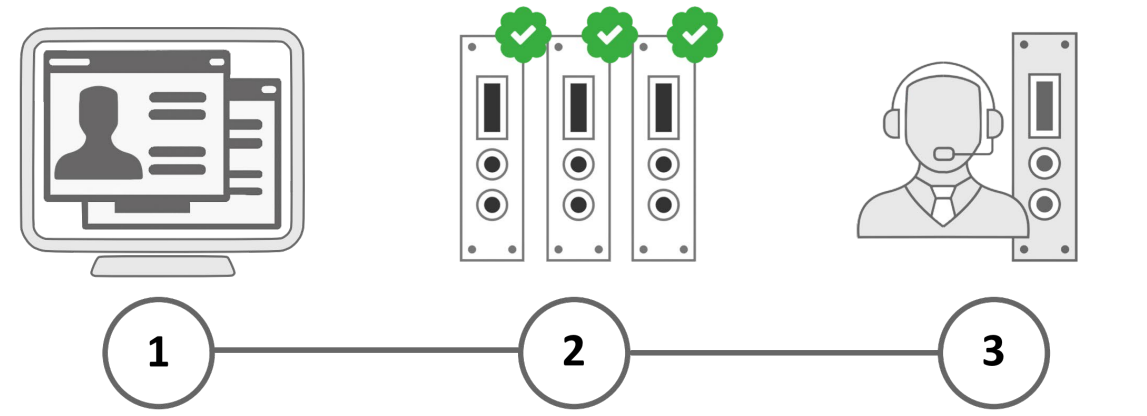
CAEN
Tools for Discovery

User Manual

Register your device

Register your device to your **MyCAEN+** account and get access to our customer services, such as notification for new firmware or software upgrade, tracking service procedures or open a ticket for assistance. **MyCAEN+** accounts have a dedicated support service for their registered products. A set of basic information can be shared with the operator, speeding up the troubleshooting process and improving the efficiency of the support interactions.

MyCAEN+ dashboard is designed to offer you a direct access to all our after sales services. Registration is totally free, to create an account go to https://www.caen.it/become-mycaenplus-user and fill the registration form with your data.



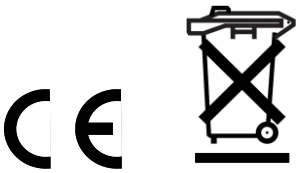
https://www.caen.it/become-mycaenplus-user/

Purpose of this Manual

This document is the DT55xxE User's Manual; it contains information about the installation, the configuration and the use of the units.

Change Document Record

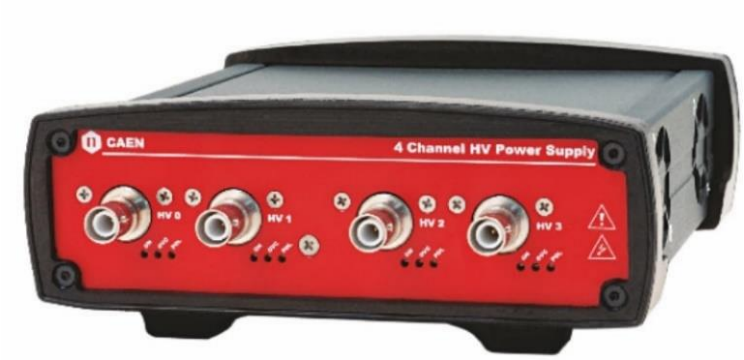
Date	Revision	Changes
18 December 2015	0	Preliminary
5 February 2016	1	Software tools updated; Technical specifications table updated
12 February 2016	2	Technical specifications table updated, Firmware upgrade
26 July 2016	3	Updated Ethernet configuration
11 October 2016	4	Updated Ethernet configuration
26 January 2017	5	Channel Status bit description
11 April 2017	6	Updated inspection and installation instructions
25 October 2017	7	Description of TRIP parameter in §2
28 November 2018	8	Updated Module access, new pictures
9 October 2019	9	Updated Overview
16 June 2020	10	Updated Channels settings, Communication Protocol, Technical specifications table
21 July 2020	11	Technical specifications table updated
5 February 2021	12	Technical specifications table updated
21 June 2021	13	Technical specifications table updated
6 December 2021	14	Updated Communication Protocol



Index

1. General description

Overview



The DT55xxE series provide 4 independent High Voltage channels in Desktop package (Powered via external AC/DC stabilized power supply); the following versions are available:

Model	Output range	Polarity
DT5519E	500 V/3 mA	Positive, Negative, Mixed
DT5521E	6 kV/300 µA	Positive, Negative, Mixed
DT5521HE	6 kV/20 µA	Positive, Negative, Mixed
DT5533E	4 kV/3 mA (4 W)	Positive, Negative, Mixed
DT5534E	6 kV/1 mA (4 W)	Positive, Negative, Mixed

HV outputs are delivered through SHV connectors. “Mixed” versions have two positive and two negative channels.

The HV output RAMP-UP and RAMP-DOWN rates may be selected independently for each channel with 1 V/s steps. The module features 16bit ISET/IMON resolution. Features include also current monitor resolution extended by 10x in a Lower range (selectable via software).

Safety features include:

- OVERVOLTAGE and UNDERVOLTAGE warning when the output voltage differs from the programmed value
- OVERCURRENT detection: if a channel tries to draw a current larger than its programmed limit, it enters TRIP status, keeping the maximum allowed value for a programmable time (TRIP), before being switched off, according to POWER DOWN setting (Kill or Ramp)
- Channels can be enabled or disabled through the Interlock logic
- Channels individually enabled via front panel jumpers (passive or active mode available)

Functional parameters can be programmed and monitored via USB and Ethernet (external PC required), supported OS: Windows 7 or later; Linux kernel Rel. 2.4 or later.

2. Technical specifications

Packaging

The DT55xxE unit is a Desktop module housed in a 154x50x164 mm^3 alloy box. The kit includes:

- DT55xxE desktop power supply unit

- External AC/DC power supply with separate power cord

- USB cable

- 10BASE-T Ethernet cable

PID (Product Identifier)

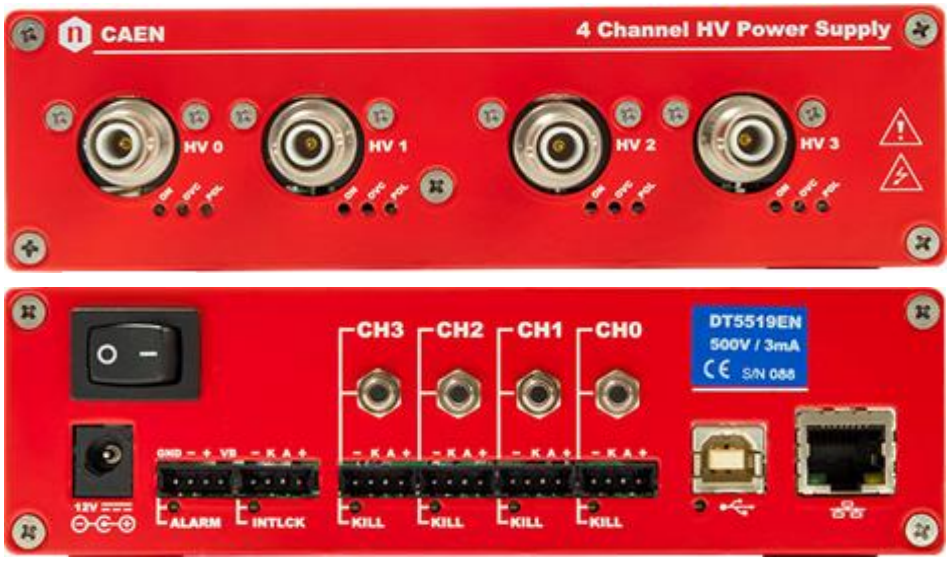
PID is the CAEN product identifier, an incremental number greater than 10000 that is unique for each product. The PID is on a label affixed to the product

Power requirements

The module is powered by the external AC/DC stabilized power supply included in the delivered kit (Switchbox Model FRA045-S12-4; see specifications in table p.5)

Note.: Using a different power supply source, like linear type, it is recommended the source to provide +12V and, at least, 2.5A; the power jack is a 2.1mm type, a suitable cable is the RS 656-3816 type (or similar).

Front and Back panel



Front panel components

HV Channel Output

NAME:	TYPE:
ON	GREEN LED; lights when the channel is active
OVC	RED LED; lights when channel draws a current > ISET (OVC detected)
POL	RED/YELLOW LED; RED (positive channel) or YELLOW (negative channel)
HV OUT	HV Channel Output; Mod. SHV RADIALL R317580; Impedance: 50 Ohm; Frequency range: 0 – 2 GHz; VSWR: <1.20 + 0.3 F (GHz) – (plug and jack); Test voltage: 10kV DC – 1mn (unmated connectors); Ratings: 12kV DC – 1mn (mated pairs); Current rating: 10 A

WARNING! These connectors produce extremely hazardous high voltages at a potentially lethal current level; never connect or disconnect the HV OUT connector with the power ON/OFF switch ON; always switch power OFF and wait at least 30s before connecting or disconnecting HV cables.

Back panel components

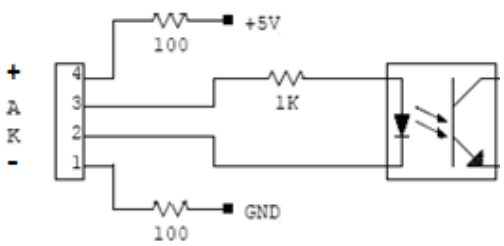
Ethernet connector

NAME:	TYPE:	SIGNAL:	FUNCTION:
ETH	10Base-T female connector	I/O	TTL signals (TCP/IP)

USB Port

NAME:	TYPE:	SIGNAL:	FUNCTION:
USB	B type USB connector	I/O	USB 2.0 and USB 1.1 compliant

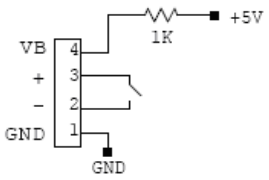
Channel control section



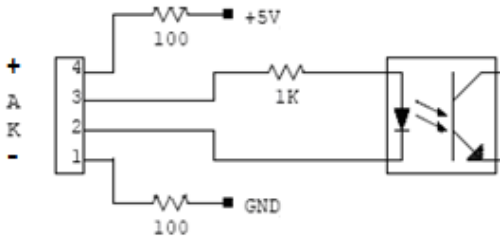
NAME:	TYPE:	FUNCTION:
KILL	PUSH BUTTON	Channel KILL; channel is turned off at the fastest available rate
KILL	RED LED	Signals Channel KILL
REMOTE KILL	AMP 280371-2	leave contact open: KILL voltage level (0÷1V, ~5mA current) between pin 2 and 3: KILL short circuit pin 1 with pin 2, and pin 3 with pin 4: ENABLED voltage level (4÷6V, ~5mA current) between pin 2 and pin 3: ENABLED

HV Status control section

ALARM



INTERLOCK



NAME:	TYPE:	SIGNAL:	FUNCTION:
ALARM	RED LED/ AMP 280371-2.	Out	Alarm status signalled (active LOW)
INTERLOCK	RED LED/ AMP 280371-2	In	Interlock signal (channels hardware disabled)

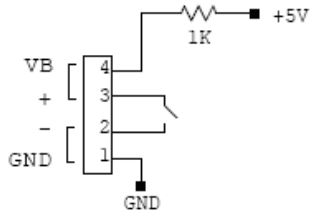
Alarm signal

As an Alarm condition is detected (see p.) pins 2 and 3 (- and +) are closed; the contact can be used to switch an external device supplied by an external source, otherwise the VB and GND references can be used to provide a TTL compatible level on pin 2 and 3.

In the first case (externally supplied device) the maximum allowed ratings are:

- Maximum voltage between + and -: 12V
- Maximum sink current across + and -: 100mA

In the latter case, to produce a TTL compatible Alarm Out, pin 3 (+) must be connected with pin 4 (VB) and pin 1 (GND) with pin 2 (-); see the diagram below:



Interlock signal

With reference to diagram of the Interlock input shown above, the diode is part of opto-coupler stage. Interlock means that channels are hardware disabled. The interlock operation is as follows:

CONFIGURATION	INTERLOCK STATUS
leave contact open	INTERLOCK
voltage level (0÷1V, ~5mA current) between pin 2 and pin 3	INTERLOCK
short circuit pin 1 with pin 2, and pin 3 with pin 4	ENABLED
voltage level (4÷6V, ~5mA current) between pin 2 and pin 3	ENABLED

The front panel Interlock LED is ON when the INTERLOCK is active; as INTERLOCK is active, channels are turned off at the fastest available rate, regardless the RAMP DOWN setting.

DC Input

NAME:	TYPE:	SIGNAL:	FUNCTION:
12V In	Kycon KLDX-0202-A-LT 2.0mm DC Power Jack	Input	+12V DC Input
ON/OFF switch	Molveno A11331122000 A1 switch		**O** → power supply OFF. **I** → power supply ON

IMON Range

The channel current can be monitored with an increased resolution (10x), by selecting the “low” range (see p.16):

Model	High range current	Hig range res.	Low range current [1]	Low range res.
DT5519E	3 mA	10 nA	300 µA	1 nA
DT5521E	300 µA	1 nA	30 µA	100 pA
DT5521HE	20 µA	100 pA	2 µA	10 pA
DT5533E	3 mA	10 nA	300 µA	1 nA
DT5534E	1 mA	5 nA	100 µA	500 pA

[1] When Low range is selected, Overcurrent is reported when these values are exceeded

Technical specifications table

Model			DT5519E	DT5521E	DT5521EH	DT5533E	DT5534E
Packaging			Desktop module housed in a 154x50x164 mm³ alloy box; weight:~800g				
Output channels			Positive, Negative and Mixed (2+2) Polarity available; common ground				
Output ranges			500 V/3mA	6kV/300 µA	6kV/20 µA	4kV/3mA	6kV /1mA
Max. Ch. Output Power			1.5 W	1.8 W	180 mW	4W	
Vset Resolution			10 mV	100 mV			
Vmon Resolution			1 mV	50 mV		10 mV	50 mV
ISET Resolution			50nA	5 nA	500 pA	50 nA	20 nA
IMON Resolution		High range	10nA	1 nA	100 pA	10 nA	5 nA
		Low range	1nA	100 pA	10 pA	1 nA	500 pA
VMAX hardware			0 ÷ 510 V	0 ÷ 6100 V		0 ÷ 4100 V	0 ÷ 6100 V
VMAX hardware resolution			1 V				
VMAX hardware accuracy			± 2% of FSR				
IMAX			3100 µA	310 µA	21 µA	3100 µA	1050 µA
Alarm output			Open collector, 100 mA maximum sink current				
Interlock input			LOW: <1V; current~5mA; HIGH: 4÷6 V				
Ramp Up/Down			1÷100 V/s, 1 V/s step	1÷500 Volt/s, 1 Volt/s step			
Trip			Max. time an “overcurrent" is allowed to last (seconds). A channel in "overcurrent" works as a current generator; output voltage varies to keep the output current lower than the programmed value. "Overcurrent" lasting more than set value (1 to 9999) causes the channel to "trip". Output voltage will drop to zero either at the Ramp-down rate or at the fastest available rate, depending on Power Down setting; in both cases the channel is put in the off state. If trip= INFINITE, "overcurrent" lasts indefinitely. TRIP range: 0 ÷ 999.9 s; 1000 s = Infinite. Step = 0.1 s				
“Zero” current			Zero Current Detect channel parameter allows to sample the present IMon value; this value (IMonZero) can be then subtracted via the Zero Current Adjust parameter ENABLE, from the monitored current (IMon), to compensate the current offset; if ZCAdjust = Enabled, then the IMon value is compensated. After the IMonZero value is sampled, Zero Current Detect, returns to Off. Allowed IMonZero values are from 0 to full scale. If Zero Current Adjust is DISABLED, the IMonZero compensation is neglected.				
Accuracy[2]	Vmon vs. Vout		±0.05% of read ±0.5V	±0.05% of read ±1V	±0.05% of read ±1V	±0.05% of read ±1V	±0.05% of read ±1V
	Vset vs. Vout		±0.05% of read ±0.5V	±0.05% of read ±1V	±0.05% of read ±1V	±0.05% of read ±1V	±0.05% of read ±1V
	IMON vs. Iout	High range	±2% of read ±1µA	±2% of read ±50nA	±2% of read ±5nA	±2% of read ±1µA	±2% of read ±500nA
		Low range	±2% of read ±100nA	±2% of read ±5nA	±2% of read ±500pA	±2% of read ±100nA	±2% of read ±50nA
	ISET vs. IMON	High range	±2% of read ±1µA	±2% of read ±50nA	±2% of read ±5nA	±2% of read ±1µA	±2% of read ±500nA
		Low range	±2% of read ±100nA	±2% of read ±5nA	±2% of read ±500pA	±2% of read ±100nA	±2% of read ±50nA
Voltage Ripple	20 ÷ 1000 Hz	typical	<3 mVpp	<7 mVpp			<10 mVpp
		max	<5 mVpp	<10 mVpp			<15 mVpp
	1 ÷ 20000 kHz	typical	<2 mVpp				<10 mVpp
		max	<5 mVpp				<15 mVpp
Ventilation Fans			Two Sunon MC35101V1-000U-A99				
Humidity range			0 ÷ 80%				
Operating temperature			0 ÷ 45°C				
Storage temperature			-10 ÷ 70°C				
Vout / Temperature coefficient			max. 50ppm / °C				
IMON / Temperature coefficient			max 100ppm/C°				
Long term stability Vout vs. Vset			± 0.02% (after one week @ constant temperature)				
External power supply			Switchbox FRA045-S12-4 (12 VDC, 3.75 A, 45 W); Universal Input C14 receptacle; INPUT Voltage range 100-240VAC 1.2A 50-60Hz. Inrush current 40A at 115VAC / 80A at 230VAC max. Dielectric withstand Input/output 3,000VDC. OUTPUT Output voltage +12V. Ripple and noise 2% p-p max. Load regulation ±5% max. No load stand by power <0.5W @ 230VAC. Efficiency >=85% for CEC requirement. Hold up time 10ms at nominal line. Protections OCP, OVP, over power & short circuit. GENERAL Std output connector Dc barrel jack. Std output cable/length UL1185, #18AWG / 5 ft. ENVIRONMENTAL Operating temperature 0°C to +40°C. Storage temperature –20°C to +85°C. STANDARDS Safety standards IEC/UL/EN60950-1, CE, CB. EMC EN55022 (CISPR 22) class B, FCC class B.				

[2] Accuracy values are measured from 10% to 90% of Full Scale Range

3. Unit operation

Safety requirements and Initial inspection

N.B. read carefully the "Precautions for Handling, Storage and Installation" document provided with the product before starting any operation!

The following HAZARD SYMBOLS are reported on the unit:

CAUTION: indicates the need to consult the "Precautions for Handling, Storage and Installation" document provided with the product. **A potential risk exists if the operating instructions are not followed**

HIGH VOLTAGE: indicates the presence of electric shock hazards. Enclosures marked with these symbols should only be opened by CAEN authorized personnel.
To avoid risk of injury from electric shock, do not open this enclosure

To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.

Avoid Electric Overload. To avoid electric shock or fire hazard, do not power a load outside of its specified range.

Avoid Electric Shock. To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

Do Not Operate without Covers. To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere. To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Do Not Operate with Suspected Failures. If you suspect this product to be damaged, have it inspected by qualified service personnel.

Prior to shipment this unit was inspected and found free of mechanical or electrical defects. Upon unpacking of the unit, inspect for any damage, which may have occurred in transport. The inspection should confirm that there is no exterior damage to the unit, such as broken knobs or connectors, and that the panels are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, file a claim with carrier immediately and notify CAEN. Before installing the unit, make sure you have read thoroughly the safety rules and installation requirements, then place the package content onto your bench; you shall find the following parts:

- DT55xxE desktop power supply unit;
- External AC/DC power supply with separate power cord
- USB cable
- 10BASE-T Ethernet cable

Moreover, an external PC is required (supported OS: Windows 7 or later; Linux kernel Rel. 2.4 or later)

Unit installation

USB installation

Connect the HV Channel Output to the load
Connect the DT55xxE to the AC/DC power supply through the DC input rear connector;
Connect the external AC/DC power supply to Mains (AC) via the separate power cord
Connect the DT55xxE to the PC via the USB cable
Power up the DT55xxE through the ON/OFF rear switch (see p. 8)
Download and install the USB driver for your OS, available at the DT55xxE page on the www.caen.it site
Now the DT55xxE is ready for operation, upon installation of one of the available software tools

Ethernet installation

Connect the HV Channel Output to the load
Connect the DT55xxE to the AC/DC power supply through the DC input rear connector;
Connect the external AC/DC power supply to Mains (AC) via the separate power cord
Connect the Ethernet port of the unit to the relevant port of the PC, using the 10BASE-T Ethernet cable
Power up the DT55xxE through the ON/OFF rear switch (see p. 8)
Now the DT55xxE is ready for operation, upon installation of one of the available software tools

Software tools

GECO2020

CAEN GECO2020 is a graphical application that allows to control the DT55xxE HV Desktop Power Supplies (and all other CAEN Power Supplies). Once the DT55xxE is correctly installed, download and install the GECO2020 software package related to your OS; follow the instructions in the GECO2020 User manual and the DT55xxE will be ready to be operated. For more info please visit www.caen.it (products>firmware/software section).

CAEN HV Wrapper

CAEN HV Wrapper is a library, available either as a set of ANSI C functions or LabVIEW™ VI's. Such set provides the software developer an unified software interface for the control of CAEN Power Supplies. This is a low level application in which the writing of the Control SW is assigned to the user. It contains a generic software interface independent by the Power Supply models and by the communication path used to exchange data with them.

CAEN HV Wrapper is logically located between an higher level application, such as GECO2020, and the lower layer software libraries. For more info please visit www.caen.it (products>firmware/software section).

Power Supply Modules LabVIEW Instrument Driver

Power Supply Modules LabVIEW Instrument Driver is a set of VI'S, developed for LabVIEW 2009 and later releases (LabVIEW™ is a Trademark of National Instruments Corp.), that allow to configure and monitor all parameters of remotely controlled CAEN Programmable HV Power Supply modules. Host PC shall run LabVIEW 2009 or later releases and NI-VISA Run-Time Engine 5.3.

To install the Power Supply Modules LabVIEW Instrument Driver, go to CAEN web site in the "Software" area, download the Power Supply Modules LabVIEW Instrument Driver installation package and follow the Set Up instructions.

4. VT emulator control

Module access

The module is provided with a USB2.0 compliant interface and Ethernet Port (TCP/IP).
For link connection, refer to instructions given at page 10.
CAEN provides the CAEN GECO2020 Control Software that allows a friendly remote management of all Unit's functional parameters (see www.caen.it software support page); anyway, the connection can be performed also via VT emulators; we suggest to use TeraTerm (see https://ttssh2.osdn.jp/index.html.en)

USB
Launch the terminal emulator (we suggest using TeraTerm), select the serial communication link and set the virtual communication port associated to the module. Select USB connection and the used port number; set port as follows

baud rate 9600

Data bits: 8

Parity: none

stop bit: 1

Flow control: none

Launch communication

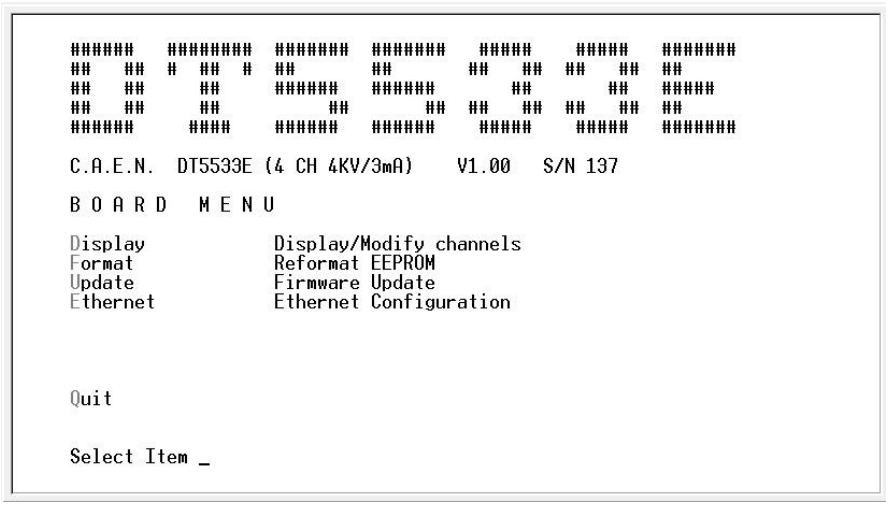
Type caen then <enter>;

Ethernet
Launch the terminal emulator (we suggest using TeraTerm); select: port number **23**, service: TELNET
Please note that line editing must be disabled prior to Ethernet access (EnableLineMode=off in the Teraterm.ini configuration file).
Default settings are:

IP address	192.168.0.1
Subnet mask	255.255.255.0
Gateway	255.255.255.0

Launch communication
Type caen then <enter>;

as the communication is established, the Main Menu will be displayed (USB connection shown):

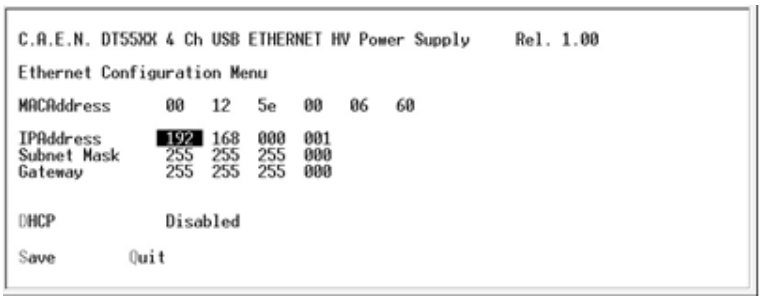


Five options are available:

- Display
- Format
- Update
- Ethernet
- Quit

Ethernet configuration

To configure the Ethernet Port (possible only with USB connection); with reference to the picture above, Type E; the following screen will open:



At first Power On the module is configured with default static IP (factory setting); such IP can be updated using the “arrows” to select the fields, typing the new values and confirming with <Enter>.

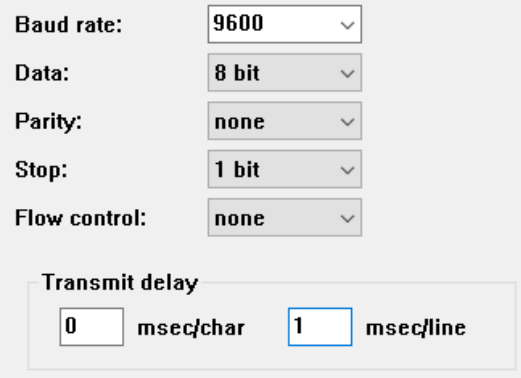
Type S to save the new setting in the EEPROM and go back to Main Menu.

The new setting will become active at next Power On; if a DHCP Server is available, then the module can be enabled or disabled as DHCP client; type S to save the new setting in the EEPROM and go back to Main Menu: the DHCP server will automatically assign a new IP to the module at next Power On.

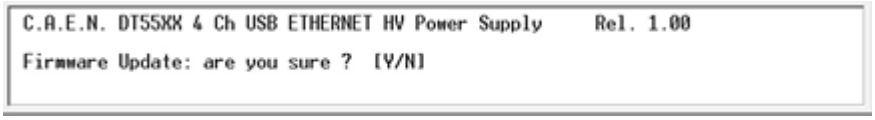
Firmware upgrade

To upgrade the firmware:

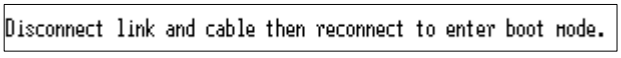
- download from www.caen.it unit page the most recent firmware revision for your module
- connect to the module via USB using TeraTerm VT Emulator
- in the TeraTerm options, select “set up” > “serial port” and enter the following settings



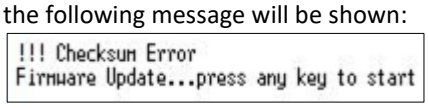
- click OK to confirm
- from the Main Menu, type U in order to upgrade the firmware



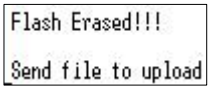
- Type y
- The following message will be shown:



- Select “File” > disconnect
- unplug the USB cable
- do not turn off the module!
- connect once again to the module, via USB
- the following message will be shown:



- Press any key
- Wait until the following message is shown:



- Select “File” > send file
- Browse the image file (for example DT55XXE.113)
- Select “open”
- Wait the upload to complete until this message is shown:

```
File Loaded.

Disconnect link and cable then reconnect to launch application...
```

- Select “File” > disconnect
- unplug the USB cable
- connect once again to the module, via USB
- now the unit is ready to operate running the upgraded firmware

Format EEPROM

By typing F on Main Menu, it is possible to access the format EEPROM menu.

```
C.A.E.N.  DT5533E (4 CH 4KV/3mA)   V1.00   SNum 137

Format EEPROM. Are you sure ? [y/n]
```

Channels settings

By typing D on Main Menu, it is possible to access channels settings.

To change one parameter: point the parameter with the “arrow keys”, and type the desired value, confirm by pressing <Enter>; Imon range, ZCDetect, ZCAdjust, Power and Power Down can be changed using the <Space> bar.

```
C.A.E.N.  DT5521HE (4 CH 6KV/20uA)   V1.11   SNum 353      Temp +028 C

                  Ch0             Ch1             Ch2             Ch3

Polarity            -               -               -               -
Vmon          0000.80 V       0001.20 V       0002.60 V       0000.00 V
Imon         -0.21709 uA     -0.12217 uA     -0.05589 uA     -0.06978 uA
Status

Power             Off             Off             Off             Off
Vset          4200.0 V        4000.0 V        4000.0 V        4000.0 V
Iset         21.0000 uA      21.0000 uA      21.0000 uA      21.0000 uA
Vmax            6100 V          6100 V          5400 V          5500 V
Ramp Up          500 V/S         500 V/S         500 V/S         500 V/S
Ramp Down        500 V/S         500 V/S         500 V/S         500 V/S
Trip            Inf. S          Inf. S          Inf. S          Inf. S
Power Down      Kill            Kill            Kill            Kill
ZC Detect       Off             Off             Off             Off
ZC Adjust       Dis             Dis             Dis             Dis
Imon Range      High            High            High            High

Group Mode    Reset Alarm    Quit
```

Please note that older units may have a different set of parameters.

By typing G, the channels are accessed in “group” mode (one setting applies to all channels).

N.B.: when one channel Status is in OVC, MAXPW, OVT, then it is switched off according to Power Down setting (Kill or Ramp); when in Interlock, it is switched off at the fastest available rate.

For the HV channels, the following parameters can be programmed and monitored:

Parameter:	Function:	Unit:
Vmon	High Voltage Monitored value	Volt
Imon	Current Monitored value	µA
Status	ON/OFF; Ramp UP/DOWN; OVV; UNV; OVC; OVP; MAXV; TRIP; OVT; OFF; KILL; CAL_ERR	
Vset	High Voltage programmed value	Volt
Iset	Current Limit programmed value	µA

VMax	Absolute maximum High Voltage level that the channel can reach (see p. 9)	V
Ramp-Up	Maximum High Voltage increase rate	V/s
Ramp-Down	Maximum High Voltage decrease rate	V/s
Power Down	Power Down mode after channel TRIP	KILL or RAMP
Trip	Max time "overcurrent" allowed to last (≥1000 = infinite)	s
Imon Range	Current Monitor Zoom	High or Low
ZC Detect	If ON, it stores the present IMon value (IMonZero) into memory for “zero current compensation” purposes (see description below); if OFF, the unit is ready to store IMon as IMonZero. After IMonZero is stored, the parameter returns to OFF	ON or OFF
ZC Adjust	If Enabled, the stored IMonZero value via ZCDetect option is subtracted from the measured, “non compensated” IMON value. The returned “compensated” IMON value will be then the difference between measured and stored values. If Disabled, the returned IMON value is not compensated	En / Dis

5. Communication Protocol

The following Protocol is based on commands made of ASCII characters strings. Please note that older units may have a different set of commands.

Board commands

The general board commands have the format: $CMD:***,PAR:***** <CR><LF>

$CMD:SET,PAR:BDCLR	Clears board alarms		
$CMD:MON,PAR:BDILK	Monitor Interlock status		
$CMD:MON,PAR:BDNCH	Number of channels		
$CMD:MON,PAR:BDNAME	Board name		
$CMD:MON,PAR:BDSNUM	Serial Number		
$CMD:MON,PAR:BDFREL	Firmware release		
$CMD:MON,PAR:BDALARM	Alarm Mask = 0x1ff8		
	IS_OVC	8	At least one ch. in Overcurrent
	IS_OVV	0x10	At least one ch. in OverVoltage
	IS_UNV	0x20	At least one ch. in UnderVoltage
	IS_MAXV	0x40	At least one ch. in MaxV
	IS_TRIP	0x80	At least one ch. in Trip
	IS_MAXPW	0x100	At least one ch. in MaxPower
	IS_TWARN	0x200	At least one ch. in Temp warning (>80°C)
	IS_OVT	0x400	At least one ch. in OVT (>125°C)
	IS_KILL	0x800	At least one ch. Killed
	IS_INTLCK	0x1000	At least one ch. in Interlock
$CMD:MON,PAR:MACADDR	Board MAC Address		
$CMD:MON,PAR:IPADDR	Board IP Address		
$CMD:MON,PAR:SUBMASK	Subnet mask		
$CMD:MON,PAR:GATEWAY	Gateway		
$CMD:MON,PAR:DHCPEN	DHCP (Enable / Disable)		

Channel Commands

The channel commands have the format: $CMD:***,CH:*,PAR:***,VAL:xxx.xx<CR,LF>

where:

CMD : SET, MON
CH : Channel (0..4); CH = 4 “group commands”
PAR : VSET, ISET, ON ...
VAL : value

Response string has the format : #CMD:***,VAL:xxx.xx<CR,LF>

Where:
CMD : OK, ERR
VAL : value
In case of MON commands related to all channels, the returned value are separated by ';'

Monitor commands

$CMD:MON,CH:XX,PAR:VSET	VSET value
$CMD:MON,CH:XX,PAR:VSRES	Resolution of VSET in Volt
$CMD:MON,CH:XX,PAR:VSDEC	Decimal digits of VSET
$CMD:MON,CH:XX,PAR:VMAX	Max value of VSET
$CMD:MON,CH:XX,PAR:VMIN	Min value of VSET
$CMD:MON,CH:XX,PAR:VMON	VMON value
$CMD:MON,CH:XX,PAR:VMRES	VMON resolution

$CMD:MON,CH:XX,PAR:VMDEC	Decimal digits of VMON		
$CMD:MON,CH:XX,PAR:ISET	ISET value		
$CMD:MON,CH:XX,PAR:ISRES	Resolution of ISET in µA		
$CMD:MON,CH:XX,PAR:IMAXH	Max value of ISET in high range		
$CMD:MON,CH:XX,PAR:IMAXL	Max value of ISET in low range		
$CMD:MON,CH:XX,PAR:IMIN	Min value of ISET		
$CMD:MON,CH:XX,PAR:ISDEC	Decimal digits of ISET		
$CMD:MON,CH:XX,PAR:IMON	IMON value		
$CMD:MON,CH:XX,PAR:IMRANGE	IMON range (high /low)		
$CMD:MON,CH:XX,PAR:IMRESL	IMON resolution in low range		
$CMD:MON,CH:XX,PAR:IMRESH	IMON resolution in high range		
$CMD:MON,CH:XX,PAR:IMDECL	Decimal digits of IMON in low range		
$CMD:MON,CH:XX,PAR:IMDECH	Decimal digits of IMON in high range		
$CMD:MON,CH:XX,PAR:MAXV	VMAX value		
$CMD:MON,CH:XX,PAR:MVMIN	VMAX minimum value		
$CMD:MON,CH:XX,PAR:MVMAX	VMAX maximum value		
$CMD:MON,CH:XX,PAR:MVRES	VMAX resolution		
$CMD:MON,CH:XX,PAR:MVDEC	Decimal digits of VMAX		
$CMD:MON,CH:XX,PAR:PDWN	Power down mode Ramp / Kill		
$CMD:MON,CH:XX,PAR:POL	Polarity		
$CMD:MON,CH:XX,PAR:STAT	Status		
	IS_ON	1	Channel On
	IS_UP	2	Channel Ramping Up
	IS_DOWN	4	Channel Ramping Down
	IS_OVC	8	Channel in Overcurrent
	IS_OVV	0x10	Channel in OverVoltage
	IS_UNV	0x20	Channel in UnderVoltage
	IS_MAXV	0x40	Channel in MaxV
	IS_TRIP	0x80	Channel in Trip
	IS_MAXPW	0x100	Channel in MaxPower
	IS_TWARN	0x200	Channel in Temperature warning (>80°C)
	IS_OVT	0x400	Channel in OVT (>125°C)
	IS_KILL	0x800	Channel Killed
	IS_INTLCK	0x1000	Channel in Interlock
N.B.: when channel is in OVC, MAXPW, OVT, then it is switched off according to Power Down setting (Kill or Ramp); when in Interlock, it is switched off at the fastest available rate			
$CMD:MON,CH:XX,PAR:RUP	RAMP UP value		
$CMD:MON,CH:XX,PAR:RUPMIN	RAMP UP minimum value		
$CMD:MON,CH:XX,PAR:RUPMAX	RAMP UP maximum value		
$CMD:MON,CH:XX,PAR:RUPRES	RAMP UP resolution		
$CMD:MON,CH:XX,PAR:RUPDEC	Decimal digits of RAMP UP		
$CMD:MON,CH:XX,PAR:RDW	RAMP DOWN value		
$CMD:MON,CH:XX,PAR:RDWMIN	RAMP DOWN minimum value		
$CMD:MON,CH:XXPAR:RDWMAX	RAMP DOWN maximum value		
$CMD:MON,CH:XX,PAR:RDWRES	RAMP DOWN resolution		
$CMD:MON,CH:XX,PAR:RDWDEC	Decimal digits of RAMP DOWN		
$CMD:MON,CH:XXPAR:TRIP	Trip value		
$CMD:MON,CH:XX,PAR:TRIPMIN	Trip minimum value		
$CMD:MON,CH:XX,PAR:TRIPMAX	Trip maximum value		
$CMD:MON,CH:XX,PAR:TRIPRES	Trip resolution		
$CMD:MON,CH:XX,PAR:TRIPDEC	Decimal digits of Trip		
$CMD:MON,CH:XX,PAR:ZCDTC	Status of ZC Detect; ON = offset current is getting stored; OFF = ready to store offset current		
$CMD:MON,CH:XX,PAR:ZCADJ	Status of ZC Adjust (EN/DIS)		

Set Commands

$CMD:SET,CH:XX,PAR:VSET,VAL:XXX.XX	VSET value
$CMD:SET,CH:XX,PAR:ISET,VAL:XXXX.XX	ISET value
$CMD:SET,CH:XX,PAR:IMRANGE,VAL:LOW	IMON range low
$CMD:SET,CH:XX,PAR:IMRANGE,VAL:HIGH	IMON range high

$CMD:SET,CH:XX,PAR:RUP,VAL:XXX	RAMP UP value
$CMD:SET,CH:XX,PAR:RDW,VAL:XXX	RAMP DOWN value
$CMD:SET,CH:XX,PAR:TRIP,VAL:XXX.X	Set TRIP time value
$CMD:SET,CH:XX,PAR:PDWN,VAL:RAMP	POWER DOWN ramp mode
$CMD:SET,CH:XX,PAR:PDWN,VAL:KILL	POWER DOWN kill mode
$CMD:SET,CH:XX,PAR:ON	Set Ch ON
$CMD:SET,CH:XX,PAR:OFF	Set Ch OFF
$CMD:SET,CH:XX,PAR:ZCDTC,VAL:ON	If ON, it stores the present IMon value (IMonZero) into memory for “zero current compensation” purposes (see description below); if OFF, the unit is ready to store IMon as IMonZero. After IMonZero is stored, the parameter returns to OFF
$CMD:SET,CH:XX,PAR:ZCDTC,VAL:ON	If ON, it stores the present IMon value (IMonZero) into memory for “zero current compensation” purposes (see description below); if OFF, the unit is ready to store IMon as IMonZero. After IMonZero is stored, the parameter returns to OFF
$CMD:SET,CH:XX,PAR:ZCADJ,VAL:EN	The stored IMonZero value via ZCDetect option is subtracted from the measured, “non compensated” IMON value. The returned “compensated” IMON value will be then the difference between measured and stored values;
$CMD:SET,CH:XX,PAR:ZCADJ,VAL:DIS	The returned IMON value is not compensated

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