NGPS

High-Stability and High-Precision New Generation Power Supply Series

CAENels
Gear For Science

OCEM
POWER ELECTRONICS

User's Manual

MAGNET POWER SUPPLY SYSTEMS

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CAEN ELS s.r.l.
via Vetraia, 11
55049 Viareggio (LU) – Italy
Mail: info@caenels.com
Web: www.caenels.com

Energy Technology s.r.l.
via della Solidarieta', 2/1
40056 Valsamoggia (BO) – Italy
Mail: power@ocem.com
Web: www.ocem.eu

User Manual – Models – Options – Custom Models

This manual covers the following standard NGPS Power Supplies models:

- **NGPS 100-100E**
- **NGPS 120-50E**
- **NGPS 140-50E**
- **NGPS 150-60E**
- **NGPS 200-50E**
- **NGPS 400-30E**
- **NGPS 200-40E**
- **NGPS 200-30E**
- **NGPS 200-60E**
- **NGPS 300-25E**
- **NGPS 300-30E**
- **NGPS 150-70E**
- **NGPS-CAX 100-100E**
- **NGPS-CAX 200-40E**
- **NGPS-CAX 200-50E**
- **NGPS-CVF 30-300E**

And it is also applicable to the basic functions of the following custom NGPS Power Supplies models:

- **NGPS 600-15EH ****
- **NGPS 1100-5EH ****
- **NGPS 400-30EH ****
- **NGPS 160-60EH ****
- **NGPS 200-25EH ****
- **NGPS 160-30EH ****
- **NGPS-CQD 1100-5EH ****
- **NGPS-CQD 600-10EH ****
- **NGPS-CQD 600-15EH ****
- **NGPS-CQD 600-5EH ****
- **NGPS-CMD 150-70E ****
- **NGPS-CMD 200-50E ****
- **NGPS-CMD 300-30E ****

****: These models are not fully compatible with "Remote Control Manual" from CAEN ELS S.r.l., are not compatible with other Firmwares other than the factory one, and support for these models must be required at: support.pe@ocem.eu**

In general, this manual also covers the basic functions of Custom Model named as following:

NGPS Cxx-xxx-yyyZK

Where:

- Cxx is an optional code only present in custom bespoke models
- xxx is a number between 30 and 1100
- yy is a number between 5 e 300
- Z can be "E" or "A" or "U"
- K can be "H" or blank

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Document Revisions

Document Revision	Date	Comment
0.1	February 7th 2016	Draft Release
0.2	February 22nd 2016	Pre Release Version
0.3	March 15th 2016	Visual PS information added and corrected
0.4	May 27th 2016	Added Safety Information and Installation Chapter 2. Removed parts from Introduction and Chapter 1
1.0	September 1st 2016	Official Release
1.01	February 1st 2017	Layout change
1.02	September 20th 2017	Chapter 2 reorganization
1.1	November 15th 2017	Added Auto shut down feature on Display
1.2	November 18th 2018	Added 100-100 model
1.3	February 25th 2019	Added 250-30, 150-60 and 300-30 models. Added parallel operation
1.4	May 2nd 2019	Parameters table updated, typographical errors fixed, added NGPS-CAX yyy-zzzK custom models info
1.5	June 18th 2019	Waveform execution minimum period updated information
1.6	October 23rd 2019	Added new standard and custom models and related information

Safety information

The following table shows the general environmental requirements for a correct operation of instruments referred in this User's Manual:

Environmental Conditions	Requirements
Environment	Indoor use
Operating Temperature	0°C to 40°C
Operating Humidity	20% to 80% RH (non-condensing)
Altitude	Up to 2000 m
Pollution degree	2
Overvoltage Category	II
Storage Temperature	-10°C to 60°C
Storage Humidity	5% to 90% RH (non-condensing)

The following symbols are used within this manual or are reported in the box and along this manual:

-  **CAUTION Risk of Electrical Shock**
-  Caution: Documentation must be consulted in all cases where this symbol is marked
-  Indicates ground terminal
-  Protective Ground Conductor Terminal
- **O** Off (Power)
- **I** On (Power)

- **WARNING** The WARNING sign denotes a hazard. An attention to a procedure is called. Not following the procedure correctly could result in personal injury. A WARNING sign should not be skipped and all indicated conditions must be fully understood and met.

- **CAUTION** The CAUTION sign denotes a hazard. An attention to a procedure is called. Not following procedure correctly could result in damage to the equipment. Do not proceed beyond a CAUTION sign until all indicated conditions are fully understood and met.

CAEN ELS s.r.l. and Energy Technology s.r.l. will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

Please read carefully the manual before operating any part of the instrument

WARNING

Do NOT open the BOX TOP COVER

CAEN ELS s.r.l. and Energy Technology s.r.l. decline all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly this User's Manual before any kind of operation.

CAEN ELS s.r.l. and Energy Technology s.r.l. reserve the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

Disposal of the Product

The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.

WARNING

- Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in this manual.
- Do not use the device if it is damaged. Before you use the device, inspect the instrument for possible cracks or breaks before each use.
- Do not operate the device around explosives gas, vapor or dust.
- Always use the device with the cables provided.
- Turn off the device before establishing any connection.
- Do not operate the device with the cover removed or loosened.
- Do not install substitute parts or perform any unauthorized modification to the product.
- Return the product to the manufacturer for service and repair to ensure that safety features are maintained
- Installation shall be made by Qualified Personnel according to the Electrical Codes and Standards
- Operation of the NGPS units shall be carried out by professional skilled personnel

1. Introduction

This chapter describes the general characteristics and main features of the NGPS – New Generation Power Supply series.

1.1 NGPS Overview

High performances, high efficiency, high stability, easiness of configuration and maintenance are the key features of the NGPS power supply series, generated by the joint effort of CAEN ELS and OCEM – Power Electronics.

The NGPS is an independent current- or voltage-controlled digital monopolar power supply module. There are available different models with different current and voltage ranges. Standard models are air-cooled units enclosed in 19-inch 3U crates.

Custom models are enclosed in 19-inch crates with different unit height size depending upon space requirements of internal electronics.
Among custom models several options are available such as:

- Auxiliary 230 Vac power supply separated from main power supply: **NGPS-CAX** models
- Coordination with Quench Detector and Heater optional crates for superconductive magnet applications: **NGPS-CQD** models
- Voltage generator: **NGPS-CVF** models
- Custom data communication protocol: **NGPS-CMD** models

Moreover, water cooled model names ends with letter "**H**".

Table 1a reports standard air-cooled units in 3U size, while Table 1b reports the list of custom models available.

Although this manual refers to standard models, it can also be applied to custom models for what regards the basic functionalities.
Dedicated manual addendum for custom models are available.

Model Name	Current (A)	Voltage (V)	Max. Power (W)
NGPS 100-100E	100	100	10
NGPS 120-50E	120	50	6
NGPS 140-50E	140	50	7
NGPS 150-70E	150	70	10.5
NGPS 200-50E	200	50	10
NGPS 200-40E	200	40	8
NGPS 200-30E	200	30	6
NGPS 200-60E	200	60	12
NGPS 300-25E	300	25	7.5
NGPS 300-30E	300	30	9
NGPS 400-30E	400	30	12
NGPS-CAX 100-100E	100	100	10
NGPS-CAX 200-40E	200	40	8
NGPS-CAX 200-50E	200	50	10
NGPS-CVF 30-300E	30	300	9

Table 1a: Standard NGPS models

Model Name	Current (A)	Voltage (V)	Max. Power (W)
NGPS 160-30EH	160	30	4.8
NGPS 160-60EH	160	60	9.6
NGPS 200-25EH	200	25	5
NGPS 400-30EH	400	30	12
NGPS 600-15EH	600	15	9
NGPS-CQD 600-5EH	600	5	3
NGPS-CQD 600-10EH	600	10	6
NGPS-CQD 600-15EH	600	15	9
NGPS-CQD 1100-5EH	1100	5	5.5
NGPS-CMD 150-70E	150	70	10.5
NGPS-CMD 200-50E	200	50	10
NGPS-CMD 300-30E	300	30	9

Table 1b: Customized NGPS models

The NGPS units are available in three different values of nominal three-phase input voltage:

Version	Three-Phase Input
"A"	208 V (AC)
"E"	400 V (AC)
"U"	480 V (AC)

Table 2: NGPS versions

The NGPS module is composed of a single 19-inch standard crate. The power unit implements a completely digital control loop with a Pulse Width Modulation (PWM) generation technique that allows adapting the system to any load condition.

The control board houses a dedicated FPGA with integrated dual-core ARM CPU. The loop regulation task is performed directly by the FPGA logic, in order to have high performance and deterministic loop control. On the ARM CPU it is installed an embedded Linux OS, that supervises all process as communication, diagnostics and local interface handling.

Remote communication is guaranteed by means of an Ethernet 10/100/1000 autosensing socket present on the front panel of the power unit. The power supply can be also monitored and controlled via a navigation switch and a graphic high-resolution color display featuring user-friendly menus.

In addition to the standard Ethernet interface it is possible to communicate with the unit using the SFP-ports on the front panel. This interface allows to communicate with the unit using a proprietary packet structure with a very high update rate (more than 10 kHz). These ports are connected directly to the FPGA logic and so the given packet is elaborated directly by the hardware logic.

This approach eliminates the software stratification that manages the packet and the computational time is smaller and deterministic, allowing a very high update rate of the setpoint, giving the user more flexibility and excellent rates for the digital control of the power supply.

1.2 NGPS at a glance

The standard NGPS system is composed by a single 19-inch 3U crate. The NGPS unit and its I/O connections can be easily seen in **Figure 1** (front view) and **Figure 2** (rear view).

Figure 1: NGPS front view

On the front side of the NGPS unit are placed: a circuit breaker, a colour graphic display with navigation switch for the local control of the module, three communication sockets (2 SFPs and one Ethernet ports), four status LEDs and one USB device connector.

Figure 2: NGPS rear view

On the rear side of the unit are placed: three-phase input connector, earth connection terminal, output terminals, the D-Sub 15 Female Pin I/O connector and a connector for the voltage remote sensing.

Custom models may mount additional I/O connectors; these cases are covered in section 1.11.

1.3 Modes of Operation

The NGPS system has multiple features and multiple configurations that allow using the unit for a very widespread topology of applications.

A brief summary of the basic configurations that the unit is able to handle are hereafter presented.

1.3.1 Regulation Mode

The NGPS can be used as current-controlled or voltage-controlled bipolar units. The regulation types are:

- **C.C.** mode: it is the Constant Current regulation mode. The power supply regulates the output current set by the user;
- **C.V.** mode: it is the Constant Voltage regulation mode. The power supply regulates the output voltage set by the user.

In C.V. mode it is possible to use the *remote sensing* terminals that allow regulating the output voltage directly on the load thus compensating the voltage drops on the output cables. The maximum voltage drop that the power supply is able to compensate is of 1V.

1.3.2 Control Mode

The NGPS unit can be controlled in three main different ways, hereafter listed:

- **LOCAL** control: the unit can be controlled directly via the front panel color display and the navigation switch. When the unit is set in LOCAL mode it is possible to perform readings and monitor from the remote interface but any setting command is denied;
- **REMOTE** control: the unit is controlled via the TCP-IP Ethernet interface. The setting and control of the unit can be performed exclusively via this interface while monitoring is still possible from the local display;

1.3.3 Update Mode

The current or voltage setting of the unit can also be performed in four different modes:

- **NORMAL**: the update of the set-point (current or voltage, depending on the operation mode) is performed as soon as a new set-point is received via the remote, local or fast interfaces;

- **WAVEFORM**: the update of the set-point is performed on a specific timing (defined as a "waveform" attribute, more information on the *Waveform* section) and it is done internally;

- **TRIGGER**: the set-point is updated by an external event – i.e. a hardware trigger coming from the rear BNC connector. Please note that this mode of operation is obtainable only on the units that have the external trigger input connector installed (ordering option – factory configurable);

- **ANALOG INPUT**: the unit is controlled by an external signal that is fed to the rear BNC connector. The unit acts as a C.C. or C.V. generator depending on the pre-set Regulation Mode. This option is only available in units that have been factory configured (ordering option).

Please note that the last two Update Modes of operation are available only in models that have been factory configured at the time of purchase to have the Trigger Input and/or the Analog Control Input features.

1.4 Interlock and status Signals

The NGPS module has four configurable dry-contact input interlocks and two output status signals that are directly available on the D-Sub 15 Pin Female connector on the rear panel (**Figure 3**).

A mating connector, a standard D-Sub 15 Pin Male type, can be installed in order to use/access these available signals.

Figure 3: I/O Connector

The pin index of the D-Sub 15 rear connector is summarized in the following table:

Pin Number	Signal name
#1	Interlock #1 return
#2	Interlock #2 return
#3	Interlock #3 return
#4	Interlock #4 return
#5	**DO NOT CONNECT**
#6	**DO NOT CONNECT**
#7	Solid State Relay- Terminal #2
#8	Solid State Relay- Terminal #1
#9	Interlock #1 input
#10	Interlock #2 input
#11	Interlock #3 input
#12	Interlock #4 input
#13	Magnetic Relay Common Contact (C-TAP)
#14	Magnetic Relay Normally Closed Contact (NC-TAP)
#15	Magnetic Relay Normally Open Contact (NO-TAP)

Table 3: D-sub 15 Pin pin-out

WARNING

Magnetic Relay Contact (C-TAP, NO-TAP & NC-TAP) and Solid State Relay Terminals (Terminal #1 & #2) shall not float more than ±60VDC above/below chassis ground.
Interlocks input and return pins shall not float more than ±60VDC above/below chassis ground.

CAUTION

Voltage between relay C-TAP and NC-TAP or NO-TAP pins shall never exceed ± 48 V.
Maximum current rating for the Magnetic Relay is 1 A; current trough pins #13 and #14 or pins #13 and #15 shall never exceed 1 A.
Maximum current rating for the Solid State Relay is 400 mA; current trough pins #7 and #8 shall never exceed 0.4 A.
Do not apply voltage between any input interlock and its corresponding return.

The interlock pins are galvanically isolated from ground and outputs terminal, nevertheless the absolute maximum voltage, referred to ground, that pins can sustain is 48V. The two interlocks inputs have their own return connection. The interlock is hardware-activated when the input pin and its corresponding return pin are shorted.

The system is provided with four external interlock inputs that can be easily configured using the VISUAL PS graphic software (provided with the power unit) or directly using the standard power supply commands. A detailed description of the configuration of the external interlock using the power supply commands is hereafter described.

Two output status signals provide the output status of the power module: when the module is ON, the Normally Closed contact (NC-TAP) switch opens and vice-versa. The Solid-state relay close the terminals when the module is ON.

The status of pins #7 and #8 in Table 3 is decided by cell #74 stored value:

Cell #74 = -1 : The status of the Solid State relay is related to the power supply output status (Short Circuited when Module is ON and Open when module is OFF)

Cell #74 = 0/1: The status of the Solid State Relay is **not** related to the power supply output status and its value can be set using the remote command. In particular:

- when cell #74 is 0: pins #7 and #8 are open circuited at the power supply start up;
- when cell #74 is 1: pins #7 and #8 are close circuited at the power supply start up;

1.4.1 Interlock Enable/Disable Mask

The NGPS series external interlock can be enabled or disabled by writing to the corresponding Interlock Enable/Disable Mask field of the advanced configuration parameters (field #90), using the MWG command. The value to be written is in ASCII format, representing the corresponding bit mask, as shown in the following table:

Bit #4 (INT #4)	Bit #3 (INT #3)	Bit #2 (INT #2)	Bit #1 (INT #1)
Enabled (1) Disabled (0)	Enabled (1) Disabled (0)	Enabled (1) Disabled (0)	Enabled (1) Disabled (0)

Table 4: Enable/Disable Mask Parameter

Example: if only interlock #2 and interlock #3 need to be enabled, it is necessary to write 0x6 (it is ASCII representation to the bit mask 0110) to the field #90. The following command has to be se sent to the power supply (after having un-locked the password protection): "MWG:90:0x6\r".

1.4.2 Interlock Activation Level Mask

Each external interlock can be chosen to trip at high or low logic level. The high level means that the interlock trips when the interlock input signal is shorted, otherwise the low level that the interlock trips when the input is open. To configure the interlock state mask it is necessary to write on the advanced configuration parameters (field #91). The value to be written is an ASCII format representing the corresponding bit mask, as shown in the following table:

Bit #4 (INT #4)	Bit #3 (INT #3)	Bit #2 (INT #2)	Bit #1 (INT #1)
High (1) **Low (0)**	**High (1)** **Low (0)**	**High (1)** **Low (0)**	**High (1)** **Low (0)**

Table 5: Activation Level Mask Parameter

***Example*:** if interlock #1 and interlock #4 need to have a high activation level (trip when the interlock input signal is shorted), it is necessary to write 0x9 (it is ASCII representation to the bit mask 1001) to the field #91. The following command has to be se sent to the power unit: "MWG:91:0x9\r". This setting has no effect if the interlock is not enabled.

1.4.3 Interlock Intervention Time

The module allows to set also the interlock intervention time (how long an interlock signal needs to be at its activation level before tripping and thus generating a

fault condition). The Intervention time parameters are stored in the field #92 for Interlock #1, in field #94 for interlock #2, in field #96 for interlock #3 and in field #98 for interlock #4. The value to be set is in ASCII format, representing the intervention time in milliseconds. The minimum settable value is 0 (immediate generating of fault condition) and the maximum value is 10.000 ms (corresponding to 10 seconds).

***Example*:** if interlock #1 needs to have an interlock intervention time of 750 ms, the following command has to be se sent to the power unit: "MWG:92:750\r". This setting has no effect if the interlock is disabled.

1.4.4 Interlock Identification Name

The NGPS also allows associating a name to the interlocks in order to read form the remote interface or to display on the local display the interlock condition name. The Intervention names are stored in the field #93 for Interlock #1, in field #95 for interlock #2, field #97 for interlock #3 in field #99 for interlock #4. The value to be set is in ASCII format, representing the interlock name.

***Example*:** if the interlock #1 is associated to the cabinet door open, the following command can to be se sent to the power unit: "MWG:93:Cabinet door\r". This setting has not effect if the interlock is disabled.

1.4.5 Output Status

The magnetic relay provides the output status of the power module: when the module is ON, the Normally Closed contact (NC-TAP) switch opens and vice-versa. The solid state relay has the same behaviour (closed, when the module is ON). The absolute maximum current that can be sunk by the relays are shown in the following table:

Relay	Pins	Max Current	Max Voltage
Magnetic	# 13-14-15	1 A	48 V
Solid state	# 7-8	400 mA	48 V

Table 6: Ratings of relays

1.5 Remote Sensing

WARNING

There is a potential shock hazard at the sense point when using power supply with rated output voltage greater than 60 V. Moreover, even at output voltages lower than 60 V the energy hazard is always present due to the high current capability of the unit. Ensure that the connections at the load end are protected to prevent accidental contact with hazardous voltages or accidental short circuit (e.g. with tools, screwdriver, etc.) of the output lines.

CAUTION

A short from **VSENS+** or **VOUT+** to **VSENS–** or **VOUT–** will cause damage to the power supply. Reverse the sense wire might cause damage to the power supply in local and remote sensing. Do not connect **+S** to **–** or **–S** to **+.**

The NGPS mounts a voltage-sensing connector on the rear panel that allows using the voltage sensing feature especially when using the power supply in C.V. mode. Connector is shown in **Figure 4**.

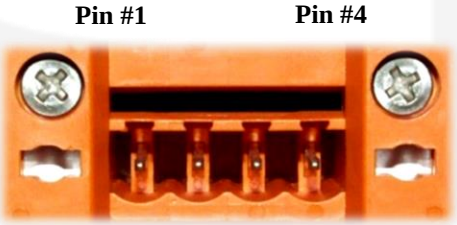


Figure 4: Remote Sensing Connector

The NGPS is provided as **factory-default** with a mating connector already shorting the pins 1-2 and 3-4 in order to have direct sensing at the output terminals.

Figure 5: Factory mating connector

The two remote sensing terminals are present on the corresponding connector on the rear panel:

Description	Pin	Name
V_{SENSE} +	#1	+S
V_{OUT} +	#2	+
V_{OUT} –	#3	–
V_{SENSE} –	#4	–S

Table 7: Remote sensing pinout

By using these two "sensing" pins it is possible to sense the output voltage directly on the load, thus recovering possible voltage drops on the output cables up to 1V.

It is strongly suggested to use twisted cables when using the *remote sensing* feature in order to minimize possible noise pick-up.

The NGPS is shipped with a mating connector for the remote sensing that short-circuits the +S and + pins and the –S and – pins respectively. This configuration performs the remote sensing directly at the output connector of the power unit. Leaving +S and –S pins disconnected will make the power supply sense the output voltage directly at the output terminal connections. When using the remote sensing feature leave pins #2 (+) and #3 (–) disconnected.

Follow the instructions below to configure the power supply for remote sensing:

1. Ensure that Mains switch is on Off position "O"
2. Remove factory jumpers between **+S** to **+** and **–S** to **–.**
3. Using a twisted pair or shielded cable (suggested wire size is 0.3 or 0.5 mm^2) connect the **+S** terminal to the positive output terminal and the **–S** to the negative output terminal as illustrated in **Figure 6**.
4. **For NGPS with output voltage rating > 60 V** Fix the Safety cover to the rear panel using the four M3x8 mm screw.

In order to perform remote sensing at different points – e.g. the load terminals – it would be necessary to connect Pin #1 and Pin #4 as in **Figure 6**:

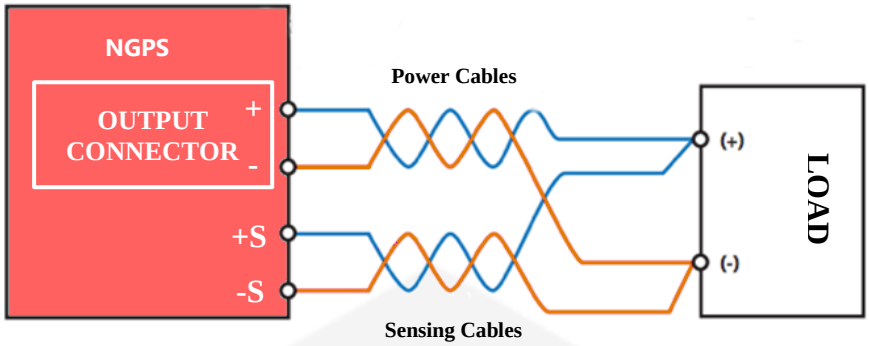


Figure 6: Example of Remote Sensing

1.6 Trigger and Analog Control inputs

On the rear side of the NGPS there are two BNC input connectors, as shown in **Figure 7**, which can be used as trigger and analog control inputs.

Figure 7: Trigger and Analog input connectors

1.6.1 Trigger input

The trigger input accepts TTL (5V) and LVTTL (3.3V) compatible signals and should be driven by a low-impedance source or generator.

The logic levels are subject to a hysteresis that allows for this recognized values that guarantee correct operation of the trigger as listed in **Table 8**:

Logic Level	Value
Low-to-HIGH	> 2.2 V
High-to-LOW	< 0.7 V

Table 8: Trigger Logic Levels

CAUTION

The absolute maximum rating for the Trigger Input signal is of **5.5 V** (a higher voltage level applied to this input can seriously damage the device).

A visual representation of the voltage levels for the trigger operation is presented in the following **Figure 8**:

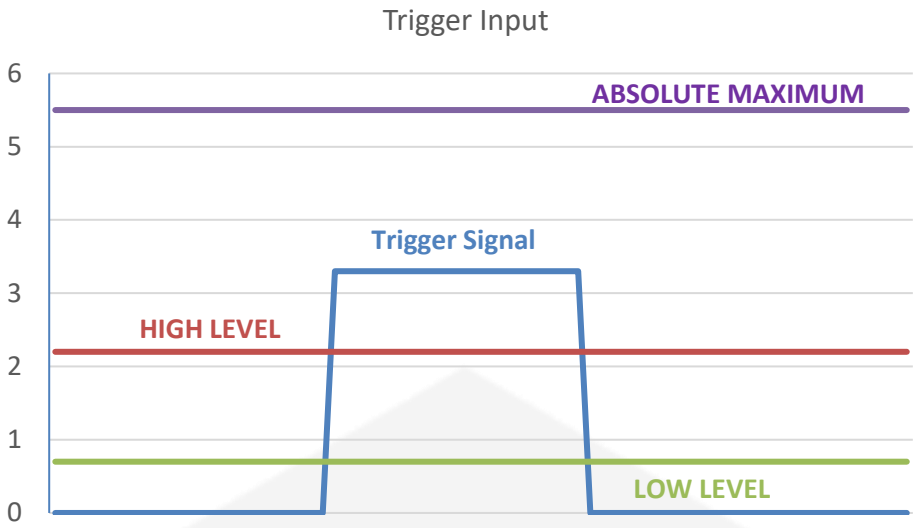


Figure 8: Trigger Thresholds

1.6.2 Analog Control input

The analog control input allows controlling the NGPS unit as an "amplifier". This input is labelled as "AN CTRL".

This input accepts signals ranging from 0V to +10V and generates an output which is proportional to the input signal, zero output for a 0V input and Full-Scale output for a +10V input. An example of the relation between the analog input signal and the output (can be either current or voltage, depending on the Regulation mode) is shown in **Figure 9**.

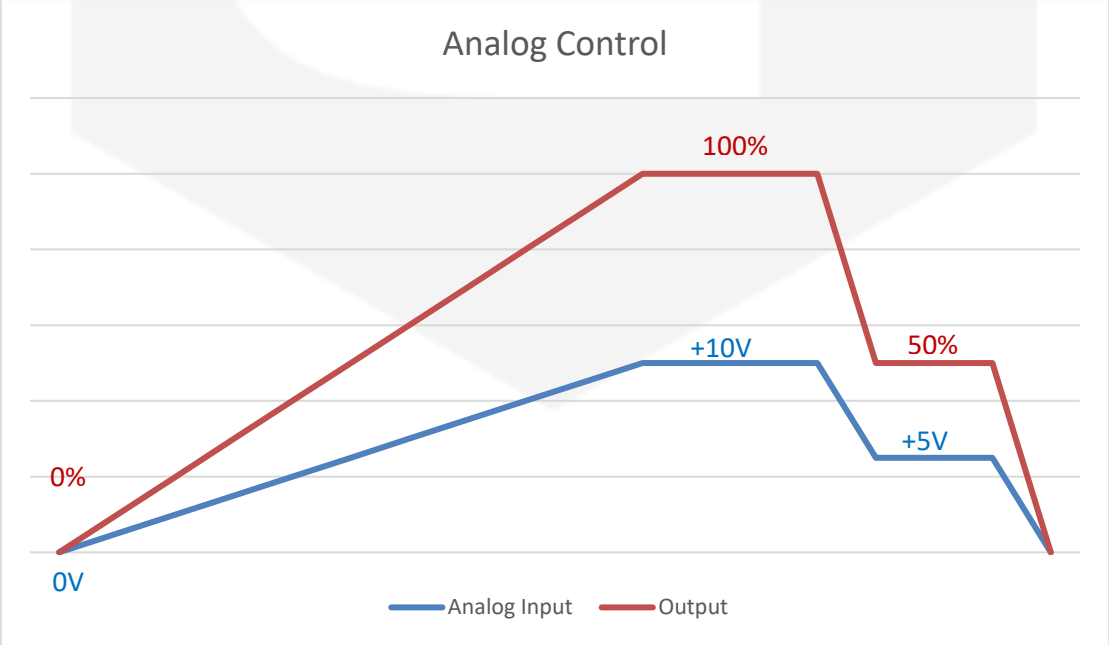


Figure 9: AN CTRL vs OUTPUT dependence

1.7 Front Panel Indicators

The NGPS has four (4) front panel LED indicators as shown in the following **Figure 10**.

Figure 10: front panel indicators

The front panel indicators and their behaviour are hereafter listed (clockwise starting from top-left):

- **C.C.**: Constant Current mode (**blue**). If turned on, the NGPS is working in constant-current mode. When off, it is regulating the ouput voltage;
- **STAT** (**green**): signals the correct operation of the module diagnostics. The blinking signaling the correct operation has a 1-second period;
- **OUT ON** (**blue**): it signals if the output is enabled or not. The blue LED is on if the output is enabled and it is regualting output current or voltage;
- **ALARM** (**red**): if turned on signals that the power unit has experienced a fault condition. It is necessary to perform a "reset fault" command in order to turn off this LED and to turn to module output again (only if the fault condition/cause has been removed).

1.8 Internal Protections

The NGPS is equipped with several internal protections that allow configuring the unit for optimal operation. These protections have the dual use of protecting the unit and the connected load/device from unwanted damages or undesired operation conditions.

A brief description of the NGPS internal protections is hereafter presented with some more basic considerations on their operation and use.

1.8.1 Earth Leakage Current

This protection continuously monitors the current flowing to earth and it has a settable threshold [A] that can be set by experienced users. The tripping of this protection generates a fault condition that shuts the power supply output off.

1.8.2 Earth Fuse

An earth fuse is present on the rear side of each NGPS and it is rated at 5A, 500 V (F5AH500VAC). The blowing of this fuse generates a fault condition of the power unit and the fuse needs to be replaced in order to get rid of the fault condition before resetting the NGPS internal status register. The fuse housing is shown in **Figure 11**.

Figure 11: earth fuse housing

CAUTION

In case of replacement use always a fuse with the same characteristics:
Fast Acting Fuse (33.2 A^2s)
Size 6.3 x 32 mm 5 A, 500 V
Breaking capacity 1500 A @ 400 VDC
(Example Schurter F5AH500VAC, code 8020.5075.G or equivalent)

1.8.3 Regulation Fault

This fault is generated when the power supply is not able to correctly regulate the output current or output voltage (in CC and CV mode respectively).

Different thresholds for the differential current, differential voltage and the intervention time can be set by experienced users.

A typical example of a regulation fault is represented by a 1Ω load on a NGPS 200-50 for example where the maximum power supply output voltage is 50V. By setting a current of 100A to the load, the output voltage should reach a value of 100V which obviously is not feasible: once the power unit supplies 50A to the load it already reaches the maximum output voltage condition. The power unit recognizes this difference between the set-point – i.e. 100A – and the actual output current, thus generating a "regulation fault" condition.

The tripping of this fault implies an automatic turning off of the NGPS unit. A status reset – i.e. reset faults – needs to be performed in order to turn the unit back on.

1.8.4 OVerPower - OVP

The NGPS can work continuously at a 1% over its power rating as expressed in the specifications.

The module is able to work at a power comprised between 1% and 5% over its rating – i.e. between 101% and 105% – for a 20-second period before turning off on an over-power fault.

If the actual output power drawn from the power supply is more than 5% above its nominal ratings the power unit will shut down after 1 second.

This behaviour is summarized in the following **Table 9** (an example of a NGPS 200-50 unit is also listed):

Output Power	Time of Operation
< 101% of P_N *e.g. NGPS 200-50: < 10.1 kW*	**Continuous**
> 101% and < 105% of P_N *e.g. NGPS 200-50: > 10.1 kW and < 10.5 kW*	**20 s**
≥ 105% of P_N *e.g. NGPS 200-50: ≥ 10.5 kW*	**1 s**

Table 9: NGPS Output Power

where P_N is the rated nominal output power of the power supply unit, as indicated in the technical specifications.

1.8.5 OVerTemperature - OVT

Internal monitoring of temperature is performed in different places inside the NGPS power supply. If a pre-defined threshold is exceeded by any of these internal sensors, an OVT condition is generated, thus shutting off the power unit.

The threshold value [°C] can be set by experienced users. A reset fault operation needs to be executed on the status register of the NGPS before turning the output off again.

1.8.6 DC-Link Undervoltage

The NGPS is composed internally by a power AC-DC section cascaded with a DC-DC stage. The voltage generated by the AC-DC section is also called DC-Link and it is proportional to the maximum rated voltage for the specific model.

A continuous monitoring of the DC-Link voltage is performed in order to always guarantee the capability of obtaining the maximum voltage from the power supply. If the DC-Link drops below a certain threshold, the power supply unit could not be able to regulate correctly or some faulty conditions have arisen so that a fault conditions is generated.

It is necessary to reset the status register and to get rid of the fault cause before turning the power supply back on again.

1.9 Waveform

The NGPS is able to act as a waveform generator both in current and in voltage regulation modes.

The waveform is stored internally in a point-by-point manner and it gives a lot of flexibility since the maximum number of points of the waveform can be defined as well as the sampling period (of the waveform execution).

The minimum time interval for the waveform execution period is rated at 0.1 ms = 100 µs, giving an equivalent output waveform update rate of 10 kHz.

In order to correctly execute the output waveform it is necessary to "tune" the PID regulator parameters of the power supply to the specific load (and have an adequate load at the output).

More information on the waveform feature can be found in the corresponding command section.

1.10 Status Register

The following table shows the NGPS internal status register structure:

Bit #	Bit name	Description
#31	**OVP**	Over Power condition
#30	**DCCT FAULT**	DCCT Not working properly
#29	**Ext. Interlock #4**	External interlock 4 has tripped
#28	**Ext. Interlock #3**	External interlock 3 has tripped
#27	**Ext. Interlock #2**	External interlock 2 has tripped
#26	**Ext. Interlock #1**	External interlock 1 has tripped
#25	/	*reserved*
#24	**Regulation Fault**	Modules has experienced a regulation fault
#23	**Earth Fuse**	Earth fuse is blown
#22	**Earth Leakage**	Earth current leakage fault
#21	**DC-Link Undervoltage**	DC-Link voltage below threshold
#20	**OVT**	Over Temperature condition
#19	/	*reserved*
#18	/	*reserved*
#17	**OVC**	Over Current
#16	/	*reserved*
#15	/	*reserved*
#14	/	*reserved*
#13	**Waveform**	Waveform is in execution
#12	**Ramping**	Module is ramping current or voltage
#11	/	*reserved*
#10	/	*reserved*
#9	/	*reserved*
#8	/	*reserved*
#7 - #6	**Update mode [2 bits]**	Normal [00], Waveform [01], Triggered FIFO [10], Analog input [11]
#5	**Regulation mode**	C.C. [0] or C.V. [1] output regulation mode
#4	/	*reserved*
#3 - #2	**Control Mode [2 bits]**	Indicates the mode of operation of the unit (Remote [00], Local [01])
#1	**Fault condition**	This bit is set if the module has experienced a fault condition
#0	**ON/OFF**	This bit is set when the module is enabled and correctly regulating the output

Table 10: Status Register structure

1.11 Custom Models

This section covers peculiars features provided in specific models only;

1.11.1 NGPS-AUX yyy-zzzK

NGPS-AUX models are common custom models provided with an additional single-phase input connector on the rear side:

Figure 12: NGPS-AUX additional single-phase input

The auxiliary 230 VAC, 1-phase input connector is a plug filter with switch and fuse-box, provided with two interchangeable fuses 5x20 rated at 2A.

For the NGPS-AUX models, the single-phase input is required to feed the control part of the power supply, while the power part is fed via the 3-phase input.

2. Installation

This chapter contains instructions for initial inspection, preparation for use

2.1 Preparation for use

In order to be operational, the power supply must be connected to an appropriate AC source. The AC source voltage should be within the power supply specification. Do not apply power before reading this chapter. **Table 11** below, describes the basic setup procedure. Follow the instructions in the sequence given to prepare the power supply for use.

Step	Checklist	Description
1	**Initial inspection**	Physical inspection of power supply
2	**Mounting**	Installing the power supply, ensuring proper ventilation
3	**AC Input Power Connection**	Connect the power supply to the AC source
5	**Load connection**	Wire size selection, Remote Sensing
4	**First switch-on**	Switch-on checkout procedure

Table 11: Installation checklist

2.2 Initial inspection

Prior to shipment this power supply was inspected and found free of mechanical or electrical defects. Upon unpacking of the power supply, inspect for any damage which may have occurred in transit.

The inspection should confirm that there is no exterior damage to the power supply such as broken switch or connectors and that the all panel and display are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, compile the RMA form available to the CAEN ELS web site.

2.3 Mounting

The NGPS is a rack-mount device since the unit form factor is designed to be installed in a standard 19-inch cabinet.

CAUTION

The unit(s) shall be installed assuring that the main circuit breaker present on the front panel can be always easily operated by user personnel.

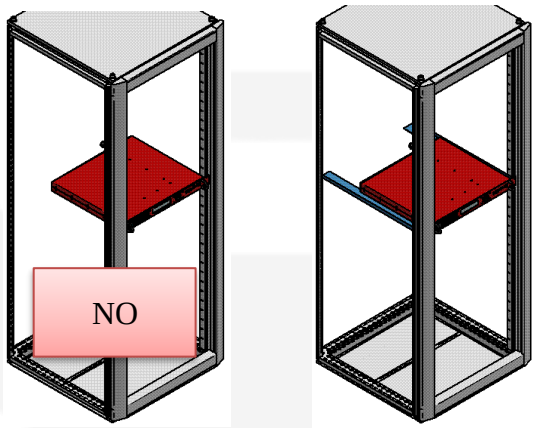
CAUTION

This power supply is fan cooled, the air intake is at the front panel and the exhaust is at the rear panel. Upon installation allow cooling air to reach the front panel ventilation inlets. Allow minimum 10 cm of unrestricted air space at the front and the read of the unit.

The NGPS power supply series is designed to fit in a standard 19" equipment rack.

CAUTION

Use a support bar to provide adequate support for the power supply.



WARNING

The front panel of the NGPS is rated IK08 (5J) against external mechanical impacts. The place of installation must be chosen so that impacts with heavy equipment or tools are unlikely

2.4 AC Input Power Connection

CAUTION

Connection of this power supply to an AC power source should be made by an electrician or other qualified personnel. Do not exceed the torque specified on input stud terminals.

WARNING

There is a potential shock hazard if the power supply chassis (with cover in place) is not connected to an electrical safety ground via the safety ground in the AC input stud terminals.

The three-phase input connector on the rear panel is a Phoenix Contact 1777749 (PC 5/4-ST1) connector. The three-phase ground has to be connected on the bottom terminal, as shown in **Figure 13**. The phases can be connected to any of the three upper phase terminals (the connection order of the phases is not defined).

Tightening torque shall be between 0.5 to 0.8 Nm.

WARNING

Perform all these operation with the cables and the power supply disconnected from the AC mains.

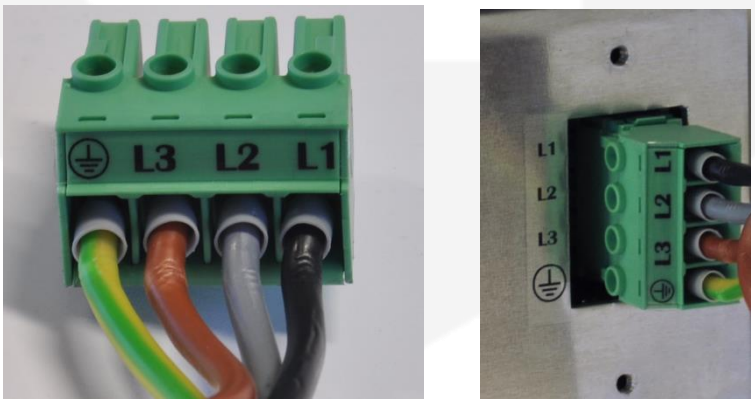


Figure 13: Three-phase input connector

Recommended Cable Size for Input Connection are listed in

Input voltage	Current RMS per phase	Recommended copper wire size
208 V	34 A	6 mm^2
400 V	18 A	4 mm^2
480 V	16 A	4 mm^2

Table 12: AC Cable size

The AC input current and voltage rating is marked on the rear terminal of the power supply.

WARNING

The Protective Earth Ground ⏚ must be connected before applying AC Line Power to the power supply. There is a potential shock hazard if the power supply chassis is not connected to an electrical safety ground via the safety ground in the AC input connector!

WARNING

Sizing of the Protective Earth Ground cable and check of the Protective Earth impedance coordination with electrical distribution system protections shall be carried out by the Qualified Installer according to the standards (e.g. IEC 60364-1, IEC 60364-5-54 CEI 64-8 in Italy, etc.)

After connecting the input connector to the crate mating connection, it is necessary to mount the metal protective cover by first screwing the four M4 threaded screw (top and bottom of the cover **Figure 14**) and then by rotating the cable fastener.

Figure 14: Protective cover mounting

Figure 15: AC Mains cable fastener

For safety reasons, the mains supply voltage ratings should not exceed the indicated voltage range.

2.4.1 AC Source requirement

The NGPS power supplies are designed for 208 V AC, 400 V AC or 480 V AC input range depending on the model; frequency ranging from 47 Hz to 63 Hz. Installation Category shall be **CAT II** so maximum impulse voltage on the network mains must be below 2500 V.

WARNING

The NGPS power supply is designed to be connected to TN-C or TN-S electrical distribution systems but without connection of the Neutral (pure three-phase system). NGPS is not suitable to be used on IT electrical systems.
AC power supply lines shall be referred to Neutral and Earth and must not float.

2.5 Load connection

WARNING

Turn off the AC input power before making or changing any rear panel connection. Ensure that all connections are securely tightened before applying power. There is a potential shock hazard when using a power supply with a rated output greater than 60 V

2.5.1 Wire selection

Two factors must be considered for the selection of the wires:

- Current carrying capacity -> Cross section area
- Maximum wire length.
- Insulation voltage

Wire cross section and length

Wire size should be selected to enable voltage drop per lead to be less than 1 V at the maximum power supply current to prevent excessive output power consumption. Suggested wire sizes are listed in the following table:

Wire Cross Section Area [mm²]	Resistivity [Ω/km] @ 20°C	Maximum Cable length in meters to limit voltage drop to be less than 2 V (1 V per lead)		
		120 A	200 A	300 A
35	0.524	16	-	-
50	0.387	21	-	-
70	0.268	31	18,5	-
95	0.193	43	25,5	17
120	0.153	54	32,5	21,6
150	0.124	66	40,1	26,7

Table 13: Wire selection

For higher lengths and/or higher currents it is advisable to use more than one cable in parallel for each polarity. In those cases, a detailed design of the lines shall be prepared by a Qualified Installer according to standards (e.g. IEC 60364-5-52).

Voltage ratings of the cable shall be rated for the maximum output voltage of the NGPS power supply.

If values of Table 13 are used the maximum voltage to the load will be limited to:

NGPS nominal output voltage + Maximum compensation Voltage if Remote sensing is used – Cable Drop Voltage

Maximum compensation Voltage for all models is 1 V

Lug Terminal connection

Cable lug terminal shall be for M8 screws.

CAUTION

Screws provided with the NGPS should be used for screw the cable lug. Maximum length of the screws is 20 mm. Longer screws may damage the power supply.
Tightening torque shall be between 4 to 5 Nm.
Always use spring washer and plane washer for a reliable connection.

The load needs to be connected to the output terminals placed on the rear panel of the unit as shown in **Figure 16**. This type of terminals offers a convenient and reliable form of connection. These screw connections accept standard **M8** connections and the terminals are already threaded.

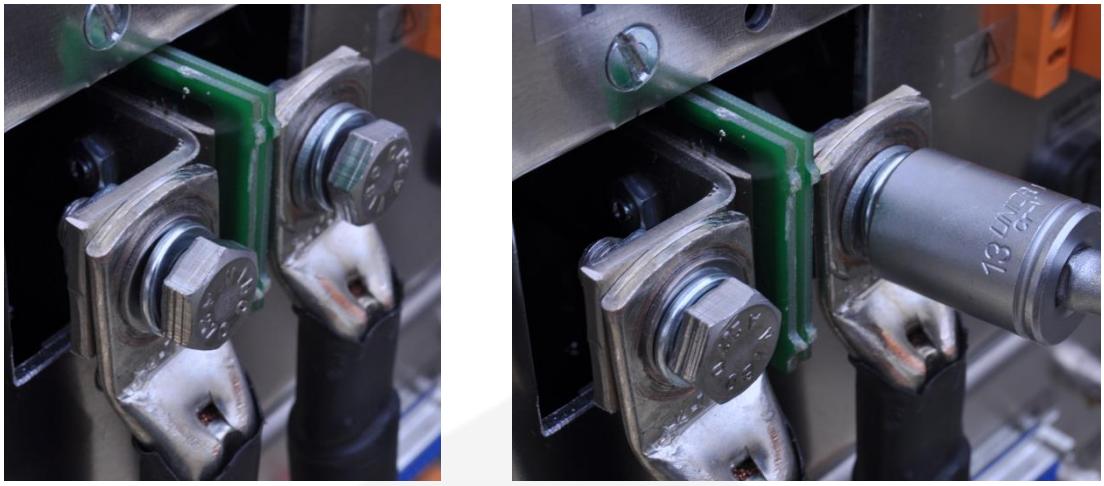


Figure 16: Output terminal connections (insert screw and secure it)

The symbols "+" and "-" on the rear panel indicate the positive and negative polarity of the terminal respectively.

After securing both output connections it is necessary to mount the metallic protective cover since the power supply has the capability of delivering a high current on these outputs and/or hazardous voltage for NGPS with output voltage ratings > 60 V.

Figure 17: Output terminal connections (insert screw and secure it)

2.6 Grounding Outputs

By factory default configuration the NGPS minus terminal is grounded to the Protective Ground (i.e. chassis, Mains-Earth terminal and all metallic parts composing the box) through a fuse. This fuse called Earth Fuse (E.F.) is accessible form the back panel. With this configuration the Output Terminals are not floating and cannot be connected to Protective Ground.

If accidentally one of the output terminals is conducting to the Protective Ground a fault will be triggered switching the power supply Off. Refer to Earth Fuse Fault and Earth Leakage Fault.

To allow floating operation of the output it is sufficient to remove the Earth Fuse from the fuse-holder and set the Power supply for Floating operation (refer to section 4.7.1).
When the FAST-PS is configured to operate in floating mode either the positive or negative output terminals can be grounded. Always use two wires to connect the load to the power supply regardless of how the system is grounded.

WARNING

Models up to 60VDC Rated Output shall not float outputs more than ±60VDC above/below chassis ground. Models > 60VDC Rated Output shall not float outputs more than ±500VDC above/below chassis ground.

2.7 Parallel Operation

NGPS modules can be run in parallel operation, thus increasing the output current of the paralleled solution while maintaining the same voltage of each building block.

When run in a parallel infrastructure, the following points have to be respected:

- The parallel system is made of modules that have the same current full scale and the same voltage full scale, i.e. the modules are exactly the same;
- Up to 4 NGPS module can be run in parallel;

The user could build e.g. a system 400A 50V out of two NGPS 200A 50V, a system 600A 50V out of three NGPS 200A 50V, a system 800A 50V out of four NGPS 200A 50V.

In order to run a paralleled system, the hardware has to be connected at first, after that one module has to be configured as Master and the others as Slaves.

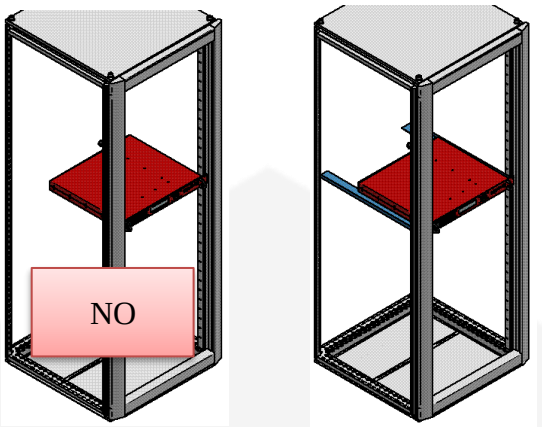
Below each step is described.

HARDWARE CONNECTION

1. Each NGPS has to be properly mounted on a 19'' rack (do not connect AC main at this point):

CAUTION

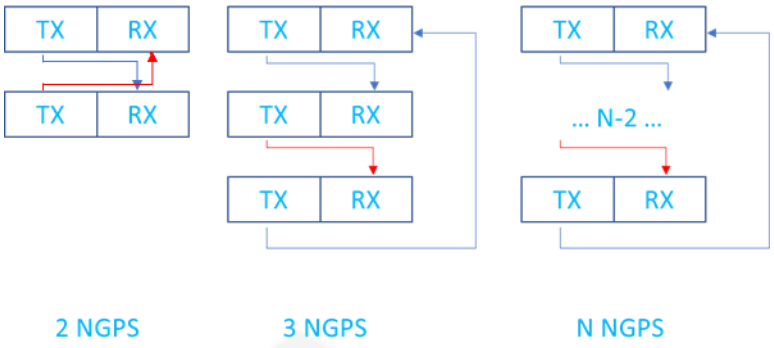
Use a support bar to provide adequate support for the power supply.

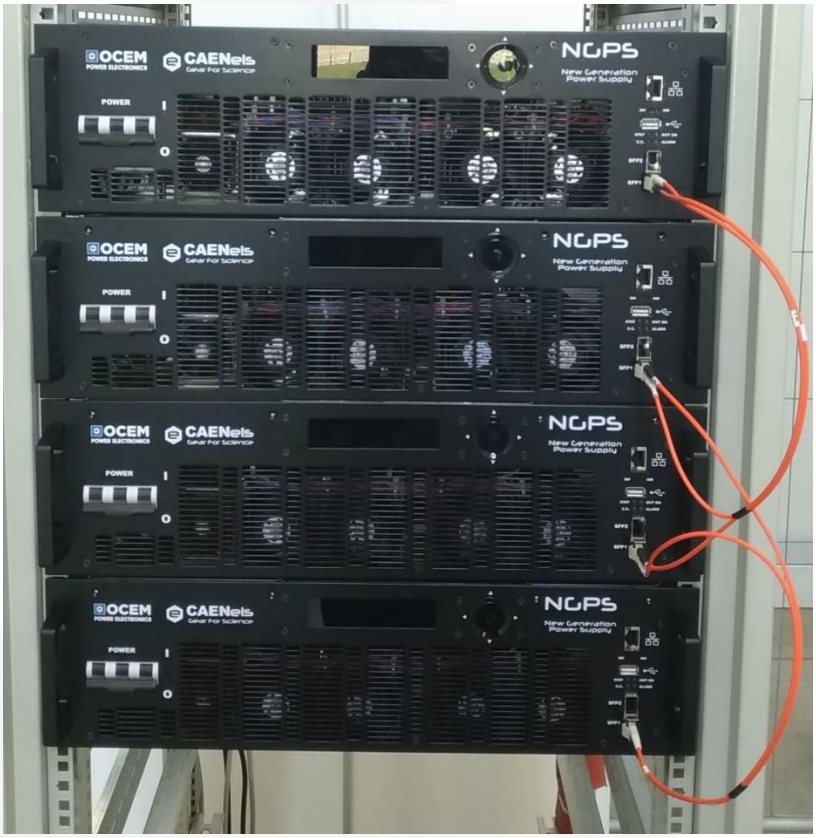


Connect the output terminals in parallel, i.e. positive with positive and negative with negative. Below an example of a 2 NGPS and a 4 NGPS system:

In order to parallel the output terminals, bar connections (as in the pictures above) have to be preferred over cable connections.

3. Connect the modules SFP transceivers in daisy-chain mode:





SFP plug-ins and optical cables already prepared in order to respect the daisy-chain will be shipped together with the modules to be paralleled. Being a daisy-chain, the user can connect the optical cables plugs to SFP plugins in any order.
Use the SFP1 connection on each module.

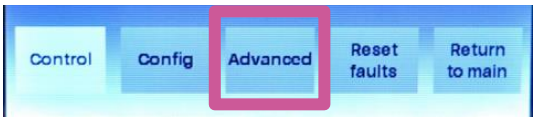
4. Remove the earth fuse from each NGPS except one. The only module with the earth fuse will then be selected as the Master.

5. Connect each module to the AC main.

6. Turn on the switch of each module (main switch on "I"). Do not set the output ON at this stage.

MASTER SLAVE(S) CONFIGURATION

1. Per each NGPS use the local control mode and select "Advanced":



2. In the "Advanced" window, select "Parallel";
3. The NGPS with the earth fuse has to be selected as "Master" and the OFF/ON selection on "ON":

After that, press "Return".

4. The other NGPSs have to be selected as "Slave" and the OFF/ON selection on "ON":

After that, press "Return".

5. Perform a power cycle on both modules (main switch OFF, main switch ON);
6. The system is now ready to be used as if it was a single module. Control the MASTER only (so for remote control connect an Ethernet cable from PC to MASTER only).

3. Local Control

This chapter describes the local control functionalities that are provided by the NGPS power supply and some useful information on how to use it.

The power supply can work either in LOCAL mode or in REMOTE mode. Please note that only readbacks are allowed from the remote communication interfaces when the unit is in LOCAL mode (i.e. settings are inhibited).

The control mode (LOCAL / REMOTE) can be set on the configuration page of the local menu.

3.1 Navigation Switch

Each NGPS power supply module is equipped with a Navigation Switch on the front panel of the unit as shown in the following **Figure 18**:

Figure 18: Navigation switch

There are multiple actions that can be performed via this front navigation switch:

- Left, Right, Up, Down arrow pushbuttons;
- Internal encoder rotation (CW and CCW);
- Central pushbutton (it will also be referred to as "Enter").

3.2 Display

The colour display on the NGPS power supply unit allows users to visualize information about the power supply status and to control the unit in order to use it locally. Screens and pages of the display can be navigated from the navigation switch though user friendly menus and sub-menus.

By default, the display will be automatically turned off after 30 minutes from the last local command or from the turning on of the power supply.

The user can disable this feature or change the turning off time. In order to do so, cell 35 of the power supply memory has to be changed.

Cell 35 contains the turning off time in minutes. To disable the automatic shutdown, please set "0" on cell 35.

3.2.1 *Power-up*

The NGPS, upon power-up or power-cycling, will display an empty screen until the unit embedded OS is initialized.

Please note that this procedure will take approximately 25-seconds before the *Home Screen* is displayed.

3.2.2 Home Screen

The NGPS home screen is the first loaded page upon power-up or power-cycling of the module, it is shown in **Figure 19**, and contains information on:

- the NGPS model;
- the module IP address;
- output current readback value [A] with the light blue status bar;
- output voltage readback value [V] with the green status bar;
- the status of the output – i.e. ON or OFF or Fault (OFF indication, without fault condition, means that the power converter is Ready);
- the status of the control – i.e. Local or Remote;
- the module Identification Name;
- the regulation mode of the unit – i.e. constant-current or constant-voltage.

Figure 19: *Home Screen*

The Home screen presents some indications on the right side as:

- **ON – OFF**: shows if the power supply output is enabled or not;
- **REM – LOC – FCI**: shows if the module is in Local, Remote or Fast Control Interface control mode;
- **C.C. – C.V.**: shows if the module is working in C.C. or in C.V. regulation mode.

An example of the indications on the right side of the Home screen is hereafter shown in **Figure 20**:

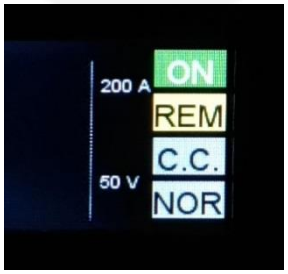


Figure 20: *Home Screen* indicators

By pushing the Up arrow pushbutton of the Navigation Switch, the Home Screen turns from showing the output current and voltage measurement to showing the current and voltage Set Points. The sign "SET POINT" substitutes the module identification name. Pressing again the Up arrow pushbutton, the Home Screen turns back to its default appearance.

If the module has experienced one or more faults – e.g. interlock intervention, over-temperature, etc. – the home page screen would display a list the faults, turning also the module OFF.

The power supply latches on every fault recognized by the internal logic so that every type of fault is recorded: this means that the first fault happening does not ban the other ones to be recorded so that, giving users more information, permits a better investigation of the fault cause.

3.2.3 Menu Page

The Menu page is reachable by performing any action on the navigation switch when in the *Home Screen*.

The Menu Page gives access to all the local features of the NGPS power supply unit. There are five different options that can be selected as shown in **Figure 21**:

Figure 21: *Menu Page*

The accessible sub-pages and/or actions from this page are hereafter listed (note that the selected sub-menu is lightened in a lighter shade):

- **Control** – *sub-page*;
- **Config** – *sub-page*;
- **Advanced** – *sub-page*;
- **Reset faults** - *action*;
- **Return to main** - *action*.

The access to each sub-menu (or action) is necessary to highlight the selected rectangle by using the encoder or the arrows of the navigation switch and press the "Enter" button.

The **Reset faults** rectangle, once pressed, resets the status register of the power supply and sends back to the visualization of the *Home Screen*.

The **Return to main** rectangle, once pressed, sends back the visualization to the *Home Screen*.

3.2.3.1 *Control Page*

The *Control Page* is reachable by selecting the corresponding rectangle from the *Menu Page*.

The *Control Page* gives access to the main settings of the NGPS power supply unit. An example of a *Control Page* visualization is shown in **Figure 22**:

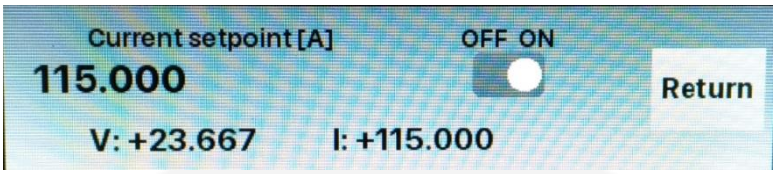


Figure 22: *Control Page*

From this screen it is possible to turn the power supply unit ON and OFF and to set the output current or voltage (depending on the regulation type, C.C. or C.V.).

Actual values of output current and output voltage (readbacks) can also be seen at the bottom line of this page.

3.2.3.2 *Config Page*

The *Config Page* is reachable by selecting the corresponding rectangle from the *Menu Page*.

This page allows the user to set the control mode of the power supply – e.g. LOCAL or REMOTE – to select the regulation mode (C.C. or C.V.) and to set the ethernet (NORM) or analog (AIN) control.

An example of a *Config Page* visualization is shown in **Figure 23**:

Figure 23: *Config Page*

The firmware installed version is shown at the bottom of this page (FW Version).

3.2.3.3 *Advanced Page*

The *Advanced Page* is reachable by selecting the corresponding rectangle from the *Menu Page*.

This page allows selecting further sub-pages:

Figure 24: *Advanced Page*

- **Network Page**

This page allows to locally set the power supply Ethernet IP address, the Network Mask and the Gateway.

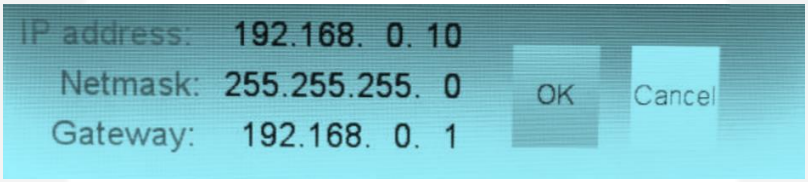


Figure 25: *Network Page*

It is very important to notice that once the "OK" button has been clicked, the user can remotely communicate and get control of the power supply again only by opening a new TCP socket to the IP that has just been set.

- **PS Params Page**

This page allows to locally set the to set the current (or voltage) ramp slew rate.

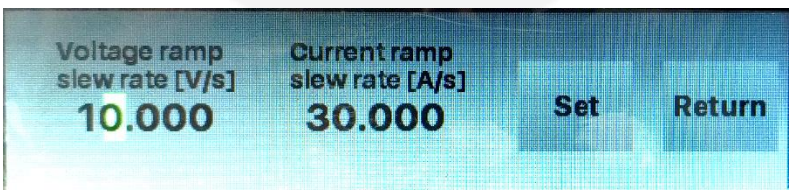


Figure 26: *PS Params Page*

- **SetPoint**

SetPoint: shows output current and voltage setpoint on the Home screen;

- >
  allows to select further sub-pages

Figure 27: *Advanced Page – second selection page*

- **System info**

Shows internal temperatures and CPU usage.

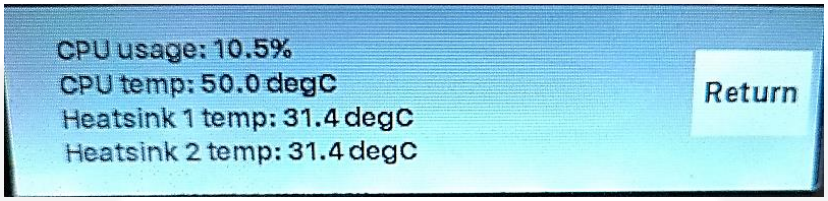


Figure 28: *System info Page*

REMARK:

- "Heatsink 1 temp" is the maximum temperature between the IGBT module heatsink temperature and the output rectifier module heatsink temperature
- "Heatsink 2 temp" refers to the temperature of the HF transformers

- **SFP info –** Not Applicable for the NGPS

- **Parallel**

Allows to configure the NGPS for parallel operation. See section 2.7.

4. Software Commands

This chapter describes the base TCP/IP software commands used for the control and configuration of the NGPS power module.

4.1 Ethernet Interface

The device is shipped with default IP address, subnet mask, and gateway and TCP-IP communication port:

Parameter	Factory Value
IP address	192.168.0.10
Subnet mask	255.255.255.0
Gateway	192.168.0.1
TCP/IP port	10001

Table 14: Default Ethernet Settings

4.2 Command Syntax

The command syntax used by the NGPS protocol is described in the following sections.

Commands must be sent in ASCII format and are composed by a *"command field"* and one, two or none *"parameter field"*, separated by a colon (*":"* or *"0x3A"* in hexadecimal notation). The number of *"parameter fields"* depends on the specific command. Commands are **NOT case sensitive** and therefore the command string can be sent either using uppercase or lowercase characters (conversion to uppercase characters is performed internally). Each command must be terminated with the termination sequence. The NGPS supports two termination sequences:

- "*carriage return\line feed*" sequence "***\r\n***" ("*0x0D 0x0A*" in hexadecimal notation or commonly CRLF).

Command Example:

MWI:20.5580\r\n

- ***"MWI"*** is the command field;
- ***":"*** is the parameter's separation character;
- ***"20.5580"*** is the first parameter field;
- ***"\r\n"*** is the termination sequences of the command.

Commands are processed one at a time; therefore **user must wait for a response from the unit before sending the next command**.

All the responses from the NGPS module are in upper case and are terminated with the same *"carriage return\line feed"* sequence ("**\r\n**"), *"0x0D 0x0A"* in hexadecimal notation or commonly CRLF.

MWI:10.5875\r\n →

← **#AK\r\n**

4.3 Command Replies

The reply from the module depends on the given command. In general the command can be grouped in two categories: Write commands and Read commands.

For **write commands** there are two specific replies that indicate that the command has been correctly elaborated or not. Those replies are hereafter presented:

- **Ac**Knowledge ("***#AK***") indicates that the command is valid and it was correctly elaborated by the device:

#AK\r\n

- ***"#AK"*** is the **Ac**Knowledged response to a valid command;
- ***"\r\n"*** is the termination sequence of the reply.

- **N**ot **Ac**Knowledge ("***#NAK***") indicates that the command is either not valid or that it was not accepted by the device; the *"NAK"* reply is followed by an *"error code"* field, which can be used to determine the cause of the error (see the List of the Error Codes appendix for a detailed list of all possible error codes):

#NAK:01\r\n

- ***"#NAK"*** is the **N**ot **A**c**K**nowledged response to an invalid command;
- ***":"*** is the parameter's separation character;
- ***"01"*** is the error code,
- ***"\r\n"*** is the termination sequence of the reply.

For **read commands**, the replies are generally formed by an echo string, followed by the corresponding read value. The echo string is preceded by the hash character ("**#**") and the echo is separated from the "**:**" separation character.

Some examples are hereafter shown:

MRI\r\n →

← **#MRI:12.8875\r\n**

or:

MWI:?\r \n →

← **#MWI:10.9850\r\n**

or:

MRG:90\r\n →

← **#MRG:90:0x2\r\n**

- the read commands are highlighted in **blue**;
- the echo string is highlighted in **green**;
- the read value is in **purple**;
- the termination char is highlighted in **red**.

For more detailed information about the single command please refer to the specific command section.

4.4 Error Table

The list of error codes returned with the ***#NAK*** reply and their description are hereafter shown:

Error Code #	Description
01	Unknown command
02	Unknown Parameter
03	Index out of range
04	Not Enough Arguments
05	Privilege Level Requirement not met
06	Saving Error on device
07	Invalid password
08	Power supply in fault
09	Power supply already ON
10	Setpoint is out of model limits
11	Setpoint is out of software limits
12	Setpoint is not a number
13	Module is OFF
14	Slew Rate out of limits
15	Device is set in local mode
16	Module is not in waveform mode
17	Module is in waveform mode
18	Device is set in remote mode
19	Module is already in the selected loop mode
20	Module is not in the selected loop mode
99	Unknown error

Table 15: NAK Error code table

4.5 Command Table

The list of commands used by the NGPS and the corresponding syntax is hereafter presented as well as a description of each command purpose and any special requirements related to the specific command. The base commands are summarized in the following table:

Command	Read/ Write	Parameter #1	Parameter #2	Detailed description	Reply value
VER	R	/	/	Return the module model and installed firmware versions	ASCII indicating the module model and firmware version
MON	W	/	/	Turn on the module	"AK" or "NAK"
MOFF	W	/	/	Turn the module OFF	"AK"
LOOP	W R	"I" or "V" "?"	/ /	Set the power module loop mode Query for the power supply loop mode	"AK" or "NAK" Loop mode ("I" or "V")
MRI	R	/	/	Read output current value	ASCII indicating the output read current
MRV	R	/	/	Read output voltage value	ASCII indicating the output read voltage
MWI	W R	I Setpoint "?"	/ /	Set the new current setpoint (ASCII) Query for the last applied current setpoint	"AK" or "NAK" ASCII indicating the current setpoint
MWV	W R	V Setpoint "?"	/ /	Set the new voltage setpoint (ASCII) Query for the last applied setpoint	"AK" or "NAK" ASCII indicating the voltage setpoint
MWIR	W R	I Setpoint "?"	/ /	Go to the given setpoint with a ramp (ASCII) Query for the last accepted final ramp setpoint	"AK" or "NAK" ASCII indicating the current setpoint
MWVR	W R	V Setpoint "?"	/ /	Go to the given setpoint with a ramp (ASCII) Query for the last accepted final ramp setpoint	"AK" or "NAK" ASCII indicating the voltage setpoint
MSRI	W R	I Ramp Slew rate "?"	/ /	Set the I ramp slew rate [A/s] (ASCII) Query for the I ramp slew-rate	"AK" or "NAK" ASCII indicating the I ramp slew-rate
MSRV	W R	I Ramp Slew rate "?"	/ /	Set the I ramp slew rate [V/s] (ASCII) Query for the I ramp slew-rate	"AK" or "NAK" ASCII indicating the I ramp slew-rate
MRT	R	/	/	Read Maximum Temperature [°C]	ASCII indicating the temperature value

Command	Read/ Write	Parameter #1	Parameter #2	Detailed description	Reply value
MRW	R	/	/	Read estimated active output power value [W]	ASCII indicating the active output power value
MGC	R	/	/	Read leakage current value [A]	ASCII indicating the Leakage voltage value
MRID	R	/	/	Read module identification	Module identification (ASCII)
MST	R	/	/	Read module internal status register	Internal status register (Hex representation)
MRESET	W	/	/	Reset the module status register	"AK" or "NAK"
PASSWORD	W R	Password word "?"	/	Set the password word (ASCII) Query for the actual user privileges	"AK" or "NAK" User privileges (ASCII representation)
MRG	R	Parameter field #		Read the given parameter field	Field content (ASCII)
MWG	W	Parameter field #	Cell content (ASCII)	Write to the given parameter field	"AK" or "NAK"
MSAVE	W	/	/	Save the used parameter in the non-volatile memory	"AK" or "NAK"
UPMODE	W	"ANALOG" or "NORMAL"	/	Set the module in analog control or normal (Ethernet control)	"AK" or "NAK"
SETFLOAT	W R	"F" or "N" ?	/	Set the module in floating output or grounded to chassis	"AK" or "NAK" F or N

Table 16: Commands overview table

4.6 Basic Commands

In the following section are described the basic commands that allow to control the NGPS unit and to monitor its status.

4.6.1 MON Command

The ***MON*** (Module ON) command is intended to turn ON the NGPS output driver, thus enabling the output current terminals and allowing the power supply to regulate and feed current or voltage to the connected load.

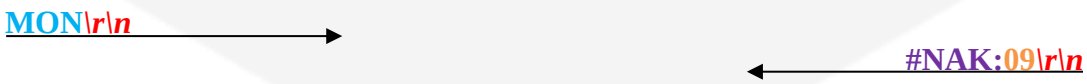
After the reception of an "MON" command, the power supply automatically sets output current to 0A or 0V (depending if the module is set in constant current or constant voltage mode).

Replies from the NGPS to a ***MON*** command are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed, with "***xx***" indicating the error code. The complete list of the error codes is shown in the Error Table. Sending an ***MON*** command when the module output is already enabled generates a non-acknowledgment response.

Examples:

MON command example:

MON command example when the module is already enabled (09 code):



4.6.2 MOFF Command

The ***MOFF*** (Module OFF) command is intended to turn OFF the NGPS output driver, thus disabling the output terminals.

The ***MOFF*** command automatically sets output current to 0A or 0V with a ramp before disabling the output drivers. This is done in order to ovoid output overshoots (especially in constant current regulation mode). The slew-rate of the ramp is factory defined.

Replies from the NGPS to a ***MON*** command are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed, with "***xx***" indicating the error code.

Examples:

MOFF command example:

MOFF\r\n →

← **#AK\r\n**

MOFF command example when the module is in local mode:

MOFF\r\n →

← **#NAK:15\r\n**

4.6.3 VER Command

The ***VER*** command returns the information regarding the NGPS model and the current installed firmware version.

The response to the ***VER*** command is in the following format:

#VER:ps_model:fw_version\r\n

where "***#VER***" is the echo string, "***ps_model***" is the NGPS model and "***fw_version***" is the current firmware version. The echo, model and firmware information are separated by "**:**"character and the string is terminated with the standard "***\r\n***" character sequence.

Example:

VER command example:

4.6.4 MST Command

The ***MST*** command returns the value of the NGPS power supply internal status. The response to the ***MST*** command is in the following format:

#MST:status_reg\r\n

where "***#MST***" is the echo string and "***status_reg***" is the hexadecimal representation of the internal status register. The internal status register has 32 bits and so its representation is composed by 8 hexadecimal values. For additional information regarding the status register, please refer to the **Status Register structure**.

The ***MST*** command, being a reading command, returns a response in any module condition.

Example:

MST command example (the status register indicates that the module is in fault):

MST\r\n →

← **#MST:00000020\r\n**

4.6.5 MRESET Command

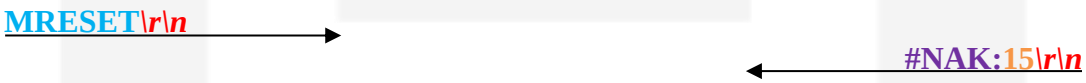
The ***MRESET*** command has to be used in order to perform a complete reset of the module status register. This is needed, for example, to enable the channel output again after a fault condition has been fixed.

Replies from the NGPS to a ***MRESET*** command are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("*xx*" is the error code). The complete list of the error codes is shown in the **Error Table**.

Examples:

MRESET command example:

MRESET command example when the module is in local mode:



4.6.6 MRI Command

The ***MRI*** command returns the readback value of the power supply actual output current.

The readback current value is represented with 6-digit precision. Replies from the power supply to this command are in the following format:

#MRI:current_value\r\n

where "***#MRI***" is the echo string, "***current_value***" is the output current value readback in Ampere [A].

Example:

MRI command example:

MRI\r\n →

← **#MRI:22.123456\r\n**

4.6.7 MRV Command

The ***MRV*** command returns the readback value of the power supply actual output voltage.

The voltage readback value is represented with 6-digit precision. Replies from the power supply to this command are in the following format:

#MRV:voltage_value\r\n

where "***#MRV***" is the echo string, "***voltage_value***" is the output voltage value readback in Volts [V].

Example:

MRV command example:

4.6.8 LOOP Command

The ***LOOP*** command can be used in order to select the mode of loop control of the NGPS unit. There are two possible modes of operation:

- Constant Current (c.c.),
- Constant Voltage (c.v.).

To set the mode of operation the following commands has to be used:

LOOP:mode\r\n

where "***mode***" is a single char indicating the mode of operation:

- "**I**" for Constant Current (c.c.) mode and
- "**V**" for Constant Voltage (c.c.) mode.

Replies from the NGPS to a ***LOOP*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code). The two modes of operation can be changed only when the module is turned OFF.

To read the current used loop mode of operation the query command: "***LOOP:?***" has to be used. The response to the "***LOOP:?***" query command is in the following format:

#LOOP:mode \r\n

where "***#LOOP***" is the echo string, "***mode***" is a single character indicating the loop mode ("***I***" for constant current mode and "***V***" for constant voltage mode).

Examples:

LOOP set example to set the constant current mode:

LOOP:I\r\n →

← **#AK\r\n**

LOOP set example when the module is ON:

LOOP:V\r\n →

← **#NAK:09\r\n**

LOOP query example when the module is in constant voltage (c.v.) mode:

LOOP:?\r\n →

← **#LOOP:V\r\n**

4.6.9 MWI Command

The ***MWI*** command can be used to set the output current value when the module is in the constant current mode (see ***LOOP*** Command). This command is usually needed when running feedback-related applications and for small changes in the output current.

The use of this command is alternative to the ***MWIR*** Command (ramping current command), which is advised for regular use.

This command has the following format:

MWI:current_setpoint\r\n

where "***current_setpoint***" is the desired current set-point expressed in Ampere [A].

Replies from the NGPS to a ***MWI*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("*xx*" is the error code).

To read last applied current setpoint the query command: "***MWI:? \r\n***" has to be used. The response to this query command is in the following format:

#MWI:current_setpoint\r\n

where "***#MWI***" is the echo string, "***current_setpoint***" is the last applied current setpoint expressed in Ampere [A].

Examples:

MWI set example, with current setpoint +1.52 A:

MWI:1.52\r\n →

← **#AK\r\n**

MWI set example when the module is OFF:

MWI:1.52\r\n →

← **#NAK:13\r\n**

MWI query example:

MWI:?\r\n →

← **#MWI:1.52\r\n**

4.6.10 MWV Command

The ***MWV*** command can be used to set the output voltage value when the constant voltage mode is used (see ***LOOP*** Command). The use of this command is alternative to the ***MWVR*** Command (ramping voltage command).

This command has the following format:

MWV:voltage_setpoint\r\n

where "***voltage_setpoint***" is the desired voltage set-point expressed in Volts [V].

Replies from the NGPS to a ***MWV*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("*xx*" is the error code).

To read last applied voltage setpoint the query command: "***MWV:? \r\n***" has to be used. The response to this query command is in the following format:

#MWV:voltage_setpoint \r\n

where "***#MWI***" is the echo string, "***voltage_setpoint***" is the last applied current setpoint expressed in Volts [V].

Examples:

MWV set example, with current setpoint +10.525 V:

MWV:10.525\r\n →

← **#AK\r\n**

MWV set example when the module is OFF:

MWV:10.525\r\n →

← **#NAK:13\r\n**

MWV query example:

MWV:?\r\n →

← **#MWV:10.525\r\n**

4.6.11 MWIR Command

The ***MWIR*** command can be used to perform a ramp to the given current setpoint. This command can be used, when the constant current mode is selected (see ***LOOP*** Command).

The use of this command is alternative to the ***MWI*** Command**.** The difference between the ***MWI*** command and the ***MWIR*** command is that the first one generates a direct change in output current characterized by the PID regulator parameters (the command is ideally suited for small output current changes and feedback purposes) while the second one makes the power supply go from the previous to the actual current value performing a ramp, defined by a slew-rate in [A/s].

The default value of the slew-rate is stored in the parameter table and it can be read and modified using the Configuration Commands.

To dynamically change the current slew-rate value it is possible using the ***MSRI*** Command. This command has the following format:

MWIR:final_ramp_setpoint\r\n

where "***final_ramp_setpoint***" is the final current value expressed in Ampere [A] to which the power unit will ramp with the defined slew-rate.

Replies from the NGPS to a ***MWIR*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("*xx*" is the error code).

To read the selected final ramp setpoint, the query command: "***MWIR:? \r\n***" has to be used. The response to this query command is in the following format:

#MWIR:final_ramp_setpoint\r\n

where "***#MWIR***" is the echo string and "***final_ramp_setpoint***" is the final ramp setpoint expressed in Ampere [A].

Examples:

MWIR set example, with final ramp setpoint +10.5 A:

MWIR:10.5\r\n →

← **#AK\r\n**

MWIR set example when the module is OFF:

MWIR:10.5\r\n →

← **#NAK:13\r\n**

MWIR query example:

MWIR:?\r\n →

← **#MWIR:10.5\r\n**

4.6.12 MSRI Command

The ***MSRI*** command can be used to dynamically change the value of the current ramp slew-rate. The default slew-rate, used at start-up of the unit, is the value stored in the parameters table.

This command has the following format:

MSRI:slew_rate\r\n

where "***slew_rate***" is slew-rate for the current ramp expressed in Ampere per second [A/s].

Replies from the NGPS to a ***MSRI*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

To read the current used slew-rate for the current ramp, the query command: "***MSRI:? \r\n***" has to be used. The response to this query command is in the following format:

#MSRI:slew_rate\r\n

where "***#MSRI***" is the echo string and "***slew_rate***" is the slew-rate value used for the current ramp expressed in Ampere per second [A/s].

Examples:

MSRI example, to set the current slew-rate to 10 A/s:

MSRI:10\r\n →

← **#AK\r\n**

MSRI set example when the NGPS is in local mode:

MSRI:10\r\n →

← **#NAK:15\r\n**

MSRI query example:

MSRI:?\r\n →

← **#MSRI:10\r\n**

4.6.13 MWVR Command

The ***MWVR*** command can be used to perform a ramp to the given voltage setpoint. This command can be used, when the constant voltage mode is selected (see ***LOOP*** Command).

The use of this command is alternative to the ***MWV*** Command**.** The difference between the ***MWV*** command and the ***MWVR*** command is that the first one generates a direct change in output voltage characterized by the PID regulator parameters while the second one makes the power supply go from the previous to the actual current value performing a ramp, defined by a slew-rate in [V/s].

The default value of the voltage slew-rate is stored in the parameter table (see the Configuration Commands).

To dynamically change the slew-rate value it is possible to use the ***MSRV*** Command.

This command has the following format:

MWVR:final_ramp_setpoint\r\n

where "***final_ramp_setpoint***" is the final voltage value expressed in Volts [V] to which the power unit will ramp with the defined slew-rate.

Replies from the NGPS to a ***MWVR*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

To read the selected final ramp setpoint, the query command: "***MWVR:? \r\n***" has to be used. The response to this query command is in the following format:

#MWVR:final_ramp_setpoint\r\n

where "***#MWVR***" is the echo string and "***final_ramp_setpoint***" is the final ramp setpoint expressed in Volts [V].

Examples:

MWVR set example, with final ramp setpoint +15.2 A:

MWVR:15.2\r\n →

← **#AK\r\n**

MWVR set example when the module is OFF:

MWVR:15.2\r\n →

← **#NAK:13\r\n**

MWVR query example:

MWVR:?\r\n →

← **#MWVR:15.2\r\n**

4.6.14 MSRV Command

The ***MSRV*** command can be used to dynamically change the value of the voltage ramp slew-rate. The default slew-rate, used at start-up of the unit, is the value stored in the parameters table.

This command has the following format:

MSRV:slew_rate\r\n

where "***slew_rate***" is slew-rate for the voltage ramp expressed in Volts per second [V/s].

Replies from the NGPS to a ***MSRV*** set are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

To read the current used slew-rate for the voltage ramp, the query command: "***MSRV:? \r\n***" has to be used. The response to this query command is in the following format:

#MSRV:slew_rate\r\n

where "***#MSRV***" is the echo string and "***slew_rate***" is the slew-rate value used for the voltage ramp expressed in Volts per second [V/s].

Examples:

MSRV example, to set the current slew-rate to 10 V/s:

MSRV:10\r\n →

← **#AK\r\n**

MSRV set example when the NGPS is in local mode:

MSRV:10\r\n →

← **#NAK:15\r\n**

MSRV query example:

MSRV:?\r\n →

← **#MSRV:10\r\n**

4.6.15 MRT Command

The ***MRT*** command returns the value of the maximum temperature between the maximum between the temperatures of the two air cooled heatsinks (shown on the local interface, in the Advanced page "System info" as Heatsink 1 temperature) and the temperature directly measured on the HF transformers (shown on the same "System info" page as Heatsink 2 temperature) .

In case of parallel operation, the command returns the maximum between all the measured temperatures of all the NGPS units parallel connected.

The response to the ***MRT*** command is in the following format:

#MRT:temperature\r\n

where "***#MRT***" is the echo string and "***temperature***" is the temperature value expressed in Celsius [°C]. The ***MRT*** command, being a reading command, returns a response in any module condition.

Example:

MRT command example:

MRT\r\n →

← **#MRT:37.4\r\n**

4.6.16 MRW Command

The ***MRW*** command returns the actual value of the estimated active power applied to the connected load.

The response to the ***MRW*** command is in the following format:

#MRW:active_power\r\n

where "***#MRW***" is the echo string and "***active_power***" is the output active power readback expressed in Watts [W], estimated as the product of the output voltage and output current readbacks. The ***MRW*** command, being a reading command, returns a response in any module condition.

Example:

MRW command example:

MRW\r\n →

← **#MRW:100.45\r\n**

4.6.17 MGC Command

The ***MGC*** command returns the readback value of the actual leakage current of the NGPS unit.

The response to the ***MGC*** command is in the following format:

#MGC:leakage_current\r\n

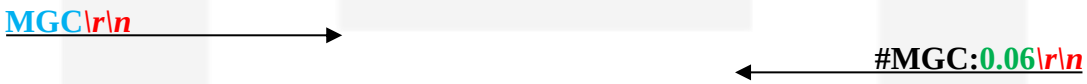
where "***#MGC***" is the echo string and "***leakage_current***" is the earth leakage current, expressed in Ampere [A].

When a leakage fault condition is tripped, the ***MGC*** command will return the value of the max leakage current that tripped the fault. To return to the normal behavior of the read command, the module status has to be reset (see ***MRESET*** Command).

The ***MGC*** command, being a reading command, returns a response in any module condition.

Example:

MGC command example for a 60mA ground leakage current:



4.6.18 MRID Command

The ***MRID*** command returns the NGPS identification name string. This description is useful in case that there are numerous units installed and it is possible to give a description for each unit (for example the name of the load on which the unit is connected). This information is also displayed on the local display.

The response to the ***MRID*** command is in the following format:

#MRID:ngps_identification\r\n

where "***#MRID***" is the echo string and "***ngps_identification***" is the module identification string. The identification string is stored in the parameters table and so it is possible to change it using the Configuration Commands.

Example:

MRID example with the module identification "SkewMag1.3":

MRID\r\n →

← **#MRID:DIPOLE1.3\r\n**

4.7 Configuration Commands

In the following section are described the software commands that allow to read, set and store the working parameters of the NGPS unit.

The ***MRG*** Command and ***MWG*** Command allow to read or modify the working parameters. The write-access to several parameters is password protected and certain parameters are read only and so it is not possible to modify them. To change the password privileges use the ***PASSWORD*** Command. In order to save the parameter on the on-board non-volatile memory, the ***MSAVE*** Command has to be used.

The complete list of the configuration parameters, their field index and the access privileges are hereafter shown:

Parameter #	Access Privileges	Parameter Name
#0	Read Only	Firmware ID
#1	Read Only	PS Model
#2	Read Only	Serial Number
#3	Read Only	MAC Ethernet
#4	Read Only	MAC SFP #1
#5	Read Only	MAC SFP #2
#6 - #8	/	Reserved
#9	Read Only	Calibration date
#10	Read Only	Current Calibration Parameter a
#11	Read Only	Current Calibration Parameter b
#12	Read Only	Current Calibration Parameter c
#13	Read Only	Current Calibration Parameter d
#14	Read Only	Voltage Calibration Parameter a
#15	Read Only	Voltage Calibration Parameter b
#16	Read Only	Voltage Calibration Parameter c
#17	Read Only	Voltage Calibration Parameter d
#18	Read Only	DC Link Calibration Parameter a
#19	Read Only	DC Link Calibration Parameter b
#20	Read Only	AC Link Calibration Parameter a
#21	Read Only	AC Link Calibration Parameter b
#22	Read Only	Current Leakage Calibration Parameter a
#23	Read Only	Current Leakage Calibration Parameter b
#24	Read Only	Analog Input Calibration Parameter a
#25	Read Only	Analog Input Calibration Parameter b
#26	Read Only	Primary Current Calibration Parameter a
#27	Read Only	Primary Current Calibration Parameter b
#28	Admin	Aux Input 2 Calibration Parameter a
#29	Admin	Aux Input 2 Calibration Parameter b
#30	User	Module Identification

Parameter #	Access Privileges	Parameter Name
#31	User	Default Current Slew Rate [A/s]
#32	User	Default Voltage Slew Rate V [V/s]
#33 - #34	/	Reserved
#33	Admin	TFT Timeout [minutes]
#33	Read Only	Feed Forward enabled
#37 - #39	/	Reserved
#40	Admin	PID I: Kp_v
#41	Admin	PID I: Ki_v
#42	Admin	PID I: Kd_v
#43	Admin	PID I: Kp_i
#44	Admin	PID I: Ki_i
#45	Admin	PID I: Kd_i
#46	Admin	PID I: Max Output Voltage
#47	Admin	PID I: Min Output Voltage
#48	Admin	PID I: Max Output Current
#49	Admin	PID I: Min Output Current
#50	Admin	PID I: Mode (-1 = single, 2 = double)
#51 - #54	/	Reserved
#55	Admin	Forced Remote Off
#56 - #59	/	Reserved
#60	Admin	PID V: Kp_i
#61	Admin	PID V: Ki_i
#62	Admin	PID V: Kd_i
#63	Admin	PID V: Kp_v
#64	Admin	PID V: Ki_v
#65	Admin	PID V: Kd_v
#66	Admin	PID V: Max Output Current
#67	Admin	PID V: Min Output Current
#68	Admin	PID V: Max Output Voltage
#69	Admin	PID V: Min Output Voltage
#70	Read Only	PID V: Mode (-1 = single, 2 = double)
#71 - #73	/	Reserved
#74	Admin	Msigpu (-1, 0, 1)
#75	Read Only	Max Transformer Temperature
#76	Read Only	Min DCCT Shunt Temperature
#77	Read Only	Max DCCT Shunt Temperature
#78 - #81	/	Reserved
#82	Admin	Max Heatsink Temperature
#83	Admin	Min DC-link Threshold
#84	Admin	Earth Leakage Limit
#85	/	Reserved

Parameter #	Access Privileges	Parameter Name
#86	Admin	Current Regulation Fault Limit [A]
#87	Admin	Voltage Regulation Fault Limit [A]
#88	Admin	Regulation Fault Intervention Time [s]
#89	Read Only	Primary Current Limit
#90	Admin	Interlock Enable Mask
#91	Admin	Interlock Activation Level
#92	Admin	Interlock #1 intervention time [ms]
#93	Admin	Interlock #1 name
#94	Admin	Interlock #2 intervention time [ms]
#95	Admin	Interlock #2 name
#96	Admin	Interlock #3 intervention time [ms]
#97	Admin	Interlock #3 name
#98	Admin	Interlock #4 intervention time [ms]
#99	Admin	Interlock #4 name
#100 - #114	/	Reserved
#115	Admin	AUX 2 min threshold
#116	Admin	AUX 2 Timer min threshold us
#117 - #122	/	Reserved
#123	Admin	SFP #1 IP Address
#124 - #128	/	Reserved
#129	Admin	Fast Address ID
#130	Read Only	Capabilities

Table 17: Parameters table

4.7.1 MRG Command

The ***MRG*** command returns the value stored in the given parameter number. The correct form for the reading request is as follow:

MRG:parameter_index\r\n

where "***parameter_index***" is the index of the parameter to be read. The response to the ***MRG*** command is in the following format:

#MRG:parameter_index:parameter_value\r\n

where "***#MRG***" is the echo string, "***parameter_index***" is the parameter's index and "***parameter_value***" is the parameter caption. The NGPS replies with "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code) – for example if the given parameter is out of the permitted range.

Examples:

MRG example of the PS-Model (parameter #1):

MRG:1\r\n →

← **#MRG:1:NGPS 100-50\r\n**

MRG example of read a not valid parameter's index (parameter # -1):

MRG:-1\r\n →

← **#NAK:03\r\n**

4.7.2 MWG Command

The ***MWG*** command lets users write a desired value in the given parameters index.

MWG:parameter_index:parameter_value\r\n

where "***parameter_index***" is the parameter's index and "***parameter_value***" is the content to be written.

Replies from the NGPS to a ***MWG*** write are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

After a ***MWG*** command the values are immediately applied, but they are not stored in the internal memory. To store the modified parameters in the non-volatile internal memory it is necessary to use the **MSAVE Command**.

Examples:

MWG example of the Module ID (parameter #30)

MWG:30:MAGNET A\r\n →

← **#AK \r\n**

MWG write example to the read-only field #1 (PS Model):

MWG:1:MAGNET A\r\n →

← **#NAK:05\r\n**

4.7.3 PASSWORD Command

The ***PASSWORD*** command can be used to unlock or lock the access to the protected parameter fields.

Several parameters are protected in order not to let inexperienced users to change some power supply parameters that might compromise the correct operation of the module. See the **Parameters table** for further details regarding the password-protected cells (parameters with *User* access privileges are not password protected; parameters with *Admin* access privileges are password protected; parameters with *Read Only* access privileges cannot be modified).

The correct format for this command is as follows:

PASSWORD:password_word\r\n

where "***password_word***" is the password to lock or unlock the protected parameter fields, that can be:

- "***PS-ADMIN***" to receive the *Admin* access privileges and unlock the protected parameter fields;
- "***LOCK***" to return to *User* access privileges and lock the protected parameters fields.

Replies from the NGPS to a ***PASSWORD*** command are in the form "***#AK\r\n***" – when the command is accepted - or "***#NAK:xx\r\n***", when the command is not accepted ("***xx***" is the error code). When a wrong password word is received, the unit replies with a "***#NAK:07\r\n***" (error code 07 – invalid password) and locks the protected parameter fields.

To read the current privileges level the following query command can be used: "***PASSWORD:?***". The response to this query command is in the following format:

#PASSWORD:privileges_level\r\n

where "***#PASSWORD***" is the echo string and "***privileges_level***" is the string indicating the privileges level.

The privileges level "***ADMIN***" indicates that the user is able to modify the protected parameter fields, otherwise "***USER***" indicates that the uses is able to modify only the not protected parameter fields.

The password to unlock password-protected cells is:

PS-ADMIN

Examples:

PASSWORD example of correct password word (unlock the protected cells):

PASSWORD:PS-ADMIN\r\n →

← **#AK \r\n**

PASSWORD example of correct password word (lock the protected cells):

PASSWORD:LOCK\r\n →

← **#AK \r\n**

PASSWORD example of wrong password word:

PASSWORD:CAENELS\r\n →

← **#NAK:07 \r\n**

PASSWORD access level query:

PASSWORD:?\r\n →

← **#PASSWORD:ADMIN\r\n**

4.7.4 MSAVE Command

The ***MSAVE*** command can be used store the parameter fields in the non-volatile internal memory. If the parameter fields are not saved, they will be lost at power-off of the power supply.

Replies from the NGPS to a ***MSAVE*** are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

Example:

MSAVE example:

MSAVE\r\n →

← **#AK \r\n**

4.7.1 UPMODE Command

The ***UPMODE*** command can be used to access the analog control of the unit or to re-put the unit in standard (Ethernet) control.

The two commands are ***UPMODE:ANALOG*** to set the unit in analog control or ***UPMODE:NORMAL*** to set the unit in Ethernet control.

Replies from the NGPS to a ***UPMODE*** are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

Example:

UPMODE example:

UPMODE:ANALOG\r\n →

← **#AK \r\n**

4.7.1 SETFLOAT Command

The ***SETFLOAT*** command can be used to set the system in floating mode.

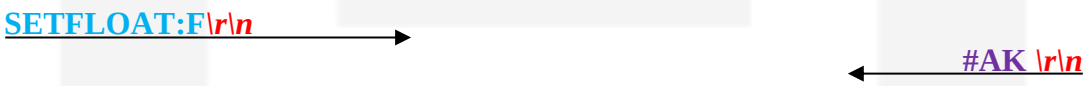
The two commands are ***SETFLOAT:F*** to set the unit in floating mode or ***SETFLOAT:N*** to set the unit as grounded. Earth fuse must be disconnected to operate the unit in floating mode. Refer to section 1.8.2

Replies from the NGPS to a ***SETFLOAT*** are in the form "***#AK\r\n***" – when the command is correctly executed - or "***#NAK:xx\r\n***", when the command cannot be executed ("***xx***" is the error code).

Replies to command ***SETFLOAT:?*** will be "***#F\r\n***" or "***#N\r\n***" respectively if the module current setting is in floating mode or standard one.

Example:

SETFLOAT example:



WARNING

When the unit operates in Floating Mode it is unable to detect earth faults of the output conductors. Thus, a first fault can remain undetected, also for long time. In this condition occurrence of a second earth fault can be dangerous for equipment and goods and can, in extreme cases, also trigger fire. Use of Floating Mode shall be reserved only for system already equipped with an external earth fault detection system.

5. NGPS Utilities

The NGPS Utilities allow a user-friendly and fast access to the functionalities and configuration of the NGPS unit.

Two different software are available for operation with the NGPS power supply: "*Device Manager"* and *"Visual PS"*. Both utilities can be downloaded from this link: http://support.caenels.com/caenels/repos/apps/ . An overview of both utilities is given in the next sections.

5.1 Device Manager

The *"Device Manager"* software can be used to detect all the NGPS devices connected to the local network and their network configuration.

The *"Device Manager"* is available for Windows and Linux platform. The system requirements are:

- Windows minimum system requirements:
  - Windows® XP or newer
  - Intel® or equivalent processor
  - 70 MB available HD space
  - Ethernet network card

- Linux minimum system requirements:
  - Linux kernel 2.2.x or newer
  - Intel® or equivalent processor
  - 70 MB available HD space
  - Ethernet network card

5.1.1 Searching for connected devices

The following steps have to be performed in order to perform a search of all the NGPS units connected to the local network:

- install the *"Device manager"* software;
- launch the software;
- perform a scan to discover the connected NGPS device(s) by clicking the *"Scan"* button as indicated in **Figure 29**. If there are multiple available connections it is possible to select the network/networks to be scanned in the *"Selected network interfaces"* window available under the "*Options*" menu. All the information about the selected devices are shown in the right side of the main window.

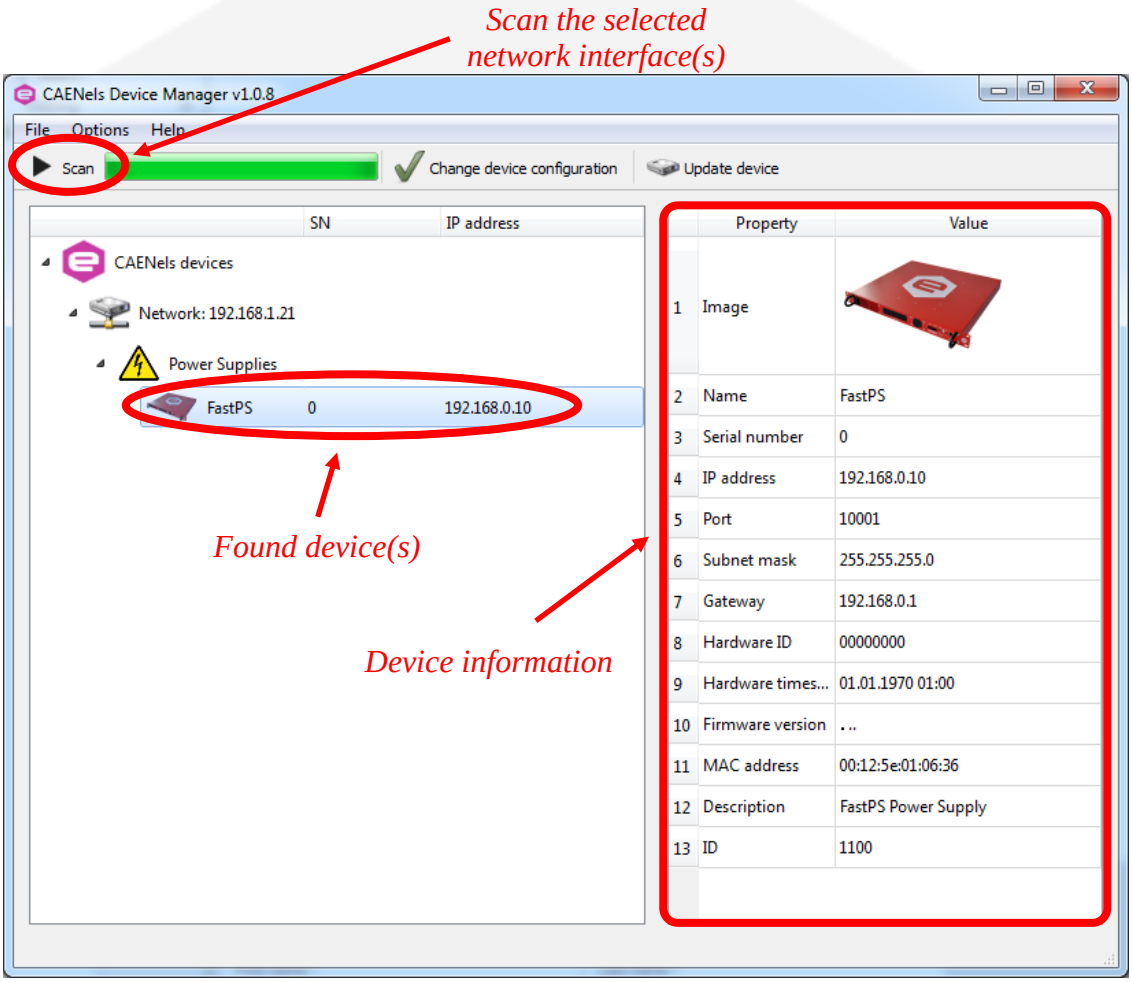


Figure 29: Device Manager - Main interface

Make sure that the firewall is not preventing communication between your computer and the NGPS unit(s). The "*Device manager"* uses **UDP port 30719** to find the device, so ensure that the UDP traffic is allowed in both directions on this port.

5.1.2 Device Configuration

The software allows also to change the Network configuration of the found device(s) in the local network.

In order to change the network configuration of the unit it is necessary to select the desired device and click on the "*Change device configuration*" button in the main window as shown in **Figure 30**. The configurable Network options are:

- Device IP address;
- TCP/IP communication port;
- Subnet mask;
- Gateway.

To apply the changes on the device configuration it is necessary to edit the corresponding fields and then to click on the "*Save*" button. A screenshot of a sample device configuration is shown in the following picture:

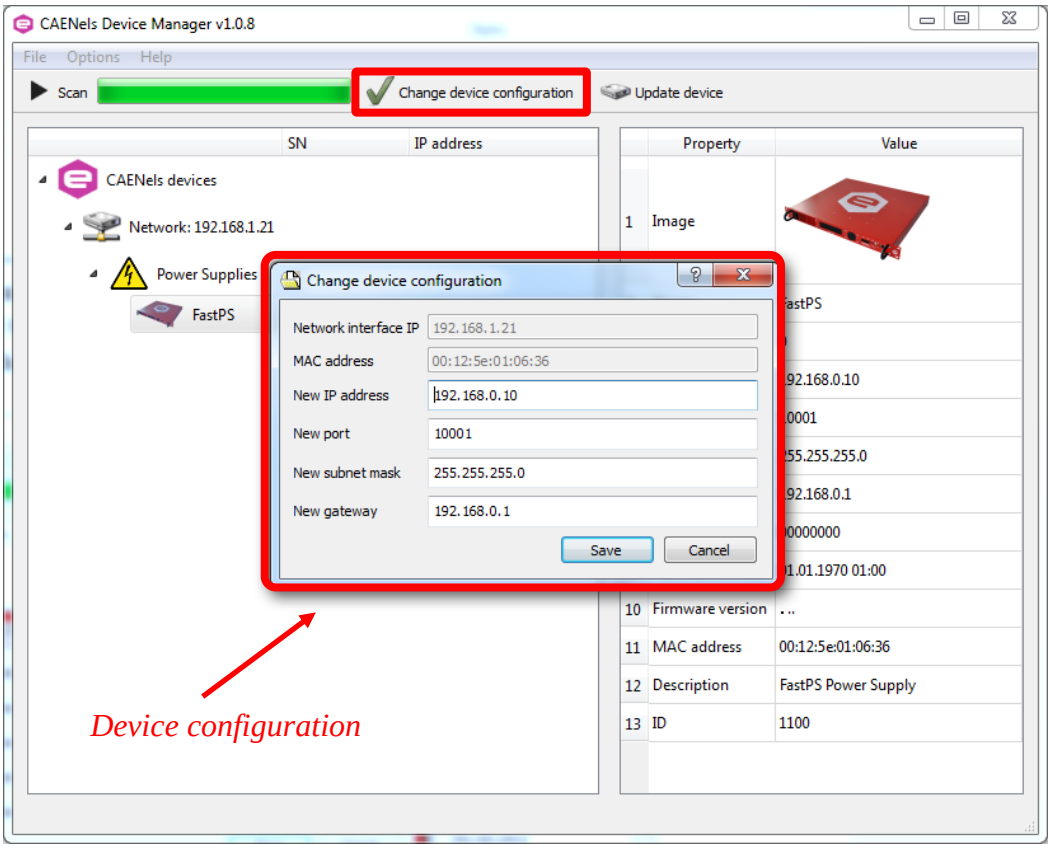


Figure 30: Device Manager - Change device configuration

5.2 Visual PS

The *VISUAL PS* software makes it easy to remote control the main features of the NGPS series using a Graphic User Interface (GUI).

The software is developed using Qt, which is a cross-platform application and UI framework with APIs for C++ programming. The software is available for Windows platform. The system requirements are as follows:

- Windows minimum system requirements:
  - Windows® XP or newer
  - Intel® or equivalent processor
  - 30 MB available HD space
  - Ethernet network card

5.2.1 Power Supply IP

To communicate with a NGPS power unit it is necessary to set its IP address and its port. This operation can be made by using the module IP address window, accessible by clicking the first "Set IP" icon of the Visual PS Toolbar.

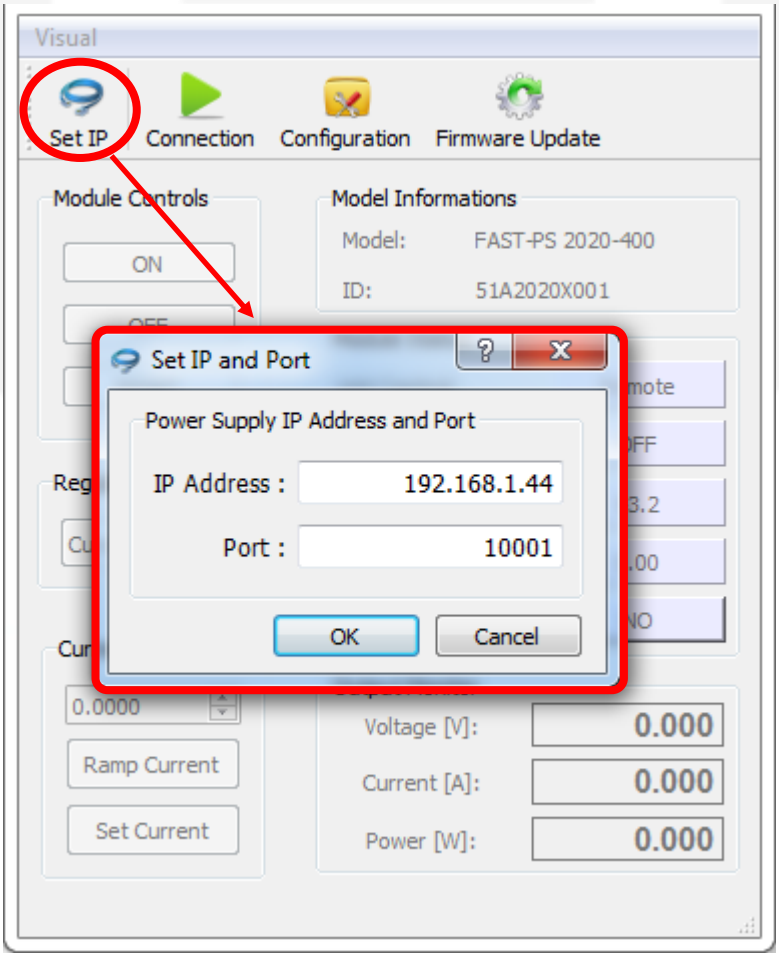


Figure 31: Visual PS – Set IP

To establish the connection with the module, it is necessary to click on the "Connection" icon. Once the communication is established it is possible to configure the unit and monitor its status.

5.2.2 Main windows

The Visual PS main window is organized in the following sections:

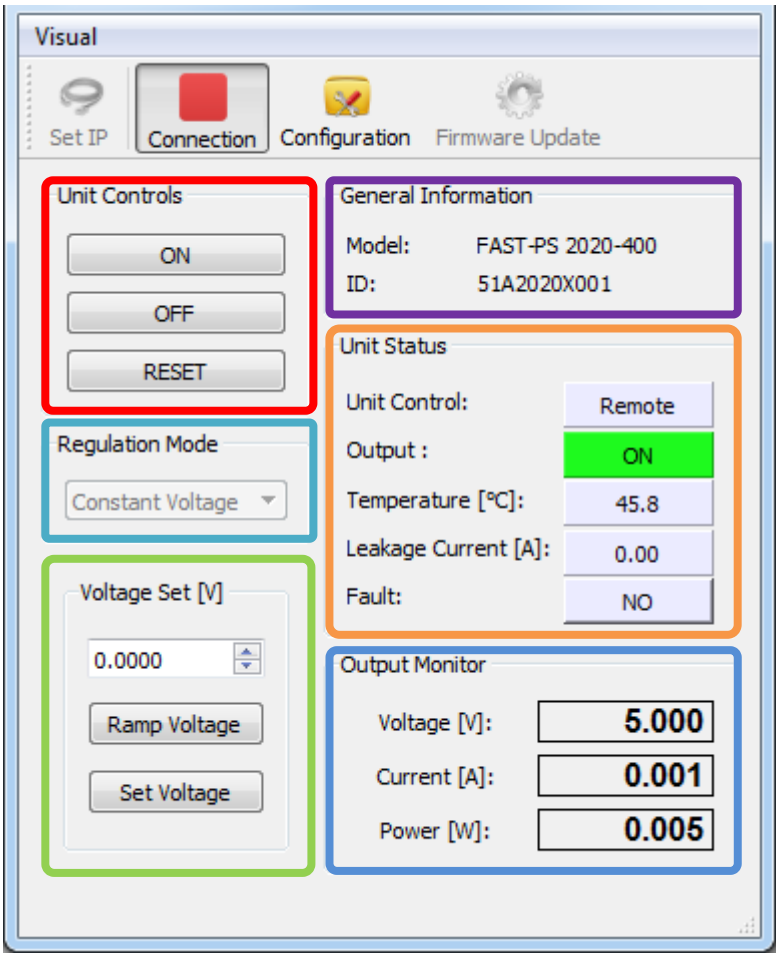


Figure 32: Visual PS – Main Window

- **Unit Controls:** allows to Switch ON/OFF the unit and to Reset its status register (in case of a fault).
- **Regulation mode:** allows to select the mode of operation. The available modes are: "Constant Voltage" mode or "Constant Current" mode. The regulation mode can be changed only when the unit is switched OFF.
- **Voltage/Current Set section:** this section allows to set the Voltage (for the "*Constant Voltage*" mode) or Current (for the "*Constant Current*" mode) setpoint. To apply a setpoint it is necessary to click on the *Ramp* or *Set* button. The *Ramp* button performs a ramp to the selected setpoint, otherwise the *Set* button applies directly the selected setpoint.

- **General information:** indicates some information regarding the connected unit, like the model and its serial number.
- **Unit status:** indicates some information regarding output status, temperature, current leakage, unit control (local or remote) and fault status. By clicking on the fault status indicator it is possible to visualize a detailed fault status windows.
- **Output monitor:** indicates the actual output voltage, current and power.

5.2.3 Unit Configuration

To display the configuration Window, click on the Configuration button on the main Toolbar. From this window it is possible to configure the unit. Several fields are password protected. To have the access to the password protected fields it is necessary to insert the correct password word. For additional inflammation regarding the password protected cells and the memory structure, please refer to Configuration Commands section. The Configuration Window is divided in the following tabs:

- **General tab:** shows the general information about the unit as the name of the unit, its model, firmware version, serial number and the calibration date.
- **Interlock and Limit tab:** from this tab the user can:
  - display and edit the names, direction, status (enabled or disabled) and intervention time of the available external interlocks,
  - visualize and edit the module limits (which generate a fault condition) as: the maximum allowable temperature, min DC-link voltage, Leakage current limit etc.
- **PID tab:** from this tab it is possible to edit the PID regulators parameters – i.e. proportional, derivative and integral terms
- **File tab:** in this tab the user can display, edit and save the content of the unit memory

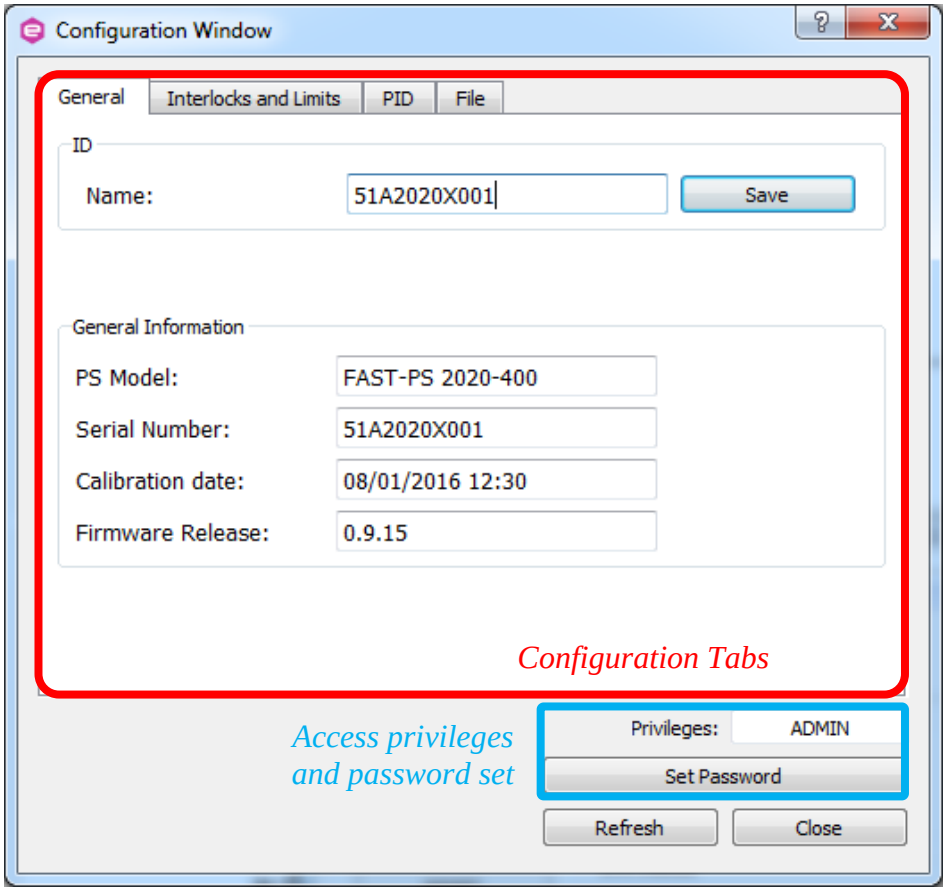


Figure 33: Visual PS – Configuration Window

5.2.4 Firmware Update

In order to have the latest features, please upgrade to the latest firmware (link: http://support.caenels.com/caenels/repos/apps/), and please not that firmware downgrade is not possible. In order to update the NGPS unit firmware it is necessary to click on the Firmware Update button on the main toolbar. From the Firmware Update window select the desired firmware file (*.udpt extension) and click on the Upload Firmware button. The update procedure can take several minutes for the firmware update procedure.

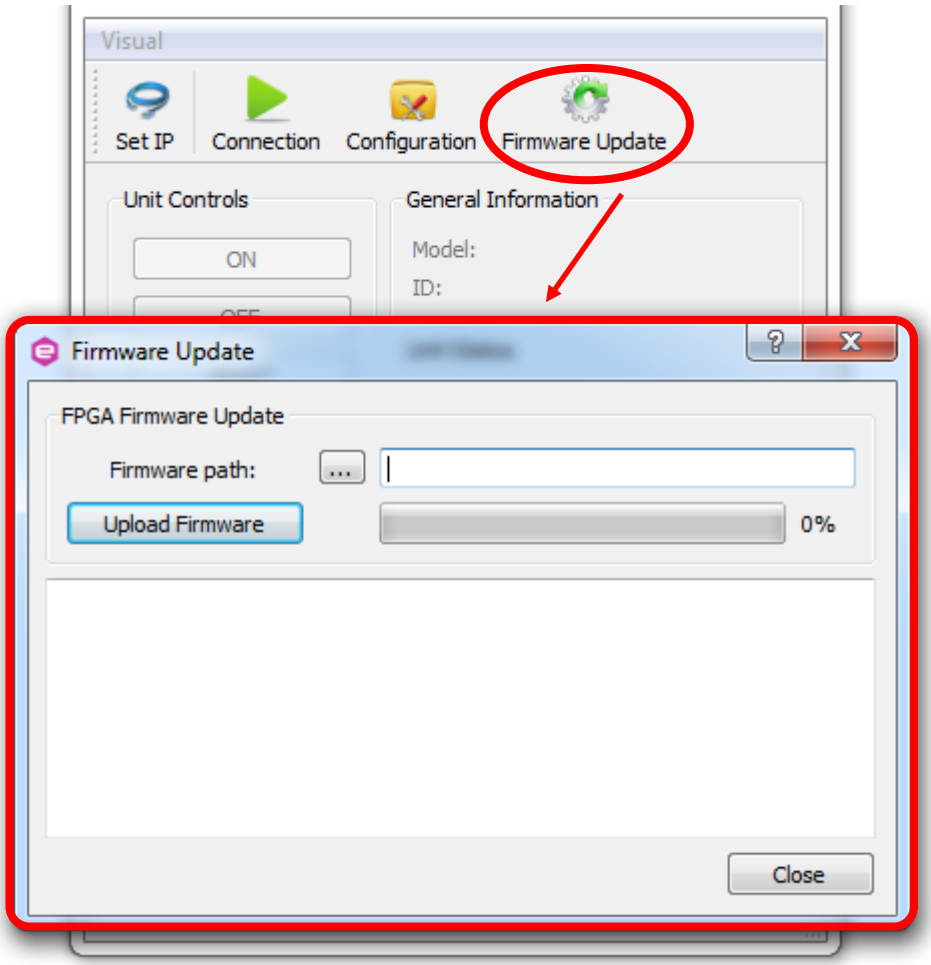


Figure 34: Visual PS – Firmware Update

6. Mechanical Dimensions

The mechanical dimensions of the NGPS unit are hereafter presented in **Figure 35**:

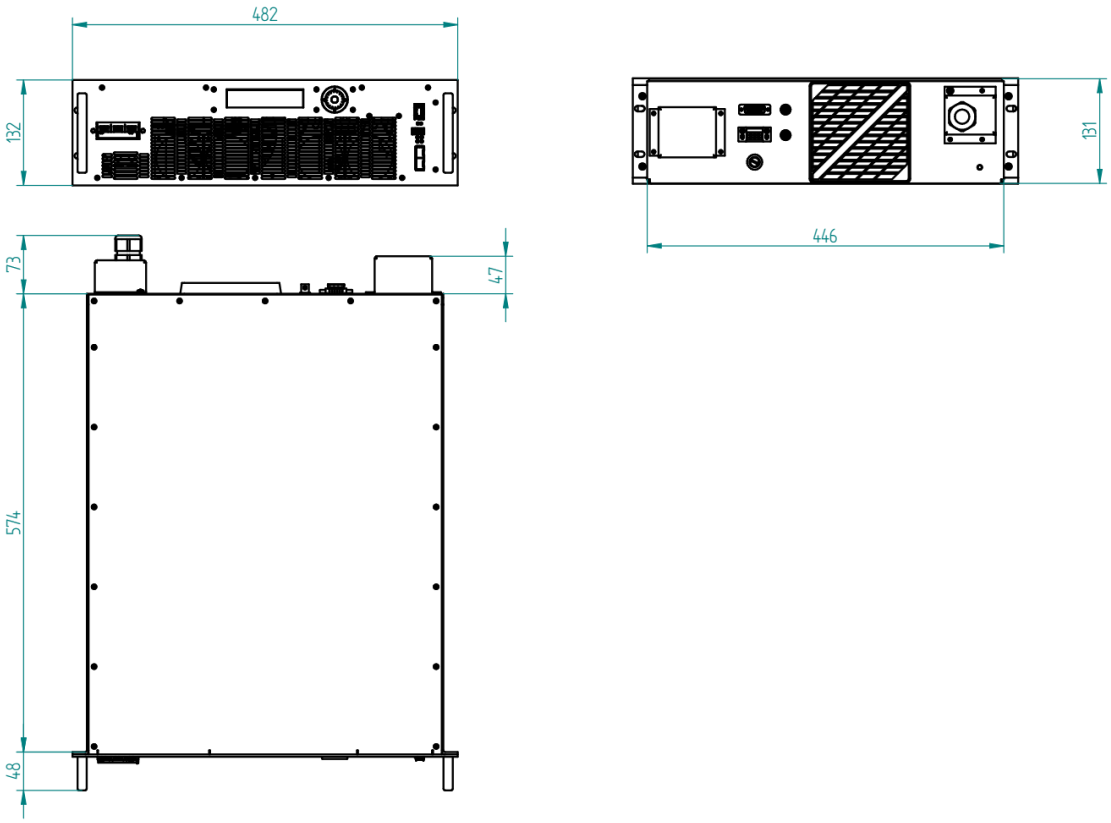


Figure 35: NGPS Mechanical Drawings

7. Technical Specifications

The main technical specifications for the NGPS models are hereafter presented:

Technical Specifications	NGPS
Output current range	30 A (NGPS-CVF 30-300) 100 A (NGPS 100-100/ NGPS-CAX 100-100) 120 A (NGPS 120-50) 140 A (NGPS 140-50) 150 A (NGPS 150-60) 200 A (NGPS 200-50/ NGPS-CAX 200-50 / NGPS-CAX 200-40) 250 A (NGPS 250-30) 300 A (NGPS 300-30)
Output voltage range	30V (NGPS 250-30 / NGPS 300-30) 40V (NGPS-CAX 200-40) 50 V (NGPS 120-50 / NGPS 140-50 / NGPS 200-50 / NGPS-CAX 200-50) 60 V (NGPS 150-60) 100 V (NGPS 100-100 / NGPS -CAX 100-100) 300 V (NGPS-CVF 30-300)
Maximum output power	6 kW (NGPS 120-50) 7 kW (NGPS 140-50) 7.5 kW (NGPS 250-30) 8 kW (NGPS-CAX 200-40) 9 kW (NGPS 150-60 / NGPS 300-30 / NGPS-CVF 30-300) 10 kW (NGPS 100-100 / NGPS-CAX 100-100 / NGPS 200-50 / NGPS-CAX 200-50)
Regulation Type	Current- or Voltage- Control
Current and Voltage Setting	18 bit
Current and Voltage Readback	20 bit
Output insolation	500 V
Power Factor	> 0.93
Efficiency	> 90%
Max Current/Voltage update rate	10 kHz (over SFP)
Closed-loop Bandwidth	> 100 Hz (C.C. mode) > 200 Hz (C.V. mode)
Accuracy	< 0.01% (0.005% upon request) (C.C. mode) < 0.05% (C.V. mode)
Line Regulation	±5 ppm / FS

Technical Specifications	NGPS
Load Regulation	±5 ppm / FS
Remote Sensing Compensation	up to 2V
Cooling	Forced Air Convection (front-to-rear)
Temperature Stability	5 ppm/K (C.C. mode) (1ppm/K upon request) 50 ppm/K (C.V. mode)
Communication interfaces	1x Ethernet 10/100/1000 TCP-IP 2x SFP ports
Itnernal Interlocks	Over-Temperature MOV Input Over-Voltage Main circuit-breaker for Over-Current Output Free-wheeling diodes Output Over-current and Over-Voltage Earth current leakage Input Phase-Loss (DC-link undervoltage)
External Interlocks/States	User-configurable "dry" contacts Magnetic relay Solid-state relay
Modularity	Parallel connection (up to 4)
Drivers	EPICS
Extra-features	Point-by-point current waveform User-definable interlock thresholds, active levels and timings Firmware remote update (with password)
Dimensions	19" x 3U x 600 mm
Input Ratings	208 VAC ± 10% ("E") Three-phase 50/60 Hz 400 VAC ± 10% ("A") Three-phase 50/60 Hz 480 VAC -15%...+5% ("U") Three-phase 50/60 Hz
Weight	28 kg
Enclosure impact withstand rating (damages possible but no safety impaired)	IK 08 (5 J)
Operating Temperature	0…40 °C
Operating current range (rated stability and accuracy)	2 - 100 %
EU directive conformity and Standard compliance	LVD: 2014/35/UE EMC - EMC: 2014/30/UE EN 61010-1:2010 - EN 61326-1:2013

Table 18: Technical Specifications