GEFRAN

GRC

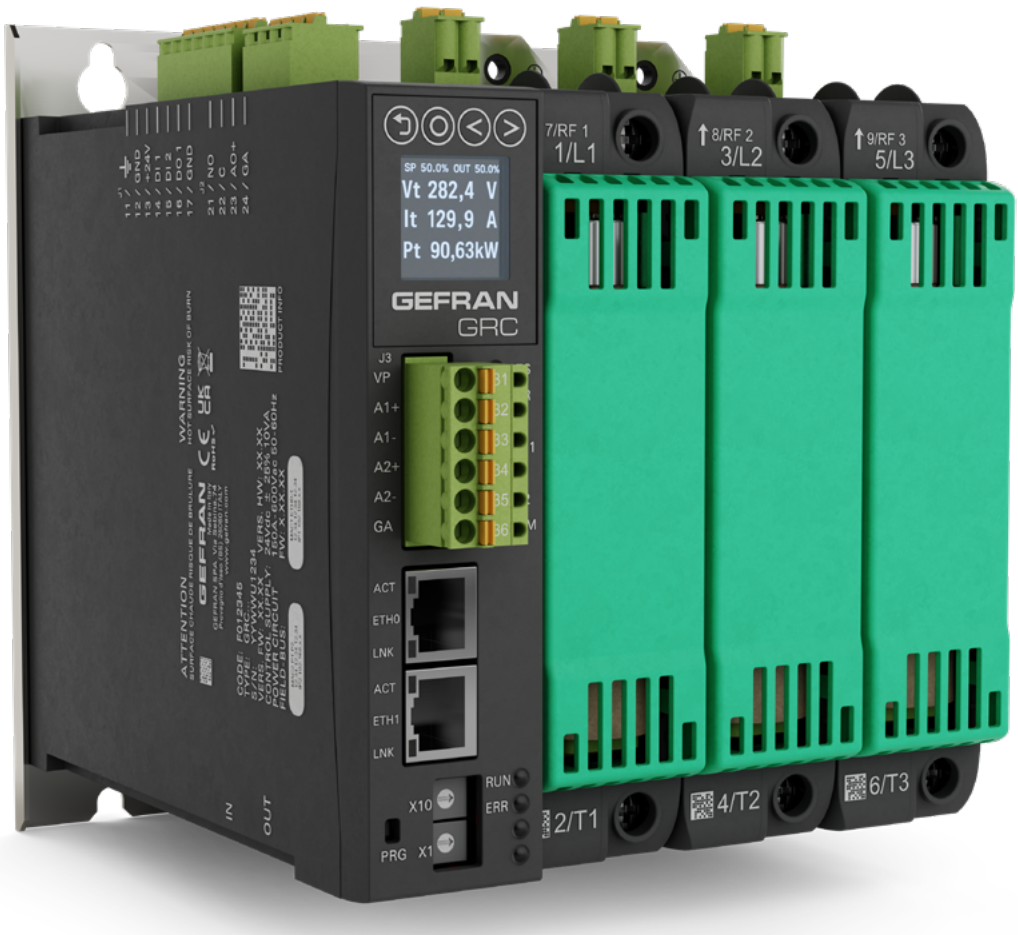
Advanced Power Controller

CONFIGURATION AND PROGRAMMING MANUAL

CE

Software version 1.0x

code: 81910 MAN GRC



81910 "MSW_GRC-40/600A"_03-2021_ENG

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PREFACE

Warnings and safety

Gefran always has the latest version of the Instruction Manual available for free downloads and in multiple languages at www.gefran.com. The current manual must be made available to all people that interact with the devices this manual describes.

Only qualified technicians, following current laws and regulations should be installing this device and care be taken to follow instructions given in this manual 2nd could be better stated

Gefran is not liable for injury to personnel, damage to property, other equipment, or to this device for improperly following the instruction manuals and safety regulations.

Installation and maintenance technicians must read the manual, following instructions written within the manual and its annexes.

Before proceeding with this device, GRC Controller, the technicians and operators must be sufficiently trained in the operation, emergency, diagnostics, and maintenance procedures for this type of device. This device can be used in applications with risk for injury or death, damage to machines and materials, in those cases the users and installers must combine auxiliary devices and system safegaurds to protect against hazards.

Caution! Do not touch the terminals on the device when it is powered.

Contact Gefran Technical Support if you suspect instrument malfunction. Prior to contact Gefran, review the manual and sections of the manual that pertains to the problem encountered. When contacting Gefran have the manual available for reference.

Caution! Repairs to the Advanced Power Controller must only be made by technical personnel suitably trained and authorised by Gefran. Any attempt to repair or modify the hardware features of the device by unauthorised personnel will void the warranty.

Disposal

The instrument must be segregated from other waste at the end of its useful life.

The user must take the equipment at the end of its useful life to an appropriate sorting centre for electrotechnical and electronic waste, or a similar facility, in accordance with the regulations in force in the country of installation, in order to dispose of the components which are potentially harmful to the environment.

This helps prevent negative effects on the environment and health and facilitates recycling of the materials from which the instrument is made.

Typographical Conventions used in the manual

Pay attention when the following symbols are found in the manual.

They indicate particularly important information relevant to correct product operation or safety, or provide instructions that must be strictly followed.

This highlights a risk condition for the installation technician or user due to hazardous voltage levels.

This calls the reader's attention to a specific point.

This indicates a suggestion that could be helpful for better use of the device.

This indicates a reference to other technical documents that may be downloaded from www.gefran.com.

Liability disclaimer

Although all the information in this document has been carefully checked, Gefran S.p.A. cannot be held liable for the possible presence of errors, or for damage to persons or property due to improper use of this manual.

Gefran S.p.A. also reserves the right to make changes to the content and form of this document and to the features of the devices it describes at any time without prior notice.

The technical and performance data given in this manual are to be considered as a guide for the user to determine the suitability for a certain use and are not a guarantee. They may be the result of Gefran S.p.A. test conditions and the user must compare them to his/her real application requirements.

Gefran S.p.A. cannot be held in any way liable for damage to persons or property resulting from tampering or use that is incorrect, improper or otherwise incompliant with the features of the controller and the instructions contained in this manual.

Gefran S.p.A. shall not be liable for installations upstream or downstream from the instrument.

Copyright

1. GENERAL DESCRIPTION

1.1. Introduction

1.1.1. Profile

The Advanced Power Controllers of the GRC series are self-contained units with the capability of controlling high electrical power levels for various types of single-phase, two-phase and three-phase heating elements.
The controllers allow great flexibility of use in all current and voltage ratings, from 40 A to 150 A and at nominal voltages of 480 Vac, 600 Vac.
They are ideal for accurate, stable temperature control in industrial heating systems.
Their advanced load control functions allow the management of linear resistors with a low thermal coefficient, non-linear resistors with a high thermal coefficient, infrared lamps, and single-phase and three-phase symmetrical and asymmetrical transformers.
Compact mechanics, together with ease of wiring with plug-in connectors and easy configuration methods ensure considerable savings in terms of panel space and installation time, without sacrificing robustness and a notable diagnostic capacity.

1.1.2. Control functions

All GRC models can be operated in different modes to adapt to the various control solutions and architectures found in the field.
The two analogue inputs are highly configurable, so that both two-phase and three-phase devices can be controlled with a single command, and up to 2 modules can be controlled individually and independently.
GRCs can also be operated with digital ON/OFF controls or in PWM mode, through potentiometers, using one of the various Fieldbuses that complete the options of this range.

Flexibility in the control of electrical loads, even very different from each other, is guaranteed by a vast choice of trigger types, freely configurable on all models.
There is a choice of "**Zero Crossing**" (ZC) mode with fixed cycle times or "**Burst Firing**" (BF) mode with optimised cycle times, for linear loads and systems with high thermal inertia.
There is also the option of faster firing modes, such as "**Half Single Cycle**" (HSC), which is ideal for handling mid-wave IR lamps, and of "**phase angle**" (PA) control, for SWIR lamps, non-linear heating elements such as silicon carbide, silicon molybdenum and both single and three-phase transformer primaries.
Whichever control configuration is chosen, GRC models are able to deliver the desired electrical power, from 0% to 100%, with precision.

The following functions complete the control:
- softstart at power-on,
- current limits settable on both peak values and RMS values,
- closed-loop feedback algorithms for voltage, current and power, which guarantee supply stability even in the presence of variations and disturbances in rated values.

Some functions of the GRC range are designed for specific applications and problems:
- For **systems with three-phase transformers**, any breakages of three-phase load branches are managed by the controller, which provides an immediate alarm signal while continuing to supply energy to the two intact phases, allowing the process to remain in a holding condition.
- In **heat treatments with non-linear resistors**, such as silicon carbide, heating elements can be brought up to temperature with "phase angle" control and active current limits, with automatic switching to "zero crossing" control when the elements are at temperature and there are no more current peaks, returning to "phase angle" control automatically only if further peaks reoccur.
- Three-phase transformers are very often used in **industrial furnaces**, with symmetrical or asymmetrical primary/secondary connections. GRC controllers can manage both types indiscriminately without any impact on performance.
- In the case of several loads managed by different controllers, there is a need to **rationalise and synchronise the power outputs of the individual controllers** so as to reduce peaks of current/energy supplied instantly or, in some cases, limit the total value to a settable maximum. These functions are performed by the integrated GSLM, a system that allows devices to communicate with each other and balance or limit consumption over time.
- Higher accuracy in current, voltage, and power measurements, combined with the ability to maintain constant power output. This combination makes it the ideal choice for optimal performance even in the most delicate applications, such as those in the **semiconductor industry**.
- The availability of phase angle (PA) control (the only control method that completely eliminates flickering in IR lamps), combined with current limit and current, voltage or load power feedback functions, means that "critical" applications such as Super-Kanthal™ special heating elements, silicon carbide resistors or single and three phase transformer primaries can be resolved with confidence.

1.1.3. Diagnostics, preventive maintenance and alarms

Great care has been taken in the development of diagnostic, preventive maintenance and alarm functions that can be associated with current, voltage and power values and operating temperatures. The process and power controller are continuously monitored.

For current values:
- Total or partial interrupted load alarm with alarm threshold teach-in.
- SCR short circuit alarm.
- Short circuit or surge load alarm.
- Internal fuse breakage alarm.

For voltage values:
- No line voltage alarm.
- Unbalanced three-phase line alarm.
- Indication of incorrect phase rotation in three-phase systems (without interruption of controller operation)

For temperature values:
- Continuous monitoring of the internal temperature of the power module with automatic disconnection and an alarm signal in the event of over-temperature.
- Fan output temperature measurement for electrical panel cooling system efficiency diagnostics.

The GF_eXpress configuration software also offers an extensive list of additional diagnostic conditions, such as alarm status storage, for immediate and easy analysis in the event of a fault.

1.1.4. Monitoring

GRC controllers can be equipped with an integrated display for monitoring key electrical parameters, alarms, general information, and basic configuration.
The device integrates a web server accessible via browser for monitoring key electrical parameters, alarms, general information, and basic configuration.

1.1.5. Configuration

The GRC controllers have been designed with various configuration levels to make initial start-up operations as simple and intuitive as possible.
The GF_eXpress configuration software (freely downloadable from the Gefran site www.gefran.com) has a “Smart Configuration” procedure to configure the controller through a few targeted questions, with limited need for knowledge of the parameters and their meanings. At the end of the procedure (average duration 5 minutes) the controller is ready to pilot the load.
Another section of the software contains the “Wizard” pages, showing the main parameters divided into topics, with a part of the parameter monitoring always active.

With GF_eXpress, you can create and save entire parameter recipes and easily duplicate them on other devices. Parameters can also be monitored and displayed graphically with the oscilloscope function.

1.1.6. Fieldbus

A Modbus TCP port is always available for connections with the configuration tool or with HMI or PLC devices equipped with Modbus Master communication.
An extensive range of certified Fieldbus options lets you add GRC controllers to control architectures with the most popular PLC brands, allowing you to access any device variable with standardised configuration files.

1.2. Field of use

As the Advanced Power Controller can be used in a multitude of installations and environments, adequate technical training is required to make full use of the instrument’s potential.
In any event, the instrument must always be used within the limits indicated in the technical specifications in the accompanying documentation.

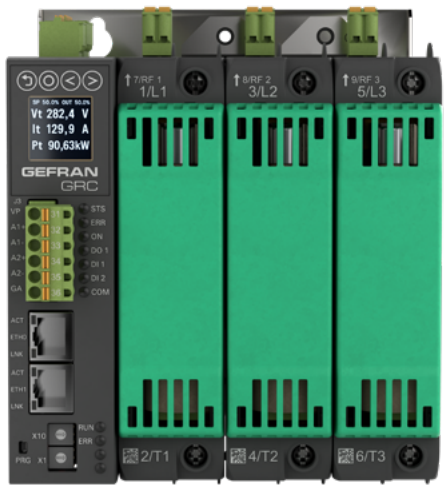
Regardless of any other consideration, **it is always strictly forbidden to**:
- use the instrument or parts of it (including software) for purposes other than those intended in the accompanying technical documentation;
- modify working parameters not accessible to the operator, or decrypt or transfer the software or any of its parts;
- use the instrument in particularly flammable environments;
- repair or modify the instrument using non-original spare parts;
- use the instrument or its parts without having read and correctly interpreted the contents of the accompanying technical documentation;
- dispose of or discard the instrument in common landfills.

1.3. Technicians and operators

The Advanced Power Controller must only be used by personnel qualified for their assigned task, in compliance with the instructions for the task, particularly the relevant safety warnings and precautions.
Qualified personnel, due to their training and experience, are able to recognise the risks involved in use of the instrument and avoid potential hazards.

In addition, it is assumed that the technicians who commission the instrument and connect it to other units, and those in charge of maintenance, have adequate technical knowledge, particularly in the field of electronics and automation, to fully understand the information provided in this manual.

1.4. GRC-L1



Main features

- Single/two/three-phase, 25 A to 150 A
- Operating voltages 480 Vac, 600 Vac
- Firing mode configurable to “Zero crossing” (Fixed Cycle, Burst Firing, Half Single Cycle) and “Phase angle”
- 2 analog control inputs configurable in volts, mA, potentiometer.
- 1 configurable analog retransmission output
- 1 PNP digital output + 1 Dry contact output
- Softstart and RMS and peak current limits
- V, V^2, I, I^2 and P feedback
- Total and partial interrupted load alarms
- Integrated WEB Server
- Modbus TCP always present
- Built-in fuses
- Temperature sensors on power terminals and cooling air inlet
- Optional Fieldbus: PROFINET, Modbus RTU, Ethernet IP, EtherCAT
- Integrated display
- PC configuration tool with setup wizard (SMART)
- CE, UL 508, certifications

1.5. Order code

GRC -	A	B	C	D	E	F	G	H	I

Phases	
Monophase	**1PH**
Biphase (2-leg control for 3PH load, or 2x1PH loads)	**2PH**
Triphase (full 3PH load control, or 3x1PH loads)	**3PH**

Current	
Size1	
25 Ampere	**25**
25 Ampere I2t++	**25I**
40 Ampere	**40**
40 Ampere I2t++	**40I**
Size2	
60 Ampere	**60**
75 Ampere	**75**
90 Ampere	**90**
120 Ampere	**120**
150 Ampere	**150**

Voltage	
480 (40…530 Vac)	**48**
600 (40…660 Vac)	**60**

Add-On Functions	
None	**0**

Fieldbus option	
0	No added fieldbus-ModbusTCP always on board
MR	Modbus RTU
PN	Profinet
EC	EtherCAT
EI	Ethernet IP

Fuses	
0	None
F	Integrated high speed fuses

Integrated Display	
0	None
D	Integraed display

Auxiliary I/O	
0	Always onboard I/O (2 DI, 1 DO)
1	2 Analog Input + 1 Analog Output +1 DO +always on board

Control load options	
0	Basic diagnostic (No current reading)
FV	Feedback V,V2
HB	FV + Current reading, HB diagnostic and Current limiter
FB	FV + HB+ Feedback I,I2,P

1.5.1. Main elements of the GRC 25A ... 40A

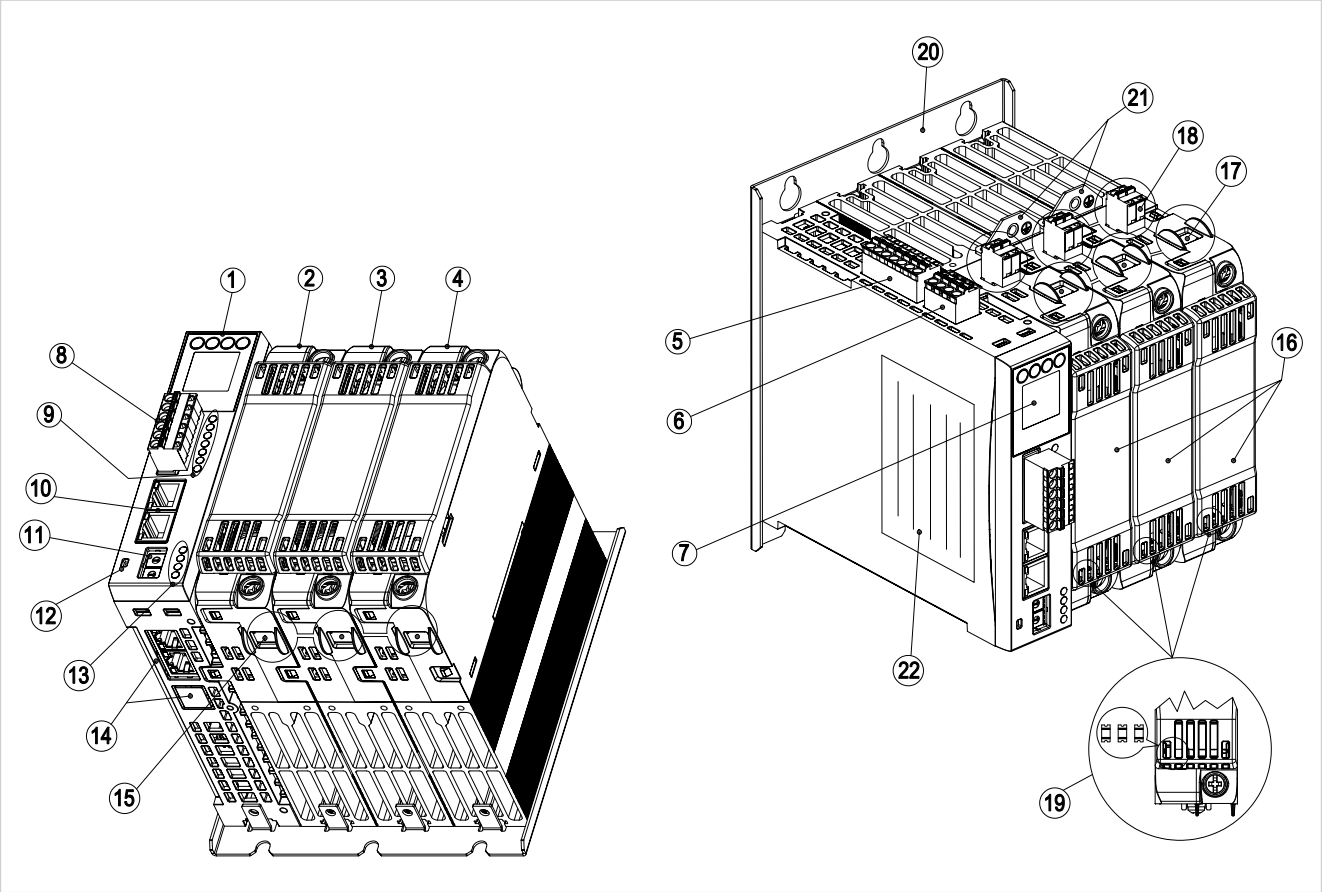


Figure 1 - Elements of the GRC 25A ... 40A

1) CPU module
2) L1 module
3) L2 module (present in 2 PH configuration)
4) L3 module (present in 3 PH configuration)
5) J1 connector 24Vdc power supply and basic I/O
6) J2 connector auxiliary outputs (optional)
7) Display and buttons (optional)
8) J3 connector analog inputs (optional)
9) Device status LEDs
10) RJ45 Ethernet ports ETH0/ETH1 (PORT1)
11) Rotary selectors x1 and x10 (optional)
12) Physical PRG button
13) Fieldbus status LED (optional)
14) Fieldbus access (PORT2, if Modbus RTU connector J5+line terminator, EtherCAT 2 RJ45 IN/OUT ports, Profinet /EthernetIP 2 RJ45 P1/P2 ports) (optional)
15) Load terminal
16) Internal fuse protection cover
17) Line terminal
18) RF1, RF2, RF3 connectors for line reference signal
19) Power module LED and inspection slot
20) Wall mounting plate
21) Grounding plate
22) Product features (serial number, order code, MAC address, default IP, product web page QR code)

1.5.2. Main elements of the GRC 60A ... 150A

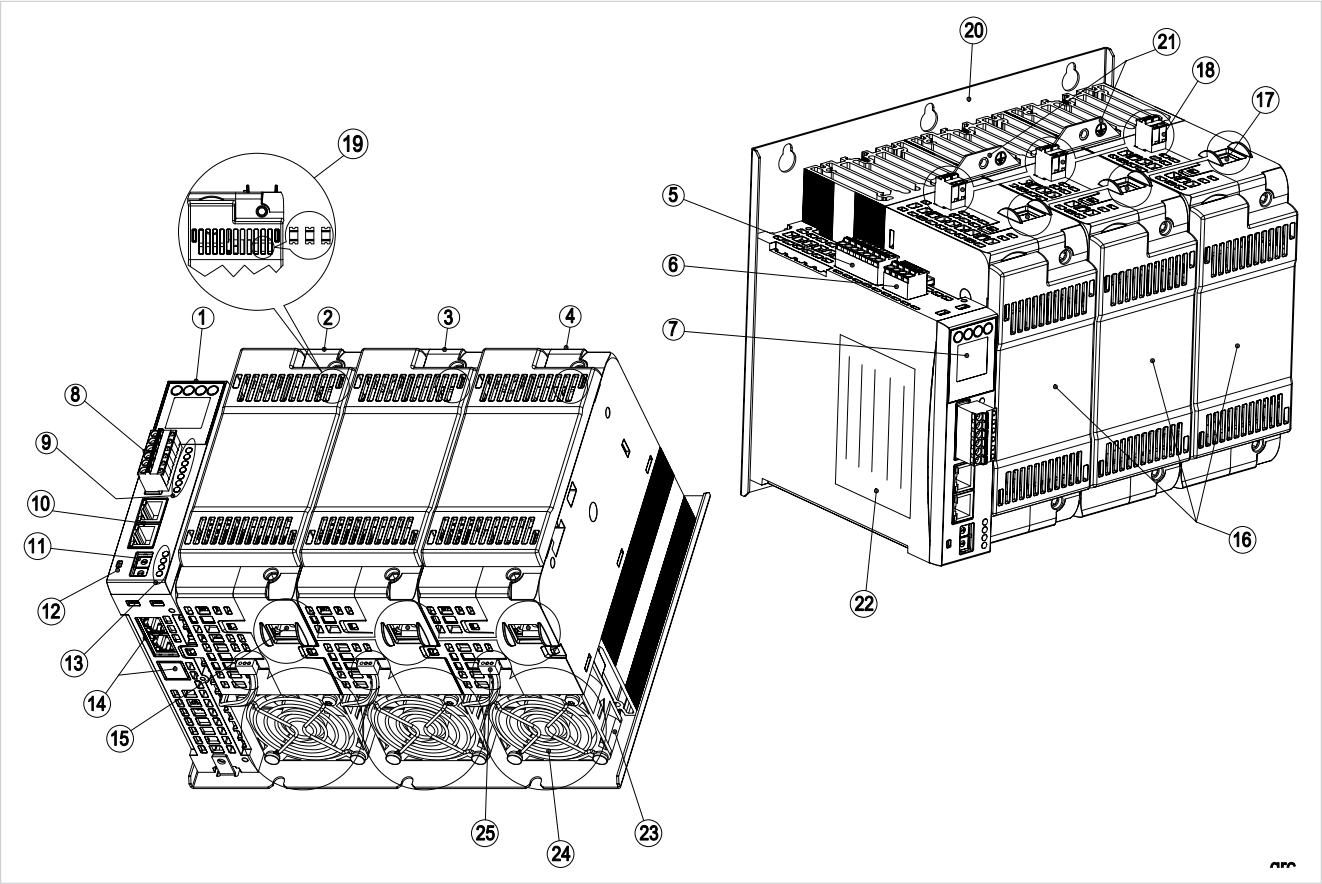


Figure 2 - Elements of the GRC 60A ... 150A

1) CPU module
2) L1 module
3) L2 module (present in 2 PH configuration)
4) L3 module (present in 3 PH configuration)
5) J1 connector 24Vdc power supply and basic I/O
6) J2 connector auxiliary outputs (optional)
7) Display and buttons (optional)
8) J3 connector analog inputs (optional)
9) Device status LEDs
10) RJ45 Ethernet ports ETH0/ETH1 (PORT1)
11) Rotary selectors x1 and x10 (optional)
12) Physical PRG button
13) Fieldbus status LED (optional)
14) Fieldbus access (PORT2, if Modbus RTU connector J5+line terminator, EtherCAT 2 RJ45 IN/OUT ports, Profinet /EthernetIP 2 RJ45 P1/P2 ports) (optional)
15) Load terminal
16) Internal fuse protection cover
17) Line terminal
18) RF1, RF2, RF3 connectors for line reference signal
19) Power module LED and inspection slot
20) Wall mounting plate
21) Grounding plate
22) Product features (serial number, order code, MAC address, default IP, product web page QR code)
23) Cooling fans (for size 75A and above)
24) Fan protection grilles
25) Integrated fan power supply

1.6. LED indicator functions

CPU LED	Colour	Description
STS	green	Run: flashing during regular operation
ERR	red	Error status: activated in the presence of an alarm
ON	green	Output status MAIN1 or MAIN2 or MAIN3
DO1	yellow	Digital output status 1
DI1	yellow	Digital input 1 status
DI2	yellow	Digital input 2 status
COM	green	Reserved

LED Moduli power

LED	Colour	Description
POWER	green	Power module powered by CPU
OVERTEMP	red	Overtemperature alarm module
SCR ON	yellow	Active command from CPU

During normal operation, the status of the LEDs follows the corresponding parameter Ld.1…Ld.7.
In the following special cases they assume different behaviours to indicate the following states:

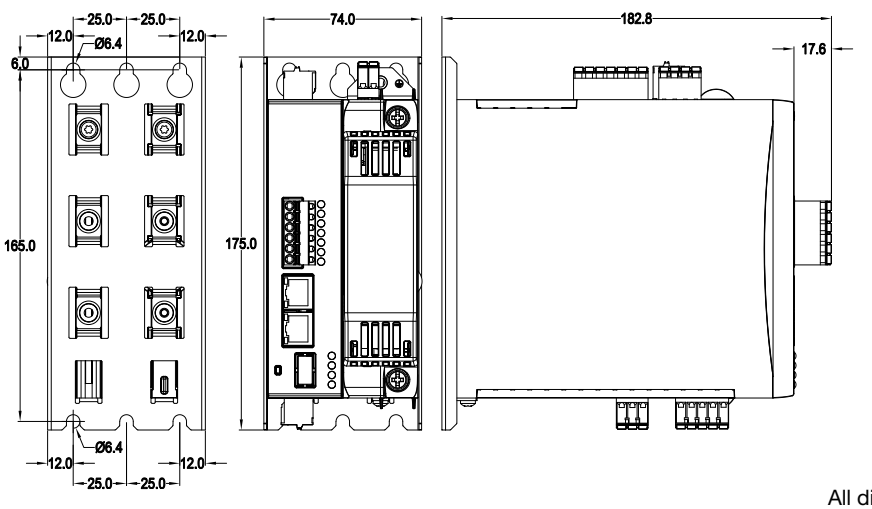
LED	Behaviour	Description
STS + **COM**	LED steady on	PRG button pressed
STS	On steadily	Change rotary switch
STS + **ERR**	Blink fast together	Autobaud in progress
ERR	Flashing	Reports one or more of the following alarms: • OVER_HEAT temperature alarm • TEMPERATURE_SENSOR_BROKEN temperature alarm • SHORT_CIRCUIT_CURRENT alarm (only in monophase) • FUSE_OPEN alarm (only in monophase) • INTERLOCK function active (Input DI2 set to OFF)
ERR + DI1	Flashing together	Indicate that the HB or POWER_FAULT alarm is active on module L1.
ERR + DI2	Flashing together	Indicate that the HB or POWER_FAULT alarm is active on module L2.
ERR + COM	Flashing together	Indicate that the HB or POWER_FAULT alarm is active on module L3.
All except **ON**	Flash rapidly	Jumper configuration not provided
All except **DO1**	Flash rapidly	30%_UNBALANCED_ ERROR alarm (only in three-phase configuration)
All except **DI1**	Flash rapidly	SHORT_CIRCUIT_CURRENTalarm (only in three-phase configuration)
All except **DI2**	Flash rapidly	NO_LINE alarm (only in three-phase configuration)
All except **COM**	Flash rapidly	FUSE_OPEN alarm (only in three-phase configuration)

For LED functions:
-BF, SF see the documentation relating to Profinet communication
-MS, NS see the documentation relating to EthernetIP communication
-RUN, ERR see the documentation relating to EtherCAT communication

1.7. Dimensions

1.7.1. Dimensions of GRC, 25 A ... 40 A models

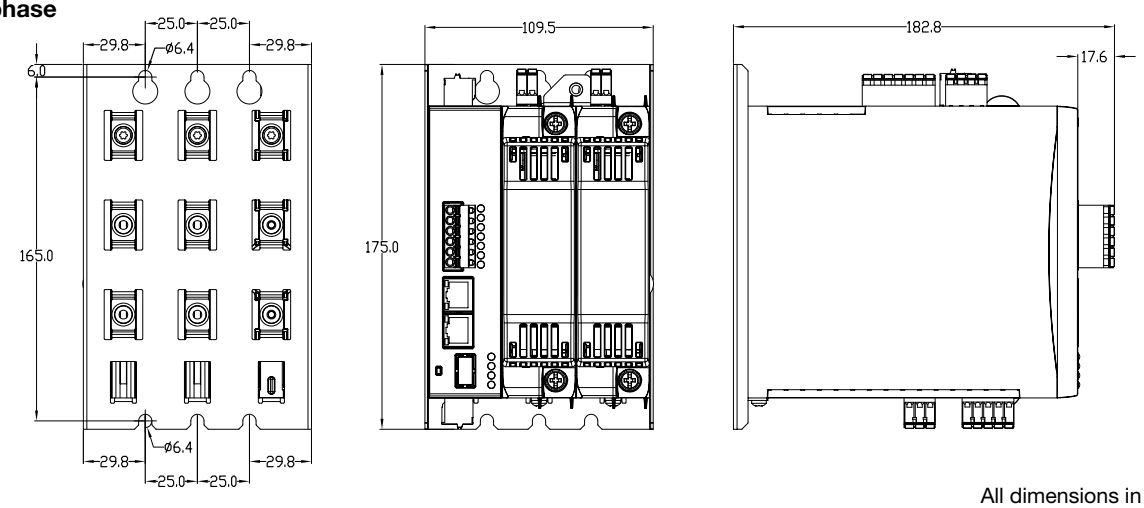
Single-phase



All dimensions in mm

Figure 3 - Dimensions of GRC 25 ... 40 A (single-phase)

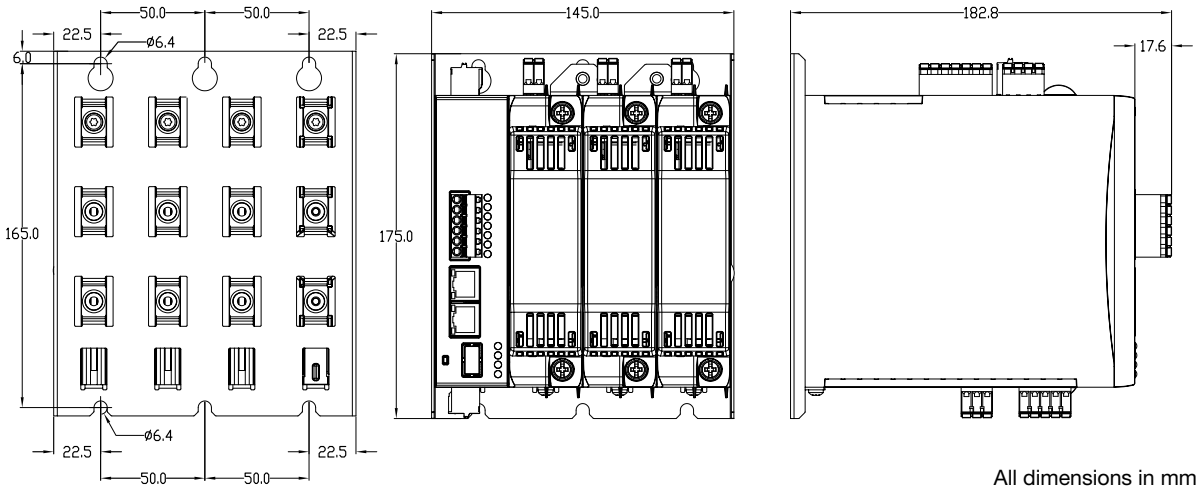
Two-phase



All dimensions in mm

Figure 4 - Dimensions of GRC 25 ... 40 A (two-phase)

Three-phase

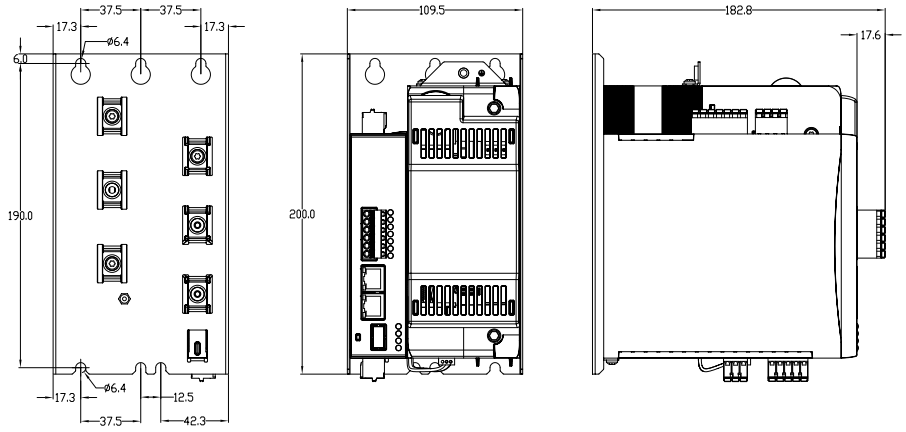


All dimensions in mm

Figure 5 - Dimensions of GRC 25 ... 40 A (three-phase)

1.7.2. Dimensions of GRC, 60 A ... 150 A

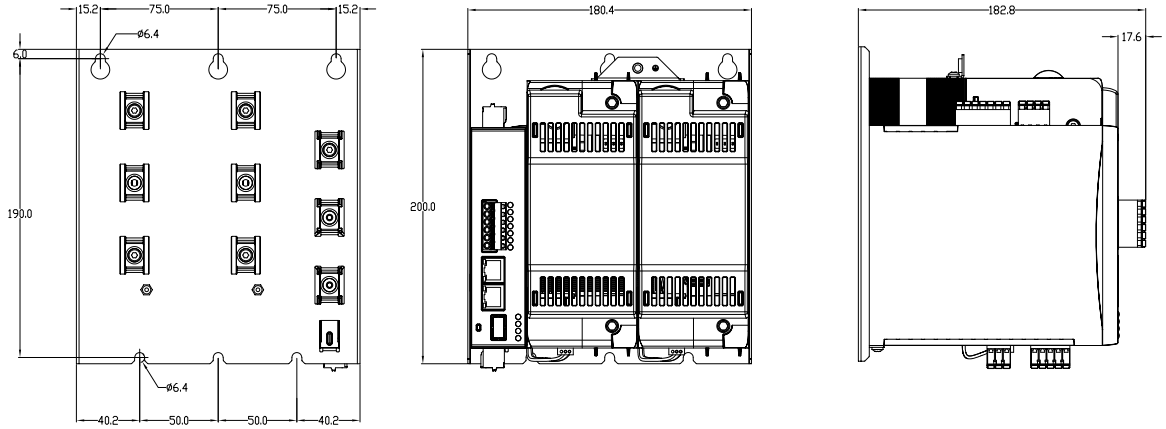
Single-phase



All dimensions in mm

Figure 6 - Dimensions of GRC-L1 400 ... 600 A (single-phase)

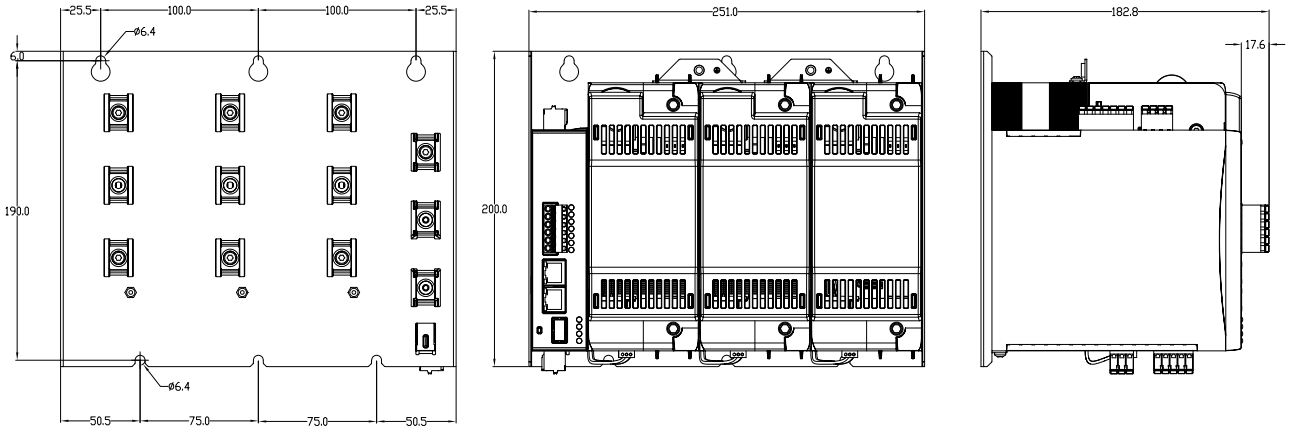
Two-phase



All dimensions in mm

Figure 7 - Dimensions of GRC 400 ... 600 A (two-phase)

(Three-phase)



All dimensions in mm

Figure 8 - Dimensions of GRC 400 ... 600 A (three-phase)

2. INSTALLATION AND POWER SUPPLY

Caution! The installation of the devices described in this manual must be carried out by qualified technicians, following current laws and regulations and in accordance with the instructions given in this manual.

Before installation, check that the controller is intact and has not been damaged during transport. Also ensure that the package contains all the accessories listed in the documentation.

Check that the order code corresponds to the configuration required for the intended use of the controller (rated supply voltage and current, number and type of inputs and outputs). See chapter "1.5. Order code" to check the configuration for each order code.

Caution! If even one of the above-mentioned requirements (qualified technician, device intact, configuration compatible with needs) is not met, suspend installation and contact your Gefran dealer or Gefran Customer Service.

2.1. Installing the controller

2.1.1. General installation rules

The GRC Advanced Power Controller is designed for permanent indoor installation. It must be installed in electrical panels or in the control panels of machines or production process systems, where the exposed terminals will be protected.

Caution! The Advanced Power Controller must NOT be installed in hazardous environments (flammable or explosive atmospheres). It may only be connected to elements operating in such environments by means of suitable types of interfaces, in conformity with the applicable safety standards.

Caution! If the Advanced Power Controller is used in applications with risk of damage to persons or property, it must be used in conjunction with dedicated alarm devices. We recommend allowing the possibility to check alarm operation also during normal operation of the controller and the system or equipment being monitored.

The Advanced Power Controller must not be installed where sudden changes in temperature, freezing or condensation can occur or where corrosive gases are present.

The Advanced Power Controller can operate in environments with a pollution degree 2 rating.

Caution! Unless adequately protected, the protection rating of the Advanced Power Controller is IP20.

2.1.2. Positioning and minimum ventilation space

To ensure the high reliability of the device, it is essential to install it properly inside the electrical panel so as to ensure an adequate exchange of heat.
Mount the device vertically (maximum 10° inclination from the vertical plane).
The temperature of the compartment containing the Controller must not exceed 40°C (for higher temperatures, see the derating curves).
Never obstruct the ventilation grills.

Ensure the minimum clearance for adequate air circulation:

- Vertical distance between a device and the panel wall >100 mm
- Horizontal distance between a device and the panel wall at least 10 mm
- Vertical distance between one device and another at least 300 mm.
- Horizontal distance between one device and another at least 10 mm.

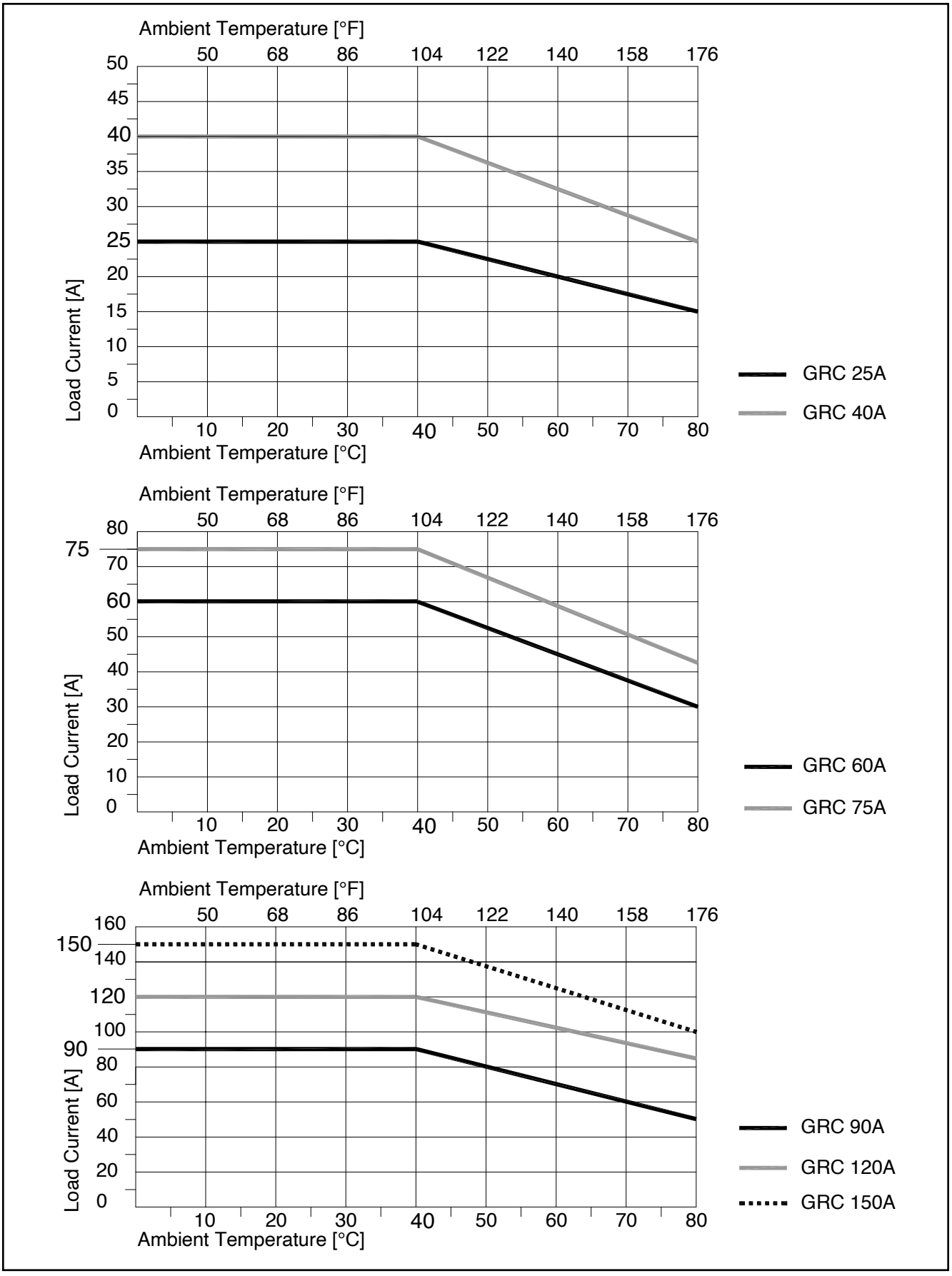
See "Figure 9 - GRC minimum ventilation spaces" on page 17.

Ensure that these distances are not reduced by cable ducting. If necessary, mount the units away from the panel wall so that the air can flow vertically without obstruction.

2.1.3. Fixing to the electrical panel

The fixing to the electrical panel is made via the slots at the top and bottom of the controller.
Use M5 screws or bolts or equivalent.
The following illustrations show the drilling templates to be used for fixing the controller, depending on the model and configuration (single-phase, two-phase or three-phase).
All measurements are in mm.

2.2. Derating curves



Note: The curves for the GRC 75/90/120/150A refer to the complete device with the standard fan in operation.

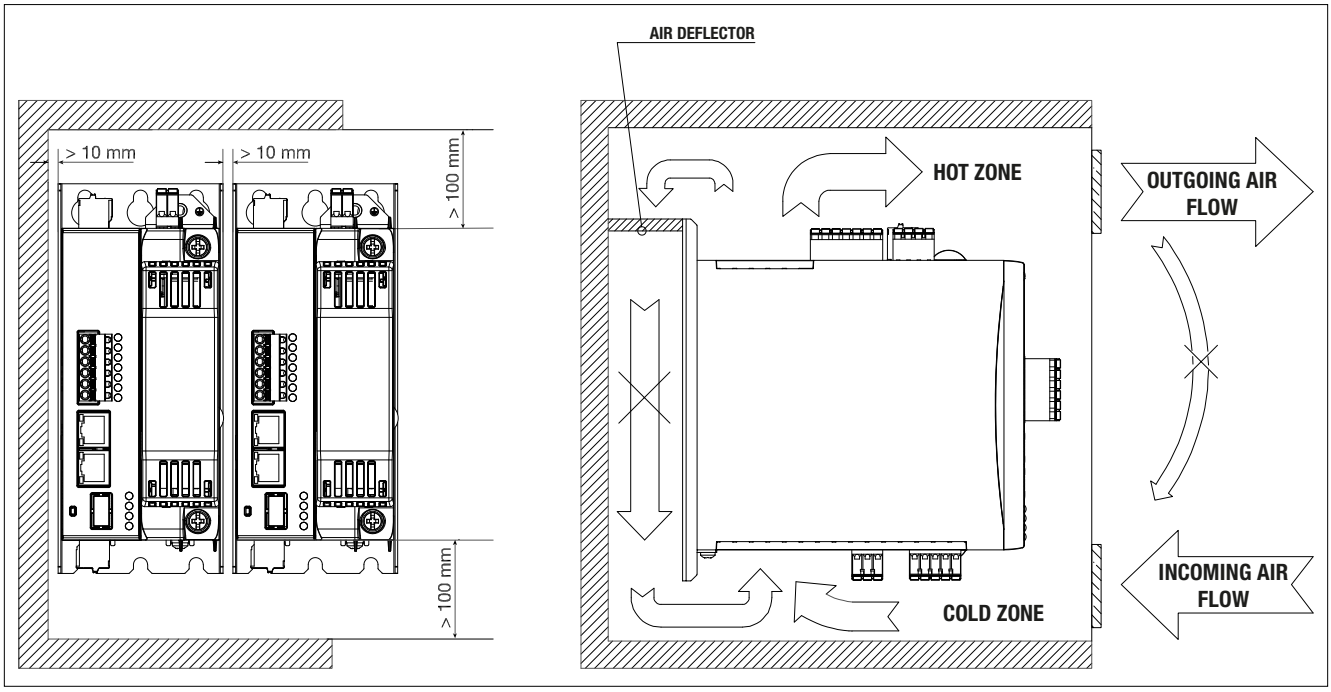


Figure 9 - GRC minimum ventilation spaces

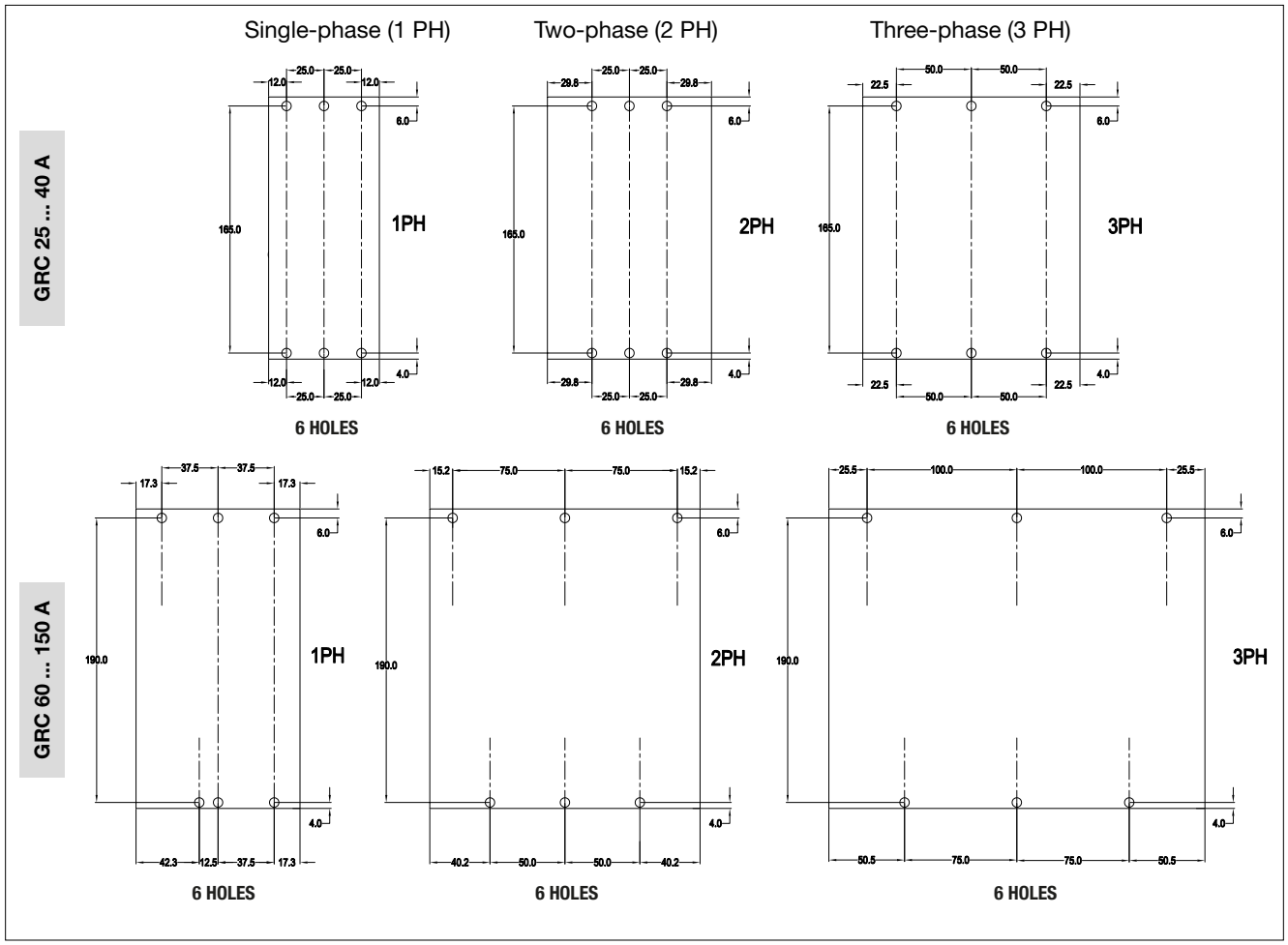


Figure 10 - GRC drilling templates

2.3. Power supply

The Advanced Power Controller is NOT supplied with an ON/OFF switch.
It is the responsibility of the user to provide a switch or disconnector compliant with the applicable safety requirements (CE marking) to disconnect the power supply upstream of the controller.
The switch, or disconnector, must be placed in the immediate vicinity of the device and be easily accessible to the operator.
A single switch can be used for several controllers.

The Advanced Power Controller must be supplied by a separate line to that used for electromechanical power devices (relays, contactors, solenoid valves, etc.).

Caution! The supply must come from a Class II or limited power source.

Suitable mains filters should be used in the vicinity of high-frequency generators or arc welding machines.

A voltage stabiliser should be used if there are large variations in the mains voltage.

Ensure that the earth connection is efficient and made via a specific conductor. A missing or ineffective earth connection can cause unstable device operation due to excessive environmental disturbances.
In particular, check that:

- the voltage between neutral and earth is ≤ 1 V;
- the ohmic resistance is < 6 Ω.

It is advisable to mount a ferrite core on the supply line, as close to the controller as possible, to limit electromagnetic interference.

The power supply line must be separate from the controller's inputs and outputs.

2.4. EMC and LVD conformity

2.4.1. EMC conformity

The Advanced Power Controller meets the electromagnetic compatibility requirements of Directive 2014/30/EU and subsequent amendments.
EMC conformity has been verified with regard to the information given in Tables 1 and 2.

The GRC series of products are mainly intended for use in an industrial environment, installed in switchboards or control panels of machines or production process systems.
The strictest general standards have been applied for electromagnetic compatibility purposes, as shown in the tables below.

Caution! The controller is designed for class A equipment. Use in a domestic environment may cause radio interference. In this case, the user may be required to adopt additional attenuation methods.

2.4.2. EMC filters

EMC filters are required in PA (Phase Angle, i.e., SCR triggering with a modulated phase angle) operating mode.
The filter model and current size depend on the configuration and the load used. It is important that the power filter is connected as close as possible to the GRC.
A filter connected between the power supply line and the GRC or an LC unit connected between the GRC output and the load may be used.

2.4.3. LVD or low voltage conformity

The GRC complies with the Low Voltage Directive 2014/35/EU.

2.4.4. Electrical safety

See table 3 for the standards applied.

EMC emission:		
AC semiconductor motor controllers and conductors for non-motor loads	CEI EN IEC 60947-4-3	
Emission enclosure compliant in firing mode single cycle and phase angle if external filter fitted	CEI EN IEC 60947-4-3 CISPR-11 EN 55011	Class A Group 2

Table 1

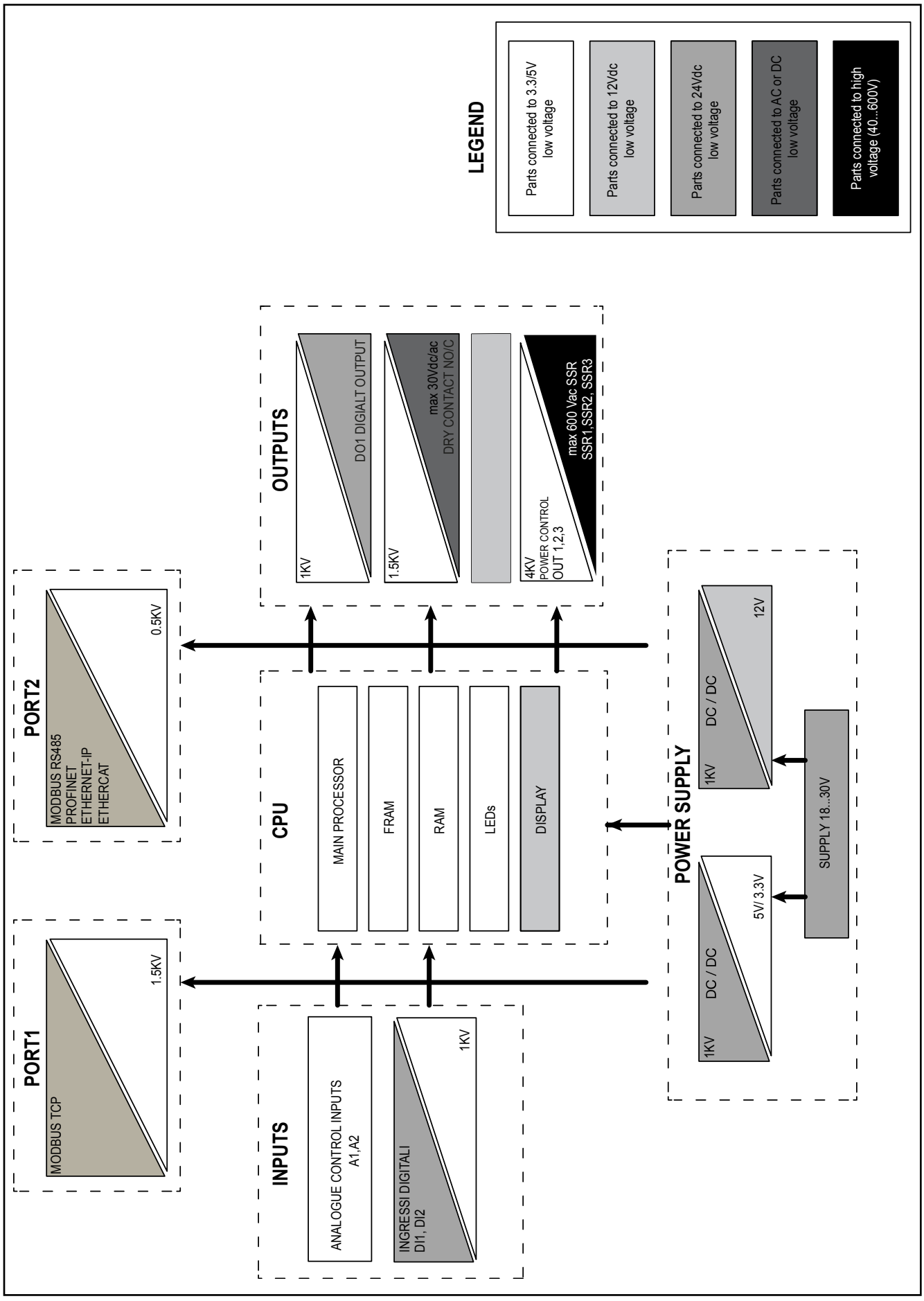
EMC Immunity		
Generic standards, immunity standard for industrial environments	CEI EN IEC 60947-4-3	
ESD immunity	CEI EN IEC 60947-4-2	4 kV contact discharge 8 kV air discharge
RF interference immunity	CEI EN IEC 61000-4-3	10 V/m amplitude modulated 80 MHz-1 GHz 10 V/m amplitude modulated 1.4 GHz-2 GHz
Conducted disturbance immunity	CEI EN IEC 61000-4-6	10 V/m amplitude modulated 0.15 MHz-80 MHz
Burst immunity	CEI EN 61000-4-4	2 kV power line 1 kV I/O signal line
Surge immunity	CEI EN 61000-4-4/5	Power line - line 1 kV Power line - earth 2 kV Signal line - earth 2 kV Signal line - line 1 kV
Magnetic fields immunity	Test is not required. Immunity is demonstrated by the successfully completion of the operating capability test.	
Voltage dips, short interruptions and voltage immunity tests	CEI EN IEC 61000-4-11	100%U, 70%U, 40%U,

Table 2

Electrical safety		
Safety requirements for electrical equipment for measurement, control and laboratory use	CEI EN 61010-1/A1	
UL Standard for Safety Industrial Control Equipment	UL 508	

Table 3

2.5. GRC insulation diagram



3. ELECTRICAL CONNECTIONS

CAUTION! Before connecting or disconnecting any connections, check that the power, power supply and control cables are isolated from voltage. External circuits connected must have double insulation. The input cables must be physically separated from those of the power supply, outputs and power connections. Use braided and shielded cables for the inputs, with the sheathing earthed at a single point. Appropriate fuses or automatic circuit breakers must always be provided to protect the power lines. The fuses in the module serve only to protect the semiconductors of the GRC.

3.1. Description of the connections

Description of the CPU GRC connections

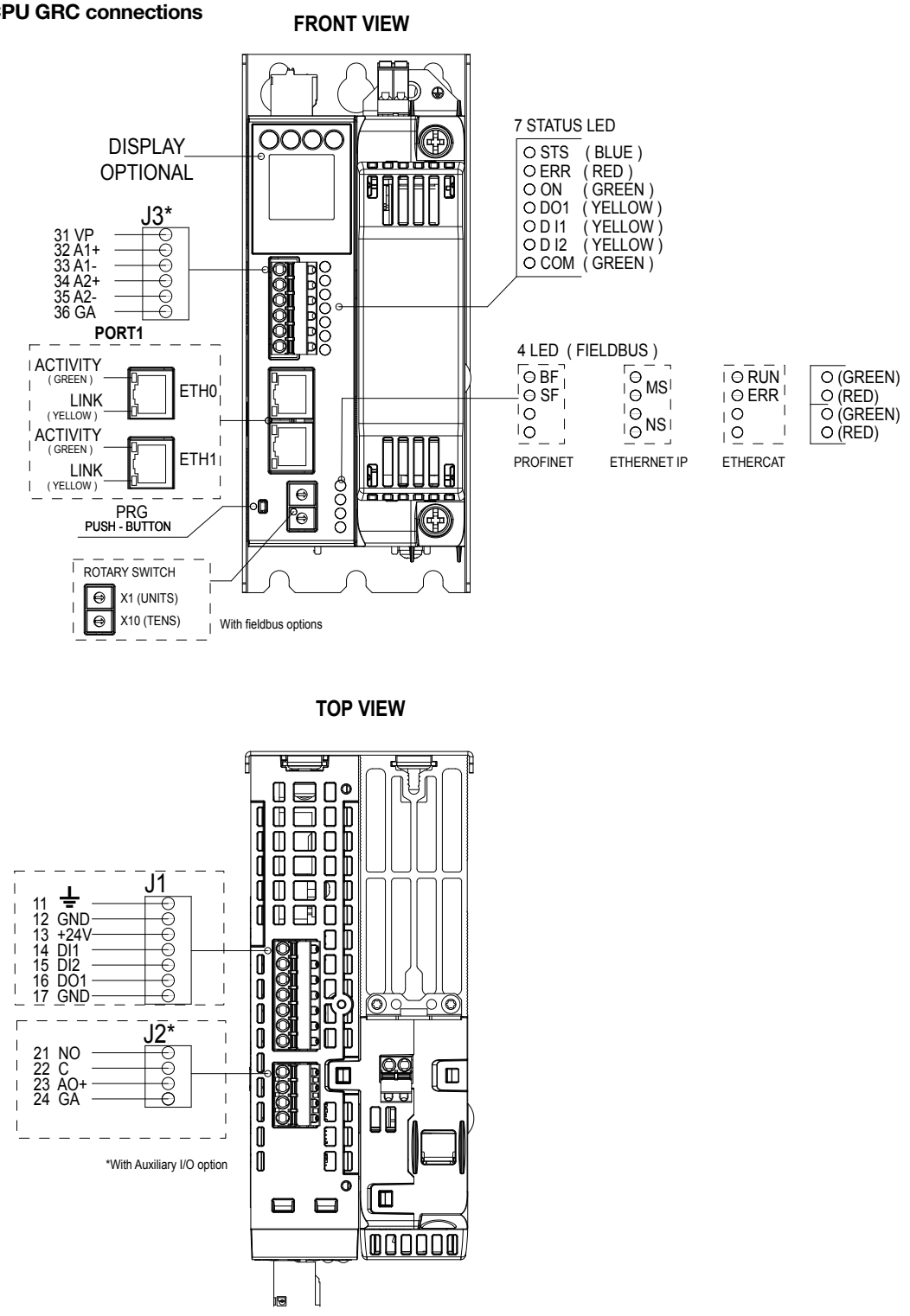
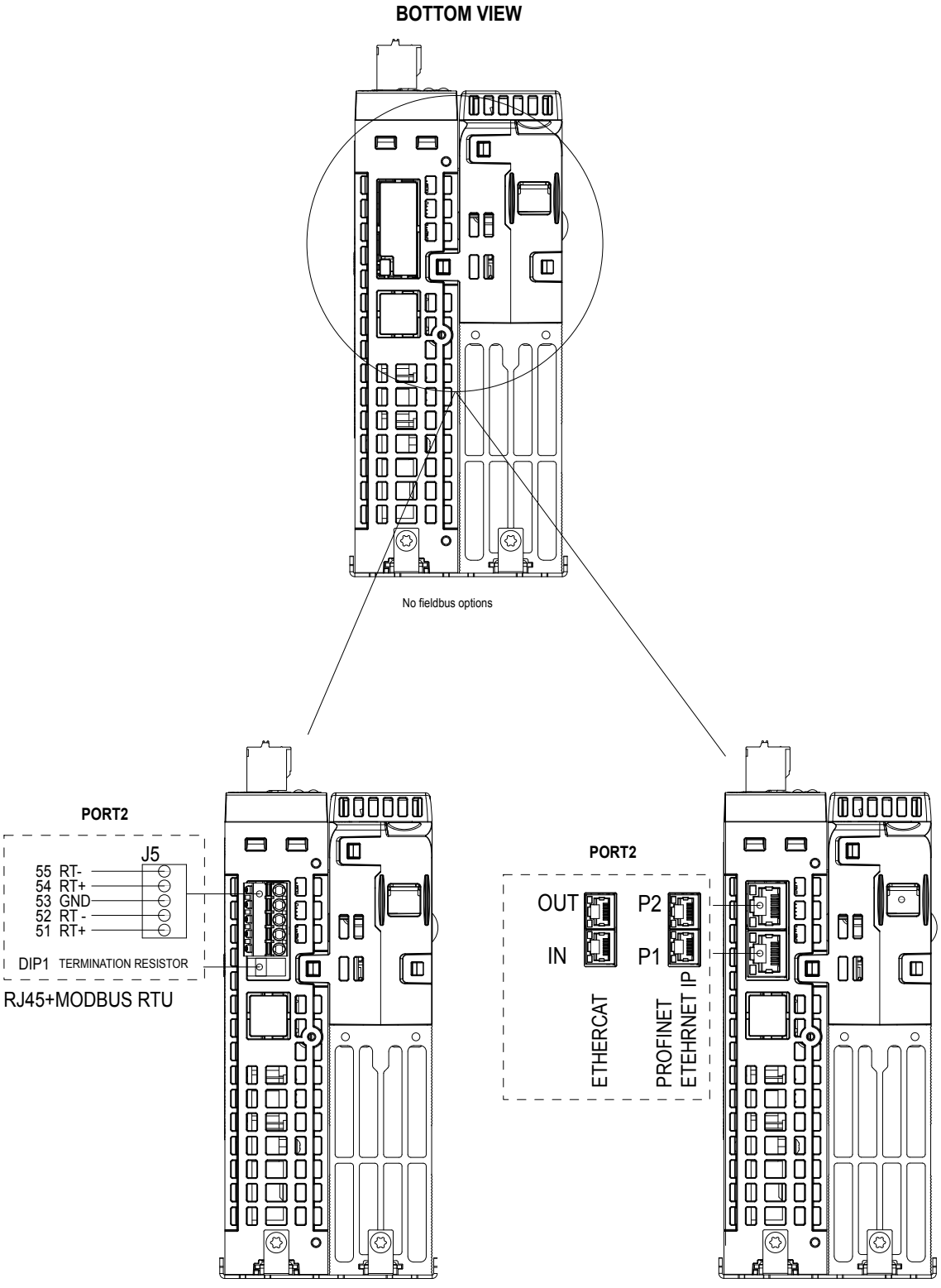
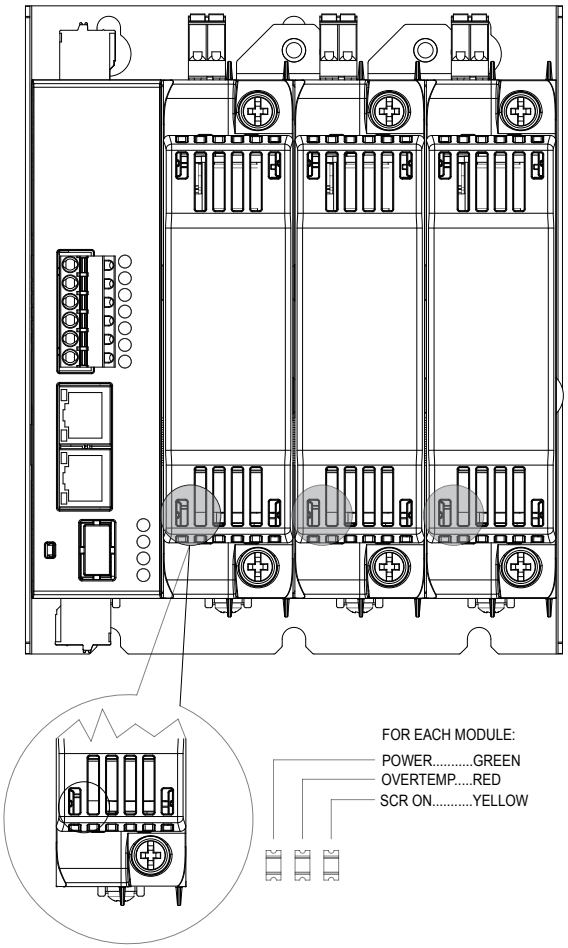


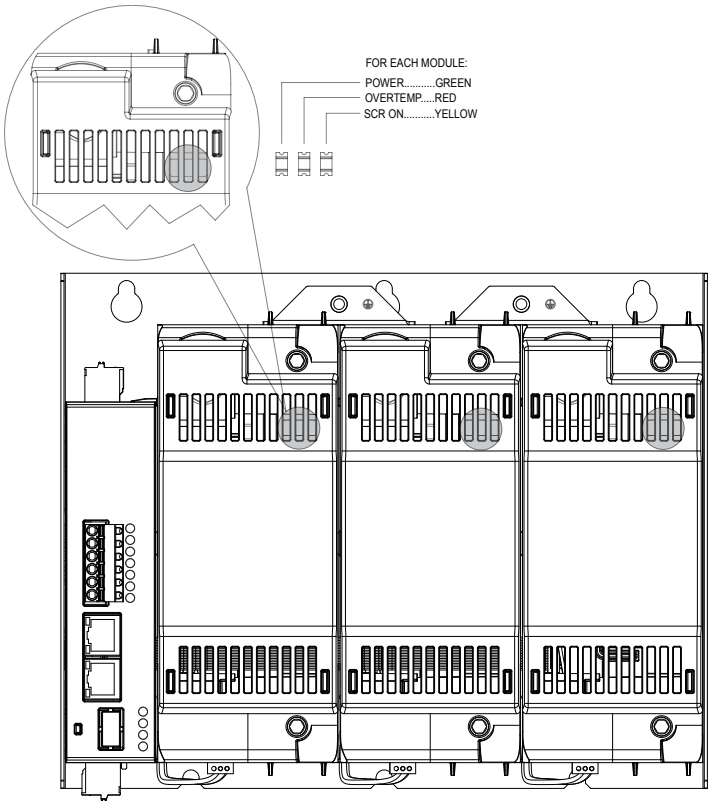
Figure 11 - Description of the GRC 40 A...GRC 300 A connections


BOTTOM VIEW
No fieldbus options
PORT2
J5
55 RT-
54 RT+
53 GND
52 RT -
51 RT+
DIP1 TERMINATION RESISTOR
RJ45+MODBUS RTU
PORT2
OUT
IN
P2
P1
ETHERCAT
PROFINET
ETEHRNET IP

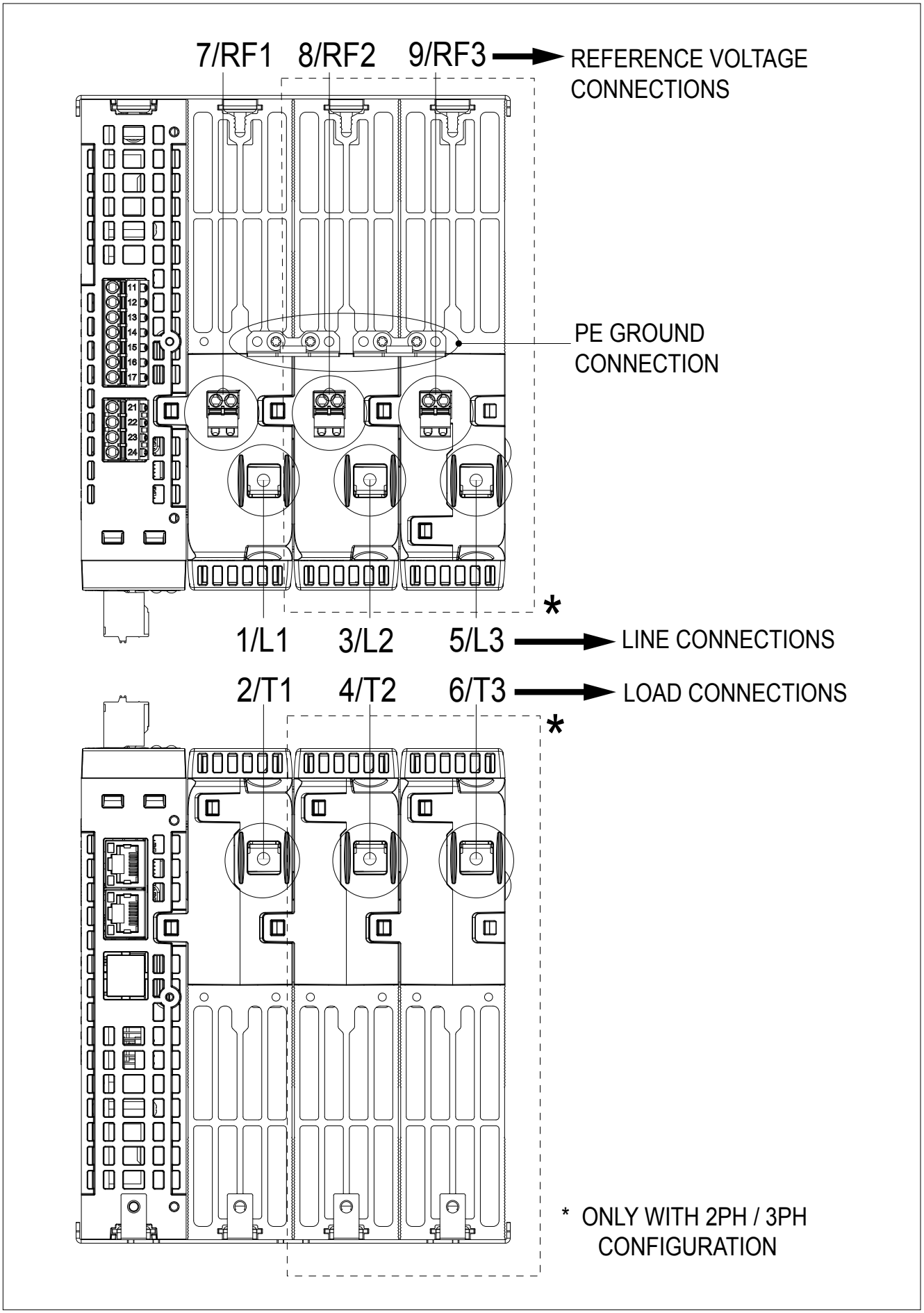
Power Modules LEDs 25-40A



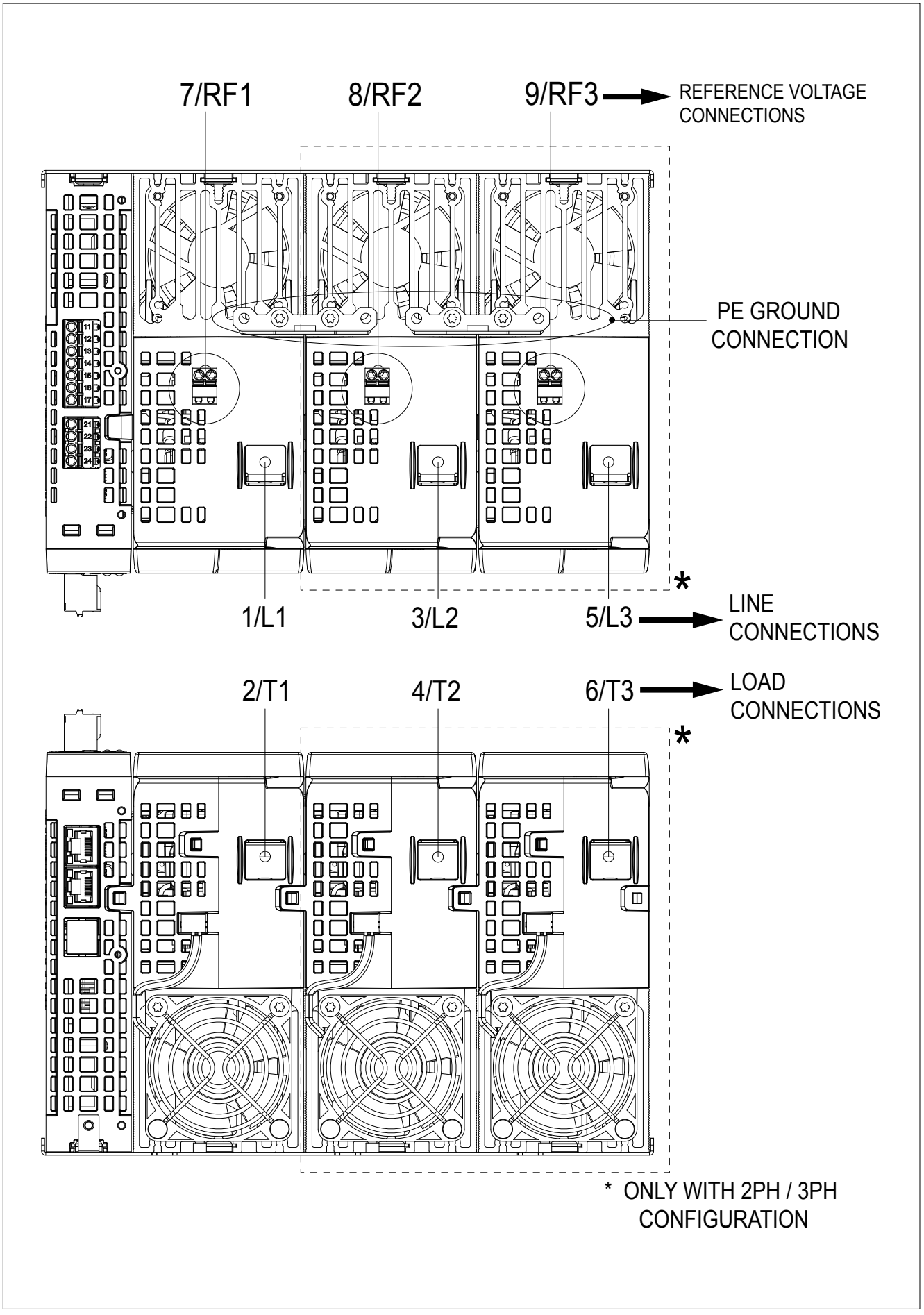
Power Modules LEDs 60-150A



Description of GRC 25 .. 40A power connections



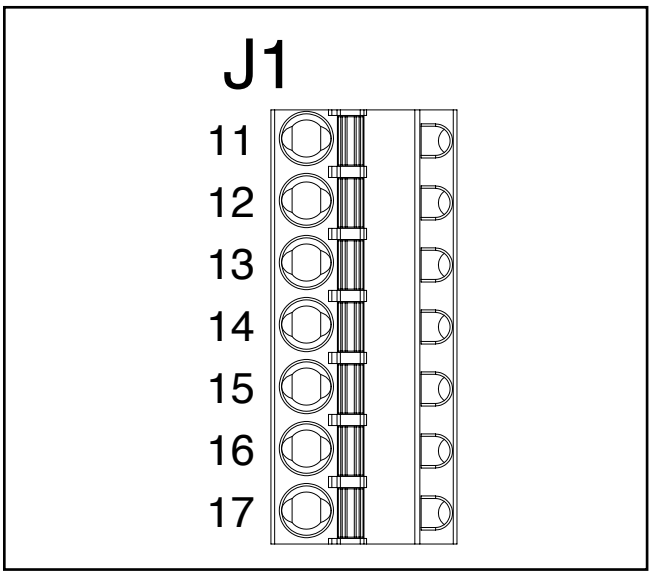
Description of GRC 60 .. 150A power connections



3.2. Inputs

3.2.1. J1 connector - Power supply Base I/O.

The J3 connector includes the power input of the GRC controller, 2 digital inputs and one PNP output, configurable via software as NPN or PNP.
For permissible voltages and currents see the Technical Data.
Use cables with a cross-section of 0.25...2.5 mm2 (23-14 AWG) terminated with ferrules for connection.



PIN	Name	Description
11	EARTH	EARTH EMC
12	GND	GND COMMON
13	+24 Vdc	Power supply 24 Vdc
14	DI1	Digital input 1 type PNP
15	DI2	Digital input 2 type PNP
16	DO1	Digital output 1 type PNP
17	GND	GND COMMON

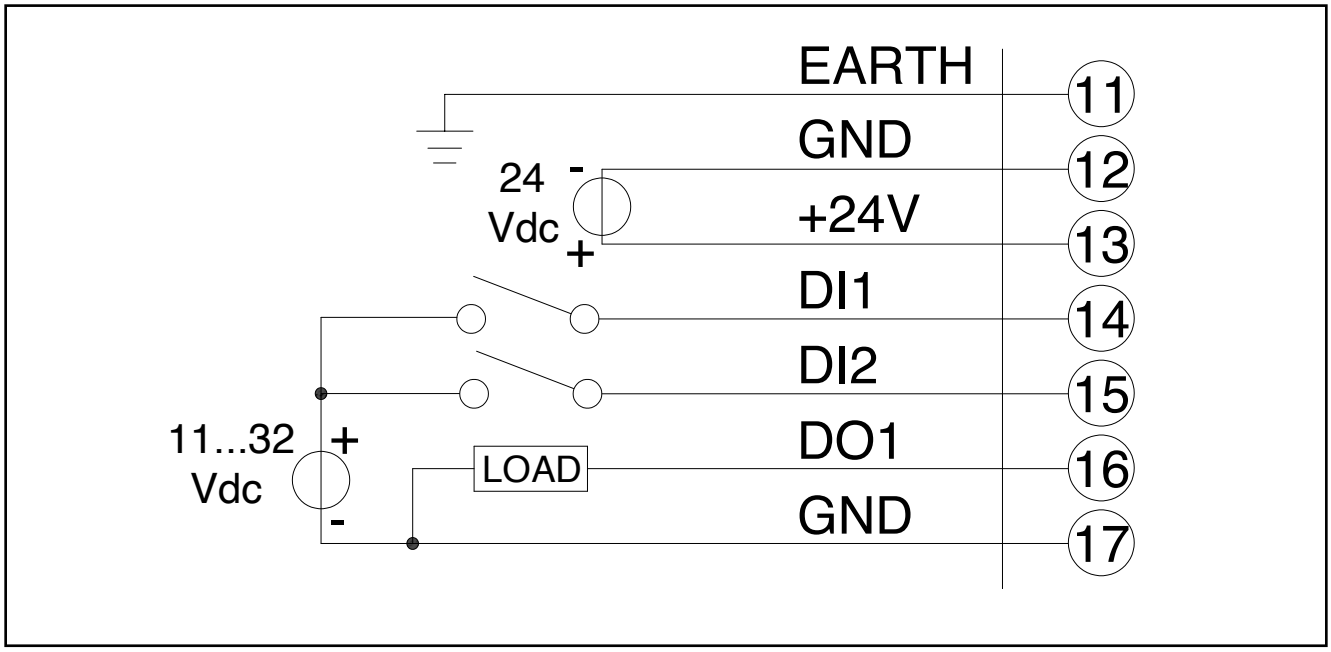
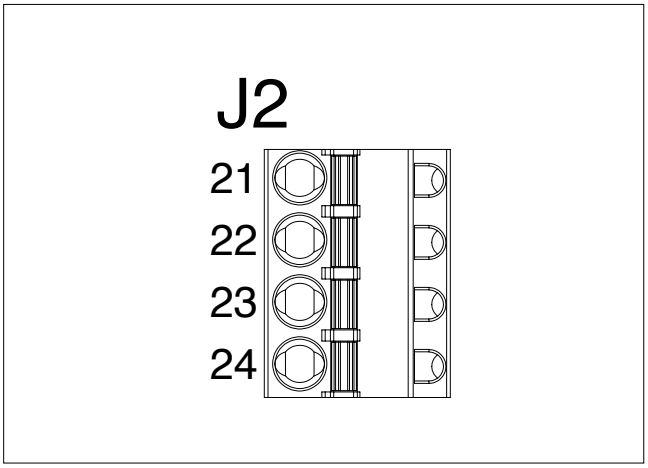


Figure 12 - Power supply and I/O base input connection diagram

3.2.2. J2 connector - Optional outputs

The J2 connector includes a dry contact output and a 12-bit analog output that can be configured via software as follows:

- Voltage 0 ... 10V
- Voltage 2 ... 10V
- Current 0 ... 20mA
- Current 4 ... 20mA (DEFAULT)



PIN	Name	Description
21	NO	Normally open contact
22	C	Common
23	AO+	Analog output
24	GA	GROUND analog output signal

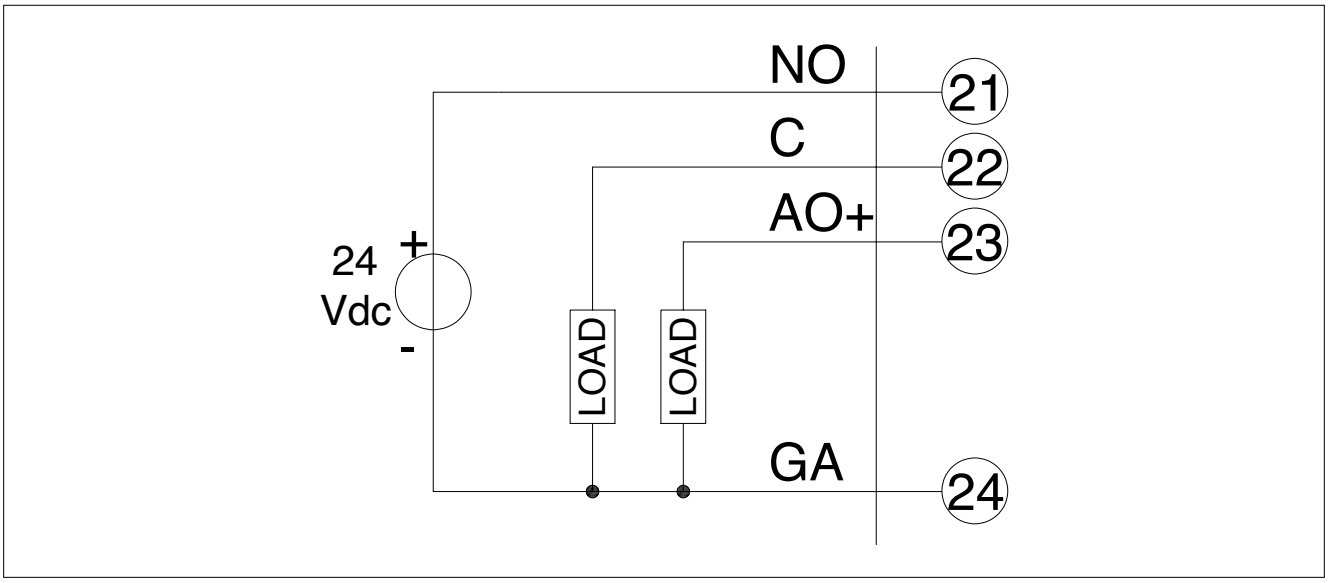


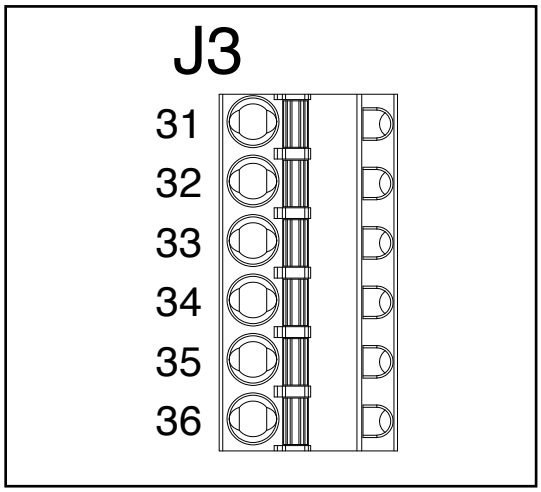
Figure 13 - Optional output connection diagram

3.2.3. J3 Connector - Analogue control inputs (optional)

The J3 connector includes 2 analogue inputs, configurable via software as:

- Voltage input 0...10 V
- Voltage input 0...5 V
- Potentiometer input
- Current input 0...20 mA
- Current input 4...20 mA

For technical specifications, see the Technical Data.
Use shielded cables with a cross-section of 0.25...2.5 mm2 (23-14 AWG) terminated with ferrules for connection.



PIN	Name	Description
31	VP	5V output for potentiometer power supply
32	A1+	Analogue command input A1+
33	A1-	Analogue command input A1-
34	A2+	Analogue command input A2+
35	A2-	Analogue command input A2-
36	GA	Ground of analog signal

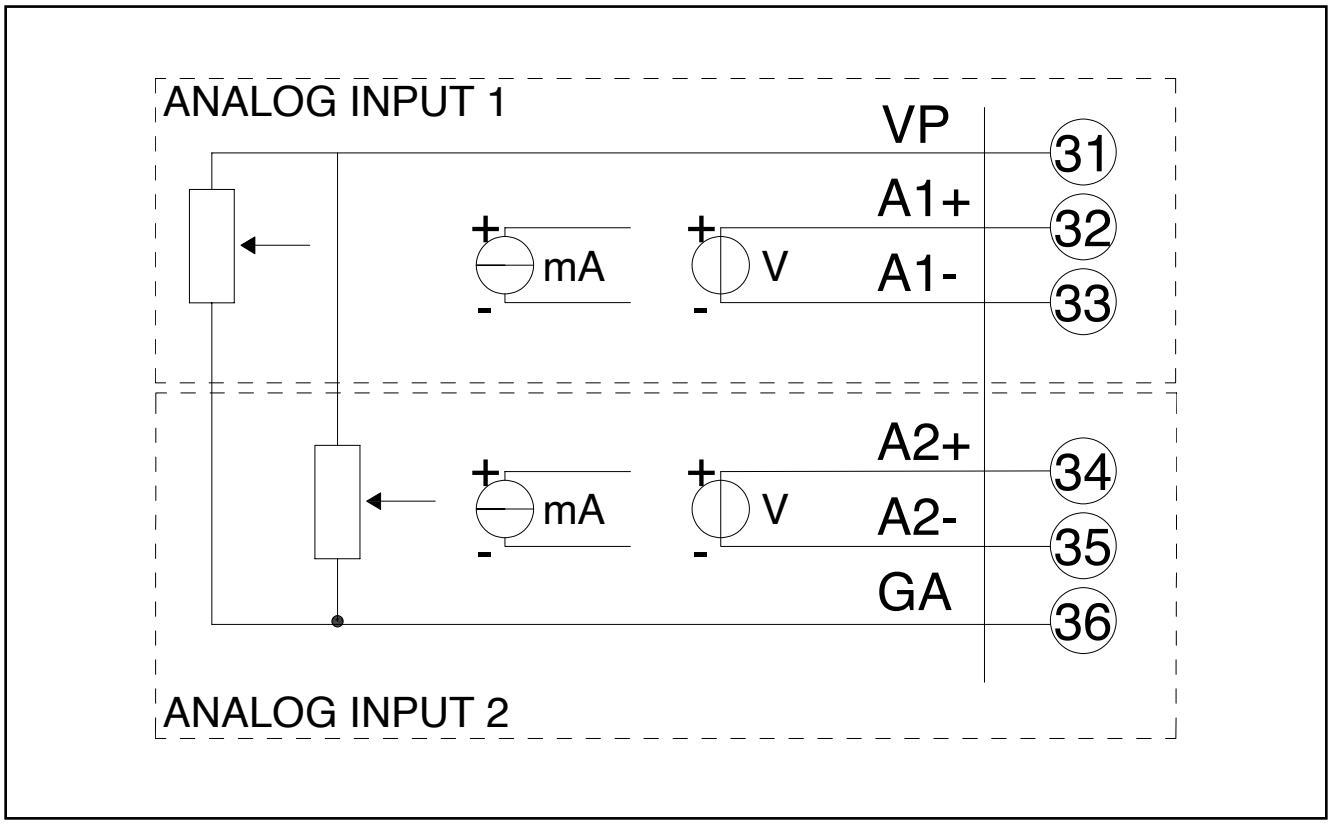
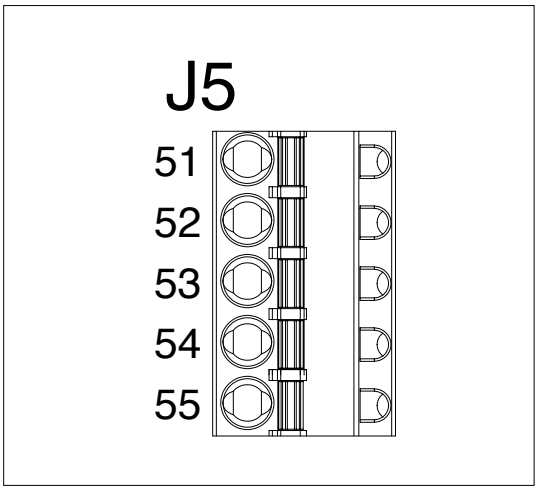


Figure 14 - Optional analog input connection diagram

3.2.4. J5 connector - Modbus RTU (optional)

The J5 connector is dedicated to ModbusRTU communication (PORT2).
Combined with the J5 connector, there is a physical dip switch (DIP1) for termination resistance and a pair of hexadecimal rotary switches (x1 for units, x10 for tens) for node number addressing

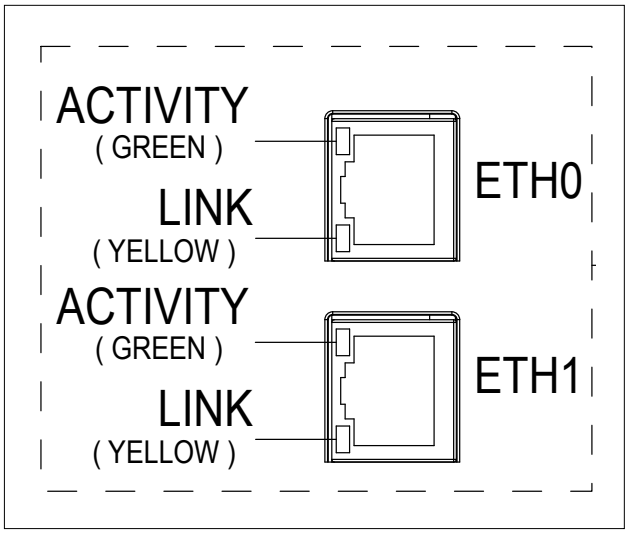


PIN	Name	Description
51	RT+	DATA Reception / Transmission (A+)
52	RT-	DATA Reception / Transmission (B-)
53	GND	GROUND
54	RT+	DATA Reception / Transmission (A+)
55	RT-	DATA Reception / Transmission (B-)

3.2.5. RJ45 ETH0/ETH1 ports (PORT1) (always on board)

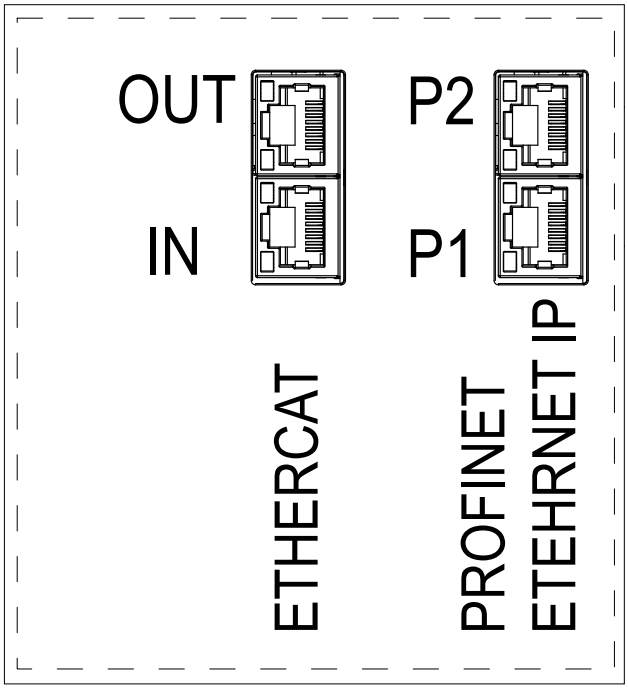
The RJ45 ETH0 and ETH1 (PORT1) ports are dedicated to different purposes:

- ModbusTCP communication
- Configuration and diagnostics via Gefran GF_eXpress software (via ModbusTCP)
- Access to the integrated WEB server
- Integrated GSLM: communication between different devices
- Bridge communication between different devices



3.2.6. RJ45 IN/OUT ports (EtherCAT) -P1/P2 (Profinet. EthernetIP) (PORT2) (optional)

The RJ45 ports are dedicated to communication with the selected fieldbus network. The port nomenclature varies depending on the selected bus.
Combined with these options, a pair of hexadecimal rotary switches (x1 for units, x10 for tens) are available for addressing (if necessary).



3.3. Power connections

3.3.1. Recommended cable cross-section

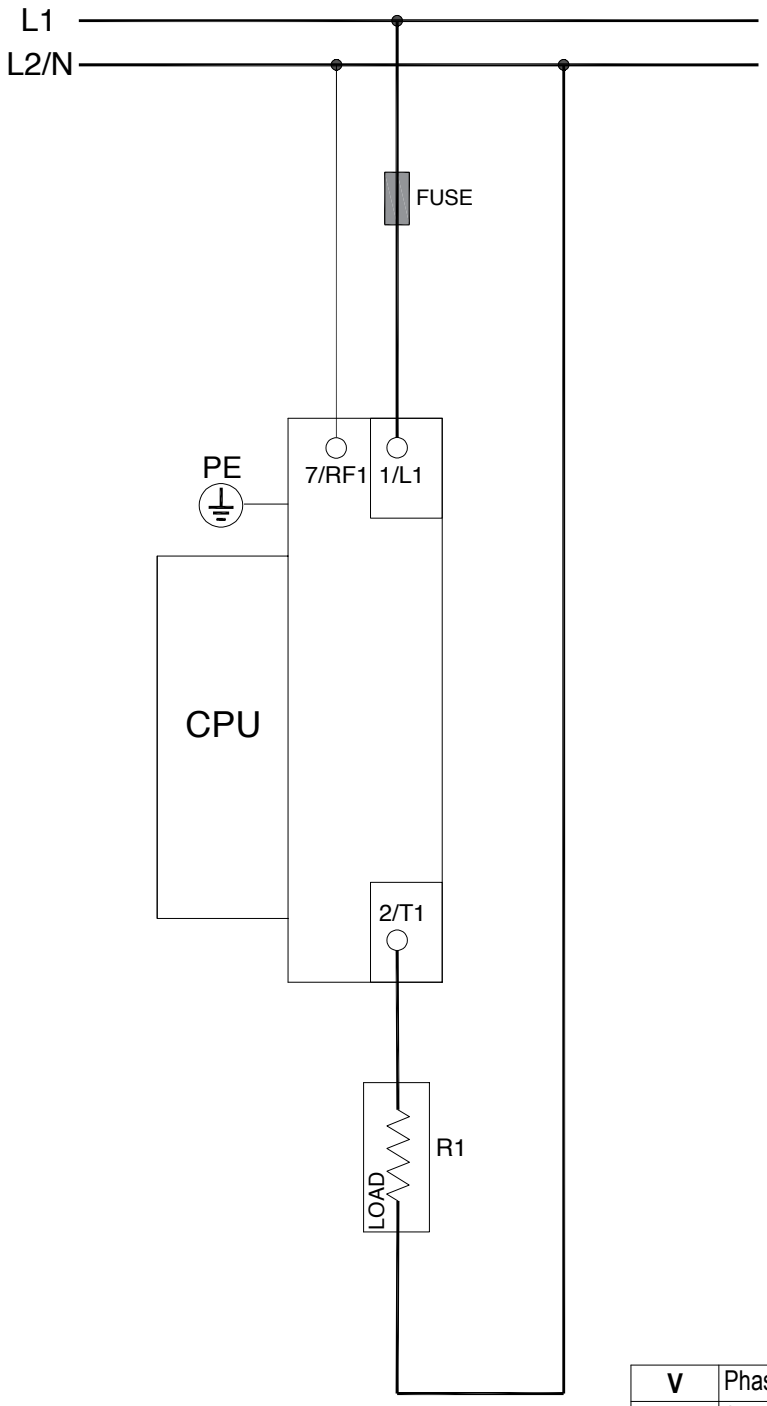
POWER TERMINALS							
Nominal current of the load	**25A**	**40A**	**60A**	**75A**	**90A**	**120A**	**150A**
Contact area (WxD)	10 x 11 mm		15 x 14 mm				
Stripping length	15 mm		20 mm				
1 Conductor section **2 Conductors section** *(minimum section)*	1 x 6 mm^2 / 2 x 4 mm^2	1 x 10 mm^2 / 2 x 6 mm^2	1 x 25 mm^2 / 2 x 16 mm^2		35 mm^2	1 x 50 mm^2 / 2 x 25mm^2	1 x 50 mm^2 / 2 x 25mm^2
	1 x 10 AWG / 2 x 12 AWG	1 x 8 AWG / 2 x 10 AWG	1 x 4 AWG / 2 x 6 AWG	1 x 3 AWG / 2 x 6 AWG	2 AWG	1 x 1/0 AWG / 2 x 3 AWG	1 x 1/0 AWG / 2 x 3 AWG
Maximum allowed section	1 x 50 mm2 / 2 x 25 mm2 1 x 1/0 AWG / 2 x 3 AWG		1 x 70 mm^2 / 2 x 35 mm^2 1 x 2/0 AWG / 2 x 2 AWG				
Tightening torque	5 Nm (44,25 lb-in)		10 Nm (88,51 lb-in)				
Note: Use 60/75°C Copper conductors only (for 150A only use 75°C)							

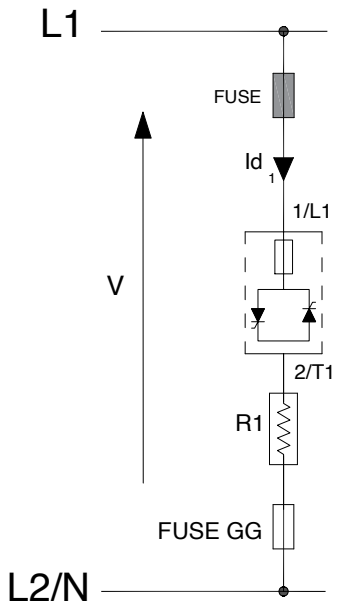
GROUND TERMINAL	
Contact area **models 25/40 A**	275 mm^2
Contact area **models 60/75/90/120/150 A**	472 mm^2
Screw type	M5
Tightening torque	1,5 - 2,5 Nm (13,3 - 22 lb-in)

VLINE TERMINAL	
1 Conductor section **2 Conductors section**	1 x 0.2 - 2.5 mm^2 / 2 x 0.5 - 1.5 mm^2
	1 x 24 – 12 AWG 2 x 20 - 16 AWG
Stripping length	10 mm

3.4. Connection examples

3.4.1. Connection example for single-phase GRC (1PH) for a single-phase load



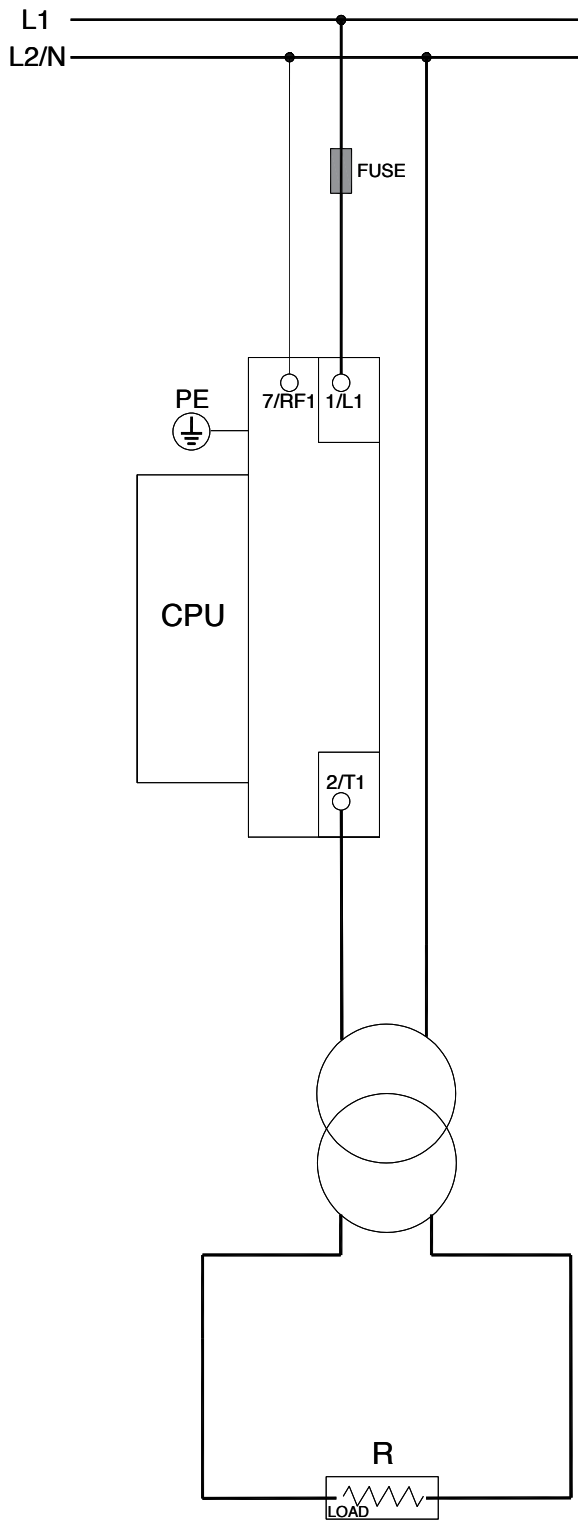


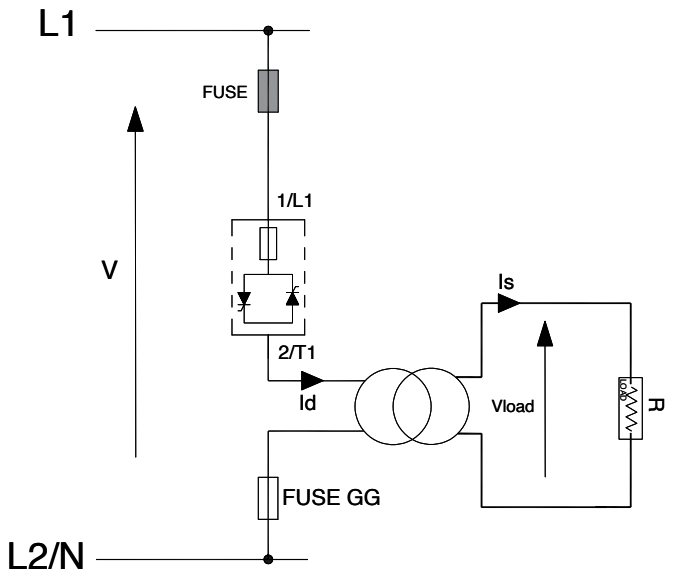
$$Id = \frac{P}{V \cos\varphi}$$

V	Phase / phase-to-phase voltage (L1 - L2 / N)
P	Single-phase single load power
Id	Load current if resistive load cosφ=1

FIRING MODE	ZC, BF, HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	0

3.4.2. Connection example for single-phase GRC (1PH) for a single-phase load with transformer



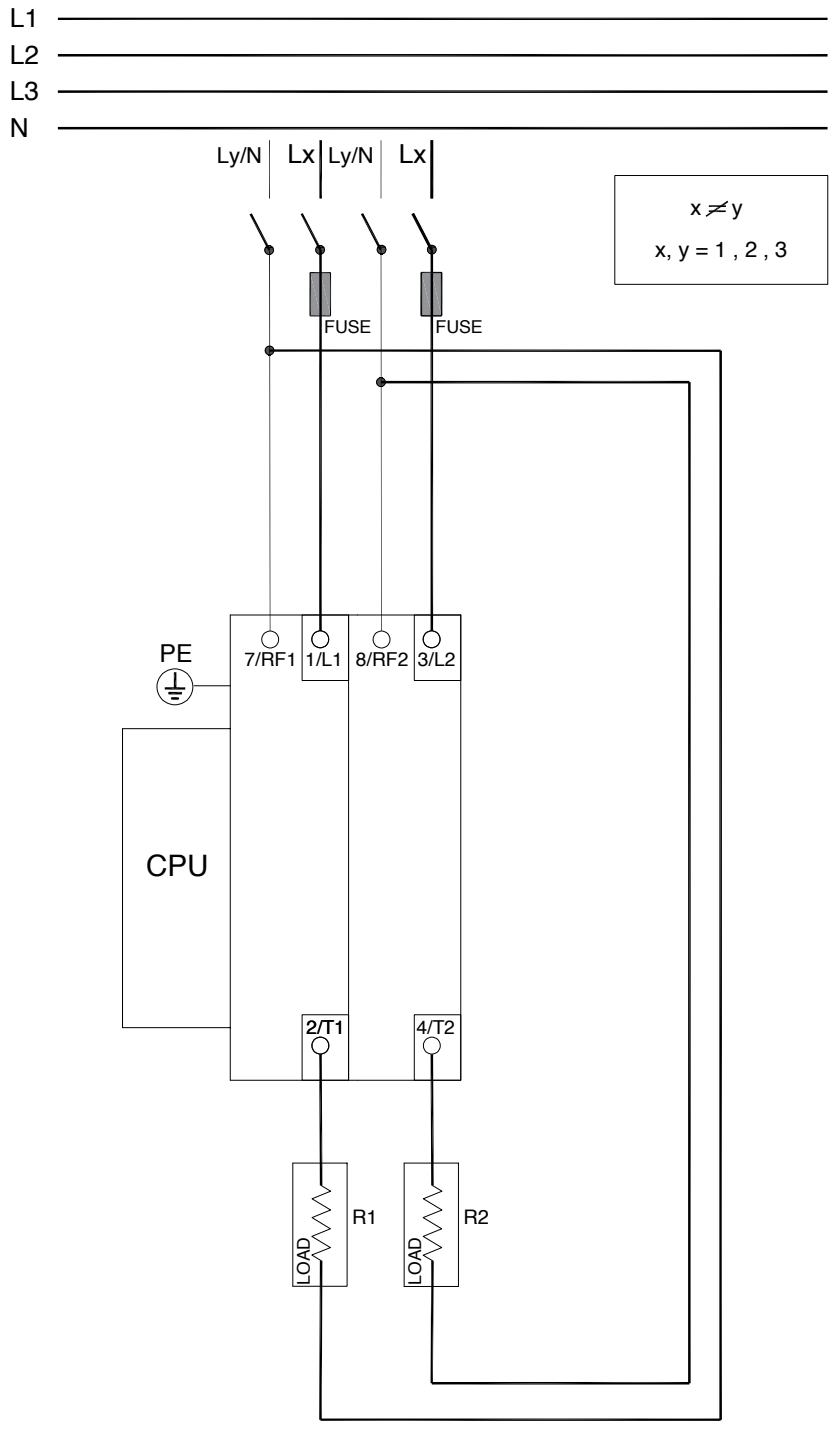


$$Id = \frac{P}{\eta \times V \times \cos\varphi} \qquad Is = \frac{P}{Vload \times \cos\varphi}$$

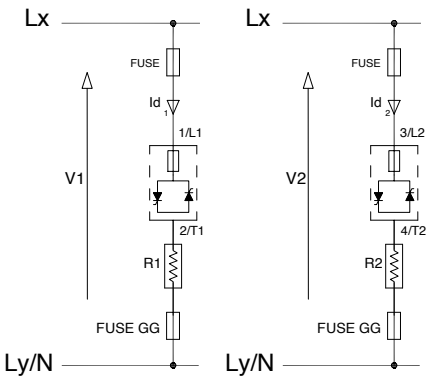
V	Phase / phase-to-phase voltage (L1 - L2 / N)
P	Single-phase single load power
Vload	Voltage on secondary (load)
Id	Current in primary
Is	Current in secondary
η	Transformer output (typical 0.9) if resistive load cosφ=1

FIRING MODE	ZC, PA, BF (bF.Cy≥ 2)
HB DIAGNOSTICS AVAILABLE	Partial and total load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	64

3.4.3. Connection example for two-phase GRC (2PH) for 2 independent single-phase loads



Two single-phase loads can also be connected to different supply lines, line to line or line and neutral.
Different power levels can be managed for each of the two loads.

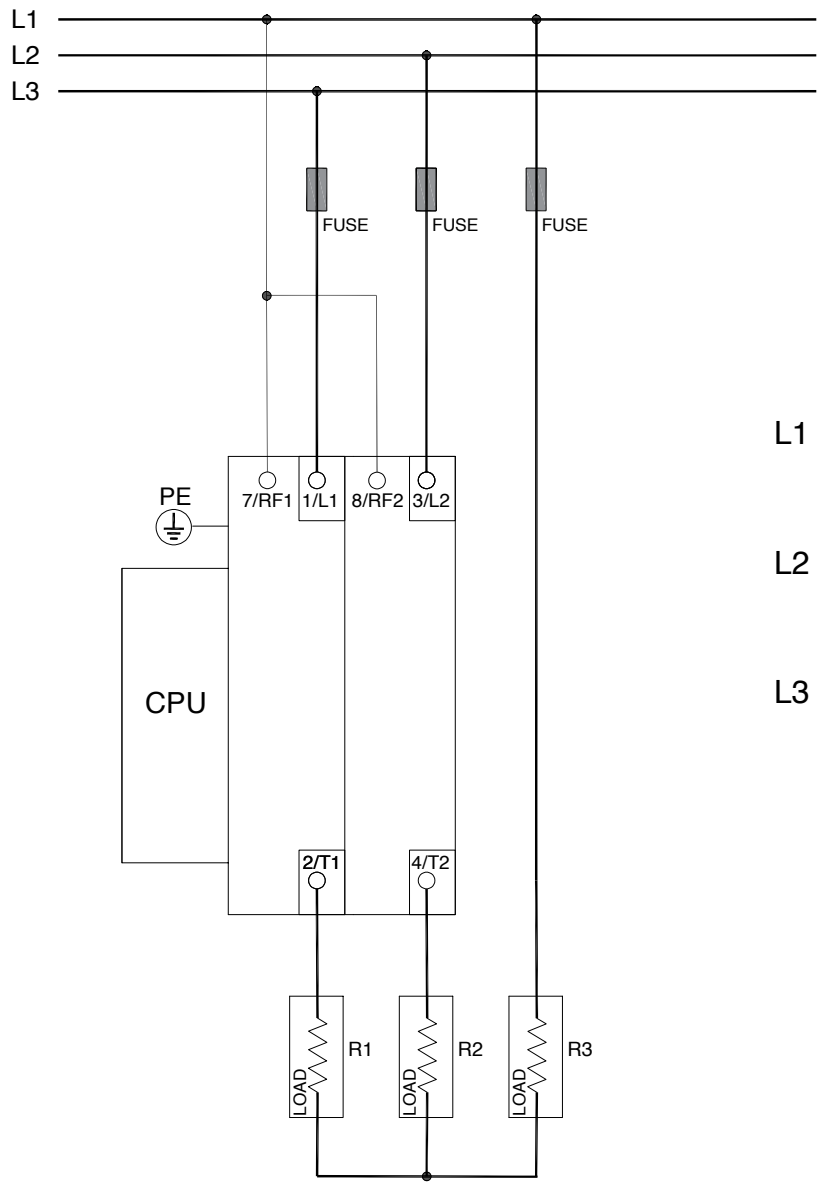


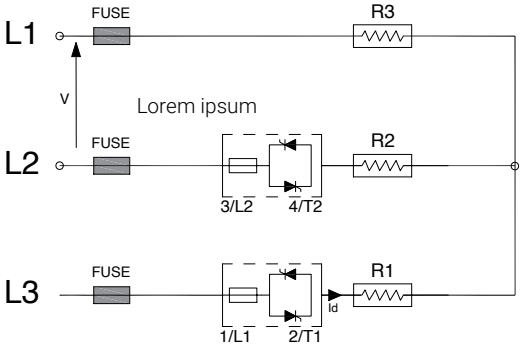
$$Id = \frac{P}{V \cos\varphi}$$

V	Phase to phase voltage (Lx - Ly / N)
P	Single-phase single load power
Id	Load current if resistive load cosφ=1

FIRING MODE	ZC, BF, HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	0

3.4.4. Connection example for two-phase GRC (2PH) for a three-phase star load without neutral



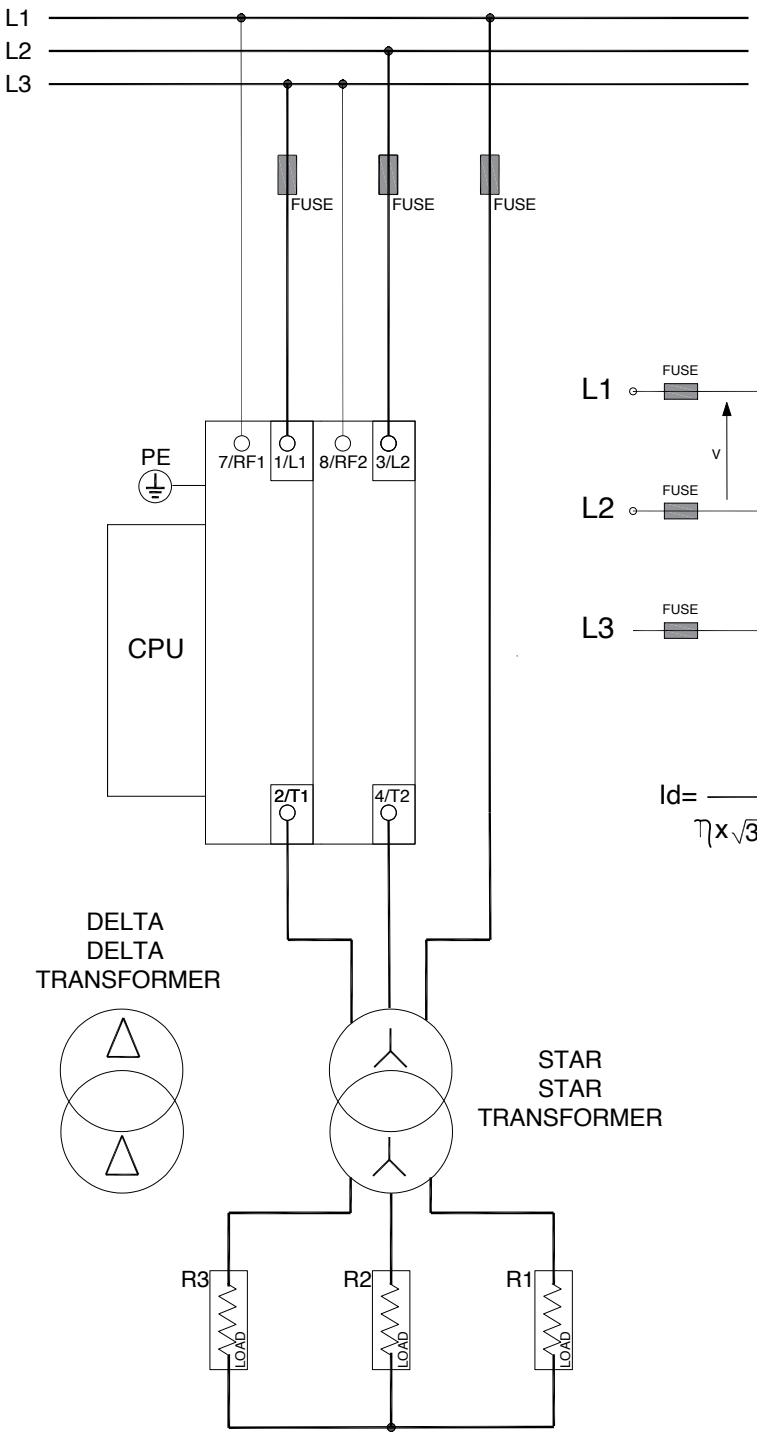


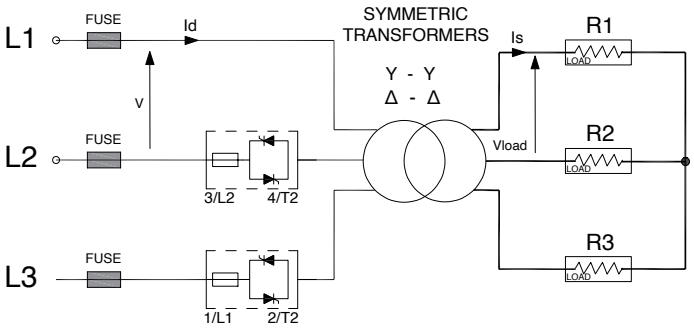
$$Id = \frac{P}{\sqrt{3} \times V \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Id	Load current if resistive load cosφ=1

FIRING MODE	ZC, BF
HB DIAGNOSTICS AVAILABLE	Total load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	4

3.4.5. Connection example for two-phase GRC (2PH) for a three-phase star load without neutral with transformer



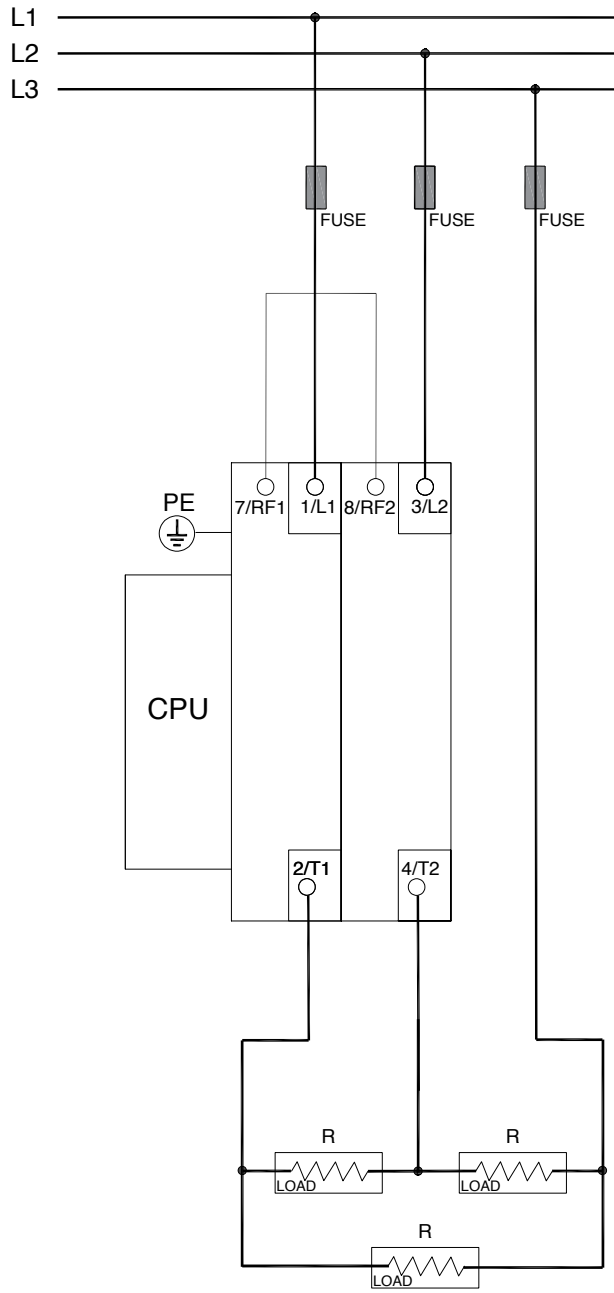


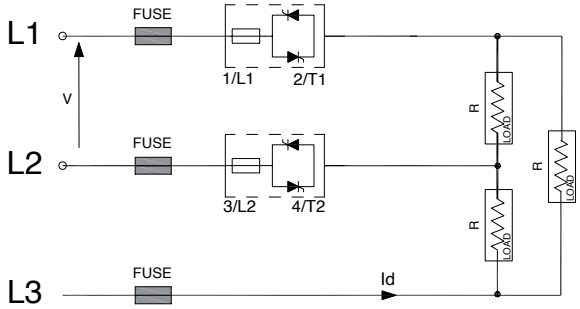
$$Id = \frac{P}{\eta x \sqrt{3}\ Vx \cos\varphi} \qquad Is = \frac{P}{\sqrt{3} \times Vload \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Vload	Voltage on secondary (load)
Id	Current in primary
Is	Current in secondary
η	Transformer output (typical 0.9) if resistive load cosφ=1

FIRING MODE	ZC, BF
HB DIAGNOSTICS AVAILABLE	Total load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	68

3.4.6. Connection example for two-phase GRC (2PH) for a three-phase closed delta load



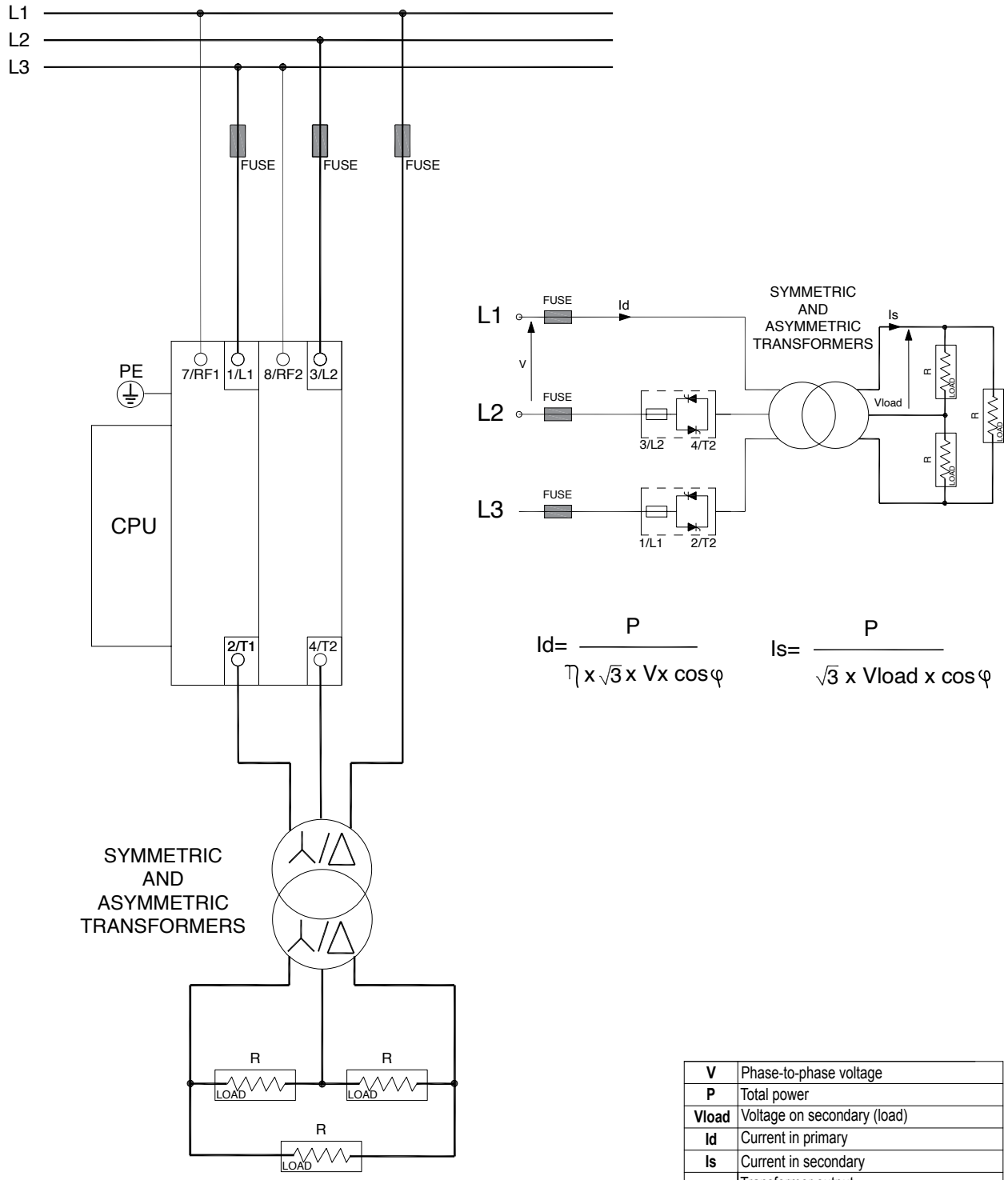


$$Id = \frac{P}{\sqrt{3} \times V \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Id	Load current if resistive load cosφ=1

FIRING MODE	ZC, BF
HB DIAGNOSTICS AVAILABLE	Total and partial load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	20

3.4.7. Connection example for two-phase GRC (2PH) for a three-phase closed delta load with transformer

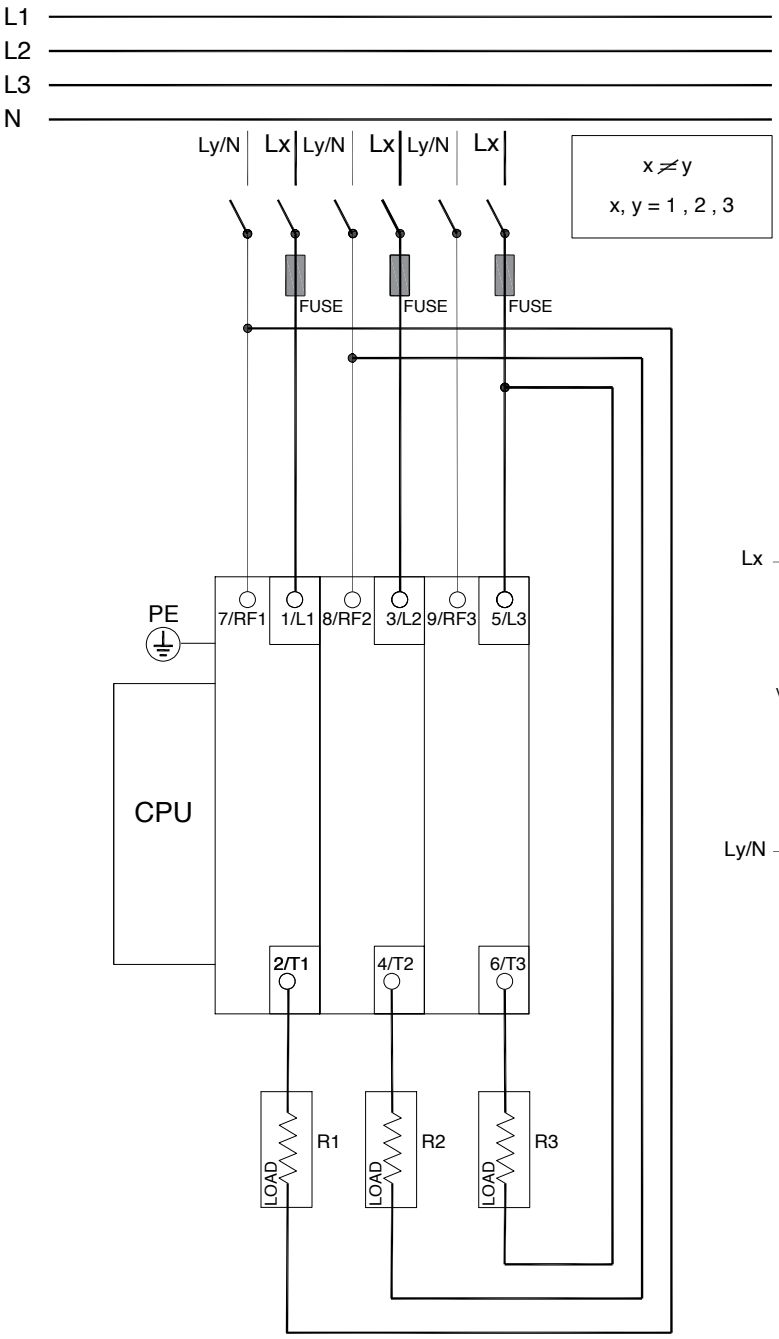


$$Id = \frac{P}{\eta \times \sqrt{3} \times Vx \cos\varphi} \qquad Is = \frac{P}{\sqrt{3} \times Vload \times \cos\varphi}$$

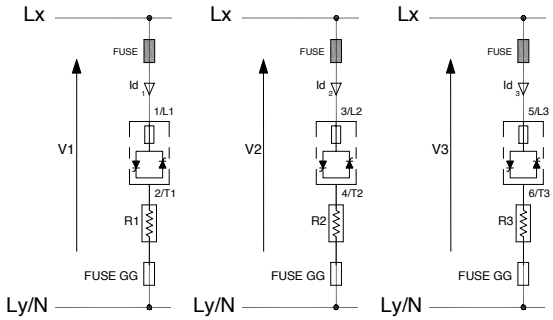
V	Phase-to-phase voltage
P	Total power
Vload	Voltage on secondary (load)
Id	Current in primary
Is	Current in secondary
η	Transformer output (typical 0.9) if resistive load cosφ=1

FIRING MODE	ZC, BF
HB DIAGNOSTICS AVAILABLE	Total load break
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	84

3.4.8. Connection example for three-phase GRC (3PH) for 3 independent single-phase loads



Two single-phase loads can also be connected to different supply lines, line to line or line and neutral.
Different power levels can be managed for each of the two loads.

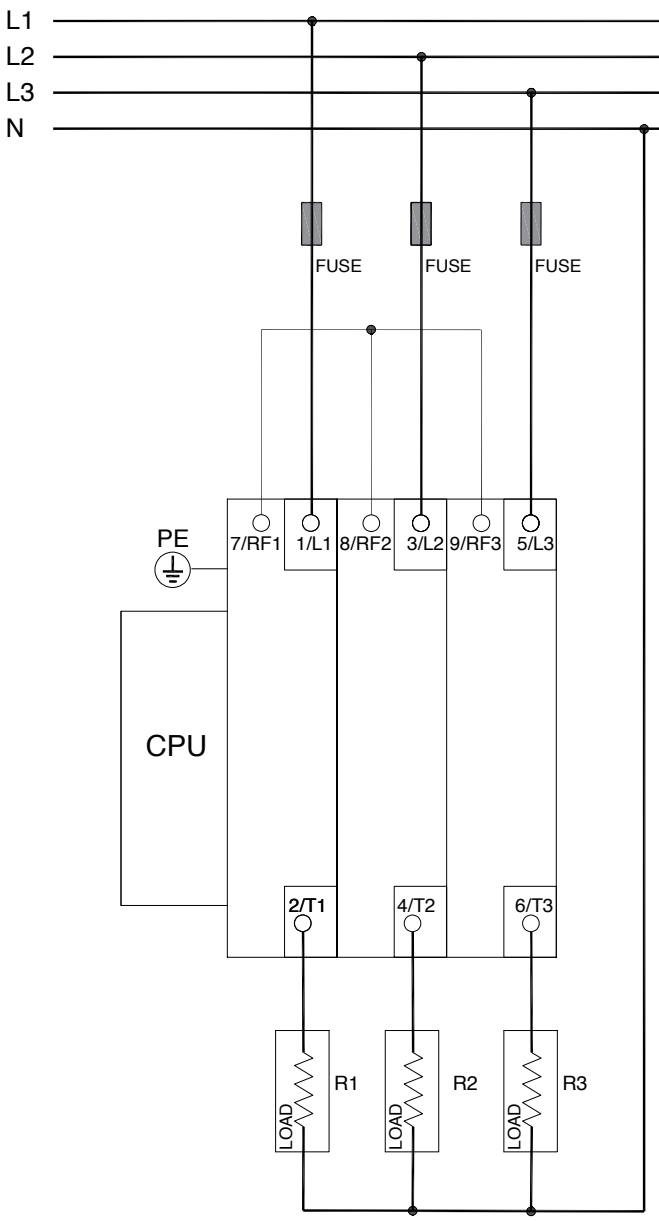


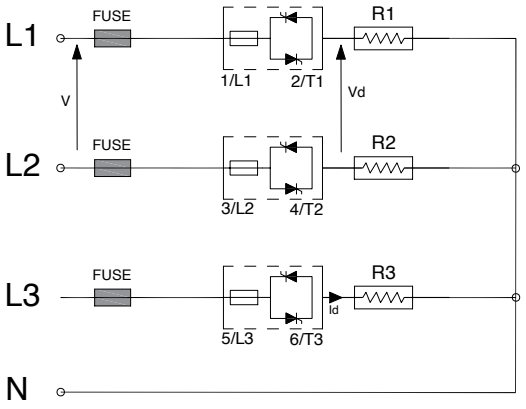
$$Id = \frac{P}{V \cos\varphi}$$

V	Phase / phase-to-phase voltage (L1 - L2 / N)
P	Single-phase single load power
Id	Load current if resistive load cos φ=1

FIRING MODE	ZC, BF, HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	0

3.4.9. Connection example for three-phase GRC (3PH) for a three-phase star load with neutral



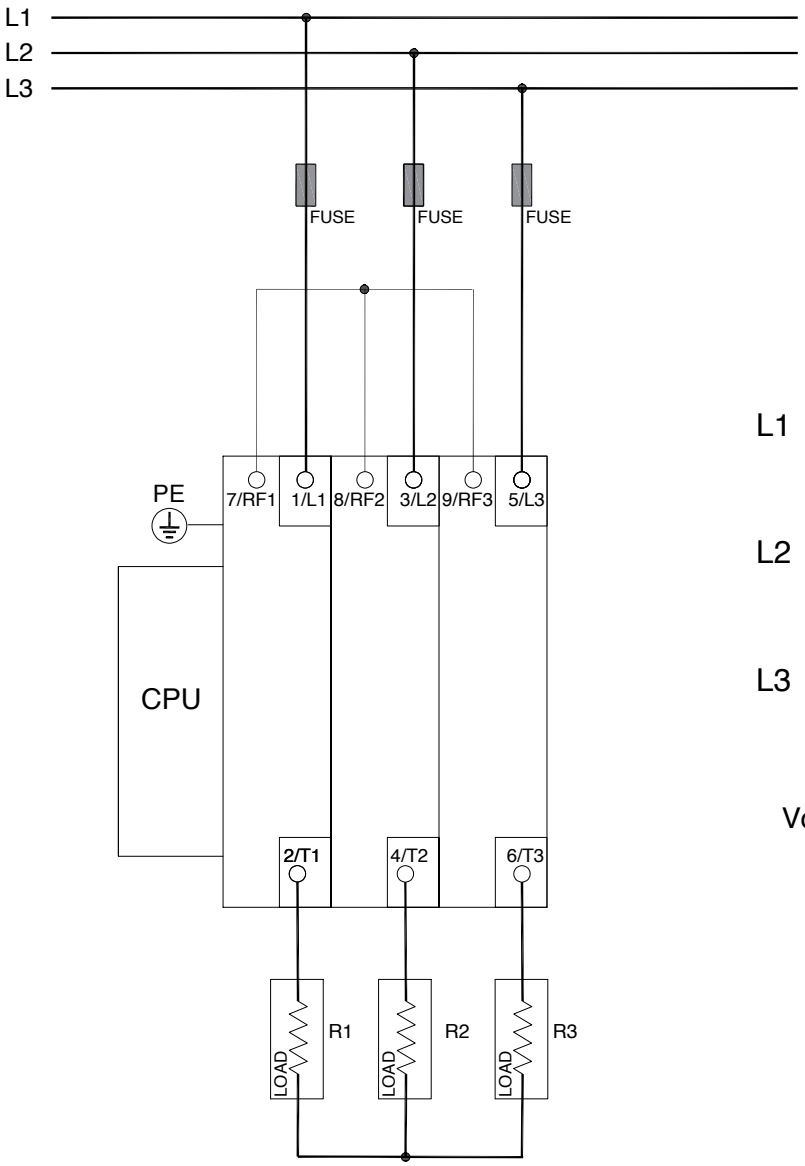


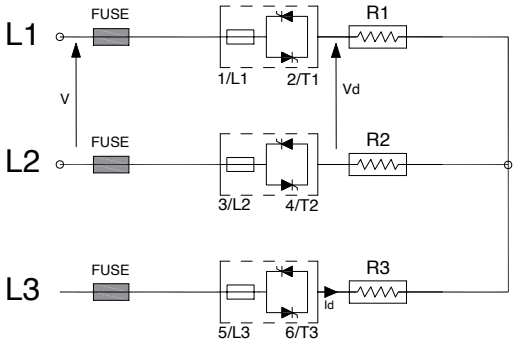
$$Vd = \frac{V}{\sqrt{3}} \qquad Id = \frac{P}{\sqrt{3} \times V \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Id	Load current if resistive load cos φ=1
Vd	Load voltage

FIRING MODE	ZC, BF,HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	12

3.4.10. Connection example for three-phase GRC (3PH) for a three-phase star load without neutral



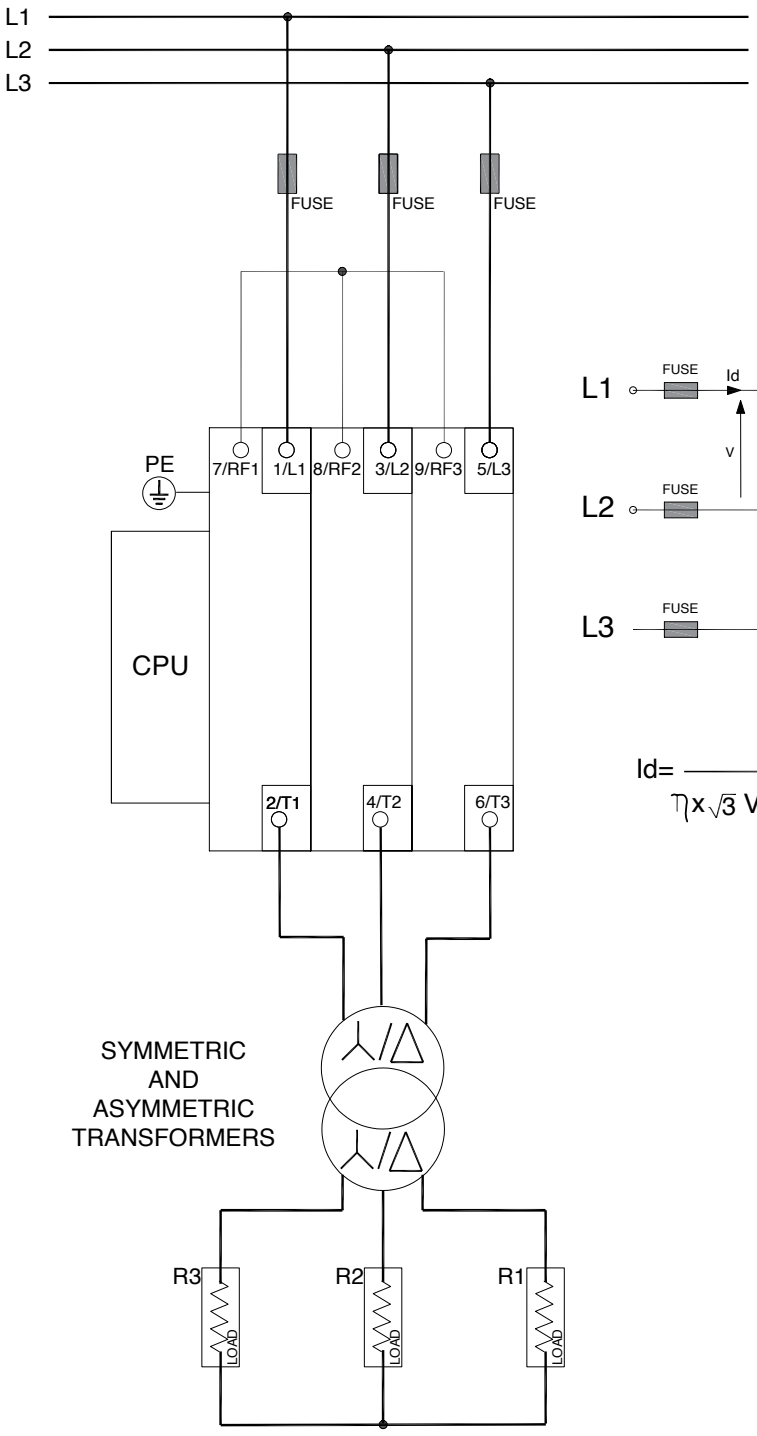


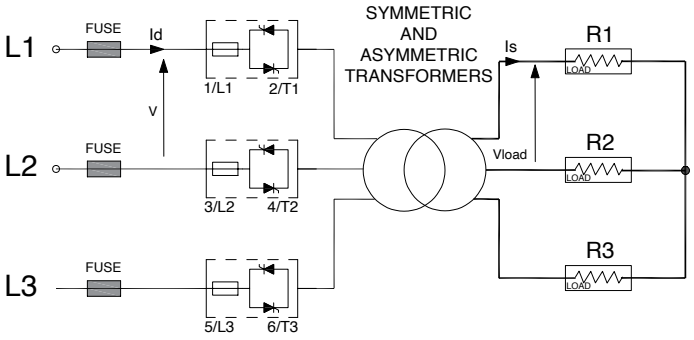
$$Vd = \frac{V}{\sqrt{3}} \qquad Id = \frac{P}{\sqrt{3} \times V \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Id	Load current if resistive load cos φ=1
Vd	Load voltage

FIRING MODE	ZC, BF, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch. For PA mode HB diagnostics active with P>30%.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	36

3.4.11. Connection example for three-phase GRC (3PH) for a three-phase star load without neutral with transformer



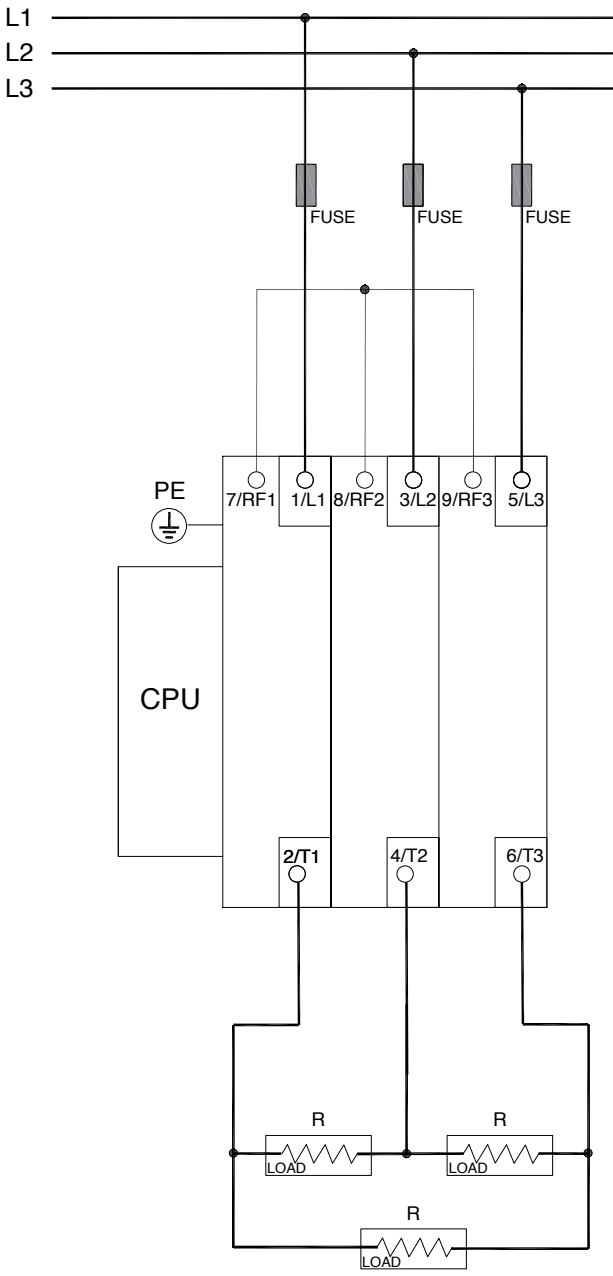


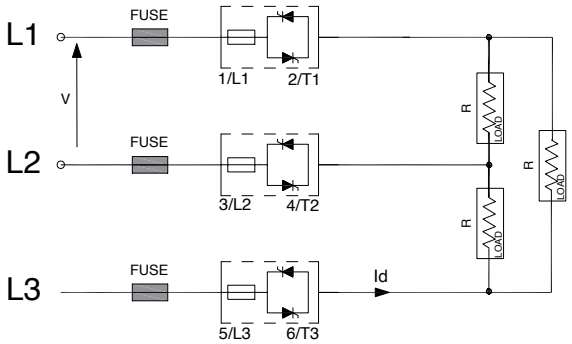
$$Id = \frac{P}{\eta \times \sqrt{3}\ V \times \cos\varphi} \qquad Is = \frac{P}{\sqrt{3} \times Vload \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Vload	Voltage on secondary (load)
Id	Current in primary
Is	Current in secondary
η	Transformer output (typical 0.9) if resistive load cos φ=1

FIRING MODE	ZC, PA, BF (bF.Cy ≥ 2)
HB DIAGNOSTICS AVAILABLE	Total load break for each individual branch. For PA mode HB diagnostics active with P>30%.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	100

3.4.12. Connection example for three-phase GRC (3PH) for three-phase closed delta load



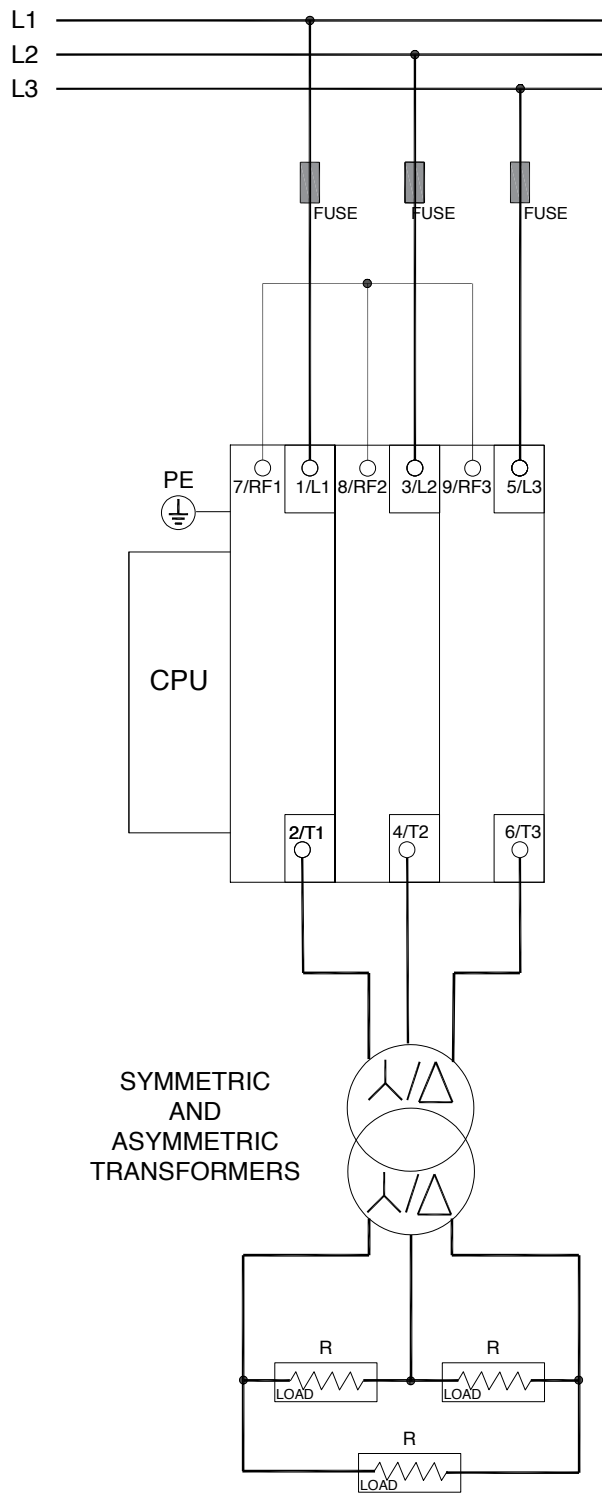


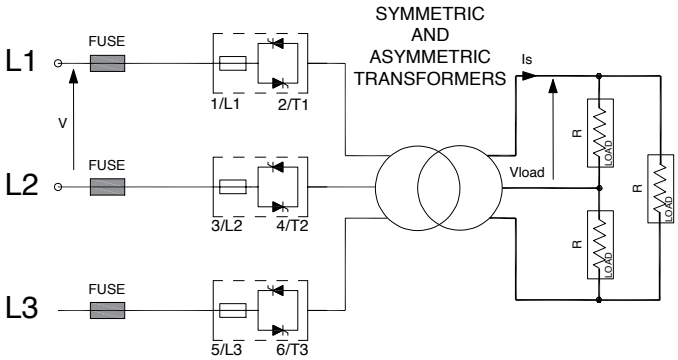
$$Id = \frac{P}{\sqrt{3} \times V \cos \varphi}$$

V	Phase-to-phase voltage
P	Total power
Id	Load current if resistive load cos φ=1

FIRING MODE	ZC, BF, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch. For PA mode HB diagnostics active with P>30%.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	28

3.4.13. Connection example for three-phase GRC (3PH) for a three-phase closed delta load with transformer



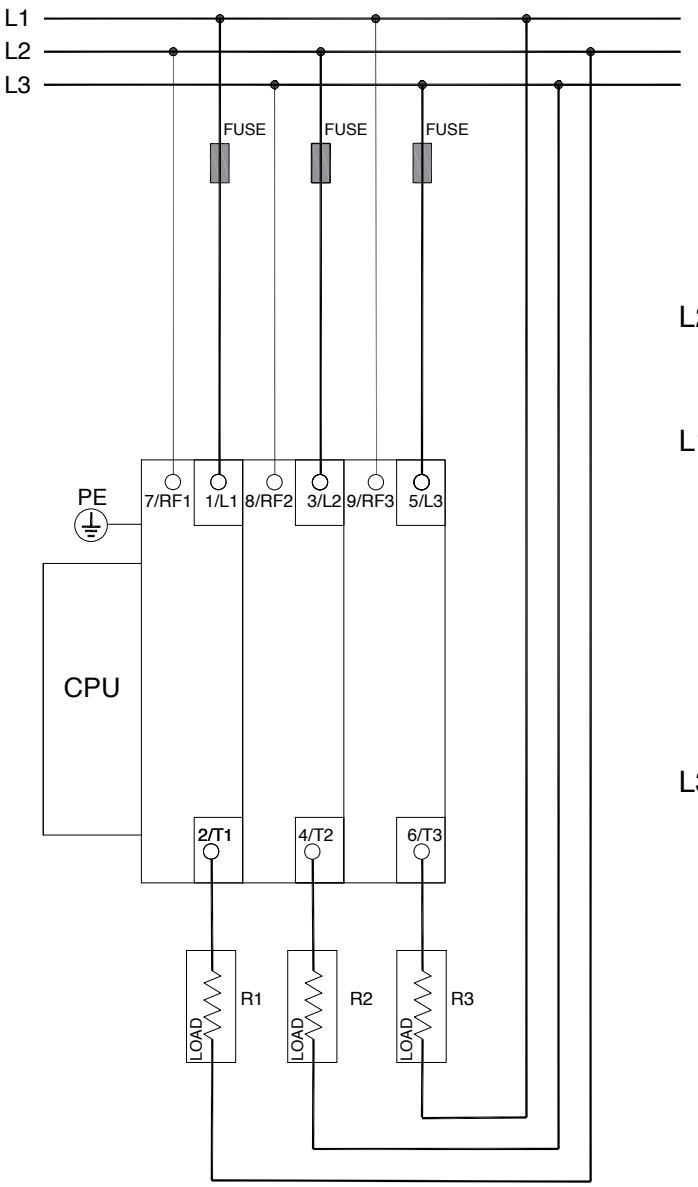


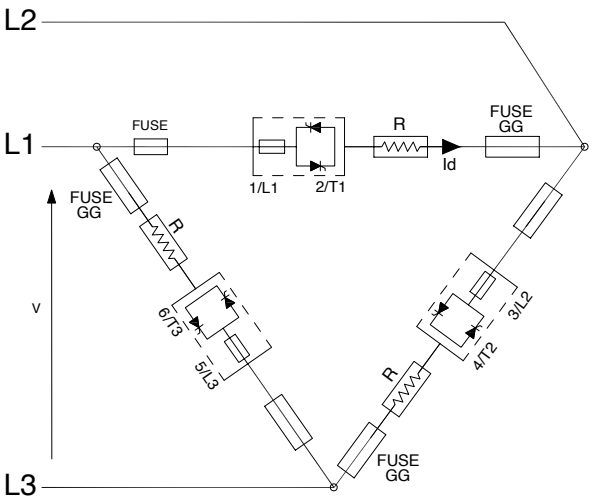
$$Id = \frac{P}{\eta \times \sqrt{3} \times V \times \cos\varphi} \qquad Is = \frac{P}{\sqrt{3} \times Vload \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Total power
Vload	Voltage on secondary (load)
Id	Current in primary
Is	Current in secondary
η	Transformer output (typical 0.9) if resistive load cosφ=1

FIRING MODE	ZC, PA BF (bF.Cy ≥ 2)
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch. For PA mode HB diagnostics active with P>30%.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	92

3.4.14. Connection example for three-phase GRC (3PH) for three-phase open delta load



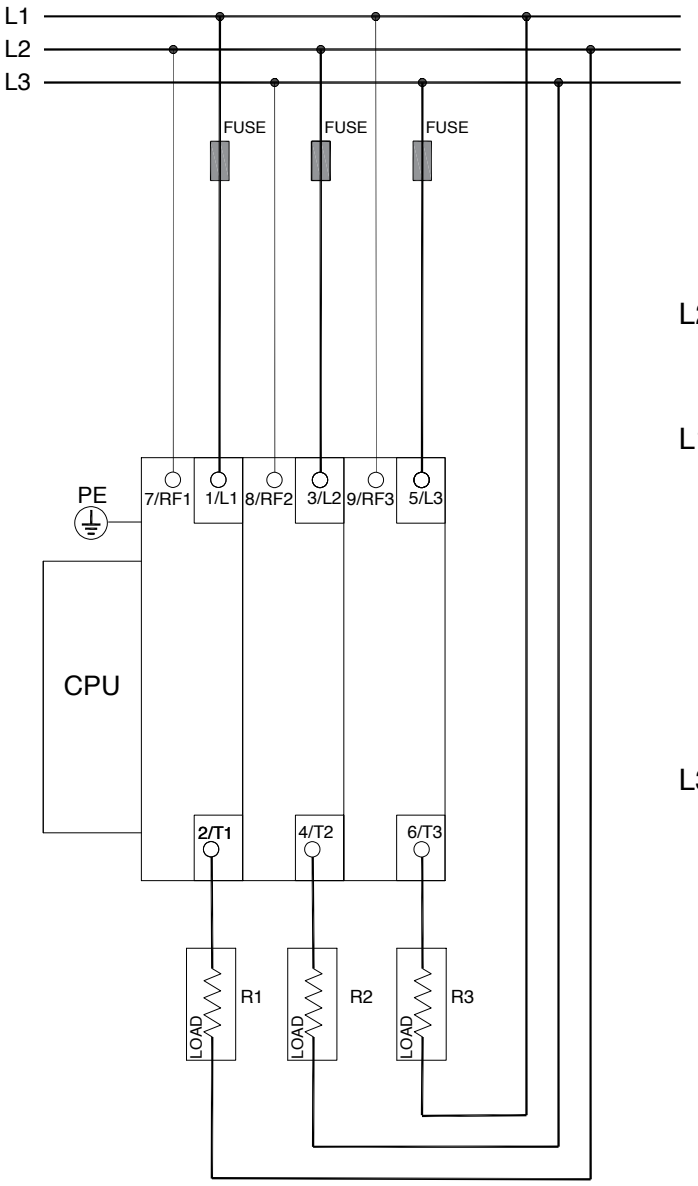


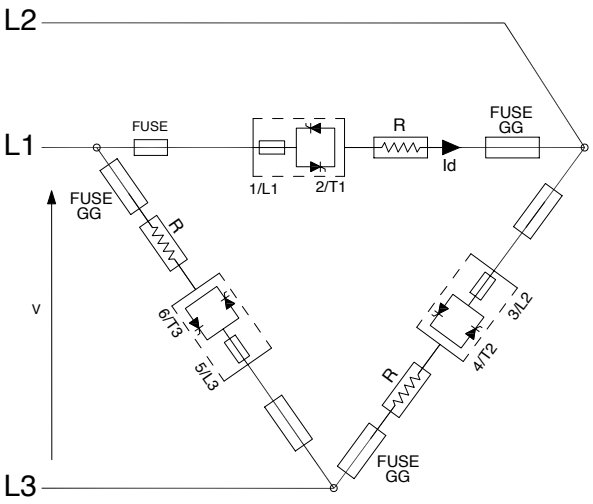
$$Id = \frac{P}{\sqrt{3} \times V \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Power of each individual phase
Id	Load current if resistive load cosφ=1

FIRING MODE	ZC, BF, HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	12

3.4.15. Connection example for three-phase GPC (3PH) for 3 independent loads in open delta





$$Id = \frac{P}{\sqrt{3} \times V \times \cos\varphi}$$

V	Phase-to-phase voltage
P	Single-phase single load power
Id	load current if resistive load cosφ=1
Vd	Load voltage

FIRING MODE	ZC, BF, HSC, PA
HB DIAGNOSTICS AVAILABLE	Partial and total load break for each individual branch.
Fuse	Ultra-rapid fuse only required for controls with option Fuse = 0
J.SEt	8

3.5. Notes on use with inductive loads and transformers

- When the GPC controller is in operation, it is NOT permissible to disconnect the connection between the GPC and the transformer or between the transformer and the load.
- The maximum current that can be controlled by the GPC is reduced compared to the nominal value of the device (see technical specifications).
- In ZC and BF trigger modes use the delay-triggering function to limit the peak magnetising current.
- In PA trigger mode use softstart function
- DO NOT use the HSC trigger mode.
- Do not connect RC snubbers in parallel to the transformer primary

4. INTRODUCTION TO OPERATING MODES

4.1. Trigger modes

The Advanced Power Controller modulates the power delivery with two modes:

- by changing the phase angle (PA mode);
- by changing the number of operating cycles with zero crossing triggering (ZC, BF, and HSC modes). This is commonly referred to a Pulse Train Mode.

4.1.1. “Zero crossing” mode

And a type of operation that does not introduce harmonic distortions, thanks to zero-crossing triggering. This mode manages load power through a series of ON operating cycles rather than OFF operating cycles.

4.1.1.1. ZC - constant cycle time

Applies to Tc ≥ 1 second (settable from 1 to 200 seconds). The cycle time is divided into a series of conduction and non-conduction cycles in the same ratio as the power to be transferred to the load (see figure).

For example, if Tc = 10 seconds and if the power value is 20%, we will have conduction for 2 seconds (100 conduction cycles @ 50Hz) and non-conduction for 8 seconds (400 non-conduction cycles @ 50Hz).

4.1.1.2. BF - variable cycle time

This mode manages the power on the load through a series of conduction (ON) cycles rather than non-conduction (OFF) cycles. The ratio of the number of ON cycles to the number of OFF cycles is proportional to the value of the power to be supplied to the load.
Setting parameter,Bf.cy, is the minimum number of conduction cycles (whereas in ZC mode this period is always fixed and not optimised).

A parameter defines the minimum number of conduction cycles that can be set from 1 to 10. In the example shown in the figure, this parameter is = 2.

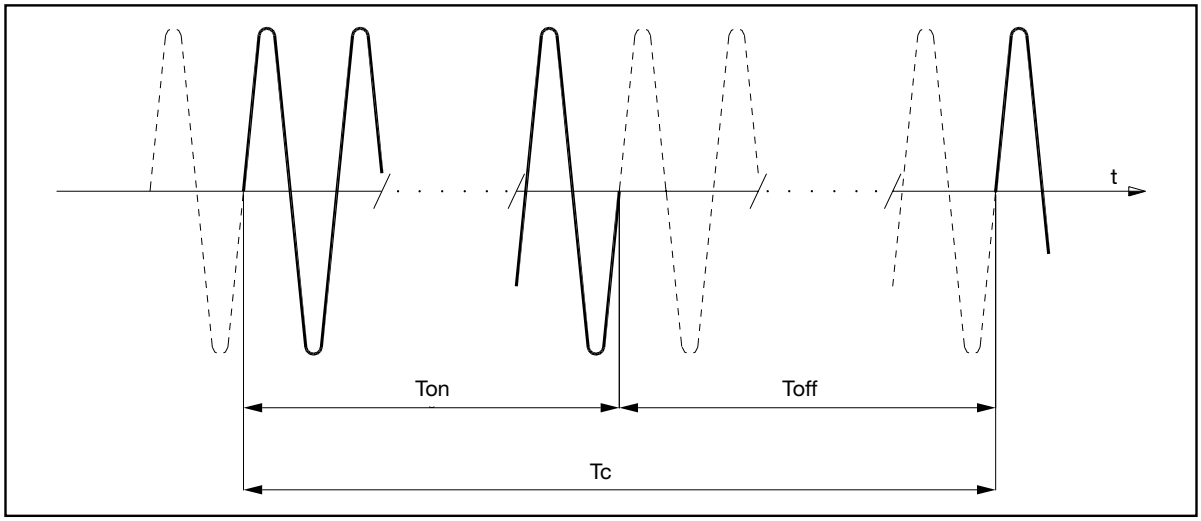


Figure 15 - Example of operation in ZC mode

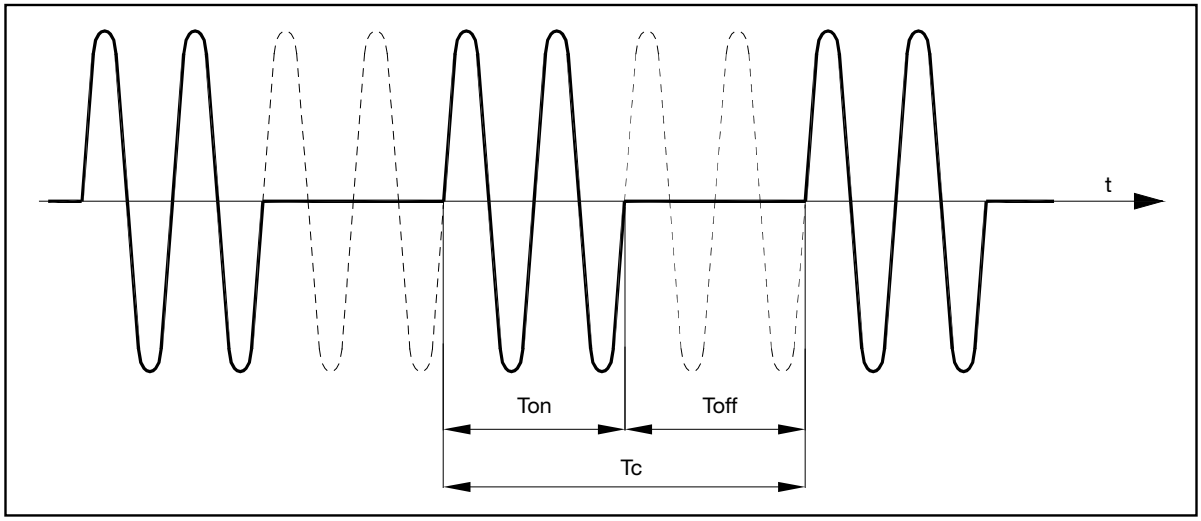


Figure 16 - Example of operation in BF mode at 50% power

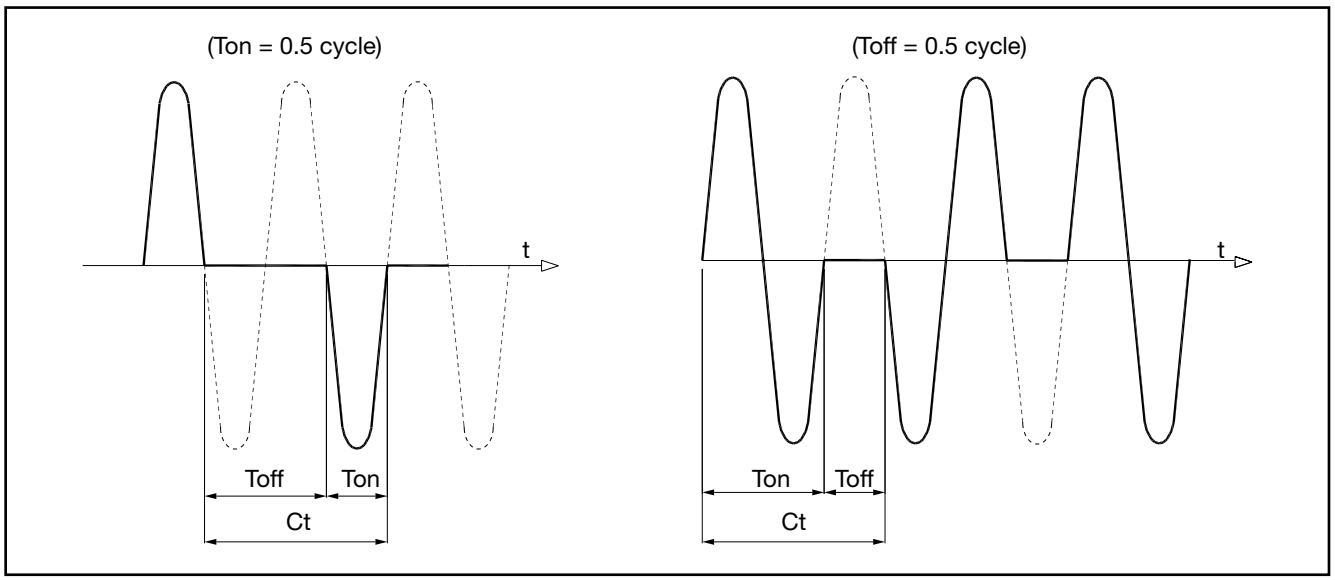


Figure 17 - Example of operation in HSC mode at 33% and 66% power

4.1.1.3. HSC - Half single cycle

This mode corresponds to Burst Firing, which handles on/off semi-cycles.
It is useful for reducing filament flickering with short/medium wave IR lamp loads. With such loads, in order to limit the steady state current with low power, it is useful to set a minimum power limit (e.g., Lo.P = 10%, see “Programming manual”).

CAUTION! This operating mode is NOT permitted with inductive loads (transformers), it is used with resistive loads in single-phase, star with neutral or open delta configuration.

4.1.2. Phase angle (PA)

This mode manages the power on the load by modulating the trigger angle q:

- if the power to be transferred to the load is 100%, q = 180°;
- if the power to be transferred to the load is 50%, q = 90°.

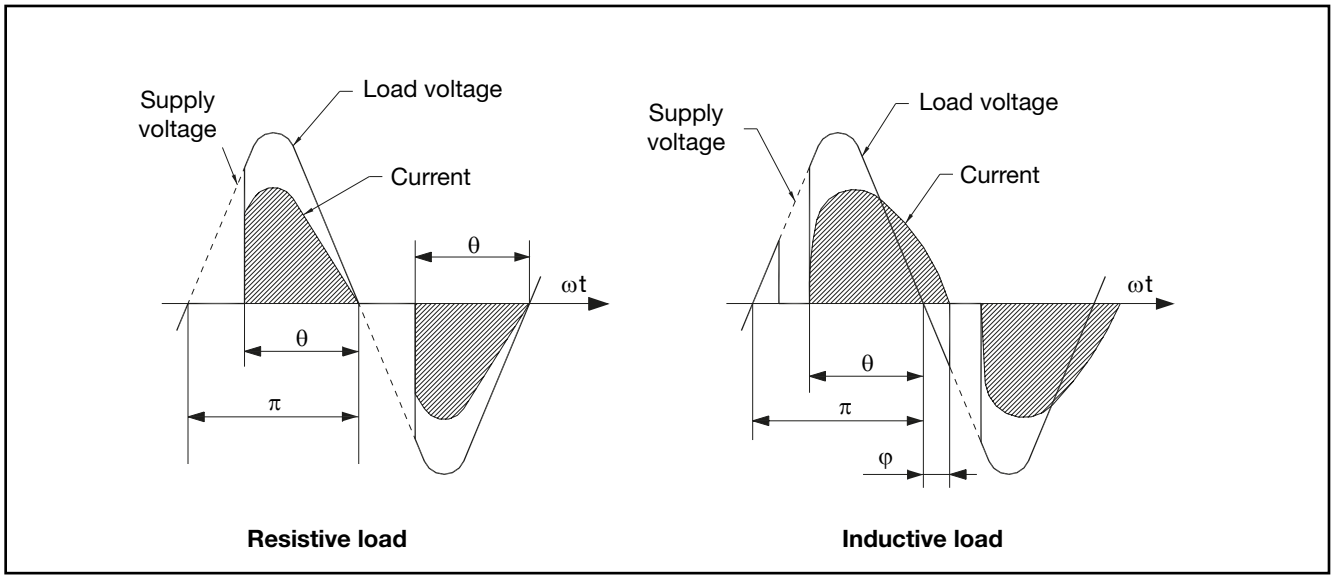


Figure 18 - Example of operation in Phase Angle (PA) mode

Vedi capitolo “7.24. Power control modes” on page 152

4.2. Additional functions

4.2.1. Softstart

This type of start can be enabled either in phase control mode or in zero-crossing mode (ZC, BF, HSC,PA).
In the case of phase control, the increase in the conduction angle q stops at the corresponding value of the power to be transferred to the load.
Control of maximum peak current can be enabled during softstart (useful in the event of a short circuit on the load or loads with high temperature coefficients, to automatically adjust start time to the load).
When the load shut-off time (settable) is exceeded, the ramp is reactivated at the next power-on, see chapter “7.25. Softstart” on page 155.

4.2.2. RMS current limit

The option to control the load current limit is available in all operating modes.
If the current value exceeds the limit (settable in the nominal full-scale range) in PA mode the conduction angle is limited, while in zero-crossing mode (ZC, BF, HSC) the cycle time conduction percentage is limited.
This limitation ensures that the RMS value (i.e., not the instantaneous value) of the load current does NOT exceed the set RMS current limit.
The illustration shows an example of limiting the conduction angle in PA mode to comply with an RMS current limit that is less than the nominal load current, see chapter «7.24. Power control modes» on page 152.

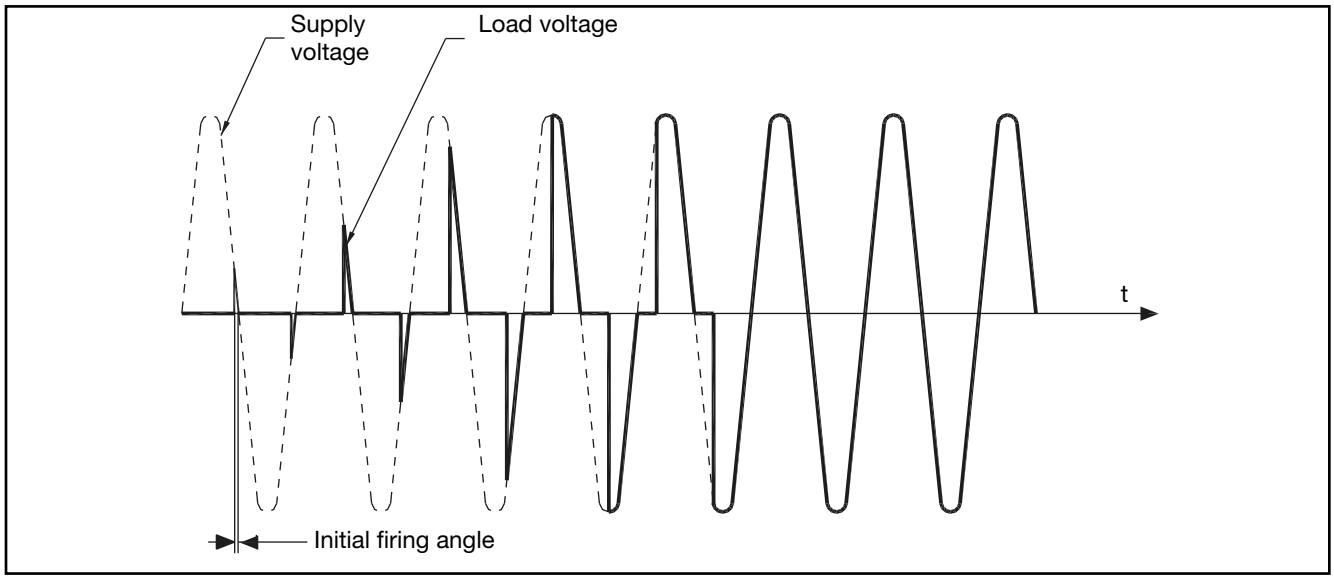


Figure 19 - Firing ramp with phase softstart

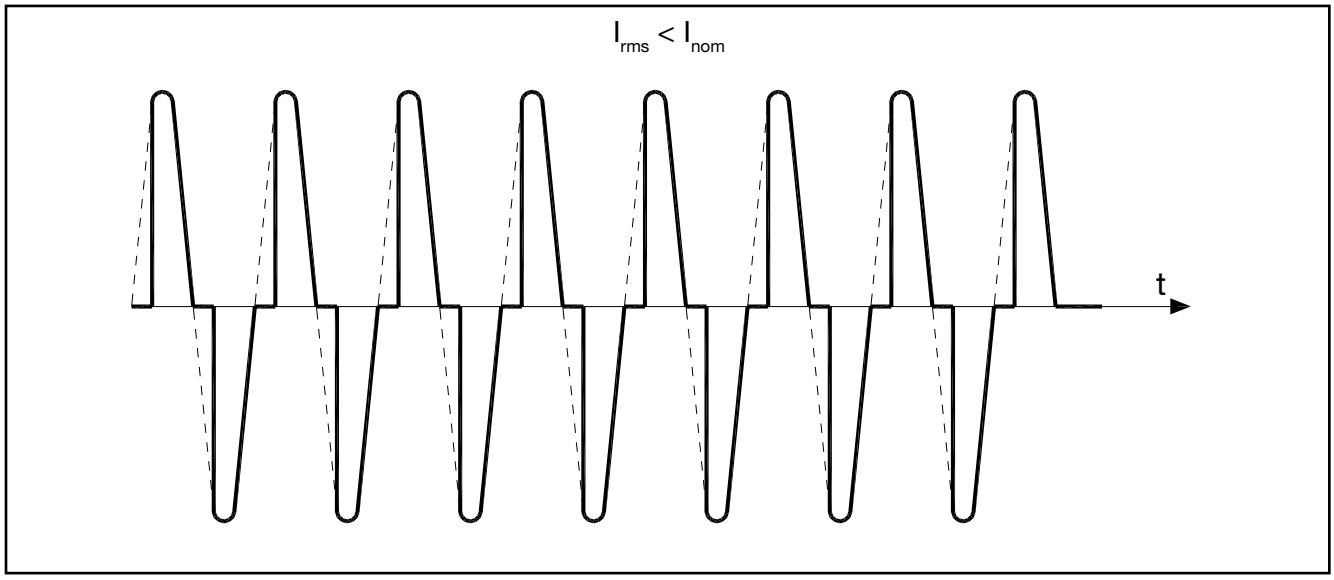


Figure 20 - Example of conduction angle limitation in PA mode

4.2.3. DT - Delay triggering

The triggering delay (only for control modes ZC, BF) can be set from 0° to 90°.
It is useful for inductive loads (transformer primaries), to prevent a current peak that could in some cases trip the ultra-rapid fuses protecting the SCRs.

The figure shows how an inductive load is switched on with and without delay-triggering.

The phase softstart ramp is used instead of delay triggering for firing inductive loads managed in PA (Phase Angle) mode.

The example in the figure compares the methods of starting a transformer: Softstart ramp (for PA mode) and Delay triggering (for ZC and BF modes) see chapter «7.26. Delay Triggering» on page 159.
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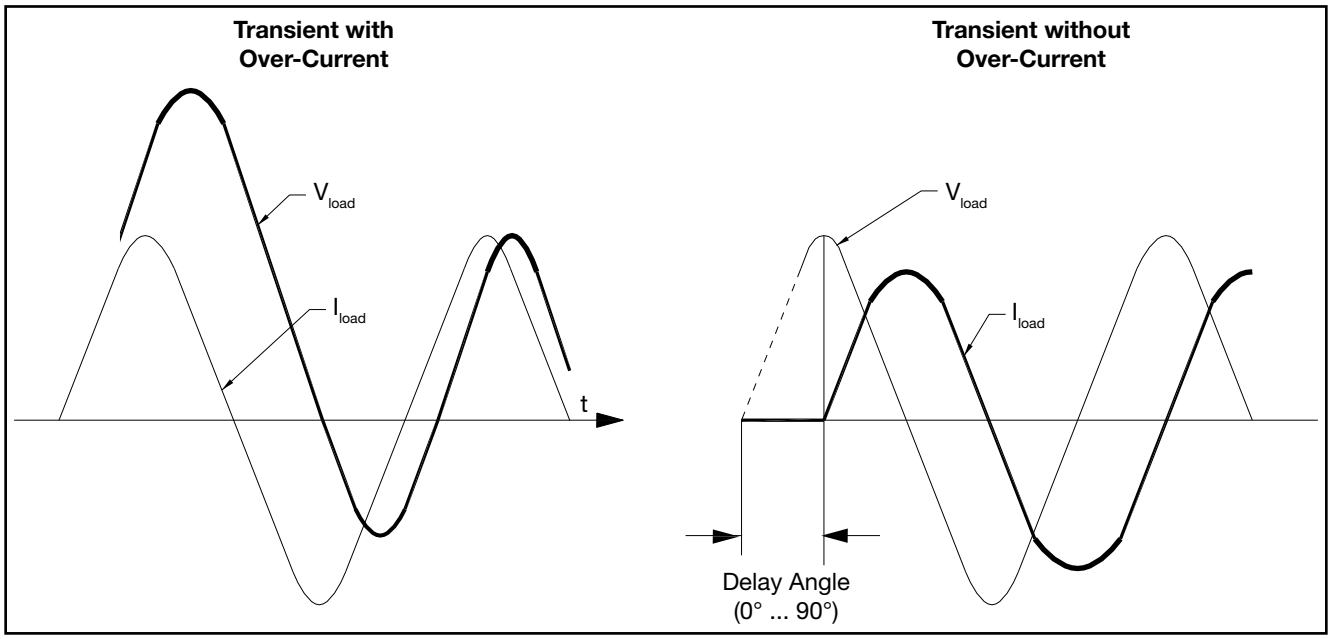

Figure 21 - Switching on an inductive load

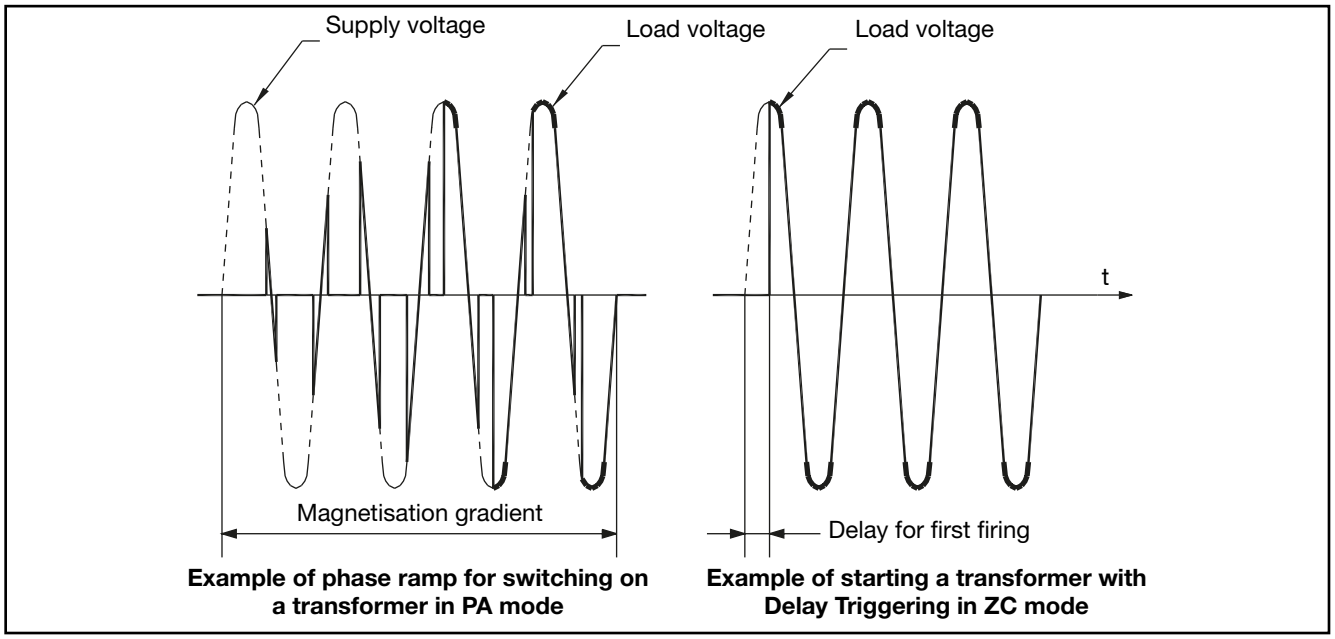

Figure 22 - Various modes of switching on an inductive load

4.2.4. DT - Delay triggering

The triggering delay (only for control modes ZC, BF) can be set from 0° to 90°.
It is useful for inductive loads (transformer primaries), to prevent a current peak that could in some cases trip the ultra-rapid fuses protecting the SCRs.

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The phase softstart ramp is used instead of delay triggering for firing inductive loads managed in PA (Phase Angle) mode.

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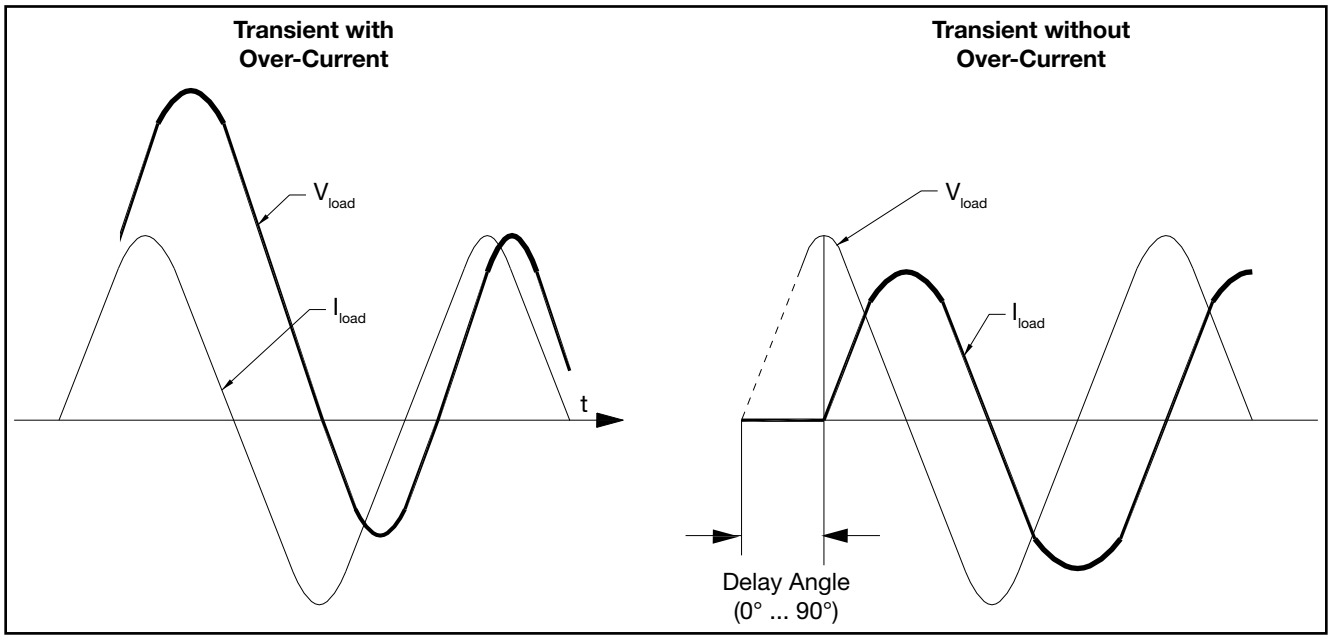


Figure 23 - Switching on an inductive load

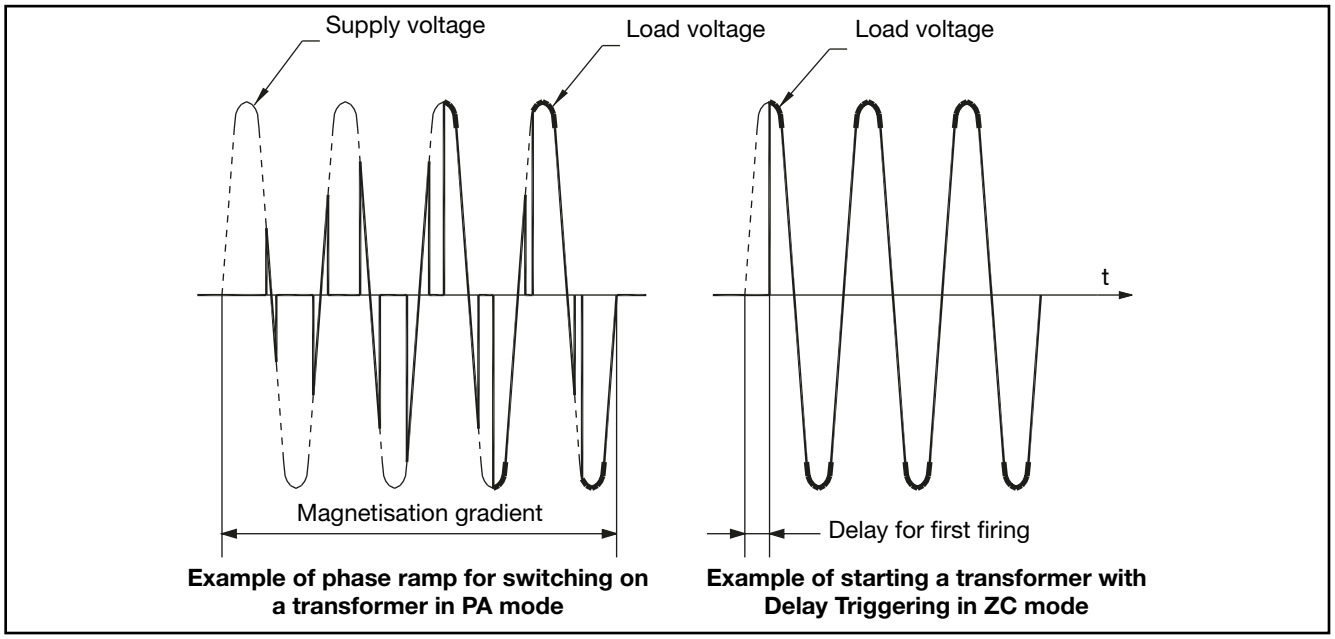


Figure 24 - Various modes of switching on an inductive load

5. MAINTENANCE

Caution! Repairs to the Advanced Power Controller must only be made by technical personnel suitably trained and authorised by Gefran. Any attempt to repair or modify the hardware features of the device by unauthorised personnel will void the warranty.

5.1. Periodic cleaning

Clean the outside of the device using only a soft cloth. Do not use solvents derived from hydrocarbons (triethylene, benzene, etc.).

Every 6-12 months (depending on the amount of dust in the installation site), blow a jet of compressed air downward through the cooling heatsink (on the opposite side of the fan).
This will clean both the heat sink and the cooling fan.

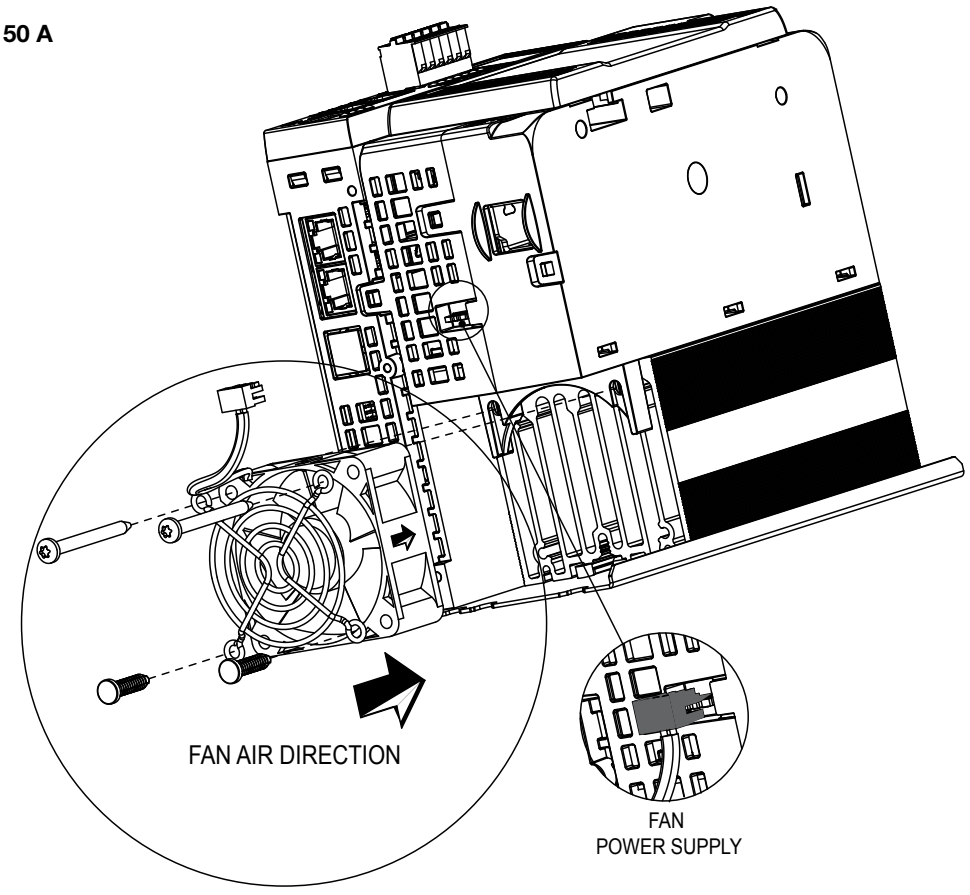
5.1.1. Overtemperature alarm

Periodic cleaning helps to prevent overtemperature alarms caused by dirt that does not allow adequate heat dissipation. If the compressed air jet does not eliminate the problem, perform the following operations after first checking that the GFW has been turned off and disconnected from the electrical power supply to ensure the operator's safety:

Procedure for GRC, models from 75 A to 150 A

1. Disconnect the fan power connector from the product.
2. Unscrew the screws securing the fan to the heat sink (using a Torx TX15 wrench).
3. Check the condition of the fan. Clean it or, if necessary, replace it.
   CAUTION: before refitting the fan to the heat sink, check that the arrow indicating the direction of air flow on the fan is pointing towards the heat sink.
4. Use a Torx TX15 screwdriver to tighten the two fixing screws, tightening them to a torque of 0.8 Nm.
5. Insert the fan power connector into the product.
6. Power up the controller and check that the fan is working correctly (to check this, you need to activate the power).

GRC 75 A ... 150 A



5.2. Replacing the internal fuse

Caution! Disconnect the voltage before and during the fuse replacement procedure.

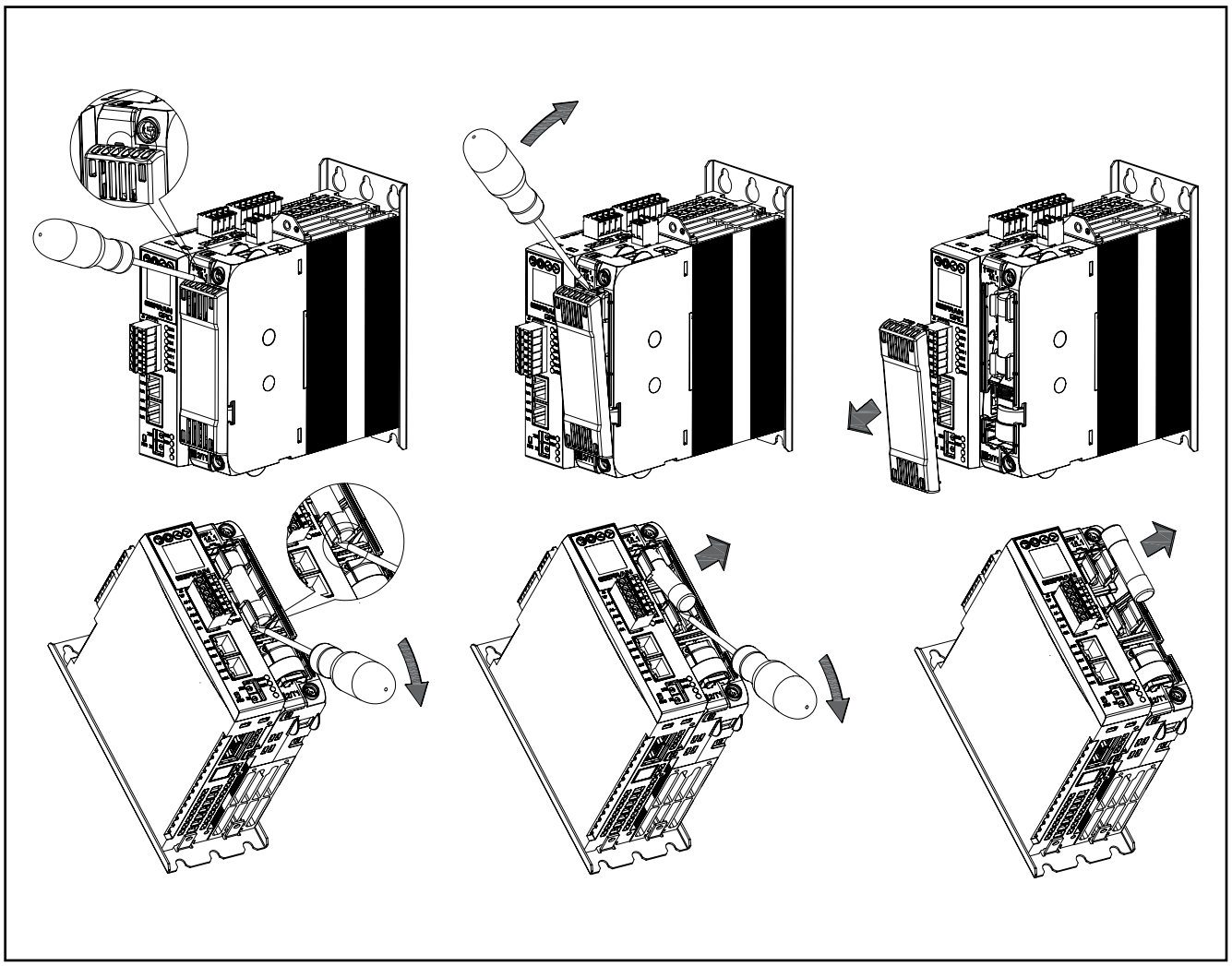
The Advanced Power Controller is equipped with an internal protection fuse (optional).
The replacement procedure and equipment required varies depending on the model.

Caution! ALWAYS USE AN ULTRA-RAPID FUSE. See paragraph “Figure 2 - Elements of the GRC 60A ... 150A” for the choice of fuse.

Procedure for replacing the internal fuse in GRC models from 25 A to 40 A

1. Insert a flathead screwdriver between the upper profile of the front cover of the power module and the fixed part.
2. Pry by bending the screwdriver from the bottom up and remove the front cover.
3. Insert the screwdriver into the back of the fuse, lower part, and the fixing clip.
4. Pry with the screwdriver from top to bottom to release one side of the fuse.
5. Slide the fuse downwards to release the upper end.
6. Insert the replacement fuse into the clips.
7. Replace the protective front panel and push to lock.

Repeat for all modules with faulty fuses.



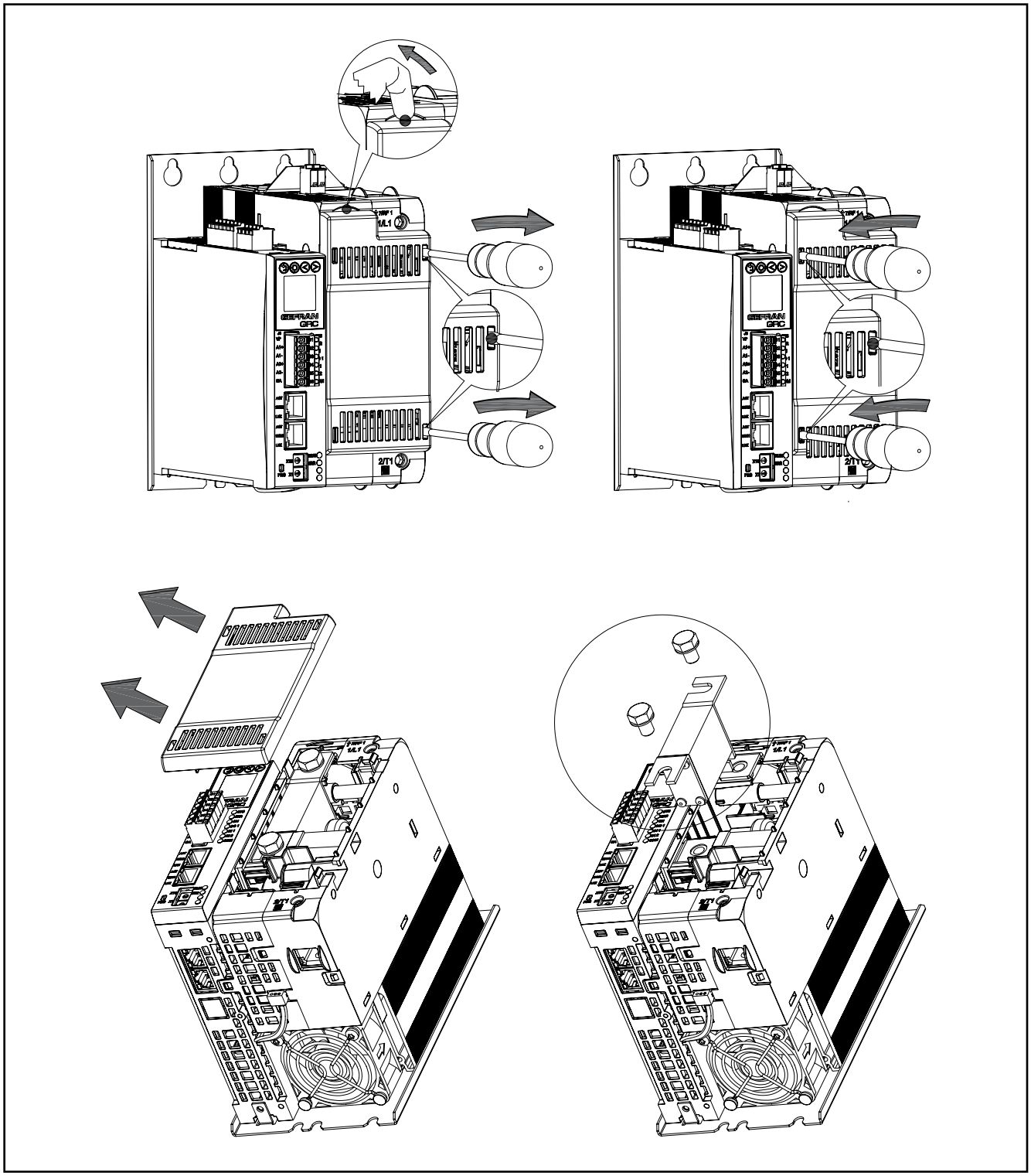
Procedure for replacing the internal fuse in GRC models from 60 A to 150 A

1. Insert a flathead screwdriver into the smallest slots on the front cover of the power module (see detail in the diagram).
2. Turn the screwdriver to release the internal locking teeth, while simultaneously pulling the front cover toward you with your finger, gripping the notch at the top of the cover.
3. Repeat for all 4 slots until all 4 hooks have been released and the cover is removed.
4. Remove the two fuse fixing bolts using a 13 mm wrench and retrieve the washers.
5. Remove the fuse.
6. Install the new fuse.

CAUTION: the washer must be positioned between the bolt head and the fuse.

7. Tighten the two bolts to a torque of 3 N m.
8. Replace the cover and push to reattach.

Repeat for all modules with faulty fuses.



5.3. Disposal

The Advanced Power Controller must be disposed of in accordance with current regulations.

Some of the components used in the devices can cause damage to the environment if incorrectly disposed.

6. COMMISSIONING

6.1. Commissioning operations

The simplest and safest way to commission GRC Advanced Power Controllers, after connecting the 24 Vdc power supply and a PC to the CPU, is to use the GF_eXpress software and its “SMART CONFIGURATION” function.

Through the “SMART CONFIGURATION” wizard menu, a safe working recipe can be created to test the controller and its load in just a few minutes, by answering some simple questions about the application.

Connection from PC to GRC, use cable Gefran F055002 which is a USB to RS485 type cable.

6.2. Programming tool

6.2.1. GF_eXpress

GF_eXpress is the configuration tool for components, automation, drives and sensors in the Gefran catalog.
GF_eXpress tool is easy and intuitive thanks to a graphical interface, with devices divided according to product type and function. The choice of the product to be configured is made through a contextual menu with visual selection using real product images.
This management makes it possible to have a single device library for all Gefran products.
The software is available free of charge and can be downloaded from www.gefran.com, where it is always updated to the latest version available.

Applications

- Create a resource library of all Gefran devices on the plant floor (instrumentation, drives, sensors, power controllers). of Gefran devices (instrumentation, sensors).
- Tuning of adjustment parameters with on-line test and Trend.
- Parameter archive management for multiple configurations.

Features

- Guided product selection.
- Simplified setting.
- Multilingual.
- Print parameters.
- Creation and saving of recipes.
- Network autoscan.

6.2.1.1. System requirements

	Minimum	Recommended
Operating system	Windows XP SP2, Windows Vista or Windows 7 (32-bit)	Windows 10 (64 bit)
Processor	Intel Pentium 1 GHz	Intel Core i7 2.9 Ghz or higher
RAM	2 GB	4 GB or more
Free hard disk space	2 GB	4 GB or more
Graphic resolution	XGA (1024 x 768 pixels)	SXGA (1280 x 1024 pixels) or higher
Browser	Microsoft Internet Explorer 8.0	Microsoft Edge or higher
Ethernet Port	1 RJ45	1 RJ45
USB port	1 USB 2.0	1 USB 2.0

6.3. First power-on

For commissioning of the Advanced Power Controller, the following steps and checks must be carried out:

1. Connect the line and load cables in accordance with the wiring diagram and leave the power line fuses open.
2. Connect the analog and/or serial/fieldbus communication signals.
3. Power the CPU module via a 24 Vdc power supply.
4. Once is switched on, the LEDs start turning on and off to indicate CPU initialisation. The following sequence is seen:
   a) The STS LED stays lit (all 3 colors) for about 2 seconds.
   b) All 7 LEDs flash simultaneously 3 times for about 2 seconds.
   c) The LEDs light up in sequence from number 1 to number 7.
5. 5. At the end, the “STS” (green) and “ER” (red) LEDs remain flashing. The “ER” LED will turn off when Digital Input 4 is subsequently connected.
6. Proceed with programming:
   a) Connect the PC to the GRC-L1.
   b) Open the GF_eXpress, in the “Power Controllers” drop-down menu, select GRC.
   c) After setting the configuration parameters, select the “SMART CONFIGURATOR” menu.
   d) Complete the indicated steps providing the required information.
   e) Save the final parameter recipe and send it to the controller.
   f) Select “WIZARD”.
   g) Select “L1” and check the following parameters and their values in the data sheet: ***OFF/ON*** = OFF; ***MAN/AUTO*** = MAN, ***Man.P*** = 0.0. Change the parameter if necessary.
7. Close the power line fuses.
8. Change the value of the following parameters with GF_eXpress: ***OFF/ON*** = ON; ***Man.P*** = 10.0. With this action the output is activated at 10% power.
9. If the “ER” (red) LED flashes, the power will not be delivered. Check for the following possible causes:
   - Fuses not closed.
   - No line voltage.
10. Check the connection of terminals 7/RF1 if 1PH, also 8/RF2 if 2PH model, also 9/RF3 if 3PH.
11. Test the system by increasing the percentage of power to the load in small steps (*Man.P*parameter) and checking the correct behaviour of the controller using the monitor functions in GF_eXpress.

7. CONFIGURATION

Configuration and programming of the Advanced Power Controller can be performed with the special GF_eXpress application software and connected to the instrument via a USB cable (F055002), which can be ordered from Gefran.

We recommend configuring and programming the Power Controller using a PC and the GF_eXpress application software, via an Ethernet connection to the ETH0 or ETH1 ports.
For convenience, we recommend using the WEB Server and Display for diagnostics and minor configuration changes. Advanced programming of the device is not possible via the WEB server and display.

For more information on programming with a PC, see the GF_eXpress documentation available at www.gefran.com.

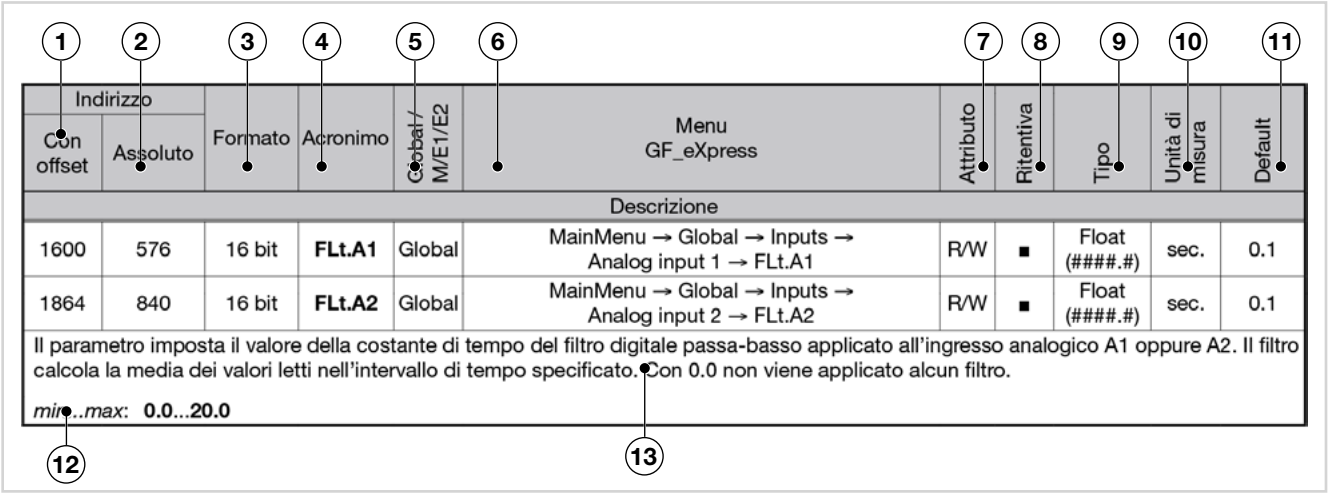
Caution! Advanced knowledge of the problems and techniques associated with control is required to correctly set the parameters needed to configure the Advanced Power Controller so that it meets the application requirements.

Caution! Before commissioning the controller, the user must ensure that the parameters are set correctly to avoid damages to persons or property.

If you are unsure of your skills or not fully aware of the potential consequences of incorrect parameter settings, we advise you not to proceed with the configuration.

If in doubt, or if you would like some clarification, please visit www.gefran.com or contact the Gefran Customer Care service.

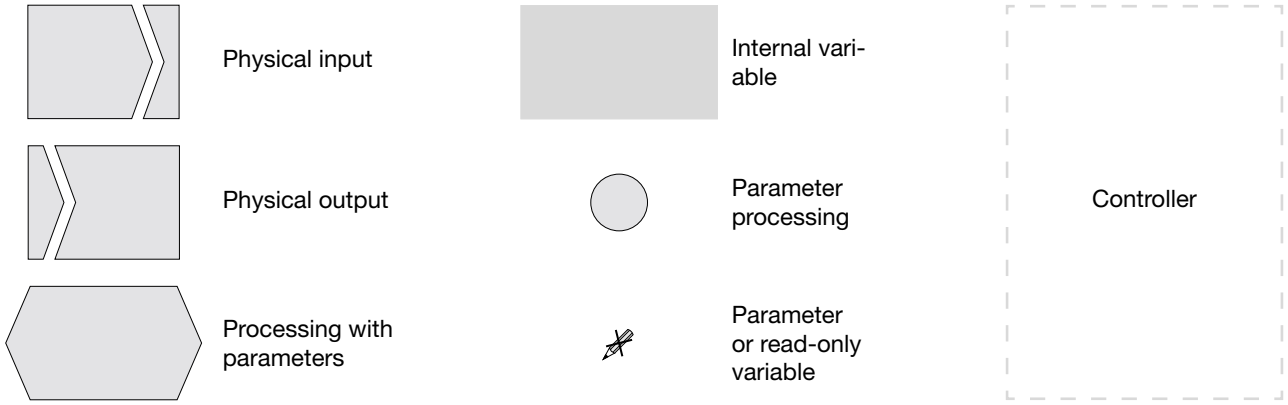
7.1. Parameter legend



1. Parameter address with offset per phase (only if the parameter is not Global, i.e., unique for the entire device)
2. Absolute address of the parameter (without phase-related offset)
3. Parameter format, which can be:
   - bit,
   - 16 bit,
   - 32 bit.
4. Acronym by which the parameter is identified.
5. Indicates whether the parameter is global or only affects a particular module.
6. Complete path of the GF_eXpress menu.
7. Parameter attribute:
   - R = the parameter is read-only,
   - R/W = the parameter can be read and written.
8. Indicates whether the parameter value remains stored even after the controller is switched off.
9. Indicates the type of parameter.
   With 16-bit parameter it can be:
   - Unsigned Short,
   - Short,
   - Float (the position of the decimal point is indicated in brackets).

   With 32-bit parameter (16-bit LSW at parameter address + 16-bit MSW at parameter address + 1) it can be:
   - Unsigned Int,
   - Float32 (the position of the decimal point is shown in brackets).
10. Unit of measurement of the value managed by the parameter. The unit of measurement can be unique or depend on other configuration choices, such as the temperature unit, which can be set either to Centigrade or Fahrenheit.
    Not all parameters have units of measurement.
11. Factory parameter value.
12. Value that the parameter can take. The value can be of two types: discrete or belonging to a range of values, typically numerical. With a discrete value, all possible values are listed. With value ranges, the minimum and maximum values that the parameter can take are shown.
13. Full description of the parameter.

7.3. Legend for functional parameter diagrams



7.2. Communication Modbus TCP

7.2.1. Addressing (Cod)

GRC devices are identified uniquely identified through the node address IP.

The memory is organized into groups: modules (max 3) plus the customizable Custom group. You will therefore have:

- GRC-L1 for the variables of the controller's L1 module.
- GRC-L2 for the variables of the controller's L2 module.
- GRC-L3 for the variables of the controller's L3 module.
- Custom, which collects up to 120 variables and parameters, each with a length of one word, whose meaning can be modified.

The address of the variables of the individual modules is equal to the base address with a fixed offset. (+1024 for GRC-L1, +2048 for GRC-L2 and +4096 for GRC-L3).

For example, to access the variable *Ou.P*, which contains the value of the control output, you use:

- 1026 (2+1024) for GRC-L1,
- 2050 (2+2048) for GRC-L2,
- 4098 (2+4096) for GRC-L3.

"2" is the base address of the Ou.P variable.

7.2.1.1. Custom Modbus memory map

The addresses 0 to 119 correspond to the words of the Custom group; variables and parameters are defined by default.

The Custom Modbus map, accessible via the Main Menu → Custom Map, allows a word memory area of 32 contiguous elements to be defined in order to make use of the Modbus multi-word read and write commands and thus speed up data exchange with a Modbus Master device.
The parameters defining the 120 internal variables, to be read or written contiguously, are available in GF_eXpress Custom Map in addresses 200 to 319. Addresses 0 to 119 contain the value of these parameters.

Addresses 200...319, the values of the Custom variables and parameters, are protected against overwriting.
To enable writing, the value 99 must be written to addresses 600 and 601. The value 99 is reset at each startup.

IPA	Name	Value	Unit	Default value	Min	Max	Description	Address	Type
10200	CustomVar1	1024 = None of M		1024 = None of M	0	0	Address of custom variable 1	200	UnsignedShort
10201	CustomVar2	1024 = None of M		1024 = None of M	0	0	Address of custom variable 2	201	UnsignedShort
10202	CustomVar3	1024 = None of M		1024 = None of M	0	0	Address of custom variable 3	202	UnsignedShort
10203	CustomVar4	1024 = None of M		1024 = None of M	0	0	Address of custom variable 4	203	UnsignedShort
10204	CustomVar5	1024 = None of M		1024 = None of M	0	0	Address of custom variable 5	204	UnsignedShort
10205	CustomVar6	1024 = None of M		1024 = None of M	0	0	Address of custom variable 6	205	UnsignedShort
10206	CustomVar7	1024 = None of M		1024 = None of M	0	0	Address of custom variable 7	206	UnsignedShort
10207	CustomVar8	1024 = None of M		1024 = None of M	0	0	Address of custom variable 8	207	UnsignedShort
10208	CustomVar9	1024 = None of M		1024 = None of M	0	0	Address of custom variable 9	208	UnsignedShort
10209	CustomVar10	1024 = None of M		1024 = None of M	0	0	Address of custom variable 10	209	UnsignedShort

IPA	Name	Value	Unit	Default value	Min	Max	Description	Address	Type
10200	CustomVar1	1026 = Ou.P of M		1024 = None of M	0	0	Address of custom variable 1	200	UnsignedShort
10201	CustomVar2	2050 = Ou.P of E1		1024 = None of M	0	0	Address of custom variable 2	201	UnsignedShort
10202	CustomVar3	4098 = Ou.P of E2		1024 = None of M	0	0	Address of custom variable 3	202	UnsignedShort
10203	CustomVar4	1024 = None of M		1024 = None of M	0	0	Address of custom variable 4	203	UnsignedShort
10204	CustomVar5	1024 = None of M		1024 = None of M	0	0	Address of custom variable 5	204	UnsignedShort
10205	CustomVar6	1024 = None of M		1024 = None of M	0	0	Address of custom variable 6	205	UnsignedShort
10206	CustomVar7	1024 = None of M		1024 = None of M	0	0	Address of custom variable 7	206	UnsignedShort
10207	CustomVar8	1024 = None of M		1024 = None of M	0	0	Address of custom variable 8	207	UnsignedShort
10208	CustomVar9	1024 = None of M		1024 = None of M	0	0	Address of custom variable 9	208	UnsignedShort
10209	CustomVar10	1024 = None of M		1024 = None of M	0	0	Address of custom variable 10	209	UnsignedShort

Note: The Custom map function is not available in Multi-node mode

Example of memory map use
You want to access the *Ou.P* (power output) variables from GRC-L1, GRC-L2 and GRC-L3.
The 3 required Modbus addresses are 1026 for GRC-L1, 2050 for GRC-L2 and 4098 for GRC-L3. Given the Modbus addresses of the three parameters, three separate requests would be necessary if the Custom map was not used.

To read these quantities in a single request, thereby reducing the update times, simply do the following in GF_eXpress:

- in the *CustomVar1* object (address 200) enter the value 1026, i.e., the Modbus address of the first parameter to be accessed;
- in the *CustomVar2* object (address 201), the value 2050, i.e., the Modbus address of the second parameter to be accessed;
- in the *CustomVar3* object (address 202), the value 4098, i.e., the Modbus address of the third parameter to be accessed.

At this point, through the Modbus read command of three consecutive addresses starting from 0, the three powers supplied can be accessed by means of a single operation.

7.4. Time constraints of Modbus TCP communication

In order to permit correct serial data exchange with the device, the following time constraints must be respected:

- **Reading register/word parameters**
  Reading *n* consecutive parameters, with *n* varying from 1 to 16, requires a time of:
  – 40 ms with retentive memory enabled (default),
  – 35 ms with retentive memory disabled.
  The retentive memory setting is obtained through the parameter EEP.E (see paragraph “7.23.2. Enabling retentive memory storage”).
  Thus, the next Modbus command to the same node, whether read or write, must be sent after this delay time has expired.

- **Writing parameters to register/word**
  The writing of *n* consecutive parameters, with *n* varying from 1 to 16 and a complete set of updated values (16 in total) with regard to those currently present on the device, requires a time of:
  – 40 ms + (*n* x 10 ms *) with retentive memory enabled (default),
  – 35 ms with retentive memory disabled

  The retentive memory setting is obtained through the parameter EEP.E (see paragraph “7.23.2. Enabling retentive memory storage”).
  Thus, the next Modbus command to the same node, whether read or write, must be sent after this delay time has expired.

The times given refer to cases with a serial baudrate of 19200. Lower baudrates increase transmission times and thus waiting times.

Notes
*) If the STATUS_W parameters (Modbus address 305) are included in the write request, and their value is different from the one currently present in the slave, the time needed to write each one will be 30ms instead of 10ms

7.5. Connections

In a network, a “Master” device can be identified, which communicates through commands, and “Slave” devices, which interpret and implement the commands. The GRC devices are the Slaves and the Master is the supervisor terminal or a PLC.

Each GRC device is equipped with an opto-isolated RS485 serial port (PORT 1 or serial 1) which uses the standard Modbus protocol. The connectors used are J8 and J9 (RJ10 type). An additional optional serial interface (PORT 2 or serial 2) can also be inserted into the device to connect to the required fieldbus. Interfaces are available for connection to Modbus, Profibus DP, CANopen and Ethernet (Modbus TCP, EtherCAT and EthernetIP).

A parameter can be read or written from both PORT 1 and PORT 2 and both communication ports respond to the same Cod address.

7.5.1. Modbus network installation

The procedure described below is for the Modbus protocol. For the remaining protocols, please refer to the specific fieldbus manuals available at www.gefran.com.
GRC devices leave the factory with the following settings:

- Cod = 0 (rotary switches set 0 + 0)

	PORT 1 (Serial 1)	**PORT 2** (Serial 2)
Speed (bit/s)	19200	19200
Parity	No parity	No parity

In summary, the valid settings on the rotary switches (tens + units) are:

- (0 + 0) = Autobaud Serial 1
- (B + 0) = Autobaud Serial 2

The communication parameters for PORT 1 are *bAu*, which allows the speed to be set in bits/s, and *Par*, which allows the parity to be set. The corresponding parameters for PORT 2 are *bAu.2* and *PAr2*.

Changing the parameters *bAu* and *PAr* may invalidate the communication.

7.5.2. Communication error

If a communication error occurs between the GRC device and the Master device, it is possible to force an output power value (*C.E.P* parameter of each module) and transmit the alarm status to a relay output (*rL.x* parameters).
If the communication error is caused by the timeout, the timeout time can be changed in the *C.E.t* parameter.

7.5.3. Device identification code

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1070	46	16 bit	**Cod**	Global	MainMenu → Global → Info → Cod	R		Unsigned Short		10
The parameter shows the identification code of the GRC device, which is set with the hexadecimal rotary switches. *min...max*: **1**...**99**										

7.5.4. Serial port transmission speed

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1069	45	16 bit	**bAu**	Global	MainMenu → Global → Info → bAu	R/W	■	Unsigned Short		4
1650	626	16 bit	**bAu.2**	Global	MainMenu → Global → Info → bAu.2	R/W	■	Unsigned Short		4
The parameter sets the transmission speed of the serial port. *Options*: **0** = Speed 1200 bit/s **1** = Speed 2400 bit/s **2** = Speed 4800 bit/s **3** = Speed 9600 bit/s **4** = Speed 19200 bit/s **5** = Speed 38400 bit/s **6** = Speed 57600 bit/s **7** = Speed 115200 bit/s										

7.5.5. Communication error timeout

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1914	890	16 bit	**C.E.t**	Global	MainMenu → Global → Info → C.E.t	R/W	■	Unsigned Short	sec.	0
The parameter sets the timeout time before a communication error is generated. Setting the parameter to “0” disables the communication error. *min...max*: **0**...**121**										

7.5.6. Power delivery mode with communication error

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1915	891	16 bit	**C.E.m**	M	MainMenu → L1 → Controls → C.E.m_1	R/W	■	Unsigned Short		0
2939				E1	MainMenu → L2 → Controls → C.E.m_2					
4987				E2	MainMenu → L3 → Controls → C.E.m_3					
The parameter defines what happens to the power delivered from the output of the GRC device when a communication error occurs. *Options*: **0** = The power delivered is not changed **1** = The power delivered is forced to the value determined by the parameter C.E.P										

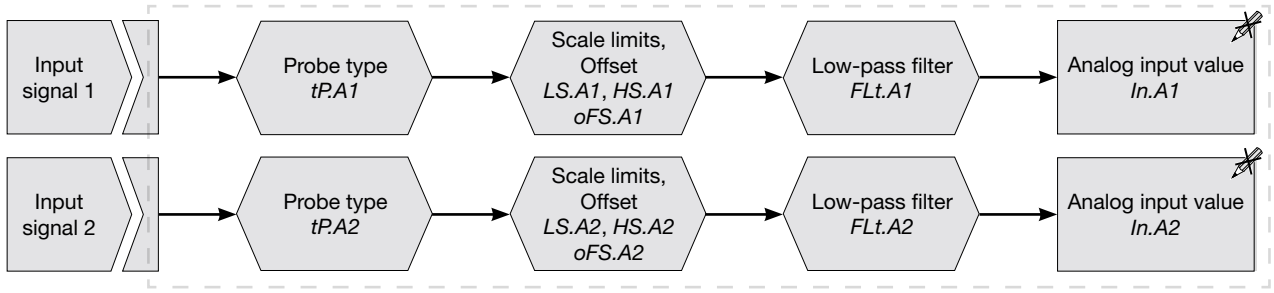
7.5.7. Output power with communication error

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1916	892	16 bit	**C.E.P**	M	MainMenu → L1 → Controls → C.E.P_1	R/W	■	Float (####.#)	%	0.0
2940				E1	MainMenu → L2 → Controls → C.E.P_2					
4988				E2	MainMenu → L3 → Controls → C.E.P_3					
When a communication error occurs, if the parameter C.E.m has been set to “1”, the parameter sets the power delivered by the output of the GRC device as a percentage value of the maximum power that can be delivered by the output. *min...max*: **0.0**...**100.0**										

7.6. Analog inputs

7.6.1. Functional diagram of analog inputs

The Advanced Power Controller has 2 analog inputs whose main purpose is to control the power output. The input electrical signal is processed to obtain a valid analog value for the control function.
The diagram shows the signal processing sequences.



7.6.2. Types of analog input

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1597	573	16 bit	**tP.A1**	Global	MainMenu → Global → Inputs → Analog input 1 → tP.A1	R/W	■	Unsigned Short		0
1861	837	16 bit	**tP.A2**	Global	MainMenu → Global → Inputs → Analog input 2 → tP.A2	R/W	■	Unsigned Short		0

The parameter sets the type of electrical signal expected on analog input A1 or A2. This signal is typically generated by a probe.

Options:
0 = Input disabled
1 = Voltage 0...10 V
2 = Voltage 0...5 V or potentiometer
3 = Current 0...20 mA
4 = Current 4...20 mA

7.6.3. Analog input lower scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1598	574	16 bit	**LS.A1**	Global	MainMenu → Global → Inputs → Analog input 1 → LS.A1	R/W	■	Float (####.#)	s.p.	0.0
1862	838	16 bit	**LS.A2**	Global	MainMenu → Global → Inputs → Analog input 2 → LS.A2	R/W	■	Float (####.#)	s.p.	0.0

The parameter sets the lower limit of the measurement scale used for analog input A1 or A2.
For examples of the use of the parameter, see paragraph “8.1. Setting parameters LS.A1/LS.A2 and HS.A1/HS.A2”.

min...max: **-100.0**...**200.0**

7.6.4. Analog input upper scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1599	575	16 bit	**HS.A1**	Global	MainMenu → Global → Inputs → Analog input 1 → HS.A1	R/W	■	Float (####.#)	s.p.	100.0
1863	839	16 bit	**HS.A2**	Global	MainMenu → Global → Inputs → Analog input 2 → HS.A2	R/W	■	Float (####.#)	s.p.	100.0
The parameter sets the upper limit of the measuring scale used for analog input A1 or A2. For examples of the use of the parameter, see paragraph “8.1. Setting parameters LS.A1/LS.A2 and HS.A1/HS.A2”. *min...max*: **LS.Ax**...**200.0**										

7.6.5. Analog input offset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1601	577	16 bit	**oFS.A1**	Global	MainMenu → Global → Inputs → Analog input 1 → oFS.A1	R/W	■	Float (####.#)	s.p.	0.0
1865	841	16 bit	**oFS.A2**	Global	MainMenu → Global → Inputs → Analog input 2 → oFS.A2	R/W	■	Float (####.#)	s.p.	0.0
The parameter sets the offset applied to the value read from analog input A1 or A2 to match the expected value. It is used to correct a possible constant probe reading error. This offset applies linearly to all readings, so it cannot be used to correct for probe linearity errors. *min...max*: **-99.9**...**99.9**										

7.6.6. Analog input low-pass filter

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1600	576	16 bit	**FLt.A1**	Global	MainMenu → Global → Inputs → Analog input 1 → FLt.A1	R/W	■	Float (####.#)	sec.	0.1
1864	840	16 bit	**FLt.A2**	Global	MainMenu → Global → Inputs → Analog input 2 → FLt.A2	R/W	■	Float (####.#)	sec.	0.1
The parameter sets the time constant value of the digital low-pass filter applied to analog input A1 or A2. The filter calculates the average of the values read in the specified time interval. With 0.0 no filter is applied. *min...max*: **0.0**...**20.0**										

7.6.7. Analog input process value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1596	572	16 bit	**In.A1**	Global	MainMenu → Global → Status → In.A1	R		Float (####.#)	s.p.	
1860	836	16 bit	**In.A2**	Global	MainMenu → Global → Status → In.A1	R		Float (####.#)	s.p.	
The parameter shows the process value of analog input A1 or A2. *min...max*: **0.0**...**100.0**										

7.7. Measuring load current

The Advanced Power Controller is able to measure the current input from the controlled load, whether single-phase or three-phase. The current input of a two-phase load can also be measured.
The absolute current input value read is processed to obtain an RMS current value useful for controlling the application.

The RMS current value can be read in the variable *I* of the individual module (each module corresponds to a single-phase load).
For three-phase loads, which use 3 modules, the average of the *I* variables of the individual modules is taken and stored in the variable *It*.

Input measurement accuracy is better than 1% in start modes ZC, BF and HSC.
In PA mode the accuracy is better than 3% with a conduction angle >90° and better than 10% for smaller conduction angles.
The circulating current in the load is acquired with a 0.2 ms sampling time.

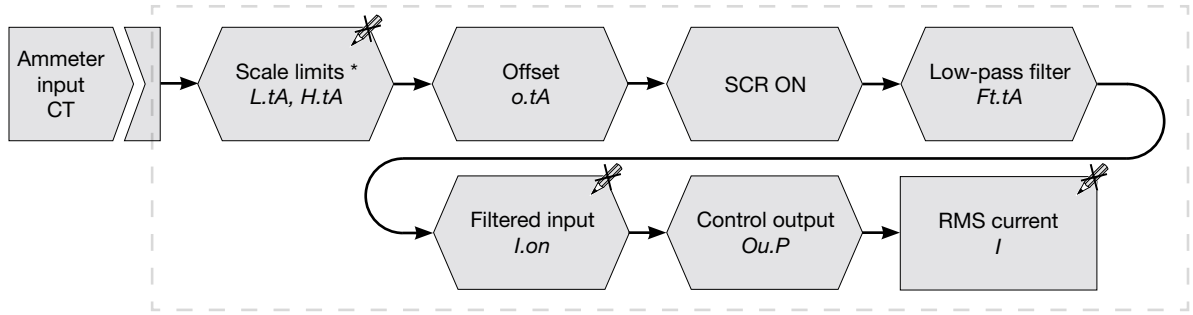
If diagnostics detects a fault condition on the load, the red ER LED.

The default value of the *H.tA* maximum limit or ammeter full-scale depends on the controller model*:*

GRC model	Rated current	H.tA
GRC 25	25	27,5
GRC 25I	25	27,5
GRC 40	40	44
GRC 40I	40	44
GRC 60	60	66
GRC 75	75	82,5
GRC 90	90	99
GRC 120	120	132
GRC 150	150	165

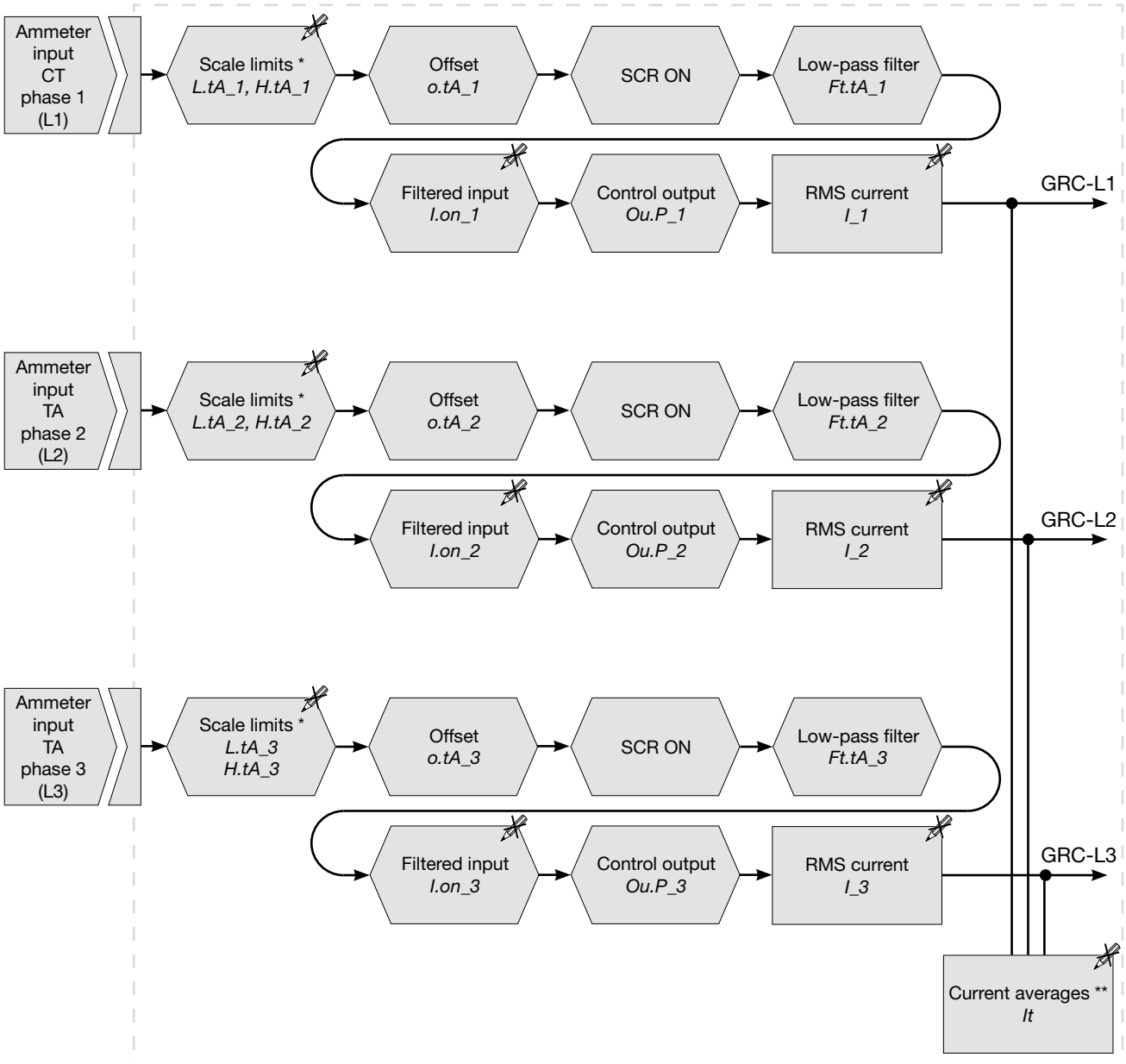
The following diagrams show the processing sequences for the initial current value.

Single-phase load



*) limits depend on the current rating of the device

Three-phase load



*) limits depend on the current rating of the device
**) with BIPHASE command the value *I_3* is calculated as the average of the values *I_1* and *I_2*

7.7.1. Ammeter input lower scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1770	746	16 bit	**L.tA**	M	MainMenu → L1 → Inputs → CT input → Lt.A_1	R		Float (####.#)	A	0.0
2794				E1	MainMenu → L2 → Inputs → CT input → Lt.A_2					
4842				E2	MainMenu → L3 → Inputs → CT input → Lt.A_3					
The parameter shows the lower limit of the measuring scale used for the CT ammeter input of device L1 or L2 or L3.										

7.7.2. Ammeter input upper scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1429	405	16 bit	**H.tA**	M	MainMenu → L1 → Inputs → CT input → Ht.A_1	R		Float (####.#)	A	see table
2453				E1	MainMenu → L2 → Inputs → CT input → Ht.A_2					
4501				E2	MainMenu → L3 → Inputs → CT input → Ht.A_3					

The parameter shows the upper limit of the measuring scale used for the CT ammeter input of device L1 or L2 or L3.

GRC model	Rated current	H.tA
GRC 25	25	27,5
GRC 25I	25	27,5
GRC 40	40	44
GRC 40I	40	44
GRC 60	60	66
GRC 75	75	82,5
GRC 90	90	99
GRC 120	120	132
GRC 150	150	165

7.7.3. Ammeter input offset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1244	220	16 bit	**o.tA**	M	MainMenu → L1 → Inputs → CT input → o.tA_1	R/W	■	Float (####.#)	A	0.0
2268				E1	MainMenu → L2 → Inputs → CT input → o.tA_2					
4316				E2	MainMenu → L3 → Inputs → CT input → o.tA_3					

The parameter shows the offset applied to the value read from the CT ammeter input of device L1 or L2 or L3 to match the expected value. It serves to correct a possible constant reading error.

This offset applies linearly to all readings.

min...max: **-99.9**...**99.9**

7.7.4. Instantaneous ammeter input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1163	139	16 bit	**I.tA**	M	MainMenu → L1 → Status → I.tA_1	R		Float (####.#)	A	
2187				E1	MainMenu → L2 → Status → I.tA_2					
4235				E2	MainMenu → L3 → Status → I.tA_3					
The parameter shows the instantaneous input read from the ammeter input of device L1 or L2 or E2.										

7.7.5. Filtered ammeter input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1492	468	16 bit	**I.on**	M	MainMenu → L1 → Status → I.on_1	R		Float (####.#)	A	
2516				E1	MainMenu → L2 → Status → I.on_2					
4564				E2	MainMenu → L3 → Status → I.on_3					
The parameter shows the input read by the ammeter input of device L1 or L2 or L3 when the output is activated.										

7.7.6. Peak ammeter input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1733	709	16 bit	**I.tAP**	M	MainMenu → L1 → Status → I.tAP_1	R		Float (####.#)	Apk	
2757				E1	MainMenu → L2 → Status → I.tAP_2					
4805				E2	MainMenu → L3 → Status → I.tAP_3					
The parameter shows the peak input value read by the ammeter input of device L1 or L2 or L3 during the phase softstart ramp.										

7.7.7. Power factor

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1740	716	16 bit	**CoS.F**	M	MainMenu → L1 → Status → CoS.F_1	R		Float (####.#)		
2764				E1	MainMenu → L2 → Status → CoS.F_2					
4812				E2	MainMenu → L3 → Status → CoS.F_3					
The parameter shows the power factor of the device L1 or L2 or E2.										

7.7.8. RMS load current

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1777	753	16 bit	**I**	M	MainMenu → L1 → Status → I_1	R		Float (####.#)	A	
2801				E1	MainMenu → L2 → Status → I_2					
4849				E2	MainMenu → L3 → Status → I_3					
The parameter shows the RMS load current input of device L1 or L2 or E2.										

7.7.9. RMS current in three-phase load

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1778	754	16 bit	**It**	Global	MainMenu → Global → Status → It	R		Float (####.#)	A	
The parameter shows the RMS current input of the three-phase load.										

7.7.10. Ammeter input digital filter

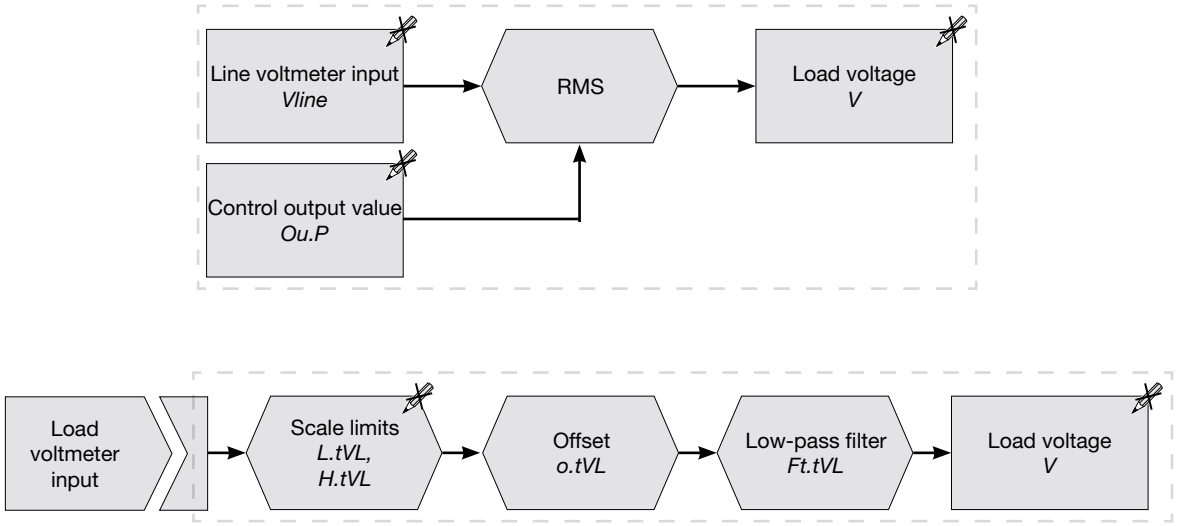
Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1243	219	16 bit	**Ft.tA**	M	MainMenu → L1 → Inputs → CT input → Ft.tA_1	R/W	■	Float (####.#)	sec.	0.1
2267				E1	MainMenu → L2 → Inputs → CT input → Ft.tA_2					
4315				E2	MainMenu → L3 → Inputs → CT input → Ft.tA_3					
The parameter sets the time constant value of the digital filter applied to the CT ammeter input of device L1 or L2 or E2. The filter calculates the average of the values read in the specified time interval. With 0.0 no filter is applied. *min...max*: **0.0**...**20.0**										

7.8. Measuring load voltage

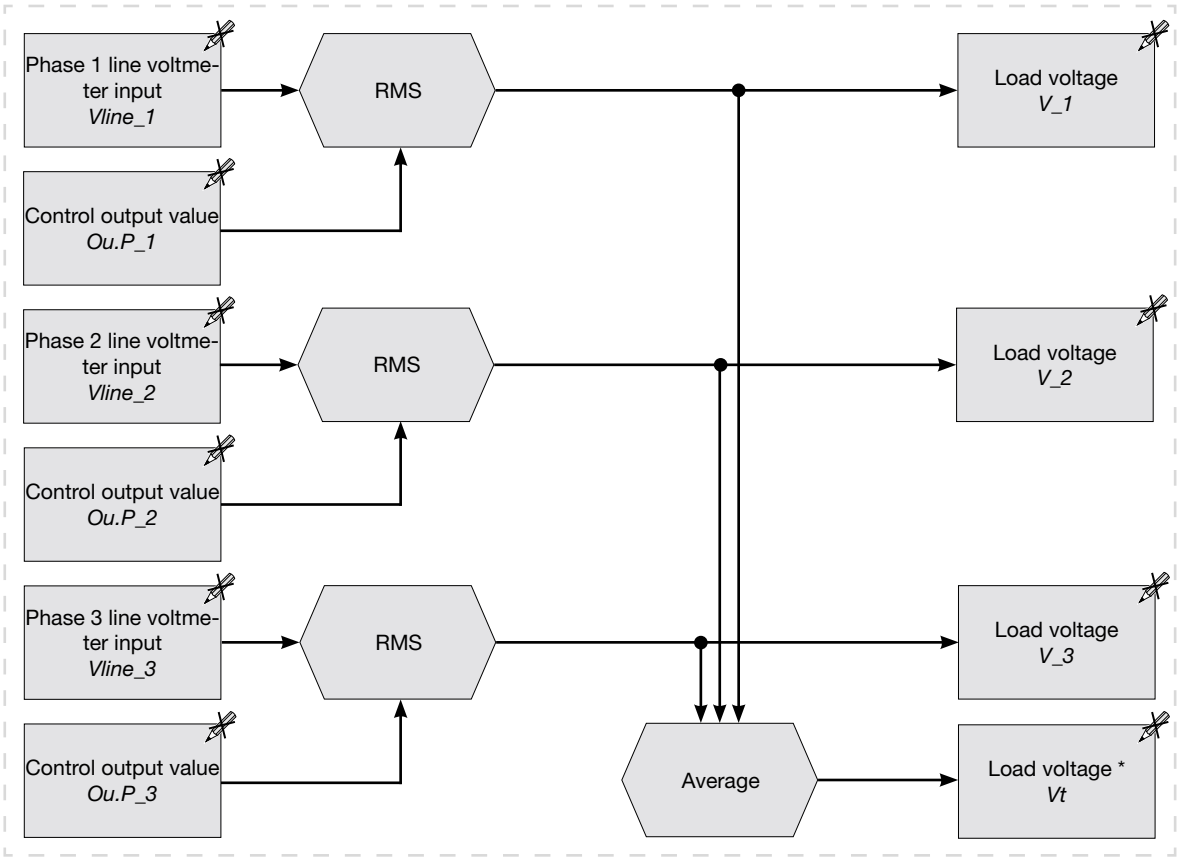
The Advanced Power Controller is able to measure the RMS voltage value of the controlled load, whether single-phase or three-phase. It can also measure the voltage of a two-phase load.

Tthe RMS voltage value of the load is calculated from the line voltage and power output values.
The following diagrams show the processing sequences for the initial voltage value.

Single-phase load



Three-phase load



*) with BIPHASE command the value *V_3* is obtained as the average of the values *V_1* and *V_2*

7.8.1. RMS load voltage

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1775	751	16 bit	**V**	M	MainMenu → L1 → Status → V_1	R		Float (####.#)	V	
2799				E1	MainMenu → L2 → Status → V_2					
4847				E2	MainMenu → L3 → Status → V_3					
The parameter shows the RMS voltage on the load.										

7.8.2. Instantaneous load voltage

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1734	710	16 bit	**Ld.VIS**	M	MainMenu → L1 → Status → Ld.VIS_1	R		Float (####.#)	V	
2758				E1	MainMenu → L2 → Status → Ld.VIS_2					
4806				E2	MainMenu → L3 → Status → Ld.VIS_3					
The parameter shows the instantaneous voltage on the load.										

7.8.3. Load voltage with output activated

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1735	711	16 bit	**Ld.Von**	M	MainMenu → L1 → Status → Ld.Von_1	R		Float (####.#)	V	
2759				E1	MainMenu → L2 → Status → Ld.Von_2					
4807				E2	MainMenu → L3 → Status → Ld.Von_3					
The parameter shows the voltage on the load when the output is activated.										

7.8.4. Voltage on three-phase load

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1776	752	16 bit	**Vt**	Global	MainMenu → Global → Status → Vt	R		Float (####.#)	V	
The parameter shows the voltage on the three-phase load.										

7.8.5. Voltmeter input offset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1468	444	16 bit	**o.tVL**	M	MainMenu → L1 → Inputs → VT load input → o.tVL_1	R/W	■	Float (####.#)	V	0.0
2492				E1	MainMenu → L2 → Inputs → VT load input → o.tVL_2					
4540				E2	MainMenu → L3 → Inputs → VT load input → o.tVL_3					

The parameter sets the offset applied to the value read from the TV_LOAD voltage transformer input to match the expected value. Its function is to correct any constant reading errors.
This offset applies linearly to all readings.
The parameter is present if the VLOAD option exists.

min...max: **-99.9**...**99.9**

7.8.6. Voltmeter input digital filter

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1466	442	16 bit	**Ft.tVL**	M	MainMenu → L1 → Inputs → VT load input → Ft.tVL_1	R/W	■	Float (####.#)	V	0.1
2490				E1	MainMenu → L2 → Inputs → VT load input → Ft.tVL_2					
4538				E2	MainMenu → L3 → Inputs → VT load input → Ft.tVL_3					

The parameter sets the time constant value of the digital filter applied to the value read from the input of the TV_LOAD voltage transformer. The filter calculates the average of the values read in the specified time interval.
With 0.00 no filter is applied.
The parameter is present if the VLOAD option exists.

min...max: **0.0**...**20.0**

7.9. Measuring line voltage

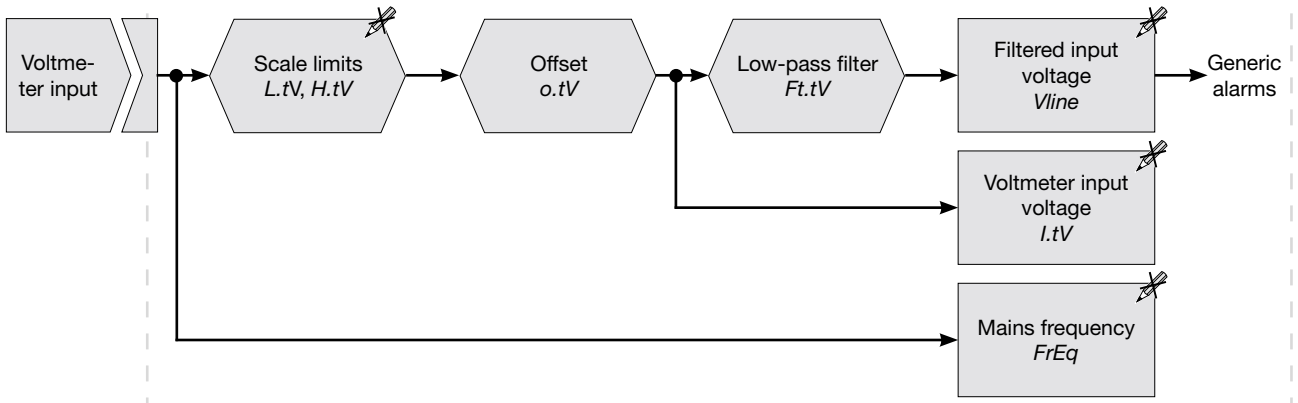
The Advanced Power Controller is able to measure the line voltage value. The parameters present depend on the type of load (single-phase or three-phase).

A voltage presence check is active for each phase, which switches off the GRC module if it detects incorrect values. For three-phase loads, unbalance diagnostics is provided to switch off the load and indicate the fault with LEDs.

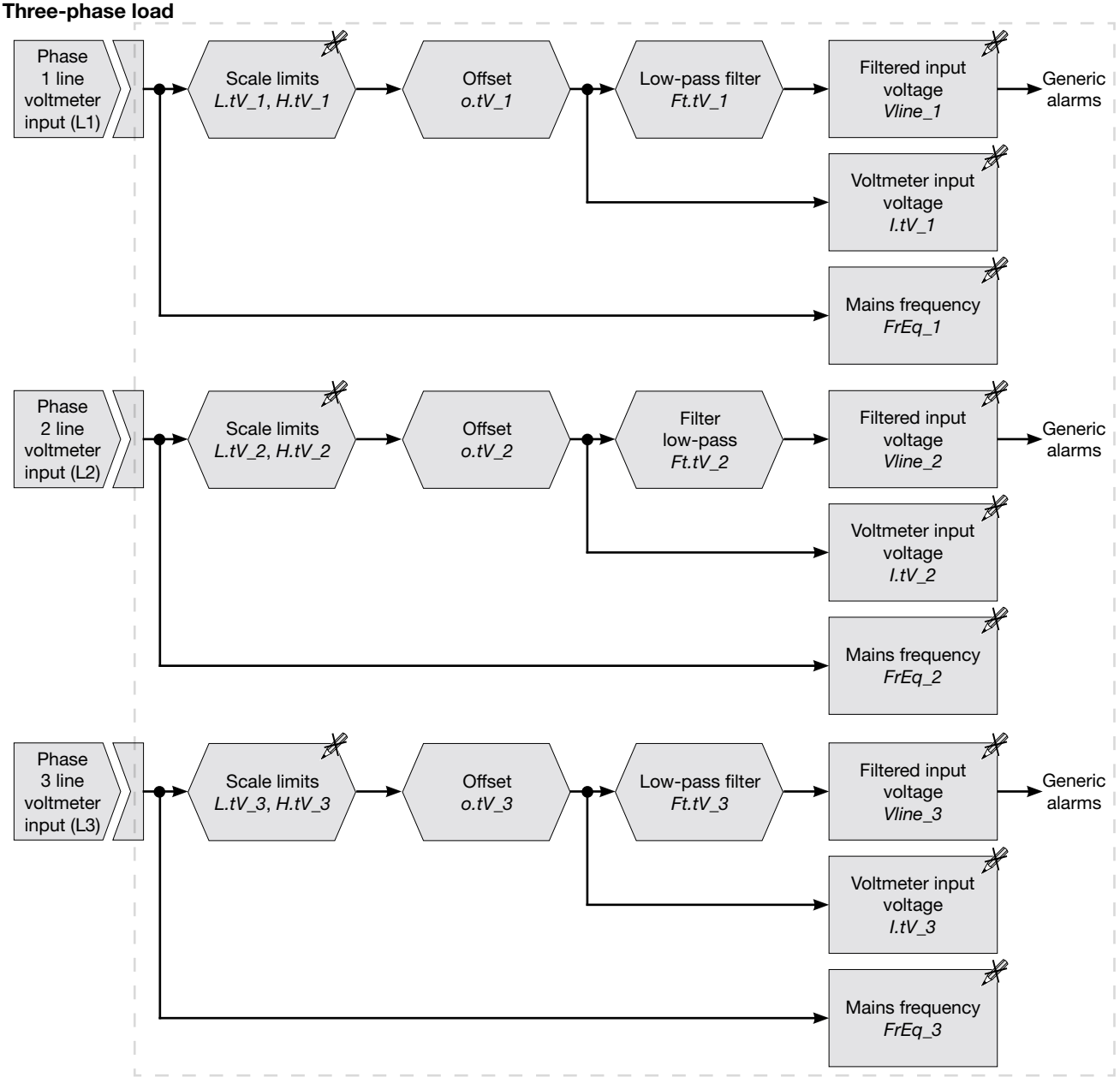
The *VOLTAGE_STATUS* parameter contains information on the status of the line voltage, including the mains frequency. With three-phase loads, diagnostics are available for correct phase connection, lack of one voltage and unbalance of the three line voltages.

The following diagrams show the processing sequences of the line voltage value.

Single-phase load



Three-phase load



7.9.1. Lower VT voltmeter input scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1477	453	16 bit	**L.tV**	M	MainMenu → L1 → Inputs → VT line input → L.tV_1	R		Float (####.#)	V	40.0
2501				E1	MainMenu → L2 → Inputs → VT line input → L.tV_2					
4549				E2	MainMenu → L3 → Inputs → VT line input → L.tV_3					
The parameter shows the lower limit of the line voltage measurement scale used for the voltmeter input.										

+

7.9.2. VT voltage transformer input offset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1435	411	16 bit	**o.tV**	M	MainMenu → L1 → Inputs → VT line input → o.tV_1	R/W	■	Float (####.#)	V	0.0
2459				E1	MainMenu → L2 → Inputs → VT line input → o.tV_2					
4507				E2	MainMenu → L3 → Inputs → VT line input → o.tV_3					
The parameter sets the offset applied to the line voltage value read at the input of the VT voltage transformer to match the expected value. Its function is to correct a possible constant reading error. This offset applies linearly to all readings. *min...max*: **-99.9**...**99.9**										

7.9.3. Three-phase line unbalance threshold

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1280	256	16 bit	**Unb.1**	Global	MainMenu → Global → Controls → Unb.1	R/W	■	Unsigned Short	%	10
1281	257	16 bit	**Unb.2**	Global	MainMenu → Global → Controls → Unb.2	R/W	■	Unsigned Short	%	20
1282	258	16 bit	**Unb.3**	Global	MainMenu → Global → Controls → Unb.3	R/W	■	Unsigned Short	%	30
The parameters set the thresholds 1, 2 and 3 for signalling a percentage unbalance on the three-phase line. Exceeding the the threshold is shown with the VOLTAGE_STATUS parameter (see paragraph “7.9.6. VOLTAGE_STATUS”). *min...max*: **0**...**50**										

7.9.4. Voltmeter input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1256	232	16 bit	**I.tV**	M	MainMenu → L1 → Status → I.tV_1	R		Float (####.#)	V	
2280				E1	MainMenu → L2 → Status → I.tV_2					
4328				E2	MainMenu → L3 → Status → I.tV_3					
The parameter shows the instantaneous value of the mains voltage for the voltmeter input.										

7.9.5. Filtered voltmeter input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1346	322	16 bit	**Vline**	M	MainMenu → L1 → Status → I.VF_1	R		Float (####.#)	V	
2370				E1	MainMenu → L2 → Status → I.VF_2					
4418				E2	MainMenu → L3 → Status → I.VF_3					
The parameter shows the filtered mains voltage value for the voltmeter input.										

7.9.6. VOLTAGE_STATUS

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1726	702	16 bit		Global	VOLTAGE_STATUS	R		Unsigned		

The stored bytes contain information about the line voltage status and other operating states of the device. Each bit contains a specific piece of information, as shown in the table.

bit	Description
0	Line frequency out of limits *
1	Line voltage unbalance > Unb.1 *
2	Line voltage imbalance > Unb.2 *
3	Line voltage unbalance > Unb.3 * (30%_UNBALANCED_ERROR)
4	Rotation of phases 1-3-2 *
5	Three-phase line failure * (TRIPHASE_MISSING_LINE_ERROR)
6	Line frequency 60 Hz
7	Device not ready (DEVICE_NOT_READY)
8	DIP switch and EEPROM configuration error (MODE_ERROR)
9	
10	Enabling from Interlock (1 = device enabled)

*) only for three-phase configuration

7.9.7. Grid frequency

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1339	315	16 bit	**FrEq**	M	MainMenu → L1 → Status → FrEq_1	R		Float (####.#)	Hz	
2363				E1	MainMenu → L2 → Status → FrEq_2					
4411				E2	MainMenu → L3 → Status → FrEq_3					
The parameter shows the filtered value of the mains frequency.										

7.9.8. VT voltmeter input digital filter

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1436	412	16 bit	**Ft.tV**	M	MainMenu → L1 → VT line input → Ft.tV_1	R/W	■	Float (####.#)	sec.	2.0
2460				E1	MainMenu → L1 → VT line input → Ft.tV_1					
4508				E2	MainMenu → L1 → VT line input → Ft.tV_1					
The parameter sets the time constant value of the digital filter applied to the value read from the VT voltage transformer input. The filter calculates the average of the values read in the specified time interval. With 0.00 no filter is applied. *min...max*: **0.0**...**20.0**										

7.10. Measuring the power on the load and energy consumed

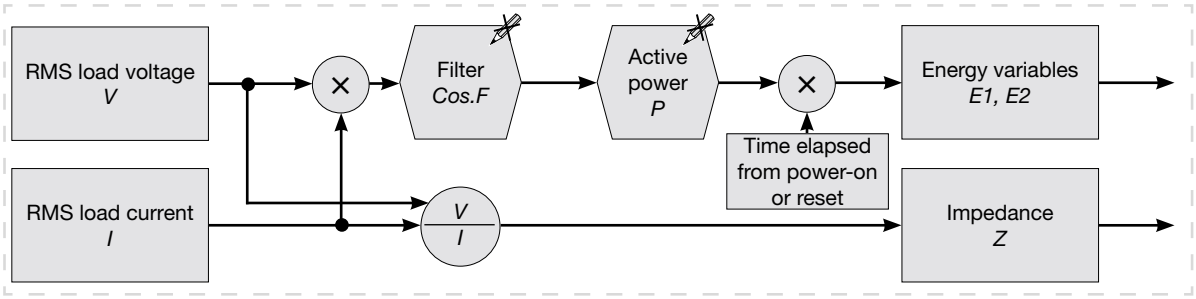
The Advanced Power Controller is able to measure the instantaneous active power value on the load and the energy consumed since the first power-on or the last reset. The parameters present depend on the type of load (single-phase or three-phase).

The update in the non-volatile memory takes place every two hours and when the line voltage is disconnected.

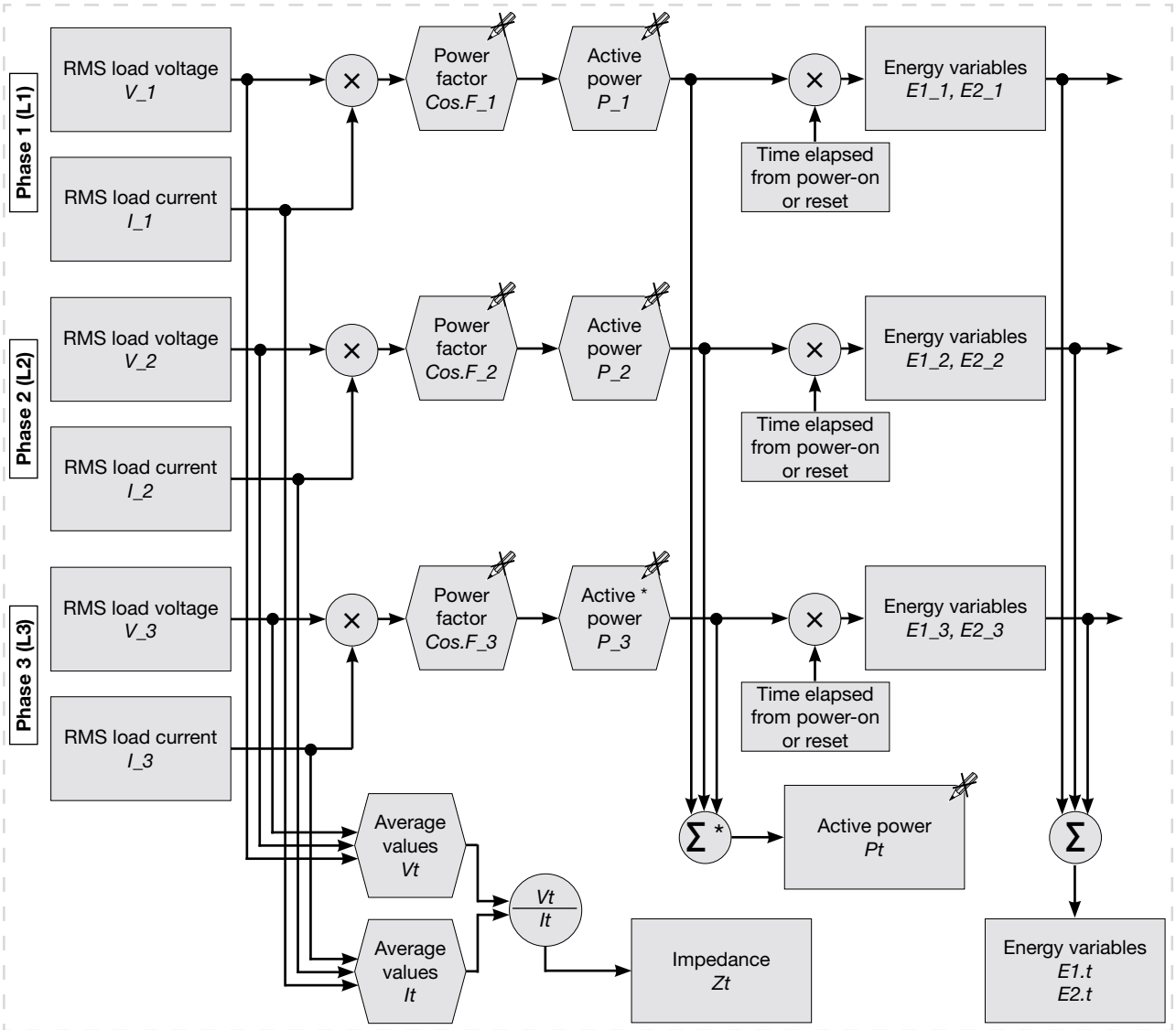
The load impedance value of the individual module is also available; if the load is three-phase, the impedance value is the total value. For loads such as IR lamps, the impedance value can vary greatly depending on the power transferred to the load.

The following diagrams show the processing sequences to arrive at the active power, energy consumed and impedance values.

Single-phase load



Three-phase load



(*) with BIPHASE command the value *P_3* is obtained as the average of the values *P_1* and *P_2*

7.10.1. Power on load

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1904	880	32 bit	**P**	M	MainMenu → L1 → Status → P_1	R		Float32 (####.#)	kW	
2928				E1	MainMenu → L2 → Status → P_2					
4976				E2	MainMenu → L3 → Status → P_2					
The parameter shows the value of the power on the load.										

7.10.2. Power on three-phase load

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1906	882	32 bit	**Pt**	Global	MainMenu → Global → Status → Pt	R		Float32 (####.#)	kW	
The parameter shows the value of the power on the 3-phase load, which is the sum of the loads on the 3 individual phases.										

7.10.3. Load impedance

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1773	749	16 bit	**Z**	M	MainMenu → L1 → Status → Z_1	R		Float (####.#)	ohm	
2797				E1	MainMenu → L2 → Status → Z_2					
4845				E2	MainMenu → L3 → Status → Z_3					
The parameter shows the load impedance value. The value is calculated by dividing the value of V *by* the value of I .										

7.10.4. Three-phase load impedance

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1774	750	16 bit	**Zt**	Global	MainMenu → Global → Status → Zt	R		Float (####.#)	ohm	
The parameter shows the impedance value of the three-phase load. The value is calculated by dividing the average value of the three *V* values by the average value of the three *I* values.										

7.10.5. E1 Energy consumed

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1555	531	32 bit	**E1**	M	MainMenu → L1 → Status → E1_1	R	■	Unsigned Int	kWh	
2579				E1	MainMenu → L2 → Status → E1_2					
4627				E2	MainMenu → L3 → Status → E1_3					
This parameter shows the value of the L2 energy consumed since the meter was switched on or last reset.										

7.10.6. E2 energy consumed

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1534	510	32 bit	**E2**	M	MainMenu → L1 → Status → E2_1	R	■	Unsigned Int	kWh	
2558				E1	MainMenu → L2 → Status → E2_2					
4606				E2	MainMenu → L3 → Status → E2_3					
This parameter shows the value of the L3 energy consumed since the meter was switched on or last reset.										

7.10.7. E1 three-phase energy consumed

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1565	541	32 bit	**E1.t**	Global	MainMenu → Global → Status → E1.t	R	■	Unsigned Int	kWh	
The parameter shows the value of the L2 three-phase energy consumed since the meter was switched on or last reset, which is the sum of the L2 energies consumed on the 3 individual phases.										

7.10.8. E2 three-phase energy consumed

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1524	500	32 bit	**E2.t**	Global	MainMenu → Global → Status → E2.t	R	■	Unsigned Int	kWh	
The parameter shows the value of the L3 three-phase energy consumed since the meter was switched on or last reset, which is the sum of the L3 energies consumed on the 3 individual phases.										

7.10.9. E1 energy consumption meter reset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1138	114	bit	**BIT_ RESET_ LDE1**	M	MainMenu → L1 → Expert → Bit → BIT_RESET_LDE1_1	R/W				OFF
2162				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_LDE1_2					
4210				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_LDE1_3					
The parameter sets the reset function of the L2 energy meter. *Options*: **OFF** = Function is disabled **ON** = The function is enabled. The meter *E1* is reset to zero.										

7.10.10. E2 energy consumption meter reset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1139	115	bit	**BIT_ RESET_ LDE2**	M	MainMenu → L1 → Expert → Bit → BIT_RESET_LDE2_1	R/W				OFF
2163				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_LDE2_2					
4211				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_LDE2_3					
The parameter sets the reset function of the L3 energy meter. *Options*: **OFF** = Function is disabled **ON** = The function is enabled. The meter *E2* is reset to zero.										

7.11. Digital inputs

The following functions are related to the digital inputs:

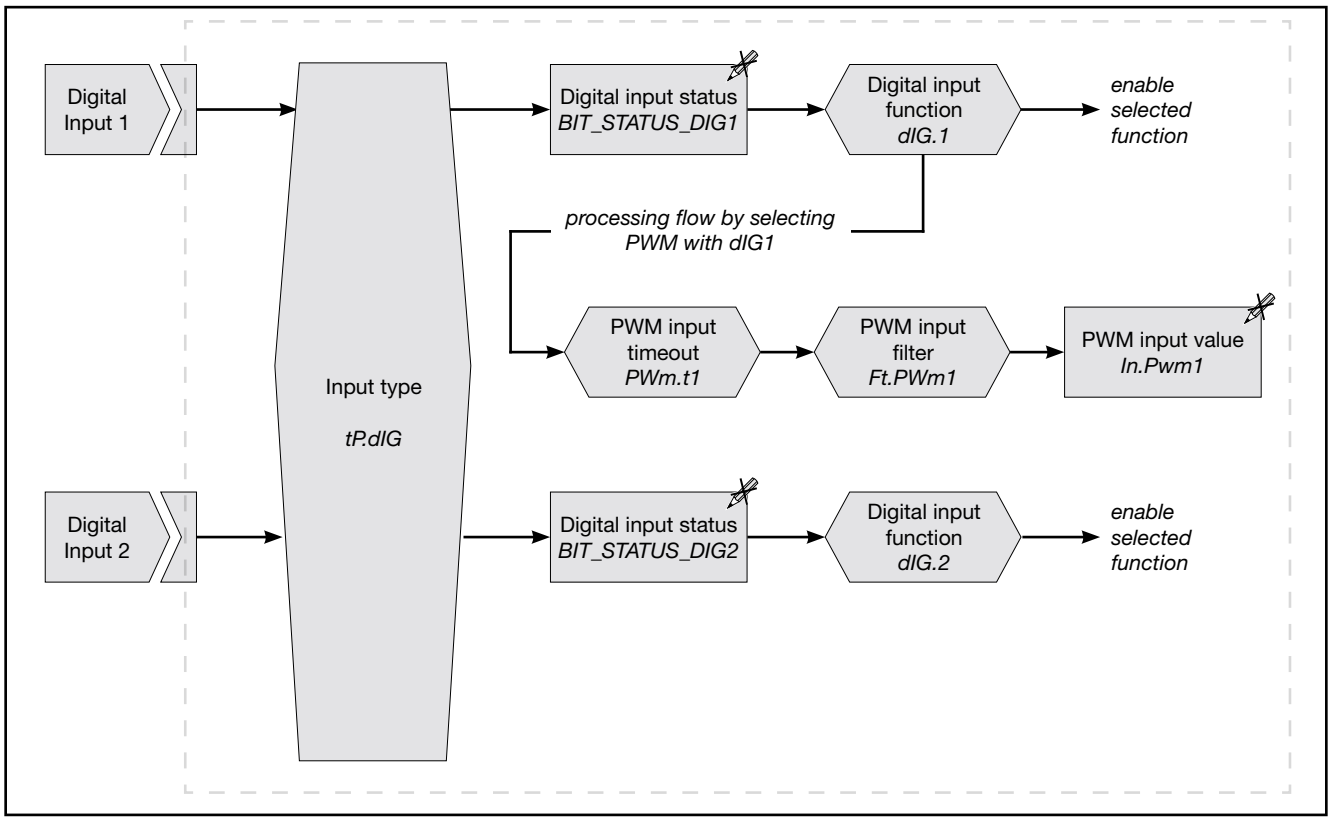
- Automatic / manual control (see paragraph “7.20. Automatic - manual control”).
- Alarm memory reset (see paragraph “7.12.13. Alarm memory reset”).
- Software shutdown / startup (see paragraph “7.22. Software shutdown”).
- Reference Feedback calibration (see paragraph “7.28.9. Feedback reference calibration”).
- HB alarm calibration (see diagrams “Functional diagram of HB calibration in ZC - BF - HSC mode” on page 106, “Functional diagram of HB calibration in PA mode” on page 106, “Functional diagram of HB calibration for infrared lamps” on page 107).

For further explanations on the use and configuration of the digital inputs, see paragraphs:

- “8.2. Using a function associated with the digital input and via serial”,
- “8.3. Using digital input 1 to enable software startup”,

particularly the examples chapter.

The following functional diagram shows the signal processing sequences of the digital inputs.



7.11.1. Digital input status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1092	68	bit	**BIT_STATUS_DIG1**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_DIG1	R				
1116	92	bit	**BIT_STATUS_DIG2**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_DIG2	R				
The parameter shows the status of digital input 1, 2, depending on the address used. *Options*: **OFF** = Digital input off **ON** = Digital input active										

7.11.2. Digital input status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1341	317	16 bit	**INPUT_DIG**	Global	MainMenu → Global → Status → INPUT_DIG	R				
The parameter shows the status of the 2 digital inputs with 2-bit status. *Options*: **bit 0** = INDIG1 status **bit 1** = INDIG2 status										

7.11.3. Digital input function

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1164	140	16 bit	**dIG.1**	Global	MainMenu → Global → Inputs → Digital inputs → dIG.1	R/W	■	Unsigned Short		0
1642	618	16 bit	**dIG.2**	Global	MainMenu → Global → Inputs → Digital inputs → dIG.2	R/W	■	Unsigned Short		0

This parameter sets the function associated with digital input 1, 2, depending on the address used. The input can be activated by a change in value ("On leading edge") or by its state ("On state").
Each main function is identified by an index. By adding a fixed value to the index, the functions are thus modified:
+16 = input in denied logic
+32 = logic state 0 (OFF) is forced
+64 = logic state 1 (ON) is forced

Options:

Index	Description	Activation
0	No function (input disabled)	On leading edge
1	MAN / AUTO controller	On leading edge
4	Generic alarm memory reset AL1...AL8	On state
6	Software ON/OFF	On leading edge
7	PWM * input	On leading edge
10	Reset POWER_FAULT alarm memory	On leading edge
12	AL1...AL8 and POWER_FAULT generic alarm memory reset	On state
13	Enable software startup **	On state
14	Reference calibration of feedback selected by *hd.6*	On leading edge
15	HB alarm threshold calibration	On leading edge
64	FUSE_OPEN / SHORT_LOAD alarm reset	On state
65	Reference calibration of feedback selected by *hd.6* for GRC-L1	On leading edge
66	Reference calibration of feedback selected by *hd.6* for GRC-L2	On leading edge
67	Reference calibration of feedback selected by *hd.6* for GRC-L3	On leading edge
68	Calibration of HB alarm threshold for GRC-L1	On leading edge
69	Calibration of HB alarm threshold for GRC-L2	On leading edge
70	Calbiration of HB alarm setpoint for GRC-L3	On leading edge
71	MAN / AUTO for GRC-L1	On leading edge
72	MAN / AUTO for GRC-L2	On leading edge
73	MAN / AUTO for GRC-L3	On leading edge
74	ON / OFF Software for GRC-L1	On leading edge
75	ON / OFF Software for GRC-L2	On leading edge
76	ON / OFF Software for GRC-L3	On leading edge
77	Trigger change for GRC-L1	On state
78	Trigger change for GRC-L2	On state
79	Trigger change for GRC-L3	On state
128	Interlock	On state

*) only for *dIG.1* (PWM1, max 100 Hz)
**) only for *dIG.1*

Examples
Setting value "4" activates the cancellation function of alarms AL.1...AL.8 (e.g., by closing the digital input); by setting 20 (=4+16) the AL.1...AL.8 alarm cancellation occurs with denied logic (e.g., by opening the digital input).

7.11.4. PWM input timeout

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1380	356	16 bit	**PWm.t1**	Global	MainMenu → Global → Inputs → Digital inputs → PWm.t1	R/W	■	Float (####.#)	sec.	0.01
1381	357	16 bit	**PWm.t2**	Global	MainMenu → Global → Inputs → Digital inputs → PWm.t2	R/W	■	Float (####.#)	sec.	1.00

The parameter sets the timeout for the digital input PWM 1, PWM 2, depending on the address used.

IMPORTANT! If the digital input is used to control the power percentage (parameter *Ou.P*) to be delivered on the load (PWM input function, *dIG* = 7), the parameter *PWm.t* must be set to a value equal to or greater than the period of the PWM control signal used, in order to guarantee the reaction time even in static conditions of low (*Ou.P* = 0%) or high (*Ou.P* = 100%) input.

min...max: **0.01**...**10.00**

7.11.5. Digital filter for PWM input

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1462	438	16 bit	**Ft.PWm1**	Global	MainMenu → Global → Inputs → Digital inputs → Ft.PWm1	R/W	■	Float (####.#)	sec.	0.1
1396	372	16 bit	**Ft.PWm2**	Global	MainMenu → Global → Inputs → Digital inputs → Ft.PWm2	R/W	■	Float (####.#)	sec.	0.1

This parameter sets the value of the digital filter time constant applied to the value read from digital input PWM 1, PWM 2, depending on the address used. The filter calculates the average of the values read in the specified time interval.
With 0.0 no filter is applied.

min...max: **0.0**...**20.0**

7.11.6. PWM input value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1542	518	16 bit	**In.Pwm1**	Global	MainMenu → Global → Status → In.Pwm1	R		Float (####.#)	%	
1459	435	16 bit	**In.Pwm2**	Global	MainMenu → Global → Status → In.Pwm2	R		Float (####.#)	%	

The parameter shows the value of the input PWM 1, PWM 2, depending on the address used, as a percentage of the ON state compared to the ON + OFF period.

min...max: **0.0**...**100.0**

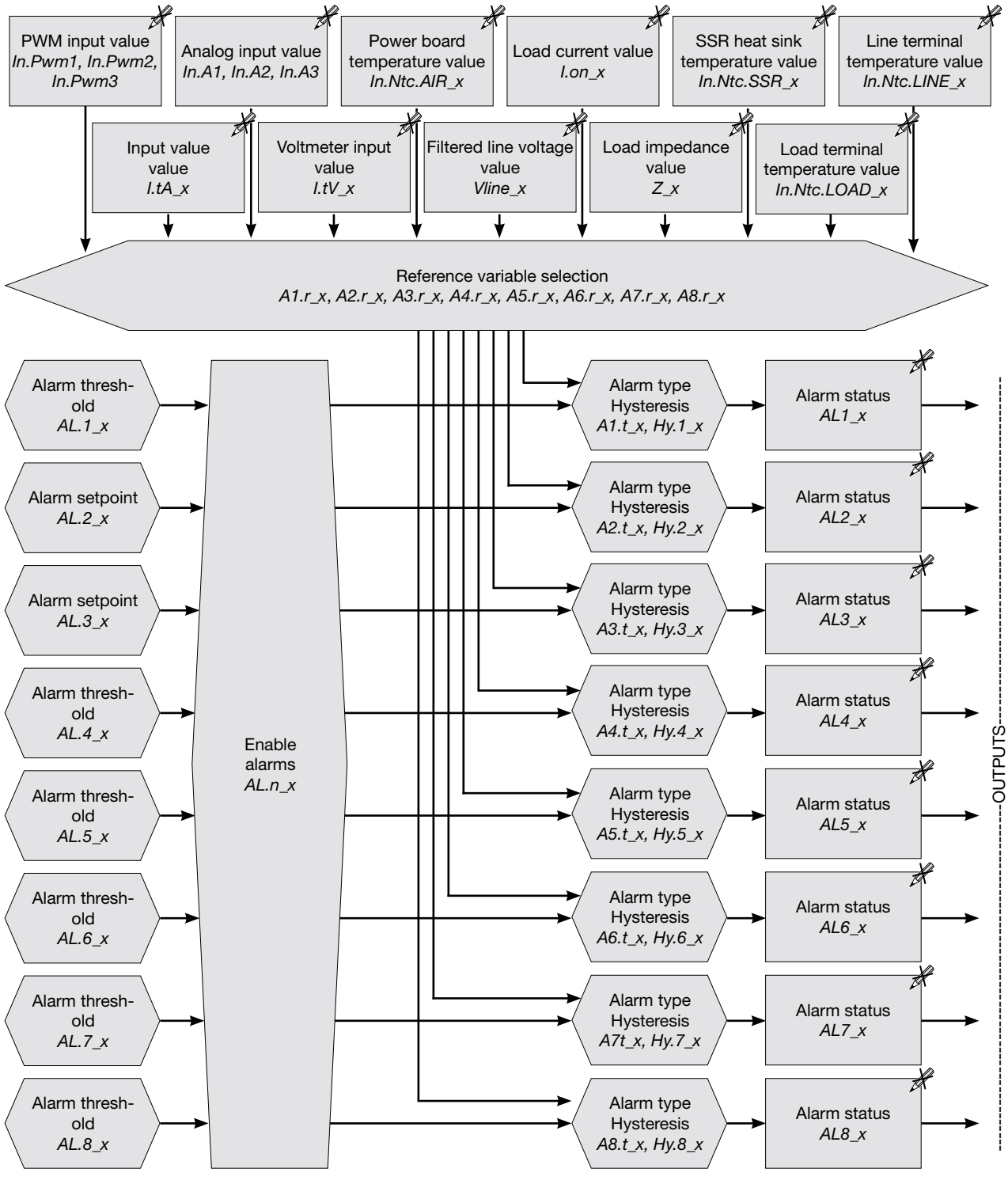
7.12. Generic alarms AL1 ... AL8

The Advanced Power Controller has 8 alarms (*AL1…AL8)* per module, described as generic, which can take on various functions.

The hysteresis value is used to define a band for the safe re-entry of the alarm condition and to avoid the continuous generation of alarms if the reference signal fluctuates around the threshold value.

Alarms can be configured to be triggered if the reference threshold is exceeded (value read greater than maximum threshold or less than minimum threshold), or if the threshold value is not reached (value read less than maximum threshold or greater than minimum threshold) or for other reasons.
The following diagram shows the parameter processing sequences for the generation of generic alarms.

Functional diagram of generic alarms



with x = 1...3

The default settings of the alarm definition parameters allow the following to be configured for each module:

- AL1: Maximum line voltage alarm with time delay.
- AL2: Minimum line voltage alarm with time delay.
- AL3: Minimum current alarm with active output with time delay disabled during softstart ramp.
- AL4: Alarm disabled.
- AL5: like AL1.
- AL6: like AL2.
- AL7: Maximum current alarm with active output with time delay.
- AL8: Alarm disabled.

The minimum and maximum values depend on the current and voltage ratings of the device.

7.12.1. Enable alarms

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1219	195	bit	**AL.n**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL.n_1	R/W	■	Unsigned Short		231
2243				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL.n_2					
4291				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL.n_3					

The parameter sets the generic alarms to be enabled. The combination of enabling and disabling is determined by the index set. The following table shows the enabled alarms according to the index.

The default index 231 (= 7 + 32 + 64 + 128) enables alarms AL.1 + AL.2 + AL.3 (index 7), AL.5 (+32), AL.6 (+64) and AL.7 (+128).

Options:

Index	Alarm 1	Alarm 2	Alarm 3	Alarm 4
0				
1	■			
2				
3	■	■		
4				
5	■			
6				
7	■	■	■	
8				
9	■			
10				
11	■	■		
12				
13	■			
14				
15	■	■	■	■

Increasing the index results in the following behaviours:
+16 to enable the HB alarm.
+32 to enable Alarm 5.
+64 to enable Alarm 6.
+128 to enable Alarm 7.
+256 to enable Alarm 8.

Example: Setting 19 (= 3 + 16) enables generic alarms 1 and 3, including their HB alarms, while all other alarms are disabled.

7.12.2. Generic alarm reference variable selection

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1239	215	16 bit	**A1.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL1 → A1.r_1	R/W	■	Unsigned Short		18
2263				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL1 → A1.r_2					
4311				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL1 → A1.r_3					
1240	216	16 bit	**A2.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL2 → A2.r_1	R/W	■	Unsigned Short		18
2264				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL2 → A2.r_2					
4312				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL2 → A2.r_3					
1241	217	16 bit	**A3.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL3 → A3.r_1	R/W	■	Unsigned Short		17
2265				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL3 → A3.r_2					
4313				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL3 → A3.r_3					
1242	218	16 bit	**A4.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL4 → A4.r_1	R/W	■	Unsigned Short		18
2266				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL4 → A4.r_2					
4314				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL4 → A4.r_3					
1226	202	16 bit	**A5.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL5 → A5.r_1	R/W	■	Unsigned Short		18
2250				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL5 → A5.r_2					
4298				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL5 → A5.r_3					
1227	203	16 bit	**A6.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL6 → A6.r_1	R/W	■	Unsigned Short		18
2251				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL6 → A6.r_2					
4299				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL6 → A6.r_3					
1228	204	16 bit	**A7.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL7 → A7.r_1	R/W	■	Unsigned Short		17
2252				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL7 → A7.r_2					
4300				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL7 → A7.r_3					
1229	205	16 bit	**A8.r**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL8 → A8.r_1	R/W	■	Unsigned Short		18
2253				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL8 → A8.r_2					
4301				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL8 → A8.r_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										

The parameter sets the reference variable for the generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The alarm and module concerned depend on the address used. The range of valid values and the position of the decimal point for alarm threshold and hysteresis can vary depending on the reference variable chosen for the alarm.

Options:

Index	Variable for comparison	Reference threshold	Alarm threshold range	Decimal point position
9	*In.A1*: Analog input 1	*AL.y* (with y = 1...8)	LS.A1…HS.A1	###.#
10	*In.Pwm1*: input PWM 1		0.0…100.0	###.#
11	*In.A2*: Analog input 2		LS.A2…HS.A2	###.#
13	*In.Pwm2*: input PWM 2		0.0…100.0	###.#
15	*I.tA_x*: instantaneous load current of module x *		L.tA_x…H.tA_x *	###.#
16	*I.tV_x*: instantaneous line voltage of module x *		L.tV_x…H.tV_x *	###.#
17	*I.on_x*: Load current of module x at activated output *		L.tA_x…H.tA_x *	###.#
18	*Vline_x*: Filtered line voltage of module x *		L.tV_x…H.tV_x *	###.#
19	*Z_x*: load impedance of module x *		0.00…655.35	####.##
20	*In.Ntc.SSR_x*: SSR heat sink temperature of module x *		10.0…120.0	###.#
21	*In.Ntc.LINE_x*: LINE terminal temperature of module x *		10.0…120.0	###.#
22	*In.Ntc.LOAD_x*: LOAD terminal temperature of module x *		10.0…120.0	###.#

*) x = 1 identifies GRC-L1, x = 2 identifies GRC-L2; x = 3 identifies GRC-L3

7.12.3. Alarm threshold

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1036	12	16 bit	**AL.1**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL1 → AL.1_1	R/W	■	Float *	s.p. *	see Table A
2060				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL1 → AL.1_2					
4108				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL1 → AL.1_3					
1037	13	16 bit	**AL.2**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL2 → AL.2_1	R/W	■	Float *	s.p. *	75.0
2061				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL2 → AL.2_2					
4109				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL2 → AL.2_3					
1038	14	16 bit	**AL.3**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL3 → AL.3_1	R/W	■	Float *	s.p. *	see Table B
2062				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL3 → AL.3_2					
4110				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL3 → AL.3_3					
1082	58	16 bit	**AL.4**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL4 → AL.4_1	R/W	■	Float *	s.p. *	see Table A
2106				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL4 → AL.4_2					
4154				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL4 → AL.4_3					
1222	198	16 bit	**AL.5**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL5 → AL.5_1	R/W	■	Float *	s.p. *	see Table A
2246				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL5 → AL.5_2					
4294				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL5 → AL.5_3					
1223	199	16 bit	**AL.6**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL6 → AL.6_1	R/W	■	Float *	s.p. *	75.0
2247				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL6 → AL.6_2					
4295				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL6 → AL.6_3					
1224	200	16 bit	**AL.7**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL7 → AL.7_1	R/W	■	Float *	s.p. *	see table
2248				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL7 → AL.7_2					
4296				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL7 → AL.7_3					
1225	201	16 bit	**AL.8**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL8 → AL.8_1	R/W	■	Float *	s.p. *	75.0
2249				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL8 → AL.8_2					
4297				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL8 → AL.8_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										

The parameter sets the alarm threshold for generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The threshold and module concerned depend on the address used. The default values may depend on the controller model.

*) The range of valid values for the threshold and the position of the decimal point may vary according to the reference variable chosen for the alarm *Ax.r* (with x = 1...8).

Table A	
Model	**Default**
480 V	528.0
600 V	658.0

Table B	
Model	**Default**
40 A	0.4
60 A	0.6
100 A	1.0
150 A	1.5

Table C	
Model	**Default**
40 A	44.0
60 A	66.0
100 A	110.0
150 A	165.0

min...max: -**999**...**999** If symmetrical alarm
0...**999** If symmetrical and relative alarm

For further information on symmetrical alarms, see paragraph “8.4.1. Generic alarms AL1...AL8”.

7.12.4. Alarm hysteresis

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1211	187	16 bit	**Hy.1**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL1 → Hy.1_1	R/W	■	Float *	s.p. * sec. min.	1
2235				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL1 → Hy.1_2					
4283				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL1 → Hy.1_3					
1212	188	16 bit	**Hy.2**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL2 → Hy.2_1	R/W	■	Float *	s.p. * sec. min.	1
2236				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL2 → Hy.2_2					
4284				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL2 → Hy.2_3					
1213	189	16 bit	**Hy.3**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL3 → Hy.3_1	R/W	■	Float *	s.p. * sec. min.	2
2237				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL3 → Hy.3_2					
4285				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL3 → Hy.3_3					
1083	59	16 bit	**Hy.4**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL4 → Hy.4_1	R/W	■	Float *	s.p. * sec. min.	1
2107				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL4 → Hy.4_2					
4155				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL4 → Hy.4_3					
1234	210	16 bit	**Hy.5**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL5 → Hy.5_1	R/W	■	Float *	s.p. * sec. min.	1
2258				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL5 → Hy.1_2					
4306				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL5 → Hy.5_3					
1235	211	16 bit	**Hy.6**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL6 → Hy.6_1	R/W	■	Float *	s.p. * sec. min.	1
2259				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL6 → Hy.6_2					
4307				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL6 → Hy.6_3					
1236	212	16 bit	**Hy.7**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL7 → Hy.7_1	R/W	■	Float *	s.p. * sec. min.	1
2260				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL7 → Hy.7_2					
4308				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL7 → Hy.7_3					
1237	213	16 bit	**Hy.8**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL8 → Hy.8_1	R/W	■	Float *	s.p. * sec. min.	1
2261				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL8 → Hy.8_2					
4309				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL8 → Hy.8_3					

The parameter sets the hysteresis for generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The alarm and module concerned depend on the address used.

*) The range of valid values for the threshold and the position of the decimal point may vary according to the reference variable chosen for the alarm *Ax.r* (with x = 1...8).

min...max: -**99.9**...**99.9** If symmetrical alarm
0...**999***With* unit of measurement in seconds, if +32 in parameter *Ax.t*, with x = alarm number
0...**999** With unit of measurement in minutes, if +64 in parameter *Ax.t*, with x = alarm number

For further information on symmetrical alarms, see paragraph “8.4.1. Generic alarms AL1...AL8”.

7.12.5. Alarm type

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1430	406	16 bit	**A1.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL1 → A1.t_1	R/W	■	Unsigned Short		32
2454				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL1 → A1.t_2					
4502				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL1 → A1.t_3					
1431	407	16 bit	**A2.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL2 → A2.t_1	R/W	■	Unsigned Short		33
2455				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL2 → A2.t_2					
4503				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL2 → A2.t_3					
1432	408	16 bit	**A3.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL3 → A3.t_1	R/W	■	Unsigned Short		161
2456				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL3 → A3.t_2					
4504				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL3 → A3.t_3					
1433	409	16 bit	**A4.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL4 → A4.t_1	R/W	■	Unsigned Short		32
2457				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL4 → A4.t_2					
4505				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL4 → A4.t_3					
1230	206	16 bit	**A5.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL5 → A5.t_1	R/W	■	Unsigned Short		32
2254				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL5 → A5.t_2					
4302				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL5 → A5.t_3					
1231	207	16 bit	**A6.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL6 → A6.t_1	R/W	■	Unsigned Short		33
2255				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL6 → A6.t_2					
4303				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL6 → A6.t_3					
1232	208	16 bit	**A7.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL7 → A7.t_1	R/W	■	Unsigned Short		32
2256				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL7 → A7.t_2					
4304				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL7 → A7.t_3					
1233	209	16 bit	**A8.t**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL8 → A8.t_1	R/W	■	Unsigned Short		33
2257				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL8 → A8.t_2					
4305				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL8 → A8.t_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										

The parameter sets the alarm type for generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The alarm and module concerned depend on the address used.

Options:

Index	Direct (maximum) or Reverse (minimum)	Absolute or Relative	Normal or Symmetrical (window)
0	Direct	Absolute	Normal
1	Reverse	Absolute	Normal
2	Direct	Relative *	Normal
3	Reverse	Relative *	Normal
4	Direct	Absolute	Symmetrical
5	Reverse	Absolute	Symmetrical
6	Direct	Relative *	Symmetrical
7	Reverse	Relative *	Symmetrical

Increasing the index by a fixed amount results in the following behaviours:
Index +8 = The alarm is disabled from startup until the alarm threshold is first intercepted.
Index +16 = Alarm memory is enabled.
Index +32 = *A1.t* becomes the alarm activation delay time (0...999 minutes)
This does not apply to the symmetrical absolute.
Index +64 = *A1.t* becomes the alarm activation delay time (0...999 seconds).
This does not apply to the symmetrical absolute.
Index +128 = Alarm is disabled during softstart.

Notes:
*) Setting not available for generic alarm 1.
The relative alarm type refers to the immediately preceding absolute alarm with index 1...8.

Examples:
Setting 20 (= 4 + 16) provides a direct, absolute and symmetrical alarm that is only enabled when the alarm threshold is exceeded for the first time since startup.
If AL1 and AL2 are absolute, by setting AL3 as relative, alarm 3 will be relative to alarm 2.

7.12.6. Direct setting of a direct or reverse alarm

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1070	46	bit	**BIT_ AL1_ DIR_INV**	M	MainMenu → L1 → Expert → Bit → BIT_AL1_DIR_INV_1	R/W	■			OFF
2094				E1	MainMenu → L2 → Expert → Bit → BIT_AL1_DIR_INV_2					
4142				E2	MainMenu → L3 → Expert → Bit → BIT_AL1_DIR_INV_3					
1078	54	bit	**BIT_ AL2_ DIR_INV**	M	MainMenu → L1 → Expert → Bit → BIT_AL2_DIR_INV_1	R/W	■			OFF
2102				E1	MainMenu → L2 → Expert → Bit → BIT_AL2_DIR_INV_2					
4150				E2	MainMenu → L3 → Expert → Bit → BIT_AL2_DIR_INV_3					
1060	36	bit	**BIT_ AL3_ DIR_INV**	M	MainMenu → L1 → Expert → Bit → BIT_AL3_DIR_INV_1	R/W	■			OFF
2084				E1	MainMenu → L2 → Expert → Bit → BIT_AL3_DIR_INV_2					
4132				E2	MainMenu → L3 → Expert → Bit → BIT_AL3_DIR_INV_3					
1094	70	bit	**BIT_ AL4_ DIR_INV**	M	MainMenu → L1 → Expert → Bit → BIT_AL4_DIR_INV_1	R/W	■			OFF
2118				E1	MainMenu → L2 → Expert → Bit → BIT_AL4_DIR_INV_2					
4166				E2	MainMenu → L3 → Expert → Bit → BIT_AL4_DIR_INV_3					

The parameter sets the direct or reverse mode for alarms 1, 2, 3 and 4, depending on the address used.

Options: **OFF** = Direct alarm (maximum)
ON = Reverse alarm (minimum)

7.12.7. Direct setting of an absolute or relative alarm

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1071	47	bit	**BIT_AL1_ABS_REL**	M	MainMenu → L1 → Expert → Bit → BIT_AL1_ABS_REL_1	R/W	■			OFF
2095				E1	MainMenu → L2 → Expert → Bit → BIT_AL1_ABS_REL_2					
4143				E2	MainMenu → L3 → Expert → Bit → BIT_AL1_ABS_REL_3					
1079	55	bit	**BIT_AL2_ABS_REL**	M	MainMenu → L1 → Expert → Bit → BIT_AL2_ABS_REL_1	R/W	■			OFF
2103				E1	MainMenu → L2 → Expert → Bit → BIT_AL2_ABS_REL_2					
4151				E2	MainMenu → L3 → Expert → Bit → BIT_AL2_ABS_REL_3					
1061	37	bit	**BIT_AL3_ABS_REL**	M	MainMenu → L1 → Expert → Bit → BIT_AL3_ABS_REL_1	R/W	■			OFF
2085				E1	MainMenu → L2 → Expert → Bit → BIT_AL3_ABS_REL_2					
4133				E2	MainMenu → L3 → Expert → Bit → BIT_AL3_ABS_REL_3					
1095	71	bit	**BIT_AL4_ABS_REL**	M	MainMenu → L1 → Expert → Bit → BIT_AL4_ABS_REL_1	R/W	■			OFF
2119				E1	MainMenu → L2 → Expert → Bit → BIT_AL4_ABS_REL_2					
4167				E2	MainMenu → L3 → Expert → Bit → BIT_AL4_ABS_REL_3					

The parameter sets the absolute or relative mode for alarms 1, 2, 3 and 4, depending on the address used.

Options: **OFF** = Absolute alarm
ON = Relative alarm

7.12.8. Direct setting of a normal or symmetrical alarm

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1072	48	bit	**BIT_AL1_NOR_SYM**	M	MainMenu → L1 → Expert → Bit → BIT_AL1_NOR_SYM_1	R/W	■			OFF
2096				E1	MainMenu → L2 → Expert → Bit → BIT_AL1_NOR_SYM_2					
4144				E2	MainMenu → L3 → Expert → Bit → BIT_AL1_NOR_SYM_3					
1080	56	bit	**BIT_AL2_NOR_SYM**	M	MainMenu → L1 → Expert → Bit → BIT_AL2_NOR_SYM_1	R/W	■			OFF
2104				E1	MainMenu → L2 → Expert → Bit → BIT_AL2_NOR_SYM_2					
4152				E2	MainMenu → L3 → Expert → Bit → BIT_AL2_NOR_SYM_3					
1062	38	bit	**BIT_AL3_NOR_SYM**	M	MainMenu → L1 → Expert → Bit → BIT_AL3_NOR_SYM_1	R/W	■			OFF
2086				E1	MainMenu → L2 → Expert → Bit → BIT_AL3_NOR_SYM_2					
4134				E2	MainMenu → L3 → Expert → Bit → BIT_AL3_NOR_SYM_3					
1096	72	bit	**BIT_AL4_NOR_SYM**	M	MainMenu → L1 → Expert → Bit → BIT_AL4_NOR_SYM_1	R/W	■			OFF
2120				E1	MainMenu → L2 → Expert → Bit → BIT_AL4_NOR_SYM_2					
4168				E2	MainMenu → L3 → Expert → Bit → BIT_AL4_NOR_SYM_3					

The parameter sets the normal or symmetrical mode for alarms 1, 2, 3 and 4, depending on the address used. For further information, see paragraph “8.4.1. Generic alarms AL1...AL8”.

Options: **OFF** = Normal alarm
ON = Symmetrical alarm

7.12.9. Direct setting of alarm enabling at startup

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1073	49	bit	**BIT_AL1_DISABLE_PWON**	M	MainMenu → L1 → Expert → Bit → BIT_AL1_DISABLE_PWON_1	R/W	■			OFF
2097				E1	MainMenu → L2 → Expert → Bit → BIT_AL1_DISABLE_PWON_2					
4145				E2	MainMenu → L3 → Expert → Bit → BIT_AL1_DISABLE_PWON_3					
1081	57	bit	**BIT_AL2_DISABLE_PWON**	M	MainMenu → L1 → Expert → Bit → BIT_AL2_DISABLE_PWON_1	R/W	■			OFF
2105				E1	MainMenu → L2 → Expert → Bit → BIT_AL2_DISABLE_PWON_2					
4153				E2	MainMenu → L3 → Expert → Bit → BIT_AL2_DISABLE_PWON_3					
1063	39	bit	**BIT_AL3_DISABLE_PWON**	M	MainMenu → L1 → Expert → Bit → BIT_AL3_DISABLE_PWON_1	R/W	■			OFF
2057				E1	MainMenu → L2 → Expert → Bit → BIT_AL3_DISABLE_PWON_2					
4135				E2	MainMenu → L3 → Expert → Bit → BIT_AL3_DISABLE_PWON_3					
1097	73	bit	**BIT_AL4_DISABLE_PWON**	M	MainMenu → L1 → Expert → Bit → BIT_AL4_DISABLE_PWON_1	R/W	■			OFF
2121				E1	MainMenu → L2 → Expert → Bit → BIT_AL4_DISABLE_PWON_2					
4169				E2	MainMenu → L3 → Expert → Bit → BIT_AL4_DISABLE_PWON_3					

This parameter sets the enabling or disabling of alarms 1, 2, 3 and 4 at startup, depending on the address used.

Options: **OFF** = Alarm enabled on startup
ON = Alarm disabled on startup

7.12.10. Direct setting of alarm memory activation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1074	50	bit	**BIT_ AL1_ MEM**	M	MainMenu → L1 → Expert → Bit → BIT_AL1_MEM_1	R/W	■			OFF
2098				E1	MainMenu → L2 → Expert → Bit → BIT_AL1_MEM_2					
4146				E2	MainMenu → L3 → Expert → Bit → BIT_AL1_MEM_3					
1082	58	bit	**BIT_ AL2_ MEM**	M	MainMenu → L1 → Expert → Bit → BIT_AL2_MEM_1	R/W	■			OFF
2106				E1	MainMenu → L2 → Expert → Bit → BIT_AL2_MEM_2					
4154				E2	MainMenu → L3 → Expert → Bit → BIT_AL2_MEM_3					
1064	40	bit	**BIT_ AL3_ MEM**	M	MainMenu → L1 → Expert → Bit → BIT_AL3_MEM_1	R/W	■			OFF
2088				E1	MainMenu → L2 → Expert → Bit → BIT_AL3_MEM_2					
4136				E2	MainMenu → L3 → Expert → Bit → BIT_AL3_MEM_3					
1098	74	bit	**BIT_ AL4_ MEM**	M	MainMenu → L1 → Expert → Bit → BIT_AL4_MEM_1	R/W	■			OFF
2122				E1	MainMenu → L2 → Expert → Bit → BIT_AL4_MEM_2					
4170				E2	MainMenu → L3 → Expert → Bit → BIT_AL4_MEM_3					

The parameter sets the activation and deactivation of alarm memory 1, 2, 3 and 4, depending on the address used.

Options: **OFF** = Alarm memory deactivated
ON = Alarm memory activated

7.12.11. Alarm validation power

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1084	60	16 bit	**A1.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL1 → A1.P_1	R/W	■	Float (####.#)	%	0.0
2108				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL1 → A1.P_2					
4156				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL1 → A1.P_3					
1085	61	16 bit	**A2.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL2 → A2.P_1	R/W	■	Float (####.#)	%	0.0
2109				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL2 → A2.P_2					
4157				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL2 → A2.P_3					
1086	62	16 bit	**A3.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL3 → A3.P_1	R/W	■	Float (####.#)	%	2.0
2110				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL3 → A3.P_2					
4158				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL3 → A3.P_3					
1087	63	16 bit	**A4.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL4 → A4.P_1	R/W	■	Float (####.#)	%	0.0
2111				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL4 → A4.P_2					
4159				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL4 → A4.P_3					
1088	64	16 bit	**A5.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL5 → A5.P_1	R/W	■	Float (####.#)	%	0.0
2112				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL5 → A5.P_2					
4160				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL5 → A5.P_3					
1089	65	16 bit	**A6.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL6 → A6.P_1	R/W	■	Float (####.#)	%	0.0
2113				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL6 → A6.P_2					
4161				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL6 → A6.P_3					
1090	66	16 bit	**A7.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL7 → A7.P_1	R/W	■	Float (####.#)	%	0.0
2114				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL7 → A7.P_2					
4162				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL7 → A7.P_3					
1091	67	16 bit	**A8.P**	M	MainMenu → L1 → Alarms → AL1...AL8 alarms → AL8 → A8.P_1	R/W	■	Float (####.#)	%	0.0
2115				E1	MainMenu → L2 → Alarms → AL1...AL8 alarms → AL8 → A8.P_2					
4163				E2	MainMenu → L3 → Alarms → AL1...AL8 alarms → AL8 → A8.P_3					

The parameter sets the validation power for generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The alarm and module concerned depend on the address used.

min...max: **0.0**...**100.0**

7.12.12. Alarm status reading

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1028	4	bit	**BIT_STATUS_AL1**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL1_1	R				
2052				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL1_2					
4100				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL1_3					
1029	5	bit	**BIT_STATUS_AL2**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL2_1	R				
2053				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL2_2					
4101				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL2_3					
1086	62	bit	**BIT_STATUS_AL3**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL3_1	R				
2110				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL3_2					
4158				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL3_3					
1093	69	bit	**BIT_STATUS_AL4**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL4_1	R				
2117				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL4_2					
4165				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL4_3					
1042	18	bit	**BIT_STATUS_AL5**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL5_1	R				
2066				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL5_2					
4114				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL5_3					
1043	19	bit	**BIT_STATUS_AL6**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL6_1	R				
2067				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL6_2					
4115				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL6_3					
1044	20	bit	**BIT_STATUS_AL7**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL7_1	R				
2068				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL7_2					
4116				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL7_3					
1045	21	bit	**BIT_STATUS_AL8**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_AL8_1	R				
2069				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_AL8_2					
4117				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_AL8_3					

The parameter shows the status of generic alarms AL1...AL8 of modules GRC-L1, GRC-L2 and GRC-L3. The alarm and module concerned depend on the address used.

Options: **OFF** = Alarm not active
ON = Alarm on

7.12.13. Alarm memory reset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1103	79	bit	**BIT_ RESET_ AL1_AL8**	M	MainMenu → L1 → Expert → Bit → BIT_RESET_AL1_AL8_1	R/W	■			
2127				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_AL1_AL8_2					
4175				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_AL1_AL8_3					

The parameter allows the memory of all generic alarms to be cleared by changing the state of the bit.
To clear the memory of a specific generic alarm, see parameters *dIG.1*, *dIG.2*, *dIG.3* and *dIG.4* for alarms 1, 2, 3 and 4 respectively.

Options: **OFF** = No function
ON = Generic alarms AL1...AL8 are reset

7.12.14. Alarm status (ALSTATE_IRQ)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1342	318	16 bit	**AL-STATE_ IRQ**	M	MainMenu → L1 → Status → ALSTATE_IRQ_1	R				
2366				E1	MainMenu → L2 → Status → ALSTATE_IRQ_2					
4414				E2	MainMenu → L3 → Status → ALSTATE_IRQ_3					

The parameter shows the status of generic alarms AL1...AL8 and HB / POWER_FAULT alarms. Bit = 0 indicates the alarm is not active, bit = 1 indicates the alarm is active.
The following table shows the correspondence between bit and individual alarms.

Options:

bit	Description	Alarm type
0	Alarm status AL1	Generic alarm
1	Alarm status AL2	Generic alarm
2	Alarm status AL3	Generic alarm
3	Alarm status AL4	Generic alarm
4	Alarm status AL.HB (or phases 1/2/3 if three-phase) or POWER_FAULT	Heater Break Alarm / POWER_FAULT
5	Alarm status AL.HB phase 1 (with three-phase load)	Heater Break Alarm
6	Alarm status AL.HB phase 2 (with three-phase load)	Heater Break Alarm
7	Alarm status AL.HB phase 3 (with three-phase load)	Heater Break Alarm
8	Alarm status AL5	Generic alarm
9	Alarm status AL6	Generic alarm
10	Alarm status AL7	Generic alarm
11	Alarm status AL8	Generic alarm

7.13. HB (Heater Break) Alarms

The HB alarms of the Power Controller are used to identify load breakage or interruption through the value of the current delivered, which is measured using a current transformer.

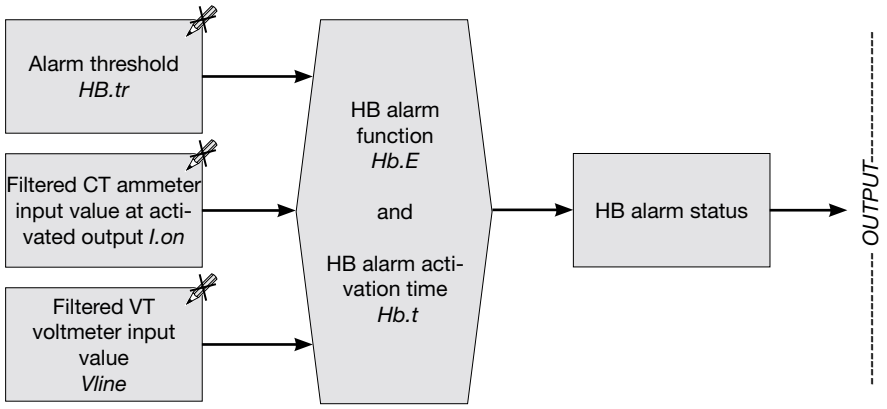
In standard configuration, the SSR output is associated with the heating control of GRC-L1, achieved by modulating the electrical power with the ON/OFF control according to the set cycle time.

The current reading taken during the ON (I.on) phase allows identification of an abnormal deviation from its rate value due to a fault on the load.

An alarm threshold teach-in function is also available. The function can be activated by a command from a serial line, a digital input (see paragraph “7.11.3. Digital input function”) or a key (see paragraph “7.33. Key functions”).

The following diagrams show the parameter processing sequence for generating an HB alarm and for calibrating the HB alarm.

Functional diagram of HB alarm single-phase load

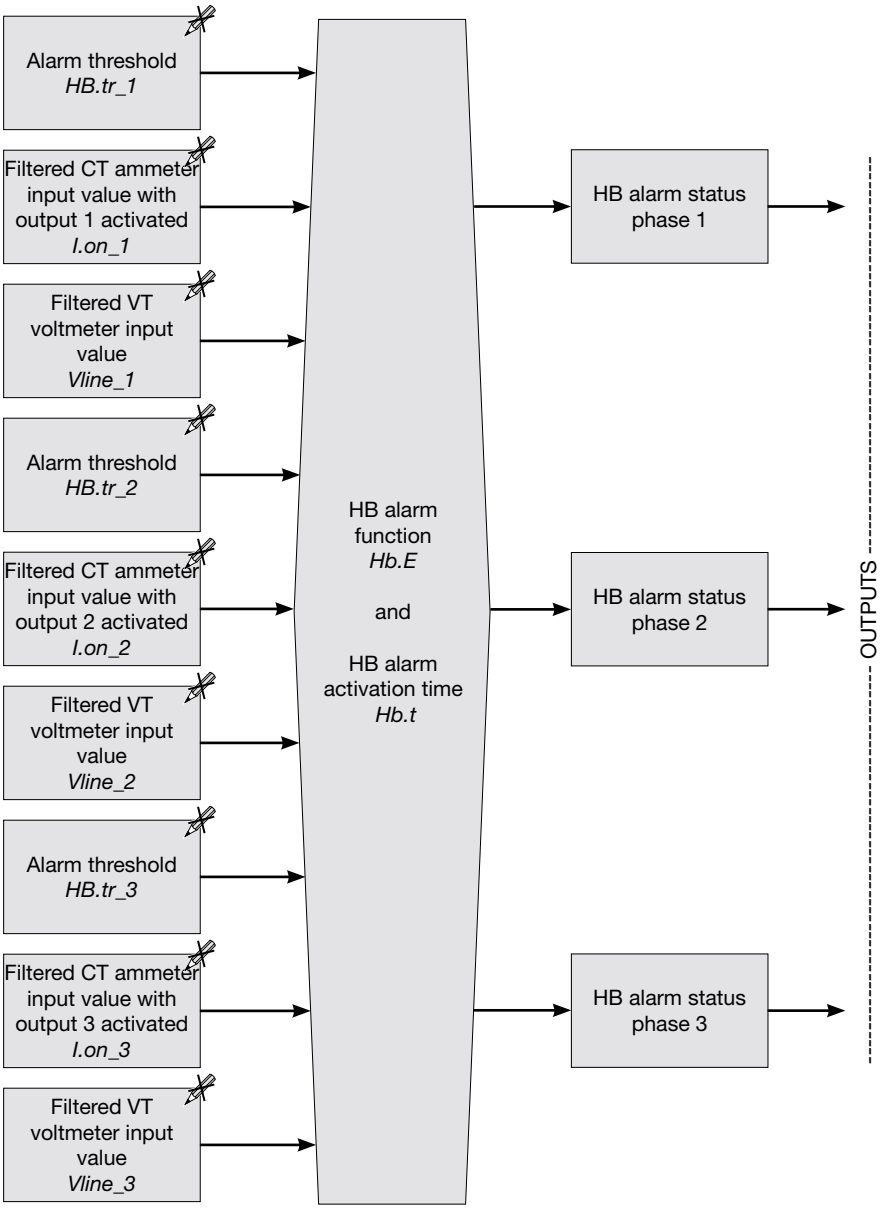


Note

The *Hb.tr* threshold value of the HB alarm is calculated in two different ways, depending on the chosen operating mode:

- with ZC, BF, HSC operating modes: $Hb.tr = A.Hb$
- with PA operating mode: $Hb.tr = A.Hb * \sqrt{(Ou.P)}$

Functional diagram of HB alarm three-phase load

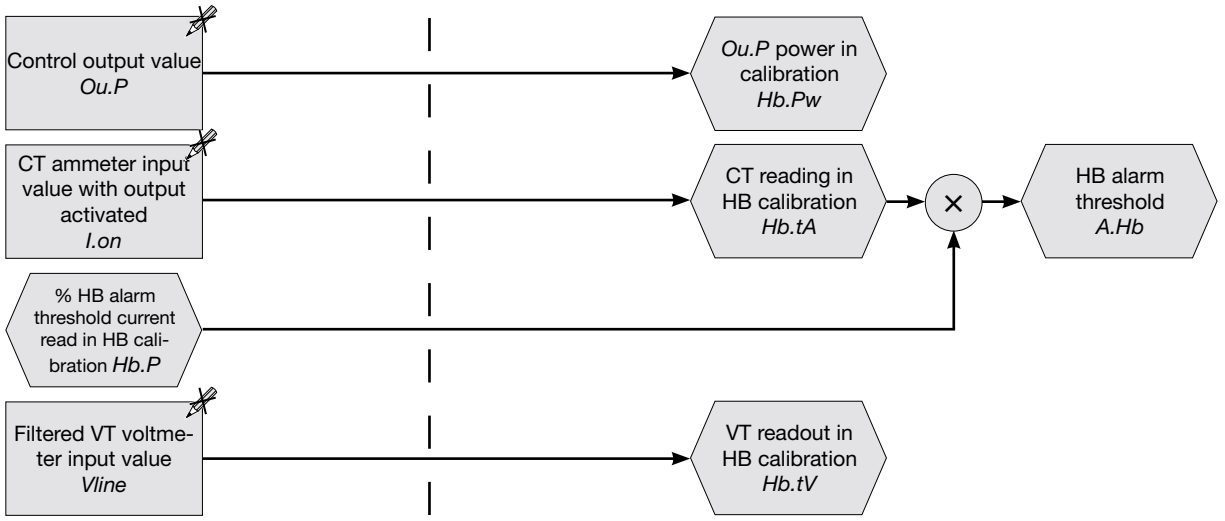


Note

The *Hb.tr* threshold value of the HB alarm is calculated in two different ways, depending on the chosen operating mode:

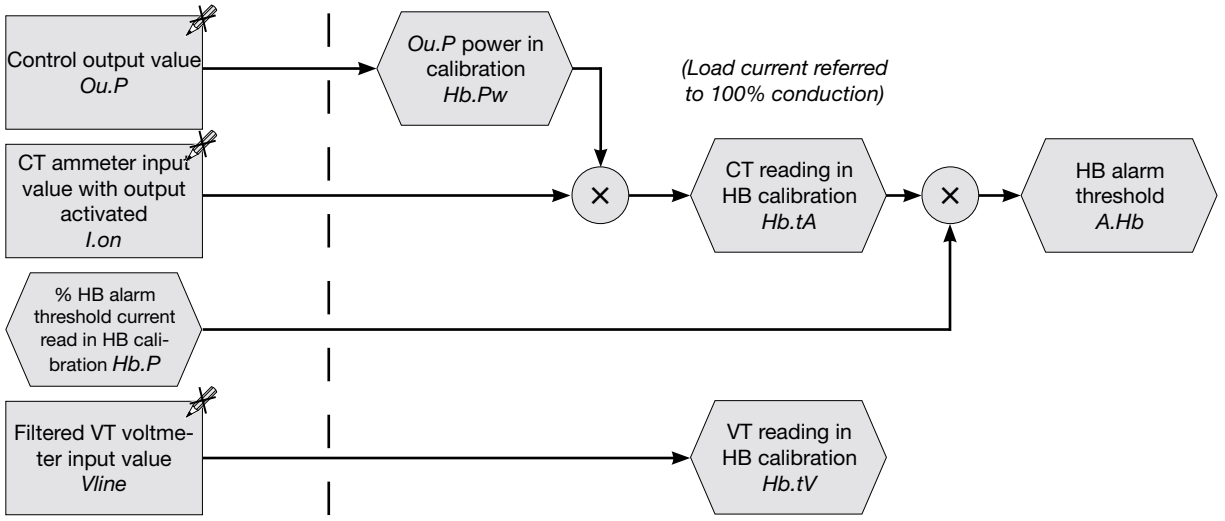
- with ZC, BF, HSC operating modes: $Hb.tr = A.Hb$
- with PA operating mode: $Hb.tr = A.Hb * \sqrt{Ou.P}$

Functional diagram of HB calibration in ZC - BF - HSC mode



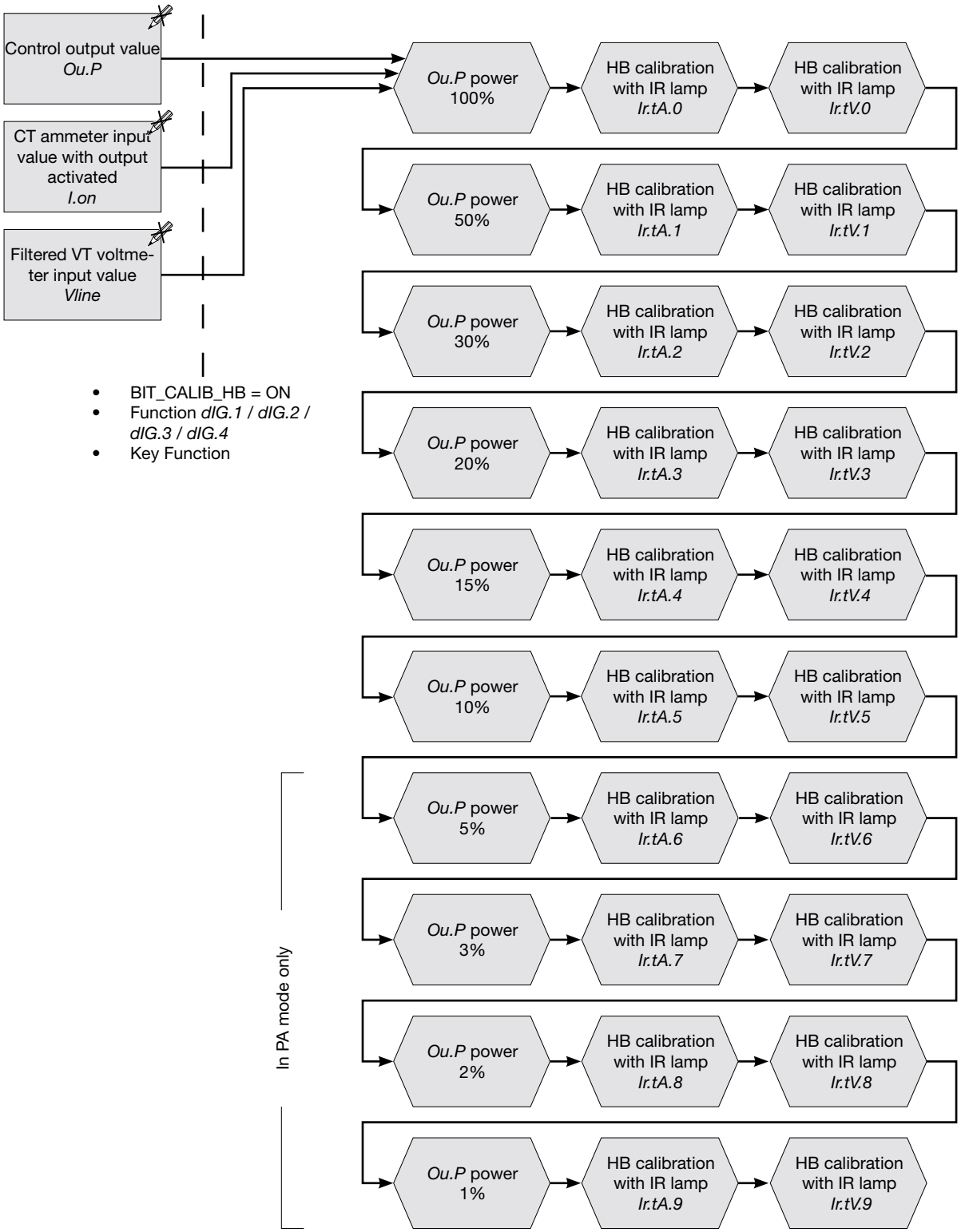
- BIT_CALIB_HB = ON
- Function *dIG.1* / *dIG.2* / *dIG.3* / *dIG.4*
- Key Function

Functional diagram of HB calibration in PA mode



- BIT_CALIB_HB = ON
- Function *dIG.1* / *dIG.2* / *dIG.3* / *dIG.4*
- Key Function

Functional diagram of HB calibration for infrared lamps



7.13.1. Enabling alarms

See paragraph “7.12.1. Enable alarms”.

7.13.2. HB alarm function

Address		Format	Acronym		GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1081	57	16 bit	**Hb.E**	M	MainMenu → L1 → Alarms → HB alarm → Hb.F_1	R/W	■	Unsigned Short		see table
2105				E1	MainMenu → L2 → Alarms → HB alarm → Hb.F_2					
4153				E2	MainMenu → L3 → Alarms → HB alarm → Hb.F_3					

The parameter sets the function of the HB alarm via an index.
With a **single-phase load**, the alarm thresholds *A.Hb_1*, *A.Hb_2* and *A.Hb_3* refer to the respective module.
With a **three-phase load**, the reference thresholds are *A.Hb_1*, *A.Hb_2* and *A.Hb_3* with OR of the states between phases 1, 2 and 3.
With a **two-phase load**, the reference thresholds are *A.Hb_1* e *A.Hb_2* with OR of the states between phases 1 and 2.

Default			
	GRC-L1	GRC-L2	GRC-L3
Single-phase load	1	1	1
Three-phase or two-phase load	17	17	17

Options:

Index	**Function description**
1	Can be used with relay or logic output. The alarm is active when the load current value is lower than the threshold set for the ON time of the SSR control output.
0	HB disable

Notes:
The alarm is automatically reset when the condition that caused it is removed.

Increasing the index by a fixed amount results in the following behaviours:
Index +8 = HB alarm is reversed.
Index +16 = Alarm is related to single thresholds and single phases with three-phase load.
Index +32 = HB alarm storage is enabled.

Examples:
Reversed logic: By setting index 9 (= 1+8), the HB alarm will normally be active. If an alarm condition is verified (current reading below the set threshold), the alarm status will go to zero.

7.13.3. Delay time for HB alarm activation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1080	56	16 bit	**Hb.t**	M	MainMenu → L1 → Alarms → HB alarm → Hb.t_1	R/W	■	Unsigned Short	sec.	5
2104				E1	MainMenu → L2 → Alarms → HB alarm → Hb.t_2					
4152				E2	MainMenu → L1 → Alarms → HB alarm → Hb.t_3					
The parameter sets the delay time before the HB alarm is activated. The *Hb.t* value must be greater than the cycle time of the output with which the HB alarm is associated. *min...max*: **0**...**999**										

7.13.4. Enabling calibration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1136	112	bit	**BIT_ CALIB_ HB**	M	MainMenu → L1 → Expert → Bit → BIT_CALIB_HB_1	R/W				0
2160				E1	MainMenu → L2 → Expert → Bit → BIT_CALIB_HB_2					
4208				E2	MainMenu → L3 → Expert → Bit → BIT_CALIB_HB_3					
This bit enables the alarm threshold calibration function for modules GRC-L1, GRC-L2 and GRC-L3, depending on the address used. It should be noted that with a three-phase load, a different value can be set for the *A.Hb* alarm thresholds. In this mode an unbalanced three-phase load can be controlled without problems. *Options:* **OFF** = Calibration not enabled **ON** = Calibration enabled										

7.13.5. HB alarm threshold

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1079	55	16 bit	**A.Hb**	M	MainMenu → L1 → Alarms → HB alarm → A.Hb_1	R/W	■	Float (####.#)	A	10.0
2103				E1	MainMenu → L2 → Alarms → HB alarm → A.Hb_2					
4151				E2	MainMenu → L3 → Alarms → HB alarm → A.Hb_3					
The parameter sets the HB alarm threshold. *min...max*: **0.0**...**3275.0**										

7.13.6. HB alarm threshold percentage

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1761	737	16 bit	**Hb.P**	M	MainMenu → L1 → Alarms → HB alarm → Hb.P_1	R/W	■	Float (####.#)	%	80.0
2785				E1	MainMenu → L2 → Alarms → HB alarm → Hb.P_2					
4833				E2	MainMenu → L3 → Alarms → HB alarm → Hb.P_3					
The parameter sets the HB alarm threshold percentage of the current read in HB calibration. *min...max*: **0.0**...**100.0**										

7.13.7. CT reading in HB calibration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1766	742	16 bit	**Hb.tA**	M	MainMenu → L1 → Alarms → HB alarm → Hb.tA_1	R/W	■	Float (####.#)	A	0.0
2790				E1	MainMenu → L2 → Alarms → HB alarm → Hb.tA_2					
4838				E2	MainMenu → L3 → Alarms → HB alarm → Hb.tA_3					
The parameter sets the CT reading in HB calibration. *min...max*: **0.0**...**3275.0**										

7.13.8. VT reading in HB calibration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1476	452	16 bit	**Hb.tV**	M	MainMenu → L1 → Alarms → HB alarm → Hb.tV_1	R/W	■	Float (####.#)	V	0.0
2500				E1	MainMenu → L2 → Alarms → HB alarm → Hb.tV_2					
4548				E2	MainMenu → L3 → Alarms → HB alarm → Hb.tV_3					
The parameter sets the VT reading in HB calibration. *min...max*: **0.0**...**999.9**										

7.13.9. Ou.P power in calibration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1767	743	16 bit	**Hb.Pw**	M	MainMenu → L1 → Alarms → HB alarm → Hb.Pw_1	R/W	■	Float (####.#)	%	0.0
2791				E1	MainMenu → L2 → Alarms → HB alarm → Hb.Pw_2					
4839				E2	MainMenu → L3 → Alarms → HB alarm → Hb.Pw_3					
The parameter sets the *Ou.P* power in HB calibration. *min...max*: **0.0**...**100.0**										

7.13.10. HB calibration with IR lamp (current)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1782	758	16 bit	**Ir.tA.0**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.0_1	R/W	■	Float (####.#)	A	0.0
2806				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.0_2					
4854				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.0_3					
1783	759	16 bit	**Ir.tA.1**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.1_1	R/W	■	Float (####.#)	A	0.0
2807				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.1_2					
4855				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.1_3					
1784	760	16 bit	**Ir.tA.2**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.2_1	R/W	■	Float (####.#)	A	0.0
2808				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.2_2					
4856				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.2_3					
1785	761	16 bit	**Ir.tA.3**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.3_1	R/W	■	Float (####.#)	A	0.0
2809				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.3_2					
4857				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.3_3					
1791	767	16 bit	**Ir.tA.4**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.4_1	R/W	■	Float (####.#)	A	0.0
2815				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.4_2					
4863				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.4_3					
1792	768	16 bit	**Ir.tA.5**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tA.5_1	R/W	■	Float (####.#)	A	0.0
2816				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tA.5_2					
4864				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tA.5_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1793	769	16 bit	**lr.tA.6**	M	MainMenu → L1 → Alarms → HB alarm → lr.tA.6_1	R/W	■	Float (####.#)	A	0.0
2817				E1	MainMenu → L2 → Alarms → HB alarm → lr.tA.6_2					
4865				E2	MainMenu → L3 → Alarms → HB alarm → lr.tA.6_3					
1406	382	16 bit	**lr.tA.7**	M	MainMenu → L1 → Alarms → HB alarm → lr.tA.7_1	R/W	■	Float (####.#)	A	0.0
2430				E1	MainMenu → L2 → Alarms → HB alarm → lr.tA.7_2					
4478				E2	MainMenu → L3 → Alarms → HB alarm → lr.tA.7_3					
1407	383	16 bit	**lr.tA.8**	M	MainMenu → L1 → Alarms → HB alarm → lr.tA.8_1	R/W	■	Float (####.#)	A	0.0
2431				E1	MainMenu → L2 → Alarms → HB alarm → lr.tA.8_2					
4479				E2	MainMenu → L3 → Alarms → HB alarm → lr.tA.8_3					
1408	384	16 bit	**lr.tA.9**	M	MainMenu → L1 → Alarms → HB alarm → lr.tA.9_1	R/W	■	Float (####.#)	A	0.0
2432				E1	MainMenu → L2 → Alarms → HB alarm → lr.tA.9_2					
4480				E2	MainMenu → L3 → Alarms → HB alarm → lr.tA.9_3					

The parameter sets the HB calibration when using IR lamps. The following table shows the correspondence between acronym and percentage of conduction current.

Acronym	Current
lr.tA.0	100 % conduction
lr.tA.1	50 % conduction
lr.tA.2	30 % conduction
lr.tA.3	20 % conduction
lr.tA.4	15 % conduction
lr.tA.5	10 % conduction
lr.tA.6	5 % conduction
lr.tA.7	3 % conduction
lr.tA.8	2 % conduction
lr.tA.9	1 % conduction

min...max: **0.0**...**3275.0**

For details of HB calibration with IR lamps see paragraph “8.4.2. HB alarm threshold teach-in function”.

7.13.11. HB calibration with IR lamp (voltage)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1469	445	16 bit	**Ir.tV.0**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.0_1	R/W	■	Float (####.#)	V	0.0
2493				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.0_2					
4541				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.0_3					
1470	446	16 bit	**Ir.tV.1**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.1_1	R/W	■	Float (####.#)	V	0.0
2494				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.1_2					
4542				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.1_3					
1471	447	16 bit	**Ir.tV.2**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.2_1	R/W	■	Float (####.#)	V	0.0
2495				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.2_2					
4543				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.2_3					
1472	448	16 bit	**Ir.tV.3**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.3_1	R/W	■	Float (####.#)	V	0.0
2496				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.3_2					
4544				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.3_3					
1473	449	16 bit	**Ir.tV.4**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.4_1	R/W	■	Float (####.#)	V	0.0
2497				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.4_2					
4545				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.4_3					
1474	450	16 bit	**Ir.tV.5**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.5_1	R/W	■	Float (####.#)	V	0.0
2498				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.5_2					
4546				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.5_3					
1475	451	16 bit	**Ir.tV.6**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.6_1	R/W	■	Float (####.#)	V	0.0
2499				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.6_2					
4547				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.6_3					
1414	390	16 bit	**Ir.tV.7**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.7_1	R/W	■	Float (####.#)	V	0.0
2438				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.7_2					
4486				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.7_3					
1415	391	16 bit	**Ir.tV.8**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.8_1	R/W	■	Float (####.#)	V	0.0
2439				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.8_2					
4487				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.8_3					
1416	392	16 bit	**Ir.tV.9**	M	MainMenu → L1 → Alarms → HB alarm → Ir.tV.9_1	R/W	■	Float (####.#)	V	0.0
2440				E1	MainMenu → L2 → Alarms → HB alarm → Ir.tV.9_2					
4488				E2	MainMenu → L3 → Alarms → HB alarm → Ir.tV.9_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									

Description

The parameter sets the HB calibration when using IR lamps. The following table shows the correspondence between acronym and percentage of conduction voltage.

Acronym	Voltage
Ir.tV.0	100 % conduction
Ir.tV.1	50 % conduction
Ir.tV.2	30 % conduction
Ir.tV.3	20 % conduction
Ir.tV.4	15 % conduction
Ir.tV.5	10 % conduction
Ir.tV.6	5 % conduction
Ir.tV.7	3 % conduction
Ir.tV.8	2 % conduction
Ir.tV.9	1 % conduction

min...max: **0.0**...**999.9**

For details of HB calibration with IR lamps see paragraph “8.4.2. HB alarm threshold teach-in function”.

7.13.12. HB alarm threshold as function of power on load

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1768	744	16 bit	**Hb.tr**	M	MainMenu → L1 → Alarms → HB alarm → Hb.tr_1	R		Float (####.#)	A	
2792				E1	MainMenu → L2 → Alarms → HB alarm → Hb.tr_2					
4840				E2	MainMenu → L3 → Alarms → HB alarm → Hb.tr_3					
The parameter shows the HB alarm threshold as a function of the power on the load. *min...max*: **0.0**...**3275.0**										

7.13.13. HB (OR TA1-TA2-TA3) OR POWER FAULT alarm status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1050	26	bit	**BIT_ STATUS_ HB_OR_ PF**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_OR_PF_1	R				
2074				E1	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_OR_PF_2					
4122				E2	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_OR_PF_3					
The parameter shows the HB (OR TA1-TA2-TA3) OR POWER_FAULT alarm status. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.13.14. HB alarm status (single-phase configuration or CT phase 1 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1100	76	bit	**BIT_ STATUS_ HB**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_1	R				
2124				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_HB_2					
4172				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_HB_3					
The parameter shows the HB alarm status in the single-phase configuration or that of CT phase 1 in the two-phase or three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.13.15. HB alarm status (single-phase configuration or CT phase 2 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1101	77	bit	**BIT_STATUS_HB_PHASE2**	Global	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_PHASE2_1	R				

The parameter shows the HB alarm status in the single-phase configuration or that of CT phase 2 in the two-phase or three-phase configuration.

Options: **OFF** = Alarm off
ON = Alarm on

7.13.16. HB alarm status (single-phase configuration or CT phase 3 three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1102	78	bit	**BIT_STATUS_HB_PHASE3**	Global	MainMenu → L1 → Expert → Bit → BIT_STATUS_HB_PHASE3_1	R				

The parameter shows the HB alarm status in the single-phase configuration or that of CT phase 3 in the three-phase configuration.

Options: **OFF** = Alarm off
ON = Alarm on

7.13.17. ALSTATE alarm status for single-phase loads and phase 1 of three-phase loads

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1536	512		**AL-STATE**	M	MainMenu → L1 → Status → ALSTATE_1	R				
2560				E1	MainMenu → L2 → Status → ALSTATE_2					
4608				E2	MainMenu → L3 → Status → ALSTATE_3					

The parameter shows the HB ALSTATE Alarm statuss for single-phase loads and phase 1 of three-phase loads. Each bit signals a state (bit = 0 corresponds to OFF, bit = 1 corresponds to ON).

Options:

bit	HB alarm status
4	HB alarm status for ON time
5	HB alarm status for OFF time
6	AL.HB alarm status (with single-phase load) or AL.HB phase 1 Alarm status (with two-phase or three-phase load)

7.13.18. ALSTATE_HB alarm status (phase 2 of two-phase/three-phase loads and phase 3 of three-phase loads)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1528	504	16 bit	**AL-STATE_HB**	Global	MainMenu → Global → Status → ALSTATE_HB	R				

The parameter shows the HB ALSTATE_HB alarm status for phase 2 of two-phase or three-phase loads and phase 3 of three-phase loads. Each bit signals a state (bit = 0 corresponds to OFF, bit = 1 corresponds to ON).

Options:

bit	HB alarm status
0	HB phase 2 alarm status for ON time
1	HB phase 2 alarm status for OFF time
2	AL.HB phase 2 alarm status (with two-phase or three-phase load)
3	HB phase 3 alarm status for ON time
4	HB phase 2 alarm status for OFF time
5	AL.HB phase 3 alarm status (with three-phase load)

7.13.19. Alarm status (ALSTATE_IRQ)

See paragraph “7.12.14. Alarm status (ALSTATE_IRQ)”.

7.13.20. HB, SSR_SHORT, NO_VOLTAGE and NO_CURRENT alarm reset

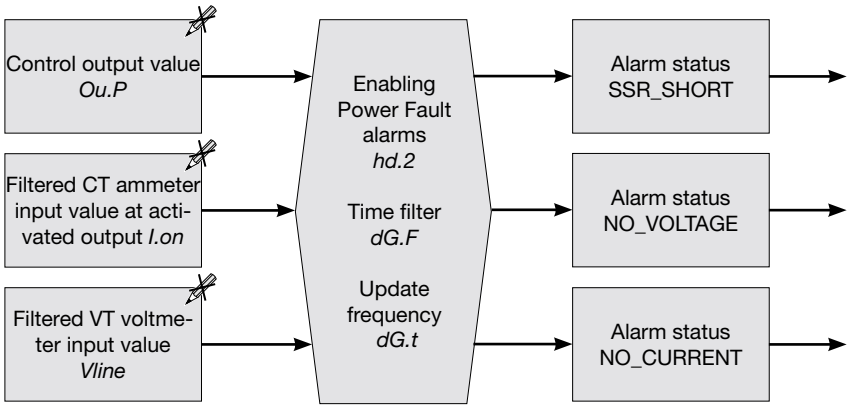
Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1129	105	bit	**BIT_RESET_HB_PF**	M	MainMenu → L1 → Expert → Bit → BIT_RESET_HB_PF_1	R/W				
2153				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_HB_PF_2					
4201				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_HB_PF_3					

The bit sets the reset for HB, SSR_SHORT, NO_VOLTAGE and NO_CURRENT alarms.

Options: **OFF** = No action
ON = Reset HB, SSR_SHORT, NO_VOLTAGE and NO_CURRENT alarms

7.14. POWER_FAULT alarms (SSR_SHORT, NO_VOLTAGE and NO_CURRENT)

Functional diagram of Power Fault alarms



7.14.1. Enable POWER_FAULT alarms

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1684	660	16 bit	**hd.2**	L1	MainMenu → L1 → Alarms → PF alarms → hd.2_1	R/W	■	Unsigned Short		11
2708				L2	MainMenu → L2 → Alarms → PF alarms → hd.2_2					
4756				L3	MainMenu → L3 → Alarms → PF alarms → hd.2_3					

The parameter sets the POWER_FAULT alarms: SSR_SHORT (SSR short circuit), NO_VOLTAGE (voltage failure) and NO_CURRENT (current failure). Active alarms are identified and set with an index.
The index 0 deactivates all 3 alarms.

Options:

Index	SSR_SHORT alarm on	NO_VOLTAGE alarm on	NO_CURRENT alarm on
0			
1	■		
2		■	
3	■	■	
8			■
9	■		■
10		■	■
11	■	■	■

Notes:
Increasing the index by a fixed amount results in the following behaviours:
Index + 32 = POWER_FAULT alarm storage is enabled.
Index + 64 = Current polarity control is disabled (only for inductive loads).

Examples:
Setting index 35 (= 3 + 32) enables SSR_SHORT and NO_VOLTAGE alarms with alarm storage.
Setting index 73 (= 9 + 64), with an inductive load, enables SSR_SHORT and NO_CURRENT alarms without polarity check for current.

7.14.2. SSR_SHORT update frequency

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1685	661	16 bit	**dG.t**	Global	MainMenu → Global → Alarms → PF alarms → dG.t	R/W	■	Unsigned Short	sec.	10
The parameter sets the update frequency for the SSR_SHORT alarm, which corresponds to the delay time for activation of the alarm. *min...max*: **1**...**999**										

7.14.3. Time filter for NO_VOLTAGE and NO_CURRENT alarms

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1686	662	16 bit	**dG.F**	L1	MainMenu → L1 → Alarms → PF alarms → dG.F_1	R/W	■	Unsigned Short	sec.	10
2710				L2	MainMenu → L2 → Alarms → PF alarms → dG.F_2					
4758				L3	MainMenu → L3 → Alarms → PF alarms → dG.F_3					
The parameter sets the time filter for the NO_VOLTAGE and NO_CURRENT alarms. It is recommended to set a value not lower than the cycle time. *min...max*: **0**...**99**										

7.14.4. HB, SSR_SHORT, NO_VOLTAGE and NO_CURRENT alarm reset

See paragraph “7.13.20. HB, SSR_SHORT, NO_VOLTAGE and NO_CURRENT alarm reset”.

7.14.5. Status 3 (STATUS3)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1657	633	16 bit	**STATUS3**	L1	MainMenu → L1 → Status → STATUS3_1	R		Unsigned Short		
2681				L2	MainMenu → L2 → Status → STATUS3_2					
4729				L3	MainMenu → L3 → Status → STATUS3_3					

The parameter shows the status of the device. The individual statuses are highlighted by the corresponding bit.

Options:

bit	Status of
3	SSR_SHORT (PHASE 1 with three-phase load)
4	SSR_SHORT PHASE 2 (with three-phase load)
5	SSR_SHORT PHASE 3 (with three-phase load)
6	NO_VOLTAGE (PHASE 1 with three-phase load)
7	NO_VOLTAGE PHASE 2 (with three-phase load)
8	NO_VOLTAGE PHASE 3 (with three-phase load)
9	NO_CURRENT (PHASE 1 with three-phase load)
10	NO_CURRENT PHASE 2 (with three-phase load)
11	NO_CURRENT PHASE 3 (with three-phase load)

7.14.6. SSR_SHORT alarm status (single-phase configuration or CT phase 1 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1120	96	bit	**BIT_STATUS_SSR_SHORT**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_SSR_SHORT_1	R				
2144				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_SSR_SHORT_2					
4192				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_SSR_SHORT_3					
The bit shows the SSR_SHORT alarm status in the single-phase configuration or that of CT phase 1 in two-phase or three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.7. SSR_SHORT alarm status (single-phase configuration or CT phase 2 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1121	97	bit	**BIT_STATUS_SSR_SHORT_PHASE2**	M	MainMenu → L*1* → Expert → Bits → BIT_STATUS_SSR_SHORT_PHASE2_1	R				
The bit shows the SSR_SHORT alarm status in the single-phase configuration or that of CT phase 2 in two-phase or three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.8. SSR_SHORT alarm status (single-phase configuration or CT phase 3 three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1122	98	bit	**BIT_STATUS_SSR_SHORT_PHASE3**	M	MainMenu → L*1* → Expert → Bits → BIT_STATUS_SSR_SHORT_PHASE3_1	R				
The bit shows the SSR_SHORT alarm status in single-phase configuration or that of CT phase 3 in three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.9. NO_VOLTAGE alarm status (single-phase configuration or CT phase 1 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1123	99	bit	**BIT_STATUS_NO_VOLTAGE**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_NO_VOLTAGE_1	R				
2147				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_NO_VOLTAGE_2					
4195				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_NO_VOLTAGE_3					
The bit shows the NO_VOLTAGE alarm status in single-phase configuration or the phase 1 CT status in two-phase or three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.10. NO_VOLTAGE alarm status (single-phase configuration or CT phase 2 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1124	100	bit	**BIT_STATUS_NO_VOLTAGE_PHASE2**	M	MainMenu → L*1* → Expert → Bits → BIT_STATUS_NO_VOLTAGE_PHASE2_1	R				
The bit shows the NO_VOLTAGE alarm status in single-phase configuration or the phase 2 CT status in two-phase or three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.11. NO_VOLTAGE alarm status (single-phase configuration or CT phase 3 three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1125	101	bit	**BIT_STATUS_NO_VOLTAGE_PHASE3**	M	MainMenu → L*1* → Expert → Bit → BIT_STATUS_NO_VOLTAGE_PHASE3_1	R				
The bit shows the NO_VOLTAGE alarm status in single-phase configuration or the phase 3 CT status in three-phase configuration. *Options:* **OFF** = Alarm off **ON** = Alarm on										

7.14.12. NO_CURRENT alarm status (single-phase configuration or CT phase 1 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1126	102	bit	**BIT_STATUS_NO_CURRENT**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_NO_CURRENT_1	R				
2150				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_NO_CURRENT_2					
4198				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_NO_CURRENT_3					

The bit shows the NO_CURRENT alarm status in single-phase configuration or the CT phase 1 status in two-phase or three-phase configuration.

Options: **OFF** = Alarm off
ON = Alarm on

7.14.13. NO_CURRENT alarm status (single-phase configuration or CT phase 2 two-phase or three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1127	103	bit	**BIT_STATUS_NO_CURRENT_PHASE2**	M	MainMenu → L*1* → Expert → Bit → BIT_STATUS_NO_CURRENT_PHASE2_1	R				

The bit shows the NO_CURRENT alarm status in single-phase configuration or the CT phase 2 status in two-phase or three-phase configuration.

Options: **OFF** = Alarm off
ON = Alarm on

7.14.14. NO_CURRENT alarm status (single-phase configuration or CT phase 3 three-phase configuration)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1128	104	bit	**BIT_STATUS_NO_CURRENT_PHASE3**	M	MainMenu → L*1* → Expert → Bit → BIT_STATUS_NO_CURRENT_PHASE3_1	R				

The bit shows the NO_CURRENT alarm status in single-phase configuration or the CT phase 3 status in three-phase configuration.

Options: **OFF** = Alarm off
ON = Alarm on

7.15. Thermal protection alarms

Each SSR power module of the Advanced Power Controller has:

- a temperature sensor for the SSR;
- an additional temperature sensor connected to the LINE terminal;
- an “in-air” sensor to measure the board temperature.

The temperature values are stored in the variables *In.Ntc.SSR*, *In.Ntc.LINE*, *In.Ntc.LOAD* and *In.Ntc.AIR* with a range of 10.0...120.0 °C.
The following are also saved:

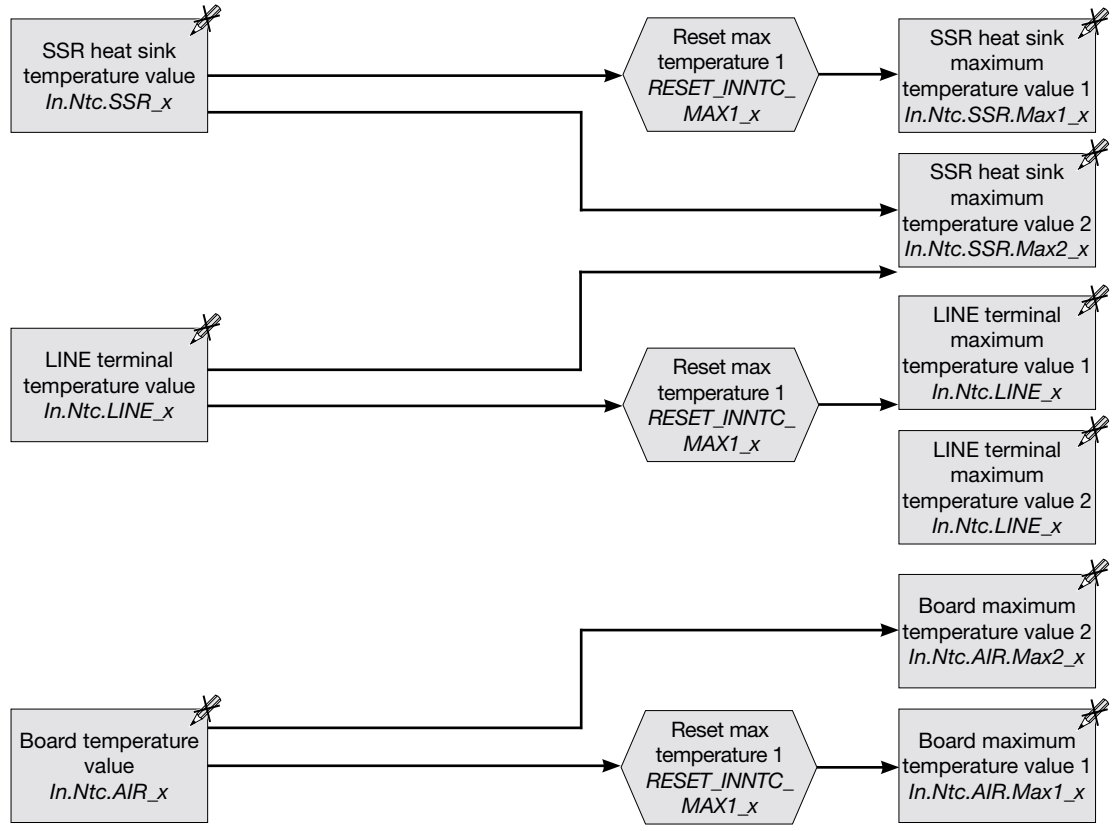
- in *In.Ntc.SSR.Max1* and *In.Ntc.SSR.Max2*, the maximum temperature reached by *In.Ntc.SSR*;
- in *In.Ntc.AIR.Max1* and *In.Ntc.AIR.Max2*, the maximum temperature reached by *In.Ntc.AIR*.

The *In.Ntc.SSR.Max1* and *In.Ntc.AIR.Max1* temperatures can be reset with a command.

The OVER_HEAT alarm is activated when at least one of the temperatures exceeds a set threshold; there is also a hysteresis to deactivate the alarm.
This condition could be caused by obstruction of the ventilation grill or blockage of the cooling fan.
With the OVER_HEAT alarm on, the control disables control outputs off SSR.

As an additional safety feature, the power modules are equipped with maximum hardware temperature protection, which disables the SSR commands.

Functional diagram of thermal protection alarms



with x = 1...3

7.15.1. SSR heat temperature value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1679	655	16 bit	**In.Ntc. SSR**	M	MainMenu → L*1* → Expert → Status → In.Ntc.SSR_1	R		Float (####.#)	°C	
2703				E1	MainMenu → L2 → Expert → Status → In.Ntc.SSR_2					
4751				E2	MainMenu → L3 → Expert → Status → In.Ntc.SSR_3					
The parameter shows the temperature recorded by the power module's internal temperature sensor.										

7.15.2. Temperature value of LINE terminals

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1558	534	16 bit	**In.Ntc. LINE**	M	MainMenu → L*1* → Expert → Status → In.Ntc.LINE_1	R		Float (####.#)	°C	
2582				E1	MainMenu → L2 → Expert → Status → In.Ntc.LINE_2					
4630				E2	MainMenu → L3 → Expert → Status → In.Ntc.LINE_3					
The parameter shows the temperature recorded by the temperature sensor connected to the LINE terminals.										

7.15.3. Temperature value of the power board

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1560	536	16 bit	**In.Ntc. AIR**	M	MainMenu → L*1* → Expert → Status → In.Ntc.AIR_1	R		Float (####.#)	°C	
2584				E1	MainMenu → L2 → Expert → Status → In.Ntc.AIR_2					
4632				E2	MainMenu → L3 → Expert → Status → In.Ntc.AIR_3					
The parameter shows the temperature of the power board measured by the sensor in the air.										

7.15.4. Maximum temperature value of SSR heat

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1352	328	16 bit	**In.Ntc. SSR. Max1**	M	MainMenu → L*1* → Expert → Status → In.Ntc.SSR.Max1_1	R	■	Float (####.#)	°C	
2376				E1	MainMenu → L2 → Expert → Status → In.Ntc.SSR.Max1_2					
4424				E2	MainMenu → L3 → Expert → Status → In.Ntc.SSR.Max1_3					
1703	679	16 bit	**In.Ntc. SSR. Max2**	M	MainMenu → L*1* → Expert → Status → In.Ntc.SSR.Max2_1	R	■	Float (####.#)	°C	
2727				E1	MainMenu → L2 → Expert → Status → In.Ntc.SSR.Max2_2					
4775				E2	MainMenu → L3 → Expert → Status → In.Ntc.SSR.Max2_3					

The parameter shows the maximum temperature shown by the SSR heat temperature sensor of GRC-L1, GRC-L2 and GRC-L3.
The differences are:

- In.Ntc.SSR.Max1 shows the maximum temperature value since the last reset. To reset the parameter, see paragraph “7.15.7. Max1 temperature reset”.
- In.Ntc.SSR.Max2 shows the maximum temperature value over the entire lifetime of the device, i.e., since the first power-on. The parameter cannot be reset.

7.15.5. Maximum temperature value of the line terminal

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1387	363	16 bit	**In.Ntc. LINE. Max1**	M	MainMenu → L*1* → Expert → Status → In.Ntc.AIR.Max1_1	R	■	Float (####.#)	°C	
2411				E1	MainMenu → L2 → Expert → Status → In.Ntc.AIR.Max1_2					
4459				E2	MainMenu → L3 → Expert → Status → In.Ntc.AIR.Max1_3					
1353	329	16 bit	**In.Ntc. LINE. Max2**	M	MainMenu → L*1* → Expert → Status → In.Ntc.AIR.Max2_1	R	■	Float (####.#)	°C	
2377				E1	MainMenu → L2 → Expert → Status → In.Ntc.AIR.Max2_2					
4425				E2	MainMenu → L3 → Expert → Status → In.Ntc.AIR.Max2_3					

The parameter shows the maximum temperature of the power board shown by the air temperature sensor of GRC-L1, GRC-L2 and GRC-L3.
The differences are:

- *In.Ntc.LINE.Max1* shows the maximum temperature value since the last reset. To reset the parameter see paragraph “7.15.7. Max1 temperature reset”.
- *In.Ntc.LINE.Max2* shows the maximum temperature value over the entire lifetime of the device, i.e., since its first power-on. The parameter cannot be reset.

7.15.6. Status reading (STATUS4)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1658	634	16 bit	**STATUS4**	M	MainMenu → L*1* → Status → STATUS4_1	R		Unsigned Short		
2682				E1	MainMenu → L2 → Status → STATUS4_2					
4730				E2	MainMenu → L3 → Status → STATUS4_3					

The parameter shows the status of the device. The OFF bit indicates off, the ON bit indicates on.

Options:

bit	Status
0	Faulty temperature sensor (TEMPERATURE_SENSOR_BROKEN)
1	Overtemperature (OVER_HEAT)
2	Active phase softstart
3	End of phase softstart
4	Frequency alarm or single-phase line failure alarm
5	60 Hz
6	Short-circuit current in phase softstart (SHORT_LOAD)
7	Peak current limiter in phase softstart
8	RMS steady state current limiter
9	24 V fan power failure (SSR_SAFETY)
10	Fuse open (FUSE_OPEN)
11	Current polarity control
12	HSC current overload limiter in phase softstart
13	Faulty current transformer sensor
14	SSR hardware overtemperature (HW_OVER_HEAT)

7.15.7. Max1 temperature reset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1146	122	bit	**RESET_INNTC_MAX1**	M	MainMenu → L*1* → Expert → Bit → BIT_RESET_INNTC_MAX1_1	R/W				
2170				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_INNTC_MAX1_2					
4218				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_INNTC_MAX1_3					

The parameter resets the *In.Ntc.SSR.Max1* and *In.Ntc.AIR.Max1* temperatures.

Options: **OFF** = No action
ON = Reset of *In.Ntc.SSR.Max1* and *In.Ntc.AIR.Max1 temperatures*

7.16. FUSE_OPEN and SHORT_LOAD alarms

The FUSE_OPEN alarm is activated when the optional internal fuse (extra-rapid type) is opened.

The SHORT_LOAD alarm is activated when the peak current on the load exceeds the maximum permitted value
The maximum permitted value depends on the current rating and is associated with the full scale H.tA.
Please note that the full scale is expressed in Arms, while the maximum limit is in Apk. Therefore, consider the default value of the PS.tA parameter (7.28.4. xxx), approximately H.tA*1.41.

During the softstart ramp or during the first power-on (with softstart ramp disabled).
The SHORT_CIRCUIT_CURRENT alarm is NOT activated in the case of a “Phase soft start for infrared lamps” type soft start ramp.

7.16.1. Number of automatic restarts

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1480	456	16 bit	**Fr.n**	Global	MainMenu → Global → Special functions → Fr.n	R/W	■	Unsigned Short		0
The parameter sets the number of automatic device restarts after a FUSE_OPEN or SHORT_LOAD alarm. The device automatically restarts in softstart mode. If the number of attempts exceeds the *Fr.n* value, the device remains disabled while awaiting manual reset with the BUT front button or the serial communication command (bit 109). Setting *Fr.n* = 0 disables automatic restart. *min...max*: **0**...**20**										

7.16.2. FUSE_OPEN and SHORT_LOAD alarm reset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1133	109	bit	**BIT_RESET_SHORT_FUSE**	M	MainMenu → L*1* → Expert → Bit → BIT_RESET_SHORT_FUSE_1	R/W				
2157				E1	MainMenu → L2 → Expert → Bit → BIT_RESET_SHORT_FUSE_2					
4205				E2	MainMenu → L3 → Expert → Bit → BIT_RESET_SHORT_FUSE_3					
The parameter resets the FUSE_OPEN or SHORT_LOAD alarms. *Options:* **OFF** = No action **ON** = Reset of FUSE_OPEN or SHORT_LOAD *alarms*										

7.16.3. STATUS4 state reading

See paragraph “7.15.6. Status reading (STATUS4)”.

7.17. General description of the outputs and Custom alarms

The Advanced Power Controller is extremely flexible with regard to the control of its physical outputs, allowing it to be used in sophisticated applications.

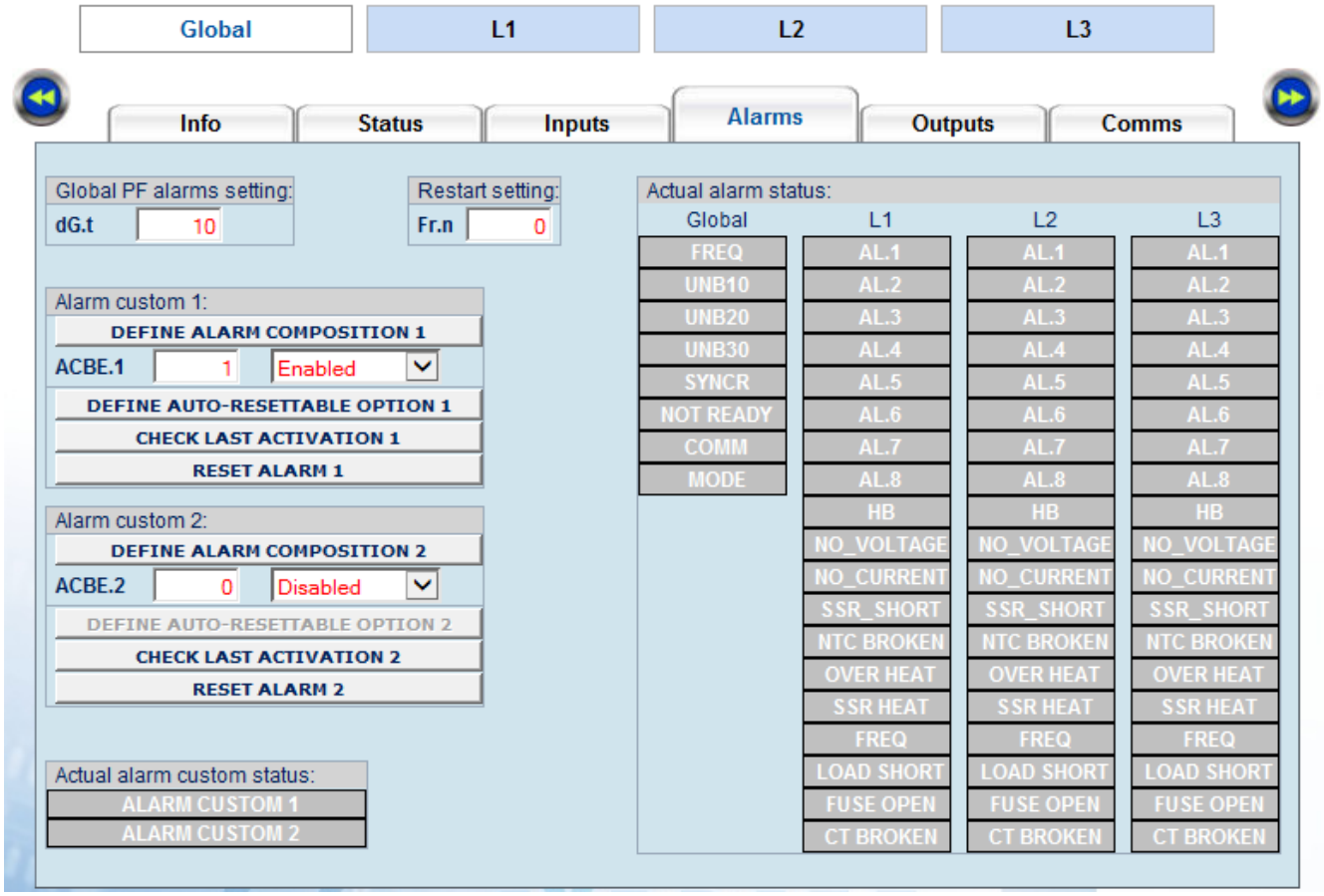
To assign a particular function to a physical output, you must:

1. Define the configuration of the 2 custom alarms, or, for more complex logic management, assign the desired function to one of the internal reference signals rL.1 ... rL.4.
2. Allocate the appropriate reference signal to parameters out.DO1 and out.NO (corresponding to physical outputs 16/DO1 and 21/NO-22/C optional).

The **standard configuration** of the outputs has the following parameter assignments:

- **Reference signals**:
- **Output parameters**:
  - out.DO1=31 (Alarm custom1)
  - out.NO=31 (Alarm custom1)

Configuration of the 2 custom alarms is available through a dedicated interface in GF_eXpress.
There are 2 custom alarms for the entire device (alarms are global, not per phase), each of which can then include alarms for all 3 phases present.



In the interface it is possible to:

-Display the status ti all individual alarms (included or not in the final alarm tally)

- View the status of the two custom alarms

-Define the composition of the custom alarm:

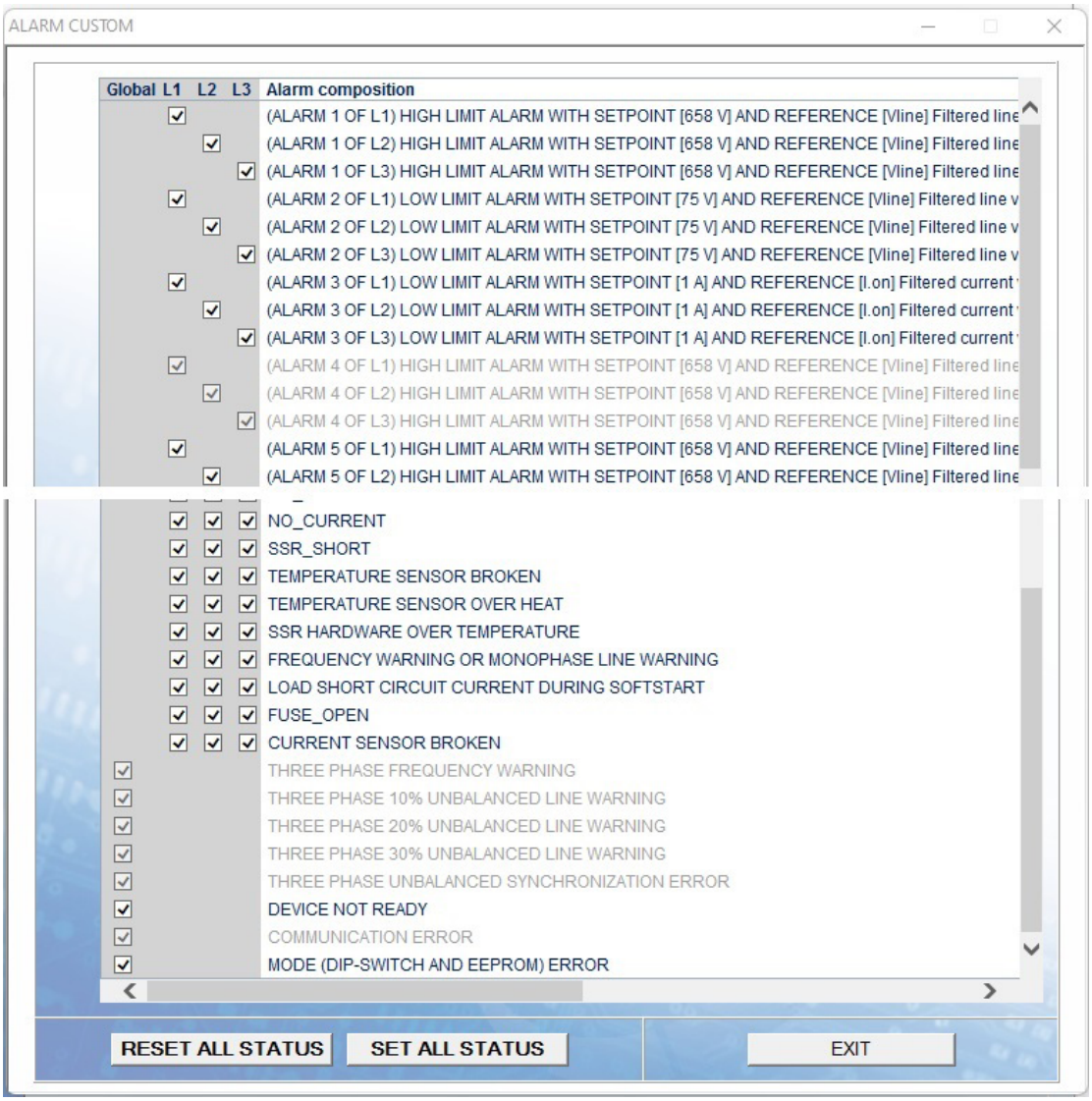
You can select which alarms make up the status of the custom alarm. All alarms included in the list will be in logical OR with each other.

The alarms alarms with checked are included in the OR the ogic of the cusotm alarm.

Those not checked are not considered.

Those present represented in gray in the interface are disabled, so it is necessary to act on the setting of the specific alarm to enable it.

Use the “DEFINE ALARM COMPOSITION x” menu.



- Define whether the custom alarm is to be considered blocking for power outputs:

If parameter ACBE.x=1 in case one of the defined conditions is triggered, the custom alarm is activated and the power outputs are disabled (ou.p=0.0%)

-Define the Auto-reset condition of the custom alarm and Reset alarm:

in the standard default configuration all the alarms that constitute the custom alarm when they activate the custom alarm when they are active, reset the custom alarm when they are not active (and no other alarms are active), for all of them the Auto-reset function is enabled.

It is possible to define a sub-set of alarms that on activation keep the custom alarm active even after the alarm condition has disappeared. This confiugration allows you to manage a memory in the custom alarm, linked to only some (or all) of the parameters.

The interface of defining which alarms are Auto-reset and which are not is similar to that of alarm composition.

Use the menu “DEFINE AUTO-RESETTABLE OPTION x”

From the interface, you can reset the alarm condition with the “RESET ALARM x” button. You can also perform the reset by special fieldbus command.

-Analyze the source of the alarm:

Via appropriate interface, it is possible to view which alarm was the cause of the last activation of the custom alarm, even if both are no longer active. Use the menu “CHECK LAST ACTIVATION x”

The “Overtemperature alarm” setting includes the following alarms, which are distinct for each module:
- Overtemperature for SCR or LINE terminal or LOAD terminal, STATUS4 bit 1 (OVER_HEAT).
- Temperature sensor failure for SCR or LINE terminal or LOAD terminal, STATUS4 bit 0 (TEMPERATURE_SENSOR_BROKEN).
- Hardware overtemperature for SCR, STATUS4 bit 14 (HW_OVER_HEAT).

The “Device not ready” setting (DEVICE_NOT_READY) includes the following alarms:
- Temperature alarm (OVER_HEAT or TEMPERATURE_SENSOR_BROKEN or HW_OVER_HEAT).
- Short-circuit current alarm during softstart (SHORT_LOAD).
- Faulty CT sensor alarm (CURRENT_SENSOR_BROKEN).
- Invalid operating mode set on DIP switches (MODE_ERROR).
- Interlock.

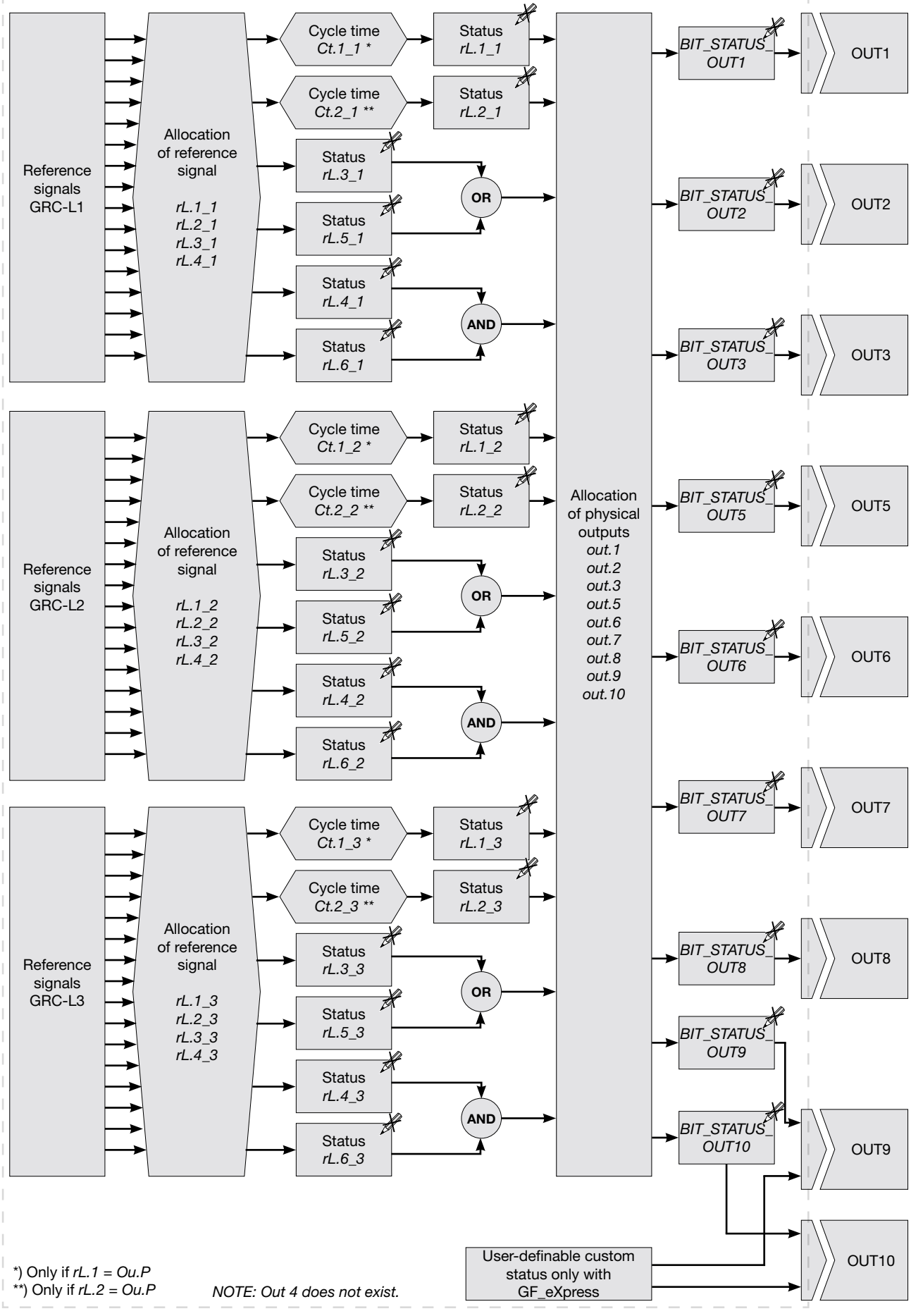
The function of each individual output can be disabled by setting the relevant parameter *out.x* = 0.
The status of outputs out.DO1, out.NO can be acquired by serial communication using bit variables.

The following configuration parameters are also linked to the outputs:
- *Ct.1*, i.e., the cycle time for control output *rL.1*. For further information, see paragraph “7.18.2. OUT cycle time”.

The following functional diagram shows the parameter processing sequence for control of the outputs.

NOTE: Out 4 does not exist.

Functional diagram of outputs



7.18. Allocation of reference signals to outputs

7.18.1. Allocation of reference signal

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1184	160	16 bit	**rL.1**	M	MainMenu → L*1* → Outputs → rL.1_1	R/W	■	Unsigned Short		0
2208				E1	MainMenu → L2 → Outputs → rL.1_2					
4256				E2	MainMenu → L3 → Outputs → rL.1_3					
1187	163	16 bit	**rL.2**	M	MainMenu → L*1* → Outputs → rL.2_1	R/W	■	Unsigned Short		5
2211				E1	MainMenu → L2 → Outputs → rL.2_2					
4259				E2	MainMenu → L3 → Outputs → rL.2_3					
1190	166	16 bit	**rL.3**	M	MainMenu → L*1* → Outputs → rL.3_1	R/W	■	Unsigned Short		2
2214				E1	MainMenu → L2 → Outputs → rL.3_2					
4262				E2	MainMenu → L3 → Outputs → rL.3_3					
1194	170	16 bit	**rL.4**	M	MainMenu → L*1* → Outputs → rL.4_1	R/W	■	Unsigned Short		35
2218				E1	MainMenu → L2 → Outputs → rL.4_2					
4266				E2	MainMenu → L3 → Outputs → rL.4_3					
1195	171	16 bit	**rL.5**	M	MainMenu → L*1* → Outputs → rL.5_1	R/W	■	Unsigned Short		4
2219				E1	MainMenu → L2 → Outputs → rL.5_2					
4267				E2	MainMenu → L3 → Outputs → rL.5_3					
1196	172	16 bit	**rL.6**	M	MainMenu → L*1* → Outputs → rL.6_1	R/W	■	Unsigned Short		160
2220				E1	MainMenu → L2 → Outputs → rL.6_2					
4268				E2	MainMenu → L3 → Outputs → rL.6_3					

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										

The parameter sets the allocation of the value of another parameter, or a function of parameters, to the reference signal *rL.x*, with x ranging from 1 to 6. The reference signal must be understood as an internal status.
To associate an alarm with an output, first associate the alarm with a *rL.x* reference signal, then associate the same *rL.x* reference signal with an output.
The signal allocation is identified by an index.

Options:

Index	Parameter or function
0	*Ou.P* (control output) *
2	*AL1* (alarm 1)
3	*AL2* (alarm 2)
4	*AL3* (alarm 3)
5	*AL.HB* OR *POWER_FAULT* with *HB* alarm (*TA1* OR *TA2* OR *TA3*)
7	*IN1* (INDIG1 logic input repetition)
8	*AL4* (alarm 4)
9	*AL1* OR *AL2*
10	*AL1* OR *AL2* OR *AL3*
11	*AL1* OR *AL2* OR *AL3* OR *AL4*
12	*AL1* AND *AL2*
13	*AL1* AND *AL2* AND *AL3*
14	*AL1* AND *AL2* AND *AL3* AND *AL4*
15	*AL1* OR *AL.HB* OR *POWER_FAULT* with *HB* alarm (*TA1* OR *TA2* OR *TA3*)
16	*AL1* OR *AL2* OR (*AL.HB* OR *POWER_FAULT*) with *HB* alarm (*TA1* OR *TA2* OR *TA3*)
17	*AL1* AND (*AL.HB* OR *POWER_FAULT*) with *HB* alarm (*TA1* OR *TA2* OR *TA3*)
18	*AL1* AND *AL2* OR (*AL.HB* OR *POWER_ FAULT*) with *HB* alarm (*TA1* OR *TA2* OR *TA3*)
19	*AL.HB* (HB alarm *TA2*)
20	*AL.HB* (HB alarm *TA3*)
22	*AL.HB* (alarm *HB TA1*)
23	*POWER_FAULT* (*SSR_SHORT* OR *NO_VOLTAGE* OR *NO_CURRENT*)
24	*IN2* (INDIG2 logic input repetition)
25	*IN3* (INDIG3 logic input repetition)
26	*IN4* (INDIG4 logic input repetition)
27	*FUSE_OPEN* / SHORT_LOAD
28	Overtemperature alarm
29	Communication error
30	Device not ready (*DEVICE_NOT_READY*)
64	*Ou.P* (control output) with fast cycle time 0.1...20.0 seconds *

Notes:
*) only for *rL.1* and *rL.2*.

OR and AND are to be understood as Boolean operators and determine the result of the function. *AL1* OR *AL2* OR *AL3*, for example, provides TRUE if at least one of the three alarms is active; *AL1* AND *AL2* AND *AL3*, for example, only provides TRUE if all alarms are active.

Increasing the index by a fixed amount results in the following behaviours:
Index +32 = The output logic level is negated (if TRUE becomes FALSE and vice versa).
Index +128 = Output is forced to 0.

7.18.2. OUT cycle time

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1033	9	16 bit	**Ct.1**	M	MainMenu → L*1* → Outputs → Ct.1_1	R/W	■	Float	sec.	see table
2057				E1	MainMenu → L2 → Outputs → Ct.1_2					
4105				E2	MainMenu → L3 → Outputs → Ct.1_3					
1183	159	16 bit	**Ct.2**	M	MainMenu → L*1* → Outputs → Ct.2_1	R/W	■	Float	sec.	20
2207				E1	MainMenu → L2 → Outputs → Ct.2_2					
4255				E2	MainMenu → L3 → Outputs → Ct.2_3					

The parameter sets the OUT1 and OUT2 cycle time, depending on the address used. The cycle time is the duration of a series of conduction and non-conduction cycles in the same ratio as the power to be transferred to the load.
The value of the parameter depends on the type of trigger.

C.SEt	Default Ct.1
+0 (resistive load)	0
+64 (inductive load)	4

Type of trigger	Parameter	
	min	max
BF	0	0
ZC with slow cycle time (see setting *rL.1*)	0	200
ZC with fast cycle time (see setting *rL.1*)	0.1	20.0

7.18.3. Status rL.x (MASKOUT_RL)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1332	308	16 bit	**MASK-OUT_RL**	M	MainMenu → L*1* → Status → MASKOUT_RL_1	R		Unsigned Short		
2356				E1	MainMenu → L2 → Status → MASKOUT_RL_2					
4404				E2	MainMenu → L3 → Status → MASKOUT_RL_3					

The parameter bits show the status of the output reference signals.

Options:

bit	Signal
0	Status *rL.1*
1	Status *rL.2*
2	Status *rL.3*
3	Status *rL.4*
4	Status *rL.5*
5	Status *rL.6*

7.18.4. Status rL

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1036	12	bit	**BIT_STATUS_RL1**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL1_1	R				
2060				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL1_2					
4108				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL1_3					
1037	13	bit	**BIT_STATUS_RL2**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL2_1	R				
2061				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL2_2					
4109				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL2_3					
1038	14	bit	**BIT_STATUS_RL3**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL3_1	R				
2062				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL3_2					
4110				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL3_3					
1039	15	bit	**BIT_STATUS_RL4**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL4_1	R				
2063				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL4_2					
4111				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL4_3					
1040	16	bit	**BIT_STATUS_RL5**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL5_1	R				
2064				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL5_2					
4112				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL5_3					
1041	17	bit	**BIT_STATUS_RL6**	L1	MainMenu → L*1* → Expert → Bit → BIT_STATUS_RL6_1	R				
2065				L2	MainMenu → L2 → Expert → Bit → BIT_STATUS_RL6_2					
4113				L3	MainMenu → L3 → Expert → Bit → BIT_STATUS_RL6_3					

The bit shows the status of the reference signals *rL.1...rL.6* of modules GRC-L1, GRC-L2, and GRC-L3, depending on the address used.

Options: **OFF** = Signal off
ON = Signal on

7.18.5. Allocation of physical outputs

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1631	607	16 bit	**out.DO1**	Global	MainMenu → Global → Outputs → Out1...Out10 → out.1	R/W	■	Unsigned Short		1
1632	608	16 bit	**out.NO**	Global	MainMenu → Global → Outputs → Out1...Out10 → out.2	R/W	■	Unsigned Short		2

The parameter sets the assignment of the rL signal to physical outputs 16/DO1 and 21/NO-22/C optional, corresponding to parameters out.DO1 and out.NO
Several *rL* signals can be allocated to the same physical output using the OR and AND logical operators. The allocation is identified by an index.

Options:

Index	Allocation
0	Output disabled
1	Output *rL.1* GRC-L1
2	Output *rL.1* GRC-L2
3	Output *rL.1* GRC-L3
5	Output *rL.2* GRC-L1
6	Output *rL.2* GRC-L2
7	Output *rL.2* GRC-L3
9	Output *rL.3* OR *rL.5* GRC-L1
10	Output *rL.3* OR *rL.5* GRC-L2
11	Output *rL.3* OR *rL.5* GRC-L3
13	Output *rL.4* AND *rL.6* GRC-L1
14	Output *rL.4* AND *rL.6* GRC-L2
15	Output *rL.4* AND *rL.6* GRC-L3
17	Output (*rL.3* OR *rL.5*) GRC-L1...GRC-L3
18	Output (*rL.4* AND *rL.6*) GRC-L1...GRC-L3
31	Custom output (for out.9 and out.10 only)

Increasing the +32 index inverts the output status for relay or static/Triac type outputs.

7.18.6. Alarm status masks for custom output 9

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1934	910	16 bit	**OCM.9_1**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_1	R/W	■	Unsigned Short		4095
1935	911	16 bit	**OCM.9_2**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_2	R/W	■	Unsigned Short		4095
1936	912	16 bit	**OCM.9_3**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_3	R/W	■	Unsigned Short		4095
1937	913	16 bit	**OCM.9_4**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_4	R/W	■	Unsigned Short		4088
1938	914	16 bit	**OCM.9_5**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_5	R/W	■	Unsigned Short		4088
1939	915	16 bit	**OCM.9_6**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_6	R/W	■	Unsigned Short		4088
1940	916	16 bit	**OCM.9_7**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_7	R/W	■	Unsigned Short		26195
1941	917	16 bit	**OCM.9_8**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_8	R/W	■	Unsigned Short		26195
1942	918	16 bit	**OCM.9_9**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_9	R/W	■	Unsigned Short		26195
1943	919	16 bit	**OCM.9_10**	Global	MainMenu → Global → Expert → Output Custom → OCM.9_10	R/W	■	Unsigned Short		943
The parameters set the alarm status masks ALSTATE_IRQ, STATUS3, STATUS4, and VOLTAGE_STATUS for custom output OUT9.										
min...max: **0...65535**										

7.18.7. Alarm status masks for custom output 10

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1944	920	16 bit	**OCM.10_1**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_1	R/W	■	Unsigned Short		4095
1945	921	16 bit	**OCM.10_2**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_2	R/W	■	Unsigned Short		4095
1946	922	16 bit	**OCM.10_3**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_3	R/W	■	Unsigned Short		4095
1947	923	16 bit	**OCM.10_4**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_4	R/W	■	Unsigned Short		4088
1948	924	16 bit	**OCM.10_5**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_5	R/W	■	Unsigned Short		4088
1949	925	16 bit	**OCM.10_6**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_6	R/W	■	Unsigned Short		4088
1950	926	16 bit	**OCM.10_7**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_7	R/W	■	Unsigned Short		26195
1951	927	16 bit	**OCM.10_8**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_8	R/W	■	Unsigned Short		26195
1952	928	16 bit	**OCM.10_9**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_9	R/W	■	Unsigned Short		26195
1953	929	16 bit	**OCM.10_10**	Global	MainMenu → Global → Expert → Output Custom → OCM.10_10	R/W	■	Unsigned Short		943
The parameters set the alarm status masks STATUS3, STATUS4, ALSTATE_IRQ and VOLTAGE_STATUS for custom output OUT10.										
min...max: **0...65535**										

7.18.8. Status reset to last activation of custom OUT9

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1134	110	bit	**BIT_RESET_OUT9_CUSTOM**	Global	MainMenu → Global → Expert → Bit → BIT_RESET_OUT9_CUSTOM	R/W				
The bit resets the status to the last activation of custom output 9. *Options:* **OFF** = No action **ON** = Resets the status to the last activation of custom OUT9										

7.18.9. Status reset to last activation of custom OUT10

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1135	111	bit	**BIT_RESET_OUT10_CUSTOM**	Global	MainMenu → Global → Expert → Bit → BIT_RESET_OUT10_CUSTOM	R/W				
The bit resets the status to the last activation of custom output 10. *Options:* **OFF** = No action **ON** = Resets the status to the last activation of custom OUT10										

7.18.10. Physical output status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1106	82	bit	**BIT_STATUS_OUT1**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT1	R				
1107	83	bit	**BIT_STATUS_OUT2**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT2	R				
1108	84	bit	**BIT_STATUS_OUT3**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT3	R				
1110	86	bit	**BIT_STATUS_OUT5**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT5	R				
1111	87	bit	**BIT_STATUS_OUT6**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT6	R				
1112	88	bit	**BIT_STATUS_OUT7**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT7	R				
1113	89	bit	**BIT_STATUS_OUT8**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT8	R				
1114	90	bit	**BIT_STATUS_OUT9**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT9	R				
1115	91	bit	**BIT_STATUS_OUT10**	Global	MainMenu → Global → Expert → Bit → BIT_STATUS_OUT10	R				
The bits show the status of the physical outputs. *Options:* **OFF** = Output off **ON** = Output on										

7.18.11. rL.x (MASKOUT_OUT) status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1688	664	16 bit	**MASK_OUT**	Global	MainMenu → Global → Status → MASK_OUT	R		Unsigned Short		

The parameter bits show the status of the physical outputs.

Options:

bit	Physical output
0	Status OUT1
1	Status OUT2
2	Status OUT3
4	Status OUT5
5	Status OUT6
6	Status OUT7
7	Status OUT8
8	Status OUT9
9	Status OUT10

NOTE: Out 4 does not exist.

7.18.12. Alarm status stored at last activation for custom output

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1321	297	16 bit	**STATUS3_FOR_OUT09**	L1	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT09_1	R		Unsigned Short		
2345				L2	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT09_2					
4393				L3	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT09_3					
1322	298	16 bit	**STATUS3_FOR_OUT10**	L1	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT10_1	R		Unsigned Short		
2346				L2	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT10_2					
4394				L3	MainMenu → Global → Expert → Output Custom → STATUS3_FOR_OUT10_3					

The parameter shows the STATUS3 status stored at the last activation of custom outputs OUT9 and OUT10.

7.18.13. STATUS4 stored with custom output activation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1323	299	16 bit	**STATUS4_FOR_OUT09**	L1	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT09_1	R		Unsigned Short		
2347				L2	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT09_2					
4395				L3	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT09_3					
1324	300	16 bit	**STATUS4_FOR_OUT10**	L1	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT10_1	R		Unsigned Short		
2348				L2	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT10_2					
4396				L3	MainMenu → Global → Expert → Output Custom → STATUS4_FOR_OUT10_3					
The parameter shows the STATUS4 status stored at the last activation of custom outputs OUT9 and OUT10.										

7.18.14. ALSTATE_IRQ stored with custom output activation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1356	332	16 bit	**ALSTATE_IRQ_FOR_OUT09**	L1	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT09_1	R		Unsigned Short		
2380				L2	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT09_2					
4428				L3	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT09_3					
1357	333	16 bit	**ALSTATE_IRQ_FOR_OUT10**	L1	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT10_1	R		Unsigned Short		
2381				L2	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT10_2					
4429				L3	MainMenu → Global → Expert → Output Custom → ALSTATE_IRQ_FOR_OUT10_3					
The parameter shows the ALSTATE_IRQ status stored at the last activation of custom outputs OUT9 and OUT10.										

7.18.15. VOLTAGE_STATUS stored with custom output activation

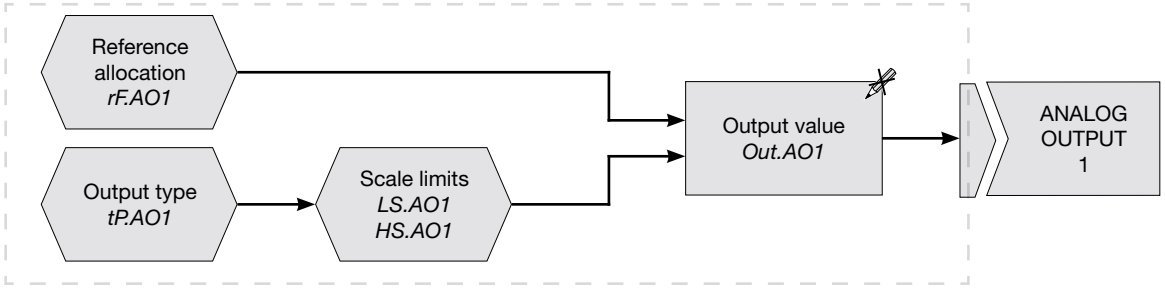
Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1325	301	16 bit	**VOLTAGE_STATUS_FOR_OUT09**	Global	MainMenu → Global → Expert → Output Custom → VOLTAGE_STATUS_FOR_OUT09	R		Unsigned Short		
1326	302	16 bit	**VOLTAGE_STATUS_FOR_OUT10**	Global	MainMenu → Global → Expert → Output Custom → VOLTAGE_STATUS_FOR_OUT10	R		Unsigned Short		
The parameter shows the VOLTAGE_STATUS stored at the last activation of custom outputs OUT9 and OUT10.										

7.19. Analog outputs

The Power Controller has 1 optional analog output that allows reference values to be retransmitted.

The engineering value of the quantity is limited to the set scale values and reparameterisation is applied according to the selected output type.

Functional diagram of analog outputs



7.19.1. Types of analog output

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1889	865	16 bit	**tP.AO1**	Global	MainMenu → Global → Outputs → Analog output1 → tP.A01	R/W	■	Unsigned Short		1

The parameter sets the type of analog output, depending on the address used. Allocation is identified by an index.

Options:

Index	Types of analog output
0	Current output 0...20 mA
1	Current output 4...20 mA
2	Voltage output 0...10 V
3	Voltage output 2...10 V

Increasing the index by +16 inverts the output status.

Examples:
Setting value 17 (= 1 + 16) ensures that the minimum output (4 mA) is at the maximum value of the set reference and the maximum output (20 mA) is at the minimum value of the set reference.

7.19.2. Analog output reference allocation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1892	868	16 bit	**rF.A01**	Global	MainMenu → Global → Outputs → Analog output1 → rF.A01	R/W	■	Unsigned Short		0

The parameter sets the type of reference signal of the analog output, depending on the address used.
Each type of signal has a unit of measurement and a scale with minimum and maximum permissible limits. The limits used are specified with the parameters *LS.AO*x and *HS.AO*x.
Allocation is identified by an index.

Options:

Index	Type of reference signal	Scale limits		Unit of measurement
		Min	*Max*	
0	None	-	-	-
1	*Ou.P* (control output) of GRC-L1	0.0	100.0	%
2	*Ou.P* (control output) of GRC-L2	0.0	100.0	%
3	*Ou.P* (control output) of GRC-L3	0.0	100.0	%
4	*In.A1* (analog input 1)	0.0	100.0	%
5	*In.A2* (analog input 2)	0.0	100.0	%
6	*In.A3* (analog input 3)	0.0	100.0	%
7	In.PWM1 (PWM input 1)	0.0	100.0	%
8	In.PWM2 (PWM input 2)	0.0	100.0	%
9	In.PWM3 (PWM input 3)	0.0	100.0	%
10	*Vline* (line voltage) of GRC-L1	0.0	6553.5	V
11	*Vline* (line voltage) of GRC-L2	0.0	6553.5	V
12	*Vline* (line voltage) of GRC-L3	0.0	6553.5	V
13	*V* (load voltage) of GRC-L1	0.0	6553.5	V
14	*V* (load voltage) of GRC-L2	0.0	6553.5	V
15	*V* (load voltage) of GRC-L3	0.0	6553.5	V
16	*Vt* (voltage on three-phase load)	0.0	6553.5	V
17	*I* (current in load) of GRC-L1	0.0	6553.5	A
18	*I* (current in load) of GRC-L2	0.0	6553.5	A
19	*I* (current in load) of GRC-L3	0.0	6553.5	A
20	*It* (current on three-phase load)	0.0	6553.5	A
21	*P* (power on load) of GRC-L1	0.0	6553.5	kW
22	*P* (power on load) of GRC-L2	0.0	6553.5	kW
23	*P* (power on load) of GRC-L3	0.0	6553.5	kW
24	*Pt* (power on three-phase load)	0.0	6553.5	kW
25	Serial line value	0.0	6553.5	-

7.19.3. Lower analog output scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1895	871	16 bit	**LS.A01**	Global	MainMenu → Global → Outputs → Analog output1 → LS.AO1	R/W	■	Float (####.#)	s.p.	0.0
1896	872	16 bit	**LS.A02**	Global	MainMenu → Global → Outputs → Analog output2 → LS.AO2	R/W	■	Float (####.#	s.p.	0.0
1897	873	16 bit	**LS.A03**	Global	MainMenu → Global → Outputs → Analog output3 → LS.AO3	R/W	■	Float (####.#	s.p.	0.0

The parameter sets the lower scale limit of analog output, depending on the address used. The type of limit and the unit of measurement are determined by the reference selected with parameter *rF.AO1*.

min...max: **0.0**...**6553.5**

7.19.4. Upper analog output scale limit

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1898	874	16 bit	**HS.A01**	Global	MainMenu → Global → Outputs → Analog output1 → HS.AO1	R/W	■	Float (####.#	s.p.	100.0

The parameter sets the upper scale limit of analog output, depending on the address used. The type of limit and the unit of measurement are determined by the reference selected with parameter *rF.AO1*.
The range of permissible values is limited at the lower end by the setting of parameter *LS.AO1*, *LS.AO2* or *LS.AO3*, depending on the address chosen.

min...max: ***LS.AO1***...**6553.5** (analog output 1)

7.19.5. Serial line value for analog output

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1751	727	16 bit	**SERIAL_ OUTA1**	Global	MainMenu → Global → Expert → Virtual → SERIAL_OUTA1	R/W		Float (####.#	s.p.	0.0

The parameter sets the serial line value of analog output, depending on the address used. The limits of analog output are defined by parameters *LS.AO1* and *HS.AO1* respectively.

min...max: ***LS.AO1...HS.AO1*** (analog output 1)

7.19.6. Analog output value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1901	877	16 bit	**Out.A01**	Global	MainMenu → Global → Status → OUT.A01	R		Float (####.#	%	

The parameter shows the percentage value of analog output, depending on the address used.

7.20. Automatic - manual control

The Advanced Power Controller allows control of power output in automatic (AUTO) or manual (MAN) mode.
In “MAN” mode, the control output is set to a constant value that can be modified via fieldbus or configuration interfaces (Gf_eXpress, display, web server).

When switching from MAN to AUTO, the setting of the output gradient(G.Out_x) will move the Power Controller from the current MAN setting to the new Reference Power (SPU_x) setting.

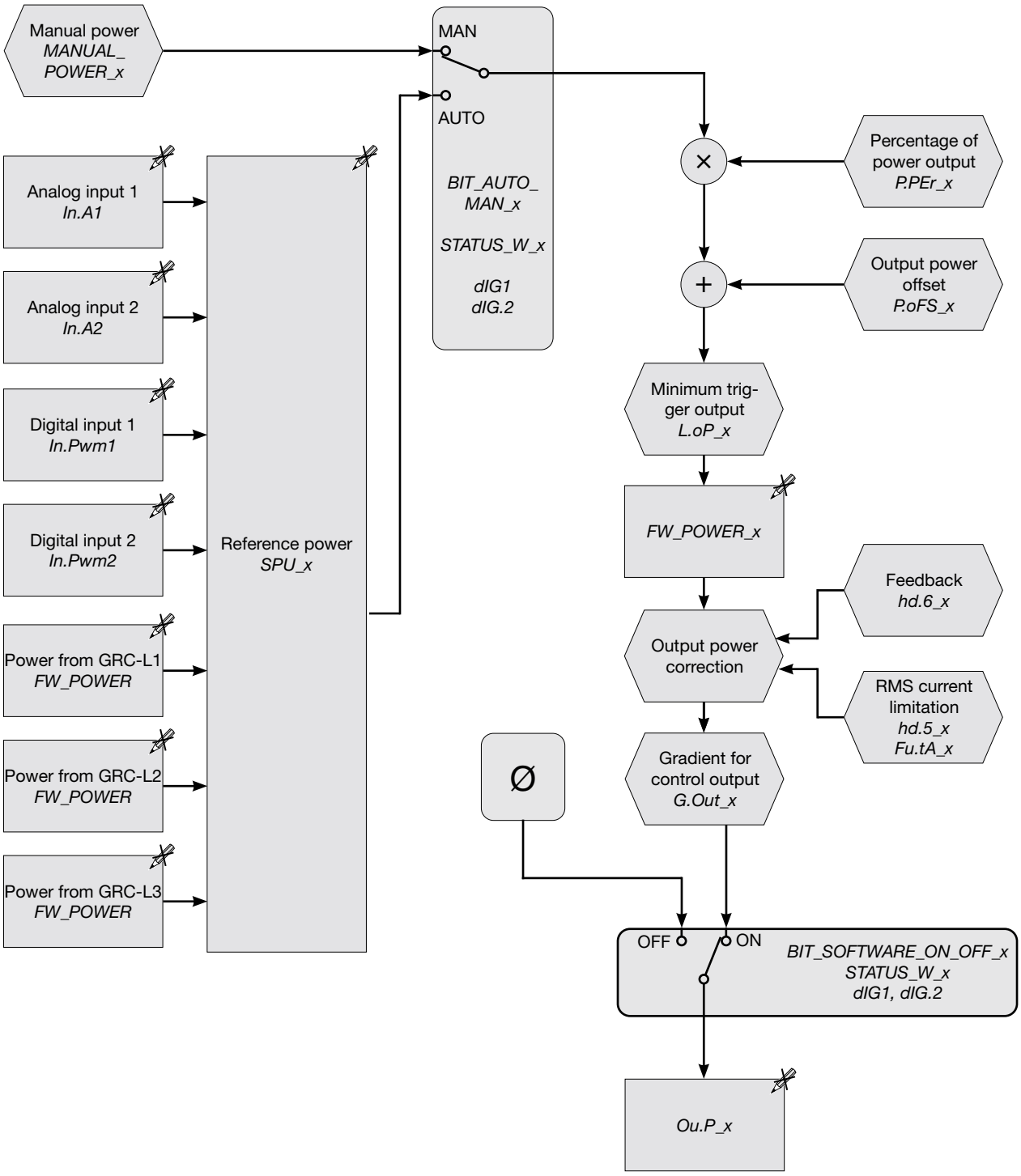
When switching from AUTO to MAN it is possible to see a sudden output change in power.
In manual mode, the power output can be automatically corrected in relation to the reference mains voltage (*riF*). *The%* value of the correction (*Cor*) is freely adjustable and acts in an inversely proportional manner, i.e., if the reference voltage increases, the power output decreases, and vice versa.

The following functional diagram shows the parameter processing sequence in power output management.

In addition to the parameters shown below, the following parameters should also be considered for automatic - manual control:

- digital input function *dIG.1* / *dIG.2* / *dIG.3* / *dIG.4* (see paragraph “7.11.3. Digital input function”);
- value of the control output *Ou.P* (see paragraph “7.20.2. Output power value”).

Functional diagram of controls



with x = 1...3

7.20.1. Reference power

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1641	617	16 bit	**SPU**	M	MainMenu → L*1* → Controls → SPU_1	R/W	■	Unsigned Short		0
2665				E1	MainMenu → L2 → Controls → SPU_2					12
4713				E2	MainMenu → L3 → Controls → SPU_3					13

The parameter sets the reference power for output power control. Allocation is identified by an index.

Options:

Index	Selection
0	Power from analog input 1 (*In.A1*)
7	Power from digital input 1 (*In.Pwm1*)
9	Power from GRC-L1 (*FW_POWER*). With “slave” module operation: • The reference power of a “slave” module in automatic operation is the power of a “master” module in automatic or manual operation. • The reference power of a “slave” module in manual operation is the manual power of the module. • Software shutdown remains independent for each module.
10	Power from GRC-L2 (*FW_POWER*). For “slave” operation, the same indications as in index 9 apply.
11	Power from GRC-L3 (*FW_POWER*) For “slave” operation, the same indications as in index 9 apply.
12	Power from analog input 2 (*In.A2*)
14	Power from digital input 2 (*In.Pwm2*)

7.20.2. Output power value

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1026	2	16 bit	**Ou.P**	M	MainMenu → L*1* → Status → Ou.P_1	R		Float (####.#)	%	
2050				E1	MainMenu → L2 → Status → Ou.P_2					
4096				E2	MainMenu → L3 → Status → Ou.P_3					

The parameter shows the value of the control output.
The parameter can also be written in manual mode (address 252).

7.20.3. Output power value without correction

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1746	722	16 bit	**FW_ POWER**	M	MainMenu → L*1* → Status → FW_POWER_1	R		Float (####.#)	%	
2770				E1	MainMenu → L2 → Status → FW_POWER_2					
4818				E2	MainMenu → L3 → Status → FW_POWER_3					

The parameter shows the power value before correction for feedback and RMS current limitation.

7.20.4. Power output percentage

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1789	765	16 bit	**P.PEr**	M	MainMenu → L*1* → Controls → P.PEr_1	R/W	■	Float (####.#)	%	100.0
2813				E1	MainMenu → L2 → Controls → P.PEr_2					
4861				E2	MainMenu → L3 → Controls → P.PEr_3					
The parameter sets the percentage of the output power It can be used for manual corrections of the calculated power, or to deliver, in a specific phase, a power connected via the multiplier factor P.Per to that delivered in another phase (using the SPU parameter). *min...max:* **0.0**...**100.0**										

7.20.5. Output power offset

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1790	766	16 bit	**P.oFS**	M	MainMenu → L*1* → Controls → P.oFS_1	R/W	■	Float (####.#)	%	0.0
2814				E1	MainMenu → L2 → Controls → P.oFS_2					
4862				E2	MainMenu → L3 → Controls → P.oFS_3					
The parameter sets the offset percentage of the output power It can be used for manual corrections of the calculated power, or to deliver power in a specific phase that is linked via the offset factor P.oFS to the power delivered in another phase (using the SPU parameter). *min...max:* **-100.0**...**100.0**										

7.20.6. Control output gradient

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1787	763	16 bit	**G.Out**	M	MainMenu → L*1* → Controls → G.Out_1	R/W	■	Float (####.#)	%/s	0.0
2811				E1	MainMenu → L2 → Controls → G.Out_2					
4859				E2	MainMenu → L3 → Controls → G.Out_3					
The parameter sets the gradient for the control output, i.e., how quickly the final value is reached. The gradient is defined as a percentage increment per second in relation to the final value to be achieved. Set the parameter to 0 to disable the gradient. *min...max:* **0.0**...**200.0** **Example:** By setting the gradient to 50%/s the *Ou.P* output is not implemented instantaneously but gradually. If the power goes from 0% to 100%, actuation occurs in a linear ramp of 2 seconds duration.										

7.20.7. Minimum trigger output

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1788	764	16 bit	**Lo.P**	M	MainMenu → L*1* → Controls → Lo.P_1	R/W	■	Float (####.#)	%	0.0
2812				E1	MainMenu → L2 → Controls → Lo.P_2					
4860				E2	MainMenu → L3 → Controls → Lo.P_3					
The parameter sets the minimum output for triggering as a percentage of the maximum achievable value. *min...max:* **0.0**...**50.0**										

7.20.8. Manual power

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1276	252	16 bit	**MANUAL_POWER**	M	MainMenu → L*1* → Controls → MANUAL_POWER_1	R/W	■	Float (####.#)	%	0.0
2300				E1	MainMenu → L2 → Controls → MANUAL_POWER_2					
4348				E2	MainMenu → L3 → Controls → MANUAL_POWER_3					
The parameter sets the percentage of manual power. *min...max:* **-100.0**...**100.0**										

7.20.9. Automatic - manual selection

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1025	1	bit	**BIT_AUTO_MAN**	M	MainMenu → L*1* → Expert → Bit → BIT_AUTO_MAN_1	R/W	■	Unsigned Short		OFF
2049				E1	MainMenu → L2 → Expert → Bit → BIT_AUTO_MAN_2					
4097				E2	MainMenu → L3 → Expert → Bit → BIT_AUTO_MAN_3					
The bit sets the automatic/manual operation of the Advanced Power Controller. *Options:* **OFF** = Automatic **ON** = Manual										

7.20.10. Status (STATUS_W)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1329	305	16 bit	**STATUS_W**	M	MainMenu → L*1* → Controls → STATUS_W_1	R/W	■	Unsigned Short		0
2353				E1	MainMenu → L2 → Controls → STATUS_W_2					
4401				E2	MainMenu → L3 → Controls → STATUS_W_3					

The parameter sets the Automatic/Manual and Software startup/shutdown operating status of the controller with bits.

Options:

bit	Status setting
3	ON/OFF selection
4	AUTO/MAN selection

7.21. Start modes

7.21.1. Start mode at Power-On

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1723	699	16 bit	**P.Ont**	M	MainMenu → L*1* → Controls → P.Ont_1	R/W	■	Unsigned Short		0
2747				E1	MainMenu → L2 → Controls → P.Ont_2					
4795				E2	MainMenu → L3 → Controls → P.Ont_3					

This parameter sets the mode in which the Advanced Power Controller starts up when power is supplied.
The mode is identified by an index.

Options:

Index	Start modes
0	Operation of the controller resumes with the same modalities as the last state prior to shutdown. Digital input states always take priority over other states.
1	Software shutdown.
2	Software startup.

7.22. Software shutdown

The Advanced Power Controller can also be switched off by a software command.
When the software shutdown function is activated:

- The digital input is only enabled if it is associated with the software shutdown function.
- Outputs are forced to OFF at shutdown. The exception is the reference signals *rL.1* and *rL.4*, which are forced to ON.
- HB alarms are reset.
- The generic alarms AL1...AL8 can be enabled or disabled via the parameter *oFF.t*.

In addition to the parameters shown below, the following parameters should also be considered for software shutdown:

- digital input function *dIG.1* / *dIG.2* / *4* (see paragraph “7.11.3. Digital input function”);
- status (STATUS_W) (see paragraph “7.20.10. Status (STATUS_W)”);
- digital input status *dIG.1* / *dIG.2* (see paragraph “7.11.1. Digital input status”).

7.22.1. Software startup/shutdown

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1035	11	bit	**BIT_ SOFT-WARE_ ON_OFF**	M	MainMenu → L*1* → Expert → Bit → IT_SOFTWARE_ON_OFF_1	R/W	■			OFF
2059				E1	MainMenu → L2 → Expert → Bit → IT_SOFTWARE_ON_OFF_2					
4107				E2	MainMenu → L3 → Expert → Bit → IT_SOFTWARE_ON_OFF_3					

The bit sets the software startup and shutdown.

Options: **OFF** = Software on
ON = Software off

7.22.2. Software shutdown modes

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1724	700	16 bit	**OFF.t**	Global	MainMenu → Global → Controls → OFF.t	R/W	■	Unsigned Short		0

The parameter sets the software shutdown mode.

Options:

Index	Description
0	Outputs *rL.1 - rL.2 - rL.3 - rL.5* = OFF Outputs *rL.4 - rL.6* = ON Generic alarms *AL1...AL8* disabled
1	Outputs *rL.1 - rL.2 - rL.3 - rL.5* = OFF Outputs *rL.4 - rL.6* = ON Generic alarms *AL1...AL8* enabled

7.23. Other functions

7.23.1. Operating hour meter

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1420	396	32 bit	**OH.c**	M	MainMenu → L*1* → Status → OH.c_1	R	■	Unsigned Int	h	
2444				E1	MainMenu → L2 → Status → OH.c_2					
4492				E2	MainMenu → L3 → Status → OH.c_3					

The parameter shows the number of operating hours of the Advanced Power Controller.
The controller is in operation when line voltage is present and the power is non-zero.
The update in the non-volatile memory takes place every two hours and when the line voltage is switched off.

7.23.2. Enabling retentive memory storage

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1925	901	16 bit	**EEP.E**	Global	MainMenu → Global → Comms → EEP.E	R/W	■	Unsigned Short		0

The parameter sets how the parameters are saved in the retentive memory.
With 0 (retentive memory enabled), when the device is first powered “on”, the device will utilize the last saved parameters for startup (saved in retentive memory). Any parameters changed while retentive memory is disabled will not be saved when device is shutdown (power off).
In any case, the parameters relating to the energy count, operating hour meter and maximum temperatures are always stored in retentive memory.

Options: **0** = Retentive memory enabled
1 = Retentive memory disabled

7.24. Power control modes

The Advanced Power Controller modulates the power delivery with two modes:

- by changing the phase angle (PA mode);
- by changing the number of operating cycles with zero crossing triggering (ZC, BF, and HSC modes). This is commonly referred to a Pulse Train Mode.

PA
An acronym for *Phase Angle*, this type of operation manages the power on the load by modulating the phase angle (power-on).

ZC
An acronym for *Zero Crossing*, this type of operation reduces EMC emissions. The load power is managed via a series of conduction (ON) cycles and non-conduction (OFF) cycles. The cycle time (one ON and one OFF phase) is constant and can be set from 1 to 200 seconds, or from 0.1 to 20.0 seconds for a fast cycle.
The cycle time can be set with two resolutions (seconds or tenths of a second) depending on the type of function allocated to outputs *rL1* and *rL2*.

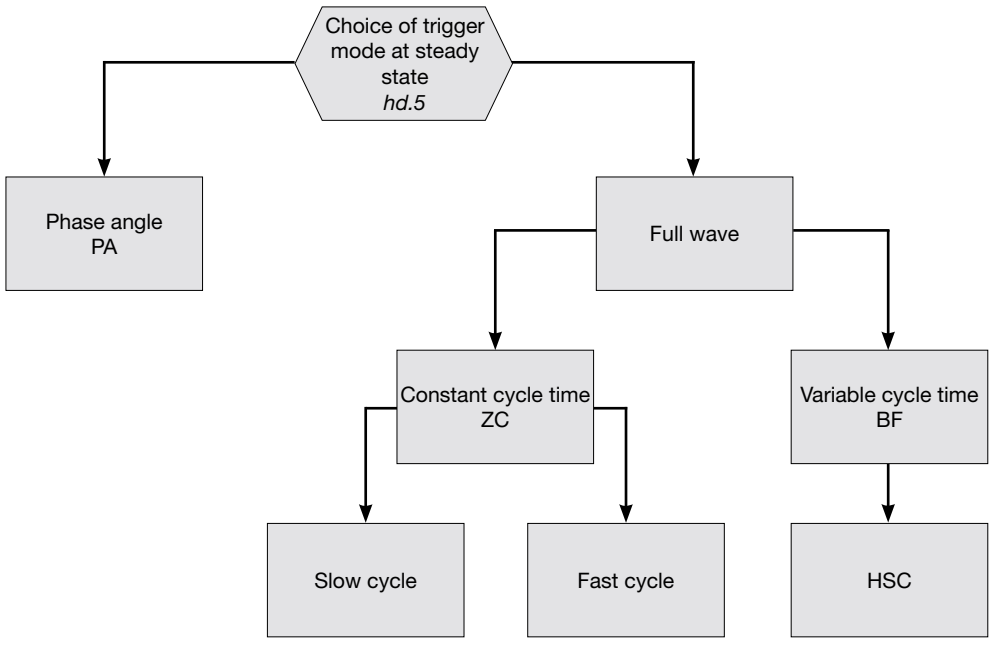
BF
An acronym for *Burst Firing*, this operating mode manages load power through a series of conduction (ON) cycles and non-conduction (OFF) cycles. The ratio of the number of ON cycles to the number of OFF cycles is proportional to the value of the power to be supplied to the load. The repetition period or cycle time is kept as short as possible for each power value.
The parameter *bF.Cy* defines the minimum number of conduction cycles, which can be set from 1 to 10.
In the case of a three-phase load (star without neutral or closed delta), a value of *bF.Cy* >= 5 must be set to ensure correct operation (current balance in the 3 loads).

HSC
An acronym for *Half Single Cycle*, this type of operation corresponds to BF operation comprising half on/off cycles. It is useful for reducing *flicker* with short-wave infrared loads. It is applied only to single-phase or three-phase loads with neutral or open delta.

The power delivery mode is set with parameter *hd.5*.
In each power delivery mode, the maximum RMS current control can bewith the Cu.F.E parameter. The maximum RMS current value is set with the parameter *Fu.tA*.

The following functional diagram shows the different power control modes.

Functional diagram of power control modes



7.24.1. Enabling trigger modes

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1727	703	16 bit	**hd.5**	M	MainMenu → L*1* → Power controls → hd.5_1	R/W	■	Unsigned Short		see table
2751				E1	MainMenu → L2 → Power controls → hd.5_2					
4799				E2	MainMenu → L3 → Power controls → hd.5_3					

This parameter shows and sets the power delivery mode. The mode is identified by an index.
The default values of the trigger mode depend on the setting of C.SEt:

C.SEt	Default	Description
resistive load	141 (= 13 + 128)	HSC trigger mode at steady state, softstart ramp for infrared lamps, peak current control in softstart load
inductive load	32 (= 0 + 32)	ZC/BF trigger mode at steady state, delay triggering enabled

Options:

Trigger mode					
Index	**Softstart ramp**	**Trigger mode in steady state**	**BF mode**	**Peak current control in softstart load**	**RMS current control in steady state load**
0	NO	ZC/BF	-	NO	NO
1	YES	ZC/BF	-	NO	NO
2	NO	PA	-	NO	NO
3	YES	PA	-	NO	NO
4	NO	ZC/BF	HSC	NO	NO
5	YES	ZC/BF	HSC	NO	NO
6	NO	PA	-	NO	NO
7	YES	PA	-	NO	NO
8	NO	ZC/BF	-	YES	NO
9	YES	ZC/BF	-	YES	NO
10	NO	PA	-	YES	NO
11	YES	PA	-	YES	NO
12	NO	ZC/BF	HSC	YES	NO
13	YES	ZC/BF	HSC	YES	NO
14	NO	PA	-	YES	NO
15	YES	PA	-	YES	NO

Trigger mode					
Index	**Softstart ramp**	**Trigger mode in steady state**	**BF mode**	**Peak current control in softstart load**	**RMS current control in steady state load**
16	NO	ZC/BF	-	NO	YES
17	YES	ZC/BF	-	NO	YES
18	NO	PA	-	NO	YES
19	YES	PA	-	NO	YES
20	NO	ZC/BF	HSC	NO	YES
21	YES	ZC/BF	HSC	NO	YES
22	NO	PA	-	NO	YES
23	YES	PA	-	NO	YES
24	NO	ZC/BF	-	YES	YES
25	YES	ZC/BF	-	YES	YES
26	NO	PA	-	YES	YES
27	YES	PA	-	YES	YES
28	NO	ZC/BF	HSC	YES	YES
29	YES	ZC/BF	HSC	YES	YES
30	NO	PA	-	YES	YES
31	YES	PA	-	YES	YES

Increasing the index by a fixed amount results in the following behaviours:
Index +32 = Enable delay triggering (only for ZC/BF modes).
Index +64 = Linear phase softstart in power.
Index +128 = Phase softstart for infrared lamps.
Index +256 = Softstart of shutdown phase in software ON/OFF switching.

7.24.2. Maximum RMS current limit in steady state

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1731	707	16 bit	**Fu.tA**	M	MainMenu → L*1* → Power controls → Fu.tA_1	R/W	■	Float (####.#)	A	see table
2755				E1	MainMenu → L2 → Power controls → Fu.tA_2					
4803				E2	MainMenu → L3 → Power controls → Fu.tA_3					

The parameter sets the maximum limit of the RMS current at steady state.
The default value depends on the size of the controller:

Size GRC-L1, GRC-L2, GRC-L3	**Default**
40 A	40.0
60 A	60.0
100 A	100.0
150 A	150.0

With a three-phase load, a different Fu.tA parameter value can be set *for* each module. This allows, for example, control of an unbalanced three-phase load.

min...max: **0.0**...**3275.0**

7.24.3. Minimum number of cycles of BF mode

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1728	704	16 bit	**Bf.Cy**	M	MainMenu → L*1* → Power controls → Bf.Cy_1	R/W	■	Unsigned Short		see table
2752				E1	MainMenu → L2 → Power controls → Bf.Cy_2					
4800				E2	MainMenu → L3 → Power controls → Bf.Cy_3					

The parameter sets the minimum number of BF mode cycles.
The default value of the parameter depends on the setting of C.SEt:

DIP C.SEt 5 position	**Default**
resistive load	1
inductive load	5

min...max: **1**...**10**

7.25. Softstart

Softstart allows a gradual increase in power output. It can be enabled in either phase control or zero crossing modes (or pulse train modes) and acts by controlling the conduction angle.
Softstart is enabled via parameter PS.E.

The softstart ramp starts from a zero conduction angle and reaches the angle set in parameter *PS.HI* within the time period set in parameter *PS.tm* (0.1 to 60.0 seconds).
The power output trend during the soft start period (i.e., the shape of the power growth curve) can be varied according to the load using the PS.E parameter.

During the ramp phase, control of the maximum peak current can be enabled via theCu.S.E parameter; the peak value can be set in parameter *PS.tA*. If the measured peak current value I.tAP is >= PS.tA, the soft start ramp is blocked, the ramp time is not advanced, the power output remains constant, waiting for the peak current absorption to fall below the PS.tA threshold.
If the measured value is within the maximum limits, the ramp continues. You can check the status of this limiter using the STATUS_4 bit7 variable.
This function is useful in the event of a short circuit on the load or of loads with high temperature coefficients in order to automatically adapt the start-up time to the load.
The softstart ramp is activated at the first startup after the Power-On and after a software restart. It can be reactivated by a software command by writing bit 108, or automatically if there are OFF conditions for a time longer than that set in *PS.oF* (if =0 the function is as if it were disabled).

The switch-off ramp can also be enabled via parameter PS.S.E. In this case, zero power is achieved within the set time.

The soft start ends before the defined time PS.tm if:
-the power % ou.P reaches the corresponding value set in manual control.
-if during the soft start phase the current measured on the load reaches the value of the active rms current limiter Fu.tA.
-if the current/voltage/power measured on the load during the ramp reaches the corresponding reference value calculated by Feedback at that moment (example: the controller controls a non-linear 8kW load, Feedback in Power active, ref.P=8kW.
Manual power is set to 50.0%, therefore Arif.P=4kW.
When first switched on, the soft start ramp is started (Ps. tm=4s).
After only 1s, 4kW of measured power is reached (in less than a quarter of the ramp time).
The ramp is interrupted because P Load >= Arif.P, without reaching the required manual power of 50%, theoretically reached in 2 seconds (with linear power ramp PS.E=2).

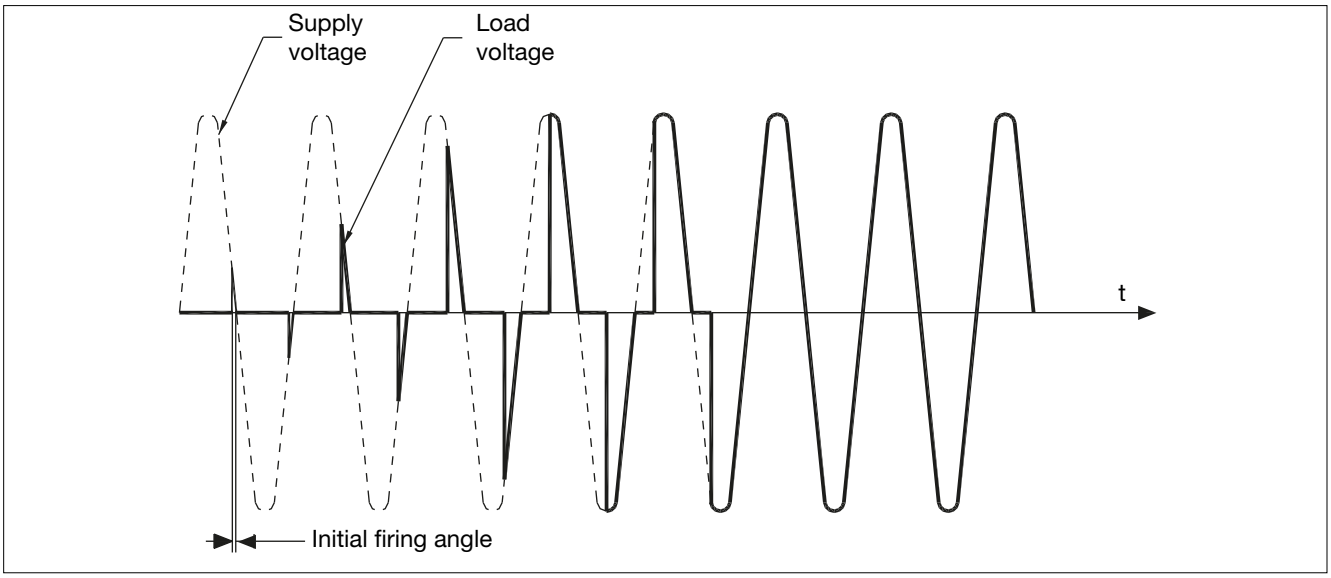


Figure 25 - Rampa di accensione con softstart di fase

7.25.1. Maximum phase of the phase softstart ramp

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1654	630	16 bit	**PS.Hi**	M	MainMenu → L*1* → Power controls → PS.Hi_1	R/W	■	Float	%	100.0
2755				E1	MainMenu → L2 → Power controls → PS.Hi_2					
4803				E2	MainMenu → L3 → Power controls → PS.Hi_3					
The parameter sets the maximum phase of the phase softstart ramp.										
min...max: **0.0**...**100.0**										

7.25.2. Phase softstart ramp duration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1729	705	16 bit	**PS.tm**	M	MainMenu → L*1* → Power controls → PS.tm_1	R/W	■	Float	sec.	10.0
2753				E1	MainMenu → L2 → Power controls → PS.tm_2					
4801				E2	MainMenu → L3 → Power controls → PS.tm_3					
The parameter sets the duration of the phase softstart ramp.										
min...max: **0.1**...**60.0**										

7.25.3. Minimum non-conduction time for ramp reactivation

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1653	629	16 bit	**PS.oF**	M	MainMenu → L*1* → Power controls → PS.oF_1	R/W	■	Unsigned Short	sec.	2
2677				E1	MainMenu → L2 → Power controls → PS.oF_2					
4725				E2	MainMenu → L3 → Power controls → PS.oF_3					
The parameter sets the minimum non-conduction time to reactivate the phase softstart ramp.										
min...max: **0**...**999**										

7.25.4. Maximum peak current limit during ramp

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1730	706	16 bit	**PS.tA**	M	MainMenu → L*1* → Power controls → PS.tA_1	R/W	■	Float (####.#)	Apk	see table
2754				E1	MainMenu → L2 → Power controls → PS.tA_2					
4802				E2	MainMenu → L3 → Power controls → PS.tA_3					

The parameter sets the maximum peak current limit during the phase softstart ramp.
The default value depends on the size of the controller:

Size GRC	Default
25	38,8
25I	38,8
40	62,0
40I	62,0
60	93,1
75	116,3
90	139,6
120	186,1
150	232,7

With a three-phase load, a different PS.tA parameter value can be set *for* each module. This allows, for example, control of an unbalanced three-phase load.

min...max: **0.0...3275.0**

7.25.5. Phase softstart ramp restart

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1132	108	bit	**BIT_ SOFTS-TART_RE-START**	M	MainMenu → L1 → Expert → Bit → BIT_SOFTSTART_RESTART_1	R/W				OFF
2156				E1	MainMenu → L2 → Expert → Bit → BIT_SOFTSTART_RESTART_2					
4204				E2	MainMenu → L3 → Expert → Bit → BIT_SOFTSTART_RESTART_3					

The bit sets enablement of phase softstart ramp restart.

Options: **OFF** = No function
ON = Restart enabled

7.25.6. Phase softstart ramp status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1130	106	bit	**BIT_STATUS_SOFTSTART**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_SOFTSTART_1	R				
2154				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_SOFTSTART_2					
4202				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_SOFTSTART_3					
The bit shows the status of the phase softstart ramp. *Options:* **OFF** = Ramp not active **ON** = Ramp active										

7.25.7. Phase softstart ramp completion status

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1131	107	bit	**BIT_STATUS_SOFTSTART_END**	M	MainMenu → L1 → Expert → Bit → BIT_STATUS_SOFTSTART_END_1	R				
2155				E1	MainMenu → L2 → Expert → Bit → BIT_STATUS_SOFTSTART_END_2					
4203				E2	MainMenu → L3 → Expert → Bit → BIT_STATUS_SOFTSTART_END_3					
The bit shows the completion status of the phase softstart ramp. *Options:* **OFF** = Ramp not ended **ON** = Ramp ended										

7.26. Delay Triggering

Delay Triggering is a function that inserts a trigger delay on the first cycle with inductive loads in start modes ZC and BF. The startup delay is expressed in degrees and can be set in the *dL.t* parameter.

7.26.1. Delay triggering

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1732	708	16 bit	**dL.t**	M	MainMenu → L*1* → Power controls → dL.t_1	R/W	■	Unsigned Short	degrees	see table
2756				E1	MainMenu → L2 → Power controls → dL.t_2					
4804				E2	MainMenu → L3 → Power controls → dL.t_3					

The parameter sets the trigger delay, expressed in sexagesimal degrees (base 60), on the first cycle. The default value of the parameter depends on the configuration:

Type of load	**Default**		
	GRC-L1	**GRC-L2**	**GRC-L3**
Three-phase star load without neutral or closed delta, C.SEt = inductive load	40	40	90
All other types of load	60	60	60

min...max: **0...90**

7.26.2. Delay triggering with rotation of phases 1-3-2

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1796	772	16 bit	**dL.tr**	M	MainMenu → L*1* → Power controls → dL.tr_1	R/W	■	Unsigned Short	degrees	see table
2820				E1	MainMenu → L2 → Power controls → dL.tr_2					
4868				E2	MainMenu → L3 → Power controls → dL.tr_3					

The parameter sets the trigger delay, expressed in sexagesimal degrees, with rotation of phases 1-3-2. The default value of the parameter depends on the configuration:

Type of load	**Default**		
	GRC-L1	**GRC-L2**	**GRC-L3**
Three-phase star load without neutral or closed delta, C.SEt = inductive load	90	90	40
All other types of load	60	60	60

min...max: **0...90**

7.27. Automatic Firing Change function

The dynamic Firing Change feature allows you to switch between phase angle (PA) and full wave (ZC/BF/HSC) firing modes in four different configurations:

1. Automatically, by comparing the RMS current on the load and the threshold (*Fu.tA - FC.tA*).
2. Automatically, by comparing the RMS current on the load and the absolute threshold *FC.thr*.
3. On request from digital input.
4. On request from serial communication.

The switchover is always made by bringing the power to zero and restarting with the set ramp.

The RMS current condition is only evaluated in steady state.

The ZC/BF/HSC trigger mode is selected by forcing bit 1 of parameter *hd.5* to 0:

- with RMS current < (*Fu.tA - FC.tA*) and actuation power > FC.P;
- with RMS current < (*FC.thr - FC.tA*) and actuation power > *FC.P*;
- with open digital input setting (logic state 0);
- with writing from serial with bit at 0.

The PA trigger mode is selected by forcing bit 1 of parameter *hd.5* to 1:

- with RMS current >= (*Fu.tA - FC.tA/2*);
- with RMS current >= (*FC.thr*);
- with closed digital input setting (logical state 1);
- with writing from serial with bit at 1.

Other features:

- The parameter FC.tA is the hysteresis for automatic switching and is expressed as a percentage [0.0...100.0%] of:
  – *Fu.tA*;
  – *FC.thr*.
- In any case, the function of the RMS current control in steady state (*Fu.tA* parameter) remains unaffected (erosion of power output to limit current).
- In PA the RMS current is obtained as a full-wave projection based on the percentage of phase angle implemented.
- In ZC/BF/HSC the RMS current is *I.on*.
- In two-phase or three-phase configuration, the conditions on the RMS currents of the modules are in logical AND when switching from PA to ZC/BF/HSC and in logical OR when switching from ZC/BF/HSC to PA.

The following settings are recommended:

- *FC.P* = 5.0%
- *PS.tm* > 4.0 sec
- *G.Out* = 20.0%

7.27.1. Enabling Firing Change function

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1919	895	16 bit	**hd.7**	Global	MainMenu → Global → Special functions → hd.7	R/W	■	Unsigned Short		0

The parameter enables the Firing Change function. The mode is identified by an index.

Options:

Index	GRC-L1 enabled	GRC-L2 enabled	GRC-L3 enabled
0			
1	■		
2		■	
3	■	■	
4			■
5	■		■
6		■	■
7	■	■	■

Increasing the index by a fixed amount results in the following behaviours:
Index +8 = Enabling of Firing Change function from digital inputs.
Index +16 = Enabling of Firing Change function from serial communication.
Index +32 = GRC-L2 follows GRC-L1 (only applies if GRC-L2 is enabled).
Index +64 = GRC-L3 follows GRC-L1 (only applies if GRC-L3 is enabled).
Index +128 = GRC-L3 follows GRC-L2 (only applies if GRC-L3 is enabled).
Index +256 = Enabling of *FC.thr* as current threshold.

7.27.2. Current threshold for activating Firing Change

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1926	902	16 bit	**FC.thr**	L1	MainMenu → L*1* → Power controls → FC.thr_1	R/W	■	Float (####.#)	A	0.0
2950				L2	MainMenu → L2 → Power controls → FC.thr_2					
4998				L3	MainMenu → L3 → Power controls → FC.thr_3					
The parameter sets the current value required to activate the Firing Change (only with *hd.7* = +256). *min...max:* **0.0**...**3275.0**										

7.27.3. Current hysteresis for activating Firing Change

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1920	896	16 bit	**FC.tA**	L1	MainMenu → L*1* → Power controls → FC.tA_1	R/W	■	Float (####.#)	%	10.0
2944				L2	MainMenu → L2 → Power controls → FC.tA_2					
4992				L3	MainMenu → L3 → Power controls → FC.tA_3					
The parameter sets the current hysteresis value required to activate the Firing Change. It is expressed in % of the current threshold *Fu.tA* or *FC.thr* (only if enabled by setting *hd.7* = +256). *min...max:* **0.0**...**100.0**										

7.27.4. Minimum power for activating Firing Change

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1924	900	16 bit	**FC.P**	L1	MainMenu → L*1* → Power controls → FC.P_1	R/W	■	Float (####.#)	%	0.0
2948				L2	MainMenu → L2 → Power controls → FC.P_2					
4996				L3	MainMenu → L3 → Power controls → FC.P_3					
This parameter sets the minimum power value required to activate the Firing Change. *min...max:* **0.0**...**100.0**										

7.27.5. Firing Change status set via serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1921	897	16 bit	**SERIAL_FC**	L1	MainMenu → L*1* → Expert → Virtual → SERIAL_FC_1	R/W		Unsigned Short		0
2945				L2	MainMenu → L*1* → Expert → Virtual → SERIAL_FC_2					
4993				L3	MainMenu → L*1* → Expert → Virtual → SERIAL_FC_3					
The parameter sets the Firing Change mode set via serial. *Options:* **0** = ZC/BF/HSC mode **1** = PA mode										

7.27.6. Firing Change status set via serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1145	121	bit	**BIT_SERIAL_FC_PA_MODE**	L1	MainMenu → L1 → Expert → Bit → BIT_SERIAL_FC_PA_MODE_1	R/W				OFF
2169				L2	MainMenu → L2 → Expert → Bit → BIT_SERIAL_FC_PA_MODE_2					
4217				L3	MainMenu → L3 → Expert → Bit → BIT_SERIAL_FC_PA_MODE_3					
The bit sets the Firing Change mode set via serial. *Options:* **OFF** = ZC/BF/HSC mode **ON** = PA mode										

7.28. Feedback mode

The Advanced Power Controller offers the following possibilities to control power through *feedback*:

- V Voltage;
- V^2 Quadratic voltage;
- I Current;
- I^2 Quadratic current;
- P Power.

Enabling of the control mode is set via parameter *hd.6*.

Voltage feedback (V)
This is used to maintain a constant load voltage. Compensates for possible variations in line voltage from the nominal voltage (value stored in the parameter *riF.V*, expressed in Vrms).
The voltage value maintained on the load is equal to the result of the formula

$$rif.V \times (Ou.P\ [\%] / 100)$$

and is contained in the Modbus 757 register.

Quadratic voltage feedback (V^2)
This is used to maintain a constant load voltage. It compensates possible variations in line voltage from the rated voltage (value stored in the parameter *riF.V*, expressed in Vrms).
The voltage value maintained on the load is equal to the result of the formula

$$rif.V \times \sqrt{Ou.P\ [\%] / 100)}$$

and is contained in the Modbus 757 register.

Current feedback (I)
This is used to maintain a constant load current. It compensates possible variations in line voltage and/or load impedance with respect to the rated current (value stored in the *riF.I* parameter, expressed in Arms).
The current value maintained on the load is equal to the result of the formula

$$rif.I \times (Ou.P\ [\%] / 100)$$

and is contained in the Modbus 757 register.

Quadratic current feedback (I^2)
This is used to maintain a constant load current. It compensates possible variations in line voltage and/or load impedance with respect to the rated current (value stored in the *riF.I* parameter, expressed in Arms).
The current value maintained on the load is equal to the result of the formula

$$rif.I \times \sqrt{Ou.P\ [\%] / 100)}$$

and is contained in the Modbus 757 register.

Power feedback (P)
This is used to keep the load power constant. It compensates possible variations in line voltage and/or load impedance with respect to the rated power (value stored in *riF.P*, expressed in kWatts).
The power value maintained on the load is equal to the result of the formula

$$rif.P \times (Ou.P\ [\%] / 100)$$

and is contained in the Modbus 757 register.

IMPORTANT!
The feedback calibration can be activated by digital input (parameters *dIG.1, dIG.2, dIG.3, diG.4*) or by serial command (ref. *bit 113*).

If required, calibration MUST only be activated after first setting parameter *hd.6* = 0 and preferably under conditions of maximum power on the load (e.g., *Ou.P* [%] at 100%).
Only after calibration has been carried out can the parameter *hd.6* be set to the desired value.

If the operating mode is changed (PA, ZC, BF, HSC), the feedback calibration procedure outlined above must be repeated.

The voltage V feedback (or current I feedback or power P feedback) corrects the % conduction with a maximum value that can be set in the parameter *Cor.V* (or *Cor.I* or *Cor.P*).

For non-linear loads (e.g., Super Kanthal or Silicon Carbide) the automatic calibration procedure is NOT NECESSARY, but the value of parameters *ref.V*, *ref.I* and *ref.P* must be set directly based on the nominal load specification given in the data-sheet (see GRC Installation Guide Document).

Note: Feedback mode can not be changed while the unit is in operation. Software must be off to make the change.

7.28.1. Enabling feedback mode

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1732	708	16 bit	**hd.6**	L1	MainMenu → L*1* → Power controls → hd.6_1	R/W	■	Unsigned Short		0
2756				L2	MainMenu → L2 → Power controls → hd.6_2					
4804				L3	MainMenu → L3 → Power controls → hd.6_3					

The parameter sets enabling of the feedback mode. The enabled mode is identified by an index.

Options:

Index	Feedback mode
0	No feedback enabled
1	V^2 (quadratic voltage feedback)
2	I^2 (quadratic current feedback)
3	P (power feedback)
4	No feedback enabled
5	V (linear voltage feedback)
6	I (linear current feedback)

7.28.2. Maximum voltage feedback correction

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1755	731	16 bit	**Cor.V**	L1	MainMenu → L*1* → Power controls → Cor.V_1	R/W	■	Float (####.#)	%	100.0
2779				L2	MainMenu → L2 → Power controls → Cor.V_2					
4827				L3	MainMenu → L3 → Power controls → Cor.V_3					

The parameter sets the maximum correction of the voltage feedback. It serves to limit the correction.

min...max: **0.0**...**100.0**

7.28.3. Maximum current feedback correction

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1756	732	16 bit	**Cor.I**	L1	MainMenu → L*1* → Power controls → Cor.I_1	R/W	■	Float (####.#)	%	100.0
2780				L2	MainMenu → L*1* → Power controls → Cor.I_2					
4828				L3	MainMenu → L*1* → Power controls → Cor.I_3					

The parameter sets the maximum correction of the current feedback. It serves to limit the correction.

min...max: **0.0**...**100.0**

7.28.4. Maximum power feedback correction

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1757	733	16 bit	**Cor.P**	L1	MainMenu → L*1* → Power controls → Cor.P_1	R/W	■	Float (####.#)	%	100.0
2781				L2	MainMenu → L2 → Power controls → Cor.P_2					
4829				L3	MainMenu → L3 → Power controls → Cor.P_3					
The parameter sets the maximum correction of power feedback. It serves to limit the correction.										
min...max: **0.0**...**100.0**										

7.28.5. Voltage feedback reference

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1758	734	16 bit	**riF.V**	L1	MainMenu → L*1* → Power controls → riF.V_1	R/W	■	Float (####.#)	V	0.0
2782				L2	MainMenu → L2 → Power controls → riF.V_2					
4830				L3	MainMenu → L3 → Power controls → riF.V_3					
The parameter sets the voltage feedback reference, i.e., the rated voltage.										
min...max: **0.0**...**999.9**										

7.28.6. Current feedback reference

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1758	734	16 bit	**riF.I**	L1	MainMenu → L*1* → Power controls → riF.I_1	R/W	■	Float (####.#)	A	0.0
2782				L2	MainMenu → L2 → Power controls → riF.I_2					
4830				L3	MainMenu → L3 → Power controls → riF.I_3					
The parameter sets the current feedback reference, i.e., the rated current.										
min...max: **0.0**...**3275.0**										

7.28.7. Power feedback reference

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1908	884	32 bit	**riF.P**	L1	MainMenu → L*1* → Power controls → riF.P_1	R/W	■	Float32 (####.#)	kW	00:00
2932				L2	MainMenu → L2 → Power controls → riF.P_2					
4980				L3	MainMenu → L3 → Power controls → riF.P_3					

The parameter sets the power feedback reference, i.e., the rated power.
The LSW data in Word format (16 bits) is available at address 736 (1760 - 2784 - 4832).

min...max: **0.00**...**1500.00**

7.28.8. Feedback response speed

Address		Format	Acronym	Global / L1/L2/L3	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1765	741	16 bit	**Fb.It**	L1	MainMenu → L*1* → Power controls → Fb.It_1	R/W	■	Float (####.#)	% / 60 ms	0.3
2813				L2	MainMenu → L2 → Power controls → Fb.It_2					
4837				L3	MainMenu → L3 → Power controls → Fb.It_3					

The parameter sets the feedback response speed. The speed is expressed as a percentage change in output power calculated every 60 ms.

min...max: **0.1**...**5.0**

7.28.9. Feedback reference calibration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1137	113	bit	**BIT_ CALIB_ FEED-BACK**	L1	MainMenu → L1 → Expert → Bit → BIT_CALIB_FEEDBACK_1	R/W				OFF
2161				L2	MainMenu → L2 → Expert → Bit → BIT_CALIB_FEEDBACK_2					
4227				L3	MainMenu → L3 → Expert → Bit → BIT_CALIB_FEEDBACK_3					

The bit enables and disables calibration of the feedback reference.

Options: **OFF** = No function
ON = Calibration enabled

7.28.10. Feedback reference

<table>
<tr><th colspan="2">Address</th><th rowspan="2">Format</th><th rowspan="2">Acronym</th><th rowspan="2">Global / M/E1/E2</th><th rowspan="2">GF_eXpress menu</th><th rowspan="2">Attribute</th><th rowspan="2">Retentive</th><th rowspan="2">Type</th><th rowspan="2">Unit of measurement</th><th rowspan="2">Default</th></tr>
<tr><th>Single-node</th><th>Multi-node</th></tr>
<tr><td colspan="11">Description</td></tr>
<tr><td>1910</td><td rowspan="3">886</td><td rowspan="3">32 bit</td><td rowspan="3">AriF</td><td>L1</td><td>MainMenu → L1 → Expert → Status → AriF_1</td><td rowspan="3">R</td><td rowspan="3"></td><td rowspan="3">Float32 (see table)</td><td rowspan="3">see table</td><td rowspan="3">see table</td></tr>
<tr><td>2934</td><td>L2</td><td>MainMenu → L2 → Expert → Status → AriF_1</td></tr>
<tr><td>4982</td><td>L3</td><td>MainMenu → L3 → Expert → Status → AriF_1</td></tr>
<tr><td colspan="11">The parameter shows the feedback reference. The data is in DWord format (32 bit).
The LSW data in Word format (16 bit) is available at address 757 (1781 - 2805 - 4853).
The default value is the threshold of V, I, P to be maintained on the load.</td></tr>
</table>

	Type of feedback		
	Voltage	**Current**	**Power**
Unit of measurement	V	A	kW
Range	0.0...999.9	0.0...3275.0	0.00...1500.00
Format	(####.#)	(####.#)	(###.##)

7.29. Heuristic power control

Heuristic mode allows for the device to synchronize outputs within the device to maintain a more steady usage of power. Heuristic mode that is not enabled could result in all outputs being turned on(full conduction) at the same time, or conversely all off at the same time. With Heuristic mode the user will set a maximum current limit and the device will manage outputs based upon this maximum current.

Heuristic mode helps limit peak power demands within the device. While in heuristic mode the power control will determine the most appropriate output combinations to stay under maximum power applied to load.

This function only works with the GRC-3PH models that are controlling 3 single phase lines in on-off modulation (zero cross modes).

Gefran has products that has the ability to manage peak power demands across the entire plant floor. See Gefran model GSLM, Smart Load Management.

Refer to section “8.4.3. Heuristic power control” Examples and Application Notes for more information.

7.28.11. Enabling heuristic power control

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1704	680	16 bit	**hd.3**	Global	MainMenu → Global → Powers → hd.3	R/W	■	Unsigned Short		0

The parameter enables the heuristic power control of GRC-L1, GRC-L2 and GRC-L3. Setting *hd.3* = 0 disables heuristic power control for all modules.
Enabling only applies to GRCs with OUT1...OUT3 outputs with slow cycle time (1...200 seconds).

Options:

Index	GRC-L1 enabled	GRC-L2 enabled	GRC-L3 enabled
0			
3	■	■	
5	■		■
6		■	■
7	■	■	■

7.28.12. Maximum current for heuristic power control

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1705	681	16 bit	**I.HEU**	Global	MainMenu → Global → Powers → I.HEU	R/W	■	Float (####.#)	A	0.0

The parameter sets the maximum current for heuristic power control.

min...max: **0.0**...**3275.0**

7.30. Heterogeneous power control

The Heterogenous power control function is like a programmable circuit breaker. It allows the user to set a maximum power to be used by the device in its entirety. If the maximum is reached then specific parts of the load are switched off (disconnected) according to a predefined priority.

GRC-L1 always has priority and is switched off last. If power control is enabled for several modules, the disconnection sequence starts with the module with the highest number (GRC-L3 before GRC-L2 and GRC-L1, GRC-L2 before GRC-L1).

7.30.1. Enabling heterogeneous power control

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1706	682	16 bit	**hd.4**	Global	MainMenu → Global → Powers → hd.4	R/W	■	Unsigned Short		0

The parameter enables heterogeneous power control of GRC-L1, GRC-L2 and GRC-L3. Setting *hd.4* = 0 disables heterogeneous power control for all modules.

Options:

Index	GRC-L1 enabled	GRC-L2 enabled	GRC-L3 enabled
0			
1	■		
2		■	
3	■	■	
4			■
5	■		■
6		■	■
7	■	■	■

7.30.2. Maximum current for heterogeneous power control

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1707	683	16 bit	**I.HEt**	Global	MainMenu → Global → Powers → I.HEt	R/W	■	Float (####.#)	A	0.0

The parameter sets the maximum current for heterogeneous power control.

min...max: **0.0**...**3275.0**

7.31. Virtual instrument control

The virtual instrument allows the hardware resources of the device to be set up from the serial line, writing dedicated configuration parameters instead of using the normal controller processing flow.

Control of the virtual instrument is activated via the parameter *hd.1*.

By setting the *S.In* e *S.Ou* parameters, it is possible to enable the writing of certain variables from the serial line and impose the value of the inputs and the status of the outputs.

Alarm thresholds AL1... must be enabled. AL4 when write operations are continuous and there is no need to keep the last value in the EEPROM.

Enabling digital input D1 allows the status of this input to be set, for example to perform MAN/AUTO switching by writing bit 10 of the SERIAL_LED register.
Similarly, the ON/OFF state of outputs OUT1...OUT10 and LEDs can be set by writing bits in the SERIAL_IN_OUT register.

7.31.1. Enabling instrument control via serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1215	191	16 bit	**hd.1**	Global	MainMenu → Global → Controls → hd.1	R/W	■	Unsigned Short		0
The parameter enables control of the virtual instrument via serial. *Options:* **0** = Virtual instrument not enabled **2** = Virtual instrument enabled										

7.31.2. Input control from serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1248	224	16 bit	**S.In**	L1	MainMenu → Global → Expert → Virtual → S.In_1	R/W	■	Unsigned Short		0
2272				L2	MainMenu → Global → Expert → Virtual → S.In_2					
4320				L3	MainMenu → Global → Expert → Virtual → S.In_3					

The parameter sets the control of inputs from serial. The table shows the correspondence between bits and inputs.

Inputs	In.A1	In.A2	In.A3	-	-	-	-	AL4	AL3	AL2	AL1
bit	10	9	8	7	6	5	4	3	2	1	0

NOTE: Inputs *In.A1*, *In.A2* and *In.A3* are only valid for GRC-L1.

min...max: **0**...**2047**

7.31.3. Output control from serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1249	225	16 bit	**S.Ou**	Global	MainMenu → Global → Expert → Virtual → S.Ou	R/W	■	Unsigned Short		0

The parameter sets the control of outputs from serial. The table shows the correspondence between bits and outputs.

Outputs	OUT10	OUT9	OUT8	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1
bit	9	8	7	6	5	4	3	2	1	0

min...max: **0**...**1023**

7.31.4. LED and digital input control from serial

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1652	628	16 bit	**S.LI**	Global	MainMenu → Global → Expert → Virtual → S.LI	R/W	■	Unsigned Short		0

The parameter sets the control of the instrument's LEDs and digital inputs from serial. The table shows the correspondence between bits, digital inputs and LEDs.

	Input				**LED**							
	D4	**D3**	**D2**	**D1**	**BUT**	**O3**	**O2**	**O1**	**DI2**	**DI1**	**ER**	**RN**
bit	11	10	9	8	7	6	5	4	3	2	1	0

min...max: **0**...**4095**

7.31.5. Virtual register address table

Parameter	bit	Enabled resource	Single-node address	Multi node address	Format	Register name
S.In_1	0	Alarm threshold AL1 for GRC-L1	1365	341	word	SERIAL_AL1_1
	1	Alarm threshold AL2 for GRC-L1	1366	342	word	SERIAL_AL2_1
	2	Alarm threshold AL3 for GRC-L1	1367	343	word	SERIAL_AL3_1
	3	Alarm threshold AL4 for GRC-L1	1345	321	word	SERIAL_AL4_1
	8	Input In.A3	1709	685	word	SERIAL_ANALOG3
	9	Input In.A2	1737	713	word	SERIAL_ANALOG2
	10	Input In.A1	4605	581	word	SERIAL_ANALOG1
S.In_2	0	Alarm threshold AL1 for GRC-L2	2389	341	word	SERIAL_AL1_2
	1	Alarm threshold AL2 for GRC-L2	2390	342	word	SERIAL_AL2_2
	2	Alarm threshold AL3 for GRC-L2	2391	343	word	SERIAL_AL3_2
	3	Alarm threshold AL4 for GRC-L2	2369	321	word	SERIAL_AL4_2
S.In_3	0	Alarm threshold AL1 for GRC-L3	4437	341	word	SERIAL_AL1_3
	1	Alarm threshold AL2 for GRC-L3	4438	342	word	SERIAL_AL2_3
	2	Alarm threshold AL3 for GRC-L3	4439	343	word	SERIAL_AL3_3
	3	Alarm threshold AL4 for GRC-L3	4417	321	word	SERIAL_AL4_3
S.Ou	0	OUT 1 output	1368	344	word, bit 0	SERIAL_IN_OUT
	1	OUT 2 output	1368	344	word, bit 1	SERIAL_IN_OUT
	2	OUT 3 output	1368	344	word, bit 2	SERIAL_IN_OUT
	4	OUT 5 output (relay)	1368	344	word, bit 4	SERIAL_IN_OUT
	4	OUT 5 output (Analog A1)	1751	727	word	SERIAL_OUTA1
	5	OUT 6 output (relay)	1368	344	word, bit 5	SERIAL_IN_OUT
	5	OUT 6 output (Analog A2)	1752	728	word	SERIAL_OUTA2
	6	OUT 7 output (relay)	1368	344	word, bit 6	SERIAL_IN_OUT
	6	OUT 7 output (Analog A3)	1753	729	word	SERIAL_OUTA3
	7	OUT 8 output (relay)	1368	344	word, bit 7	SERIAL_IN_OUT
	8	OUT 9 output	1368	344	word, bit 8	SERIAL_IN_OUT
	9	OUT 10 output	1368	344	word, bit 9	SERIAL_IN_OUT
S.LI	0	LED STS	1375	351	word, bit 0	SERIAL_LED
	1	LED ERR	1375	351	word, bit 1	SERIAL_LED
	2	LED D1	1375	351	word, bit 2	SERIAL_LED
	3	LED D2	1375	351	word, bit 3	SERIAL_LED
	4	LED DI1	1375	351	word, bit 4	SERIAL_LED
	5	LED O2	1375	351	word, bit 5	SERIAL_LED
	6	LED O3	1375	351	word, bit 6	SERIAL_LED
	7	LED COM	1375	351	word, bit 7	SERIAL_LED
	8	D1 input	1368	344	word, bit 10	SERIAL_LED
	9	D2 input	1368	344	word, bit 11	SERIAL_LED
	10	D3 input	1368	344	word, bit 12	SERIAL_LED
	11	D4 input	1368	344	word, bit 13	SERIAL_LED

7.32. HW and SW information

The hardware and software of the Advanced Power Controller can be identified and its functioning checked by accessing the information registers.

7.32.1. Software version code

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1146	122	16 bit	**UPd**	Global	MainMenu → Global → Info → UPd	R		Float (###.##)		
The register shows the software version (versione_major.versione_minor).										

7.32.2. Hardware configuration codes

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1214	190	16 bit	**C.Hd**	Global	MainMenu → Global → Info → C.Hd	R		Unsigned Short		

The register shows the output hardware configuration.

Options:

bit	Configuration
0	OUTPUT AUX absent
1	OUTPUT AUX relay
2	OUTPUT AUX logic
3	OUTPUT AUX triac 250 Vac 1 A
5	AUX OUTPUT analog 12bit 20mA/10V
14	EXTERNAL CT (for all models: 1PH / 2PH / 3PH)

7.32.3. Hardware configuration codes 1

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1532	508	16 bit	**C.Hd1**	Global	MainMenu → Global → Info → C.Hd1	R		Unsigned Short		

The register shows the hardware configuration of the controller's Fieldbuses.

Options:

bit	Configuration
2	-
3	FIELDBUS ETH4 (ProfiNet)
4	FIELDBUS ETH8
5	FIELDBUS ETH6
6	FIELDBUS absent
7	FIELDBUS Modbus
8	FIELDBUS Profibus
9	FIELDBUS CanOpen
10	FIELDBUS DeviceNet
11	FIELDBUS Ethernet
12	FIELDBUS Euromap66
13	FIELDBUS ETH3
14	FIELDBUS ETH7 (Ethercat)
15	FIELDBUS ETH1 (Ethernet IP)

7.32.4. Hardware configuration codes 2/3/4

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1567	543	16 bit	**C.Hd2**	Global	MainMenu → Global → Info → C.Hd2	R		Unsigned Short		
1216	162	16 bit	**C.Hd3**	Global	MainMenu → Global → Info → C.Hd3	R		Unsigned Short		
1217	193	16 bit	**C.Hd4**	Global	MainMenu → Global → Info → C.Hd4	R		Unsigned Short		

The register shows the hardware configuration (rating) of GRC-L1, GRC-L2 and GRC-L3, according to the chosen address.

Options:

bit	Configuration
0	no power
1	40 A
2	60 A
3	100 A
4	150 A
5	200 A
6	250 A
7	300 A
8	400 A
9	500 A
10	600 A

7.32.5. Fieldbus board firmware version

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1717	693	16 bit	**UPd.F**	Global	MainMenu → Global → Info → UPd.F	R		Float (###.##)		
The log shows the firmware version of the Fieldbus board.										

7.32.6. Fieldbus board node

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1719	695	16 bit	**Cod.F**	Global	MainMenu → Global → Info → Cod.F	R		Unsigned Short		
The register shows the node number of the Fieldbus board.										

7.32.7. Fieldbus board baudrate

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1720	696	16 bit	**bAu.F**	Global	MainMenu → Global → Comms → bAu.F	R		Unsigned Short		

The register shows the transmission speed of the Fieldbus board, based on the Fieldbus type.

Options:

Profibus	
bAu.f	**baudrate**
0	12.00 Mbit/s
1	6.00 Mbit/s
2	3.00 Mbit/s
3	1.50 Mbit/s
4	500.00 kbit/s
5	187.50 kbit/s
6	93.75 kbit/s
7	45.45 kbit/s
8	19.20 kbit/s
9	9.60 kbit/s

CANopen	
bAu.f	**baudrate**
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s
3	250 kbit/s
4	125 kbit/s
5	100 kbit/s
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s

Ethernet	
bAu.f	**baudrate**
0	100 Mbit/s
1	10 Mbit/s

7.32.8. I/O data size for Fieldbus

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1918	894	16 bit	**F.SIZE**	Global	MainMenu → Global → Comms → F.SIZE	R/W	■	Unsigned Short		0
This parameter sets the I/O data size for the Fieldbus.										

Options: **0** = 12 WORD per input + 12 WORD per output
1 = 24 WORD per input + 24 WORD per output

7.32.9. Load type configuration

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1798	774	16 bit	**C.SEt**	Global	MainMenu → Global → Parameters → J.Ser	R/W	■	Unsigned Short		0

This parameter allows you to define the behavior of the power controller based on the type of electrical connection, type of load, and the need to restore default values.

The table shows the settings of DIP switches 1...5 depending on the load to be controlled.

Type of load connection	HW configuration			C.SEt
	GRC 1PH	GRC 2PH	GRC 3PH	
1 single-phase load	■	■	■	0
2 single-phase loads		■	■	
3 single-phase loads			■	
3 independent single-phase open delta loads			■	8
Three-phase open delta load			■	12
Three-phase star load with neutral			■	
Three-phase closed delta load			■	28
Three-phase star load without neutral			■	36
Three-phase star load without neutral with TWO-PHASE control		■		4
Three-phase closed delta load with TWO-PHASE control		■		20

Resistive load = +0
Inductive load (transformers) = +64
For example, closed delta three-phase inductive load C.Set = 28 + 64 = 92

7.32.10. Manufacturer identification

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1370	120	16 bit		Global		R		Unsigned Short		5000

The log shows the name of the manufacturer (Gefran).

7.32.11. Product identification

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1371	121	16 bit	**deviceID**	Global	MainMenu → Global → Info → deviceID	R		Unsigned Short		218

The register shows the device identifier (GRC) within the Modbus communication network.

7.32.12. Status (STATUS_W)

For STATUS_W, see paragraph “7.20.10. Status (STATUS_W)”.

7.32.13. Alarm status reading

To read the status of ALSTATE_IRQ alarms, see paragraph “7.12.14. Alarm status (ALSTATE_IRQ)”.

7.32.14. Status (STATUS)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1491	467	16 bit	**STATUS**	L1	MainMenu → L1 → Status → STATUS_1	R		Unsigned Short		
2515				L2	MainMenu → L2 → Status → STATUS_2					
4563				L3	MainMenu → L3 → Status → STATUS_3					

The parameter shows the status of the device. The individual statuses are highlighted by the corresponding bit.

Options:

bit	State of
0	*AL1* OR *AL2* OR *AL3* OR *AL4* or *AL.HB* (OR PHASES 1/2/3 with three-phase load) OR POWER_FAULT
5	*Ou.P* > 0
8	*AL1*
9	*AL2*
10	*AL3*
11	*AL4*
12	*AL.HB* OR POWER_FAULT
13	ON/OFF
14	AUTO/MAN

7.32.15. Status 1 (STATUS1)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1493	469	16 bit	**STATUS1**	L1	MainMenu → L1 → Status → STATUS1_1	R		Unsigned Short		
2517				L2	MainMenu → L2 → Status → STATUS1_2					
4565				L3	MainMenu → L3 → Status → STATUS1_3					

The parameter shows the status of the device. The individual statuses are highlighted by the corresponding bit.

Options:

bit	State of
0	*AL1* OR *AL2* OR *AL3* OR *AL4* or *AL.HB* (OR PHASES 1/2/3 with three-phase load) OR POWER_FAULT
8	*AL1*
9	*AL2*
10	*AL3*
11	*AL4*
12	*AL.HB* PHASE 1 (with three-phase load)
13	*AL.HB* PHASE 2 (with three-phase load)
14	*AL.HB* PHASE 3 (with three-phase load)

7.32.16. Status 2 (STATUS2)

Address		Format	Acronym	Global / M/E1/E2	GF_eXpress menu	Attribute	Retentive	Type	Unit of measurement	Default
Single-node	Multi-node									
Description										
1656	632	16 bit	**STATUS2**	L1	MainMenu → L1 → Status → STATUS2_1	R		Unsigned Short		
2680				L2	MainMenu → L2 → Status → STATUS2_2					
4728				L3	MainMenu → L3 → Status → STATUS2_3					

The parameter shows the status of the device. The individual statuses are highlighted by the corresponding bit.

Options:

bit	State of
0	AL1
1	AL2
2	AL3
3	AL4
4	AL.HB PHASE 1 (with three-phase load)
5	AL.HB PHASE 2 (with three-phase load)
6	AL.HB PHASE 3 (with three-phase load)

7.32.17. Status 3 (STATUS3)

See paragraph “7.14.5. Status 3 (STATUS3)”.

7.32.18. Status 4 (STATUS4)

See paragraph “7.15.6. Status reading (STATUS4)”.

7.32.19. Voltage status (VOLTAGE_STATUS)

See paragraph “7.9.6. VOLTAGE_STATUS”.

7.33. Key functions

The Advanced Power Controller key allows the status of the device to be changed.
A pressing and holding the key changes the status; the length of time key is pressed determines the new status.

Release the key before switching to another status.

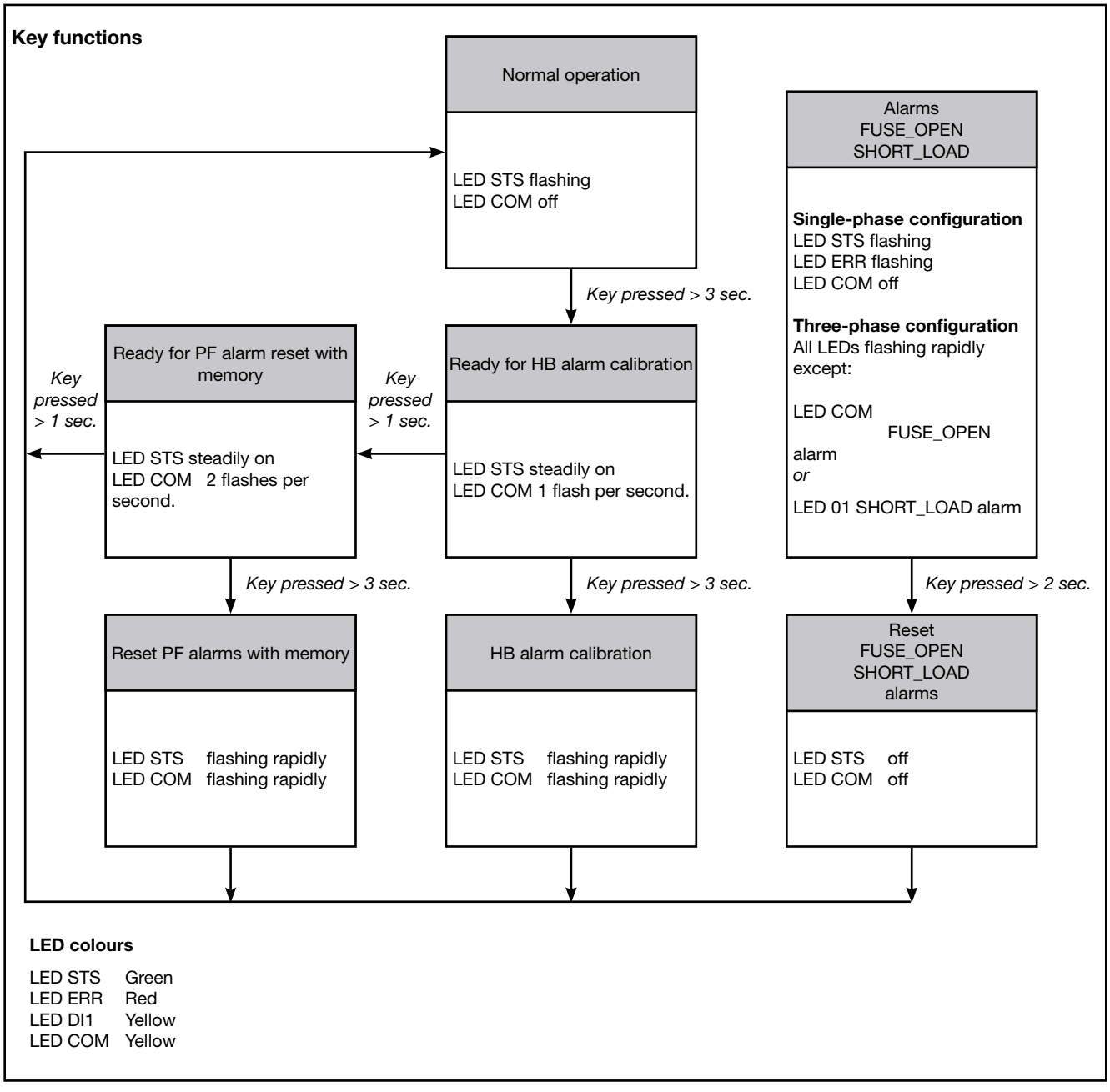
The arrival status is determined by the departure status.

When the key is pressed, the RN and BUT LEDs light up steadily and then go out after 2 or 3 seconds to indicate the change of status.

Example of key use
To activate the HB alarm calibration, start from normal operation (RN LED flashing, BUT LED off):

1. press and hold the key for at least 3 seconds, the LEDs will light up steadily;
2. release the key;
3. wait for the LEDs to go out;
4. press the key again for at least 3 seconds;
5. wait for the LEDs to go out;
6. the HB alarm calibration procedure starts (LEDs flash rapidly);
7. When the LEDs resume normal operation, the calibration procedure is complete.

The following diagram shows how to use the key.
Each box represents a status, which is identified in the grey area.

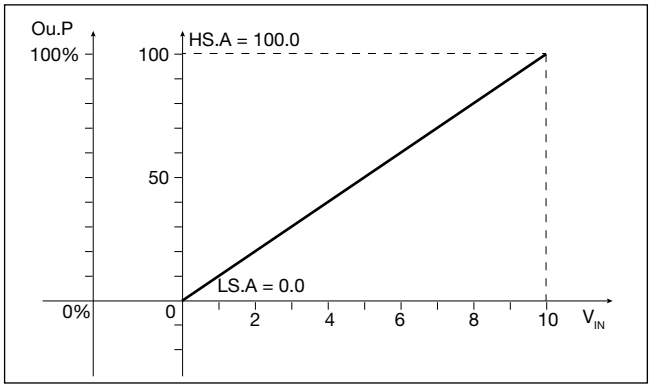


8. EXAMPLES AND APPLICATION NOTES

8.1. Setting parameters LS.A1/LS.A2 and HS.A1/HS.A2

The default values*(LS.A1*/*LS.A2* = 0.0 and *HS.A1*/*HS.A2* = 100.0) can be changed to obtain different assignments between the physical input value (V or mA) and the engineering value (*In.A1*/*In.A2*).
In automatic operation the engineering value (*In.A1*/*In.A2*) is allocated, for values between 0.0 and 100.0, to power *Ou.P*.

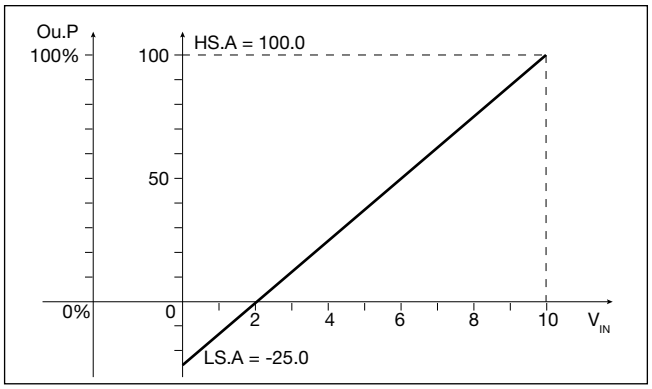
8.1.1. Full input voltage range



Initial data
V_{IN} = 0...10 V
tyP = 1

In this case the input voltage V_{IN} covers the entire range that the device can control. There is therefore no need to modify *LS.A* and *HS.A*, which can be left at their default values.

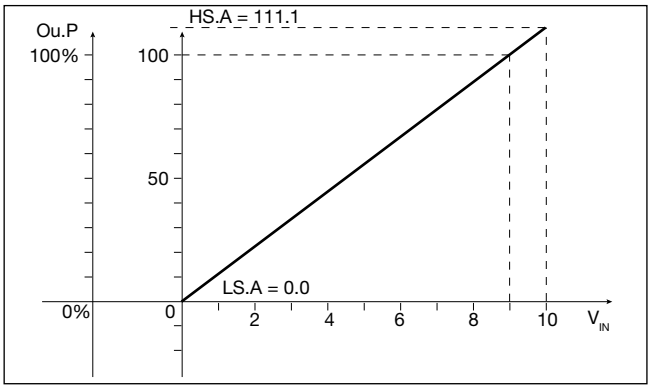
8.1.2. Input voltage range limited downwards



Initial data
V_{IN} = 2...10 V
tyP = 1

In this case, the V_{IN} input voltage only covers the upper 80% of the range that the device can control. This range should therefore be extended downwards so that 80% of the modified range corresponds to the useful range (0...100). 80% of 125 corresponds to 100.
Setting *LS.A* = -25.0 and *HS.A* = 100.0 gives the desired result.

8.1.3. Input voltage range limited upwards



Initial data
V_{IN} = 0...9 V
tyP = 1

In this case the V_{IN} input voltage only covers the lower 90% of the range that the device can control. This range should therefore be extended upwards so that 90% of the modified range corresponds to the useful range (0...100). 90% of 111.1 corresponds to 100.
Setting *LS.A* = 0.0 and *HS.A* = 111.1 gives the desired result.

8.1.4. Formulas for calculating LS.Ax and HS.Ax

Given the following definitions:

min_d = lower limit of the range controllable by the input device
max_d = upper limit of the range controllable by the input device
min_{in} = real lower limit of the input signal
max_{in} = real upper limit of the input signal

we have

$$LS.Ax = 100 \frac{min_d - min_{in}}{max_{in} - min_{in}}$$

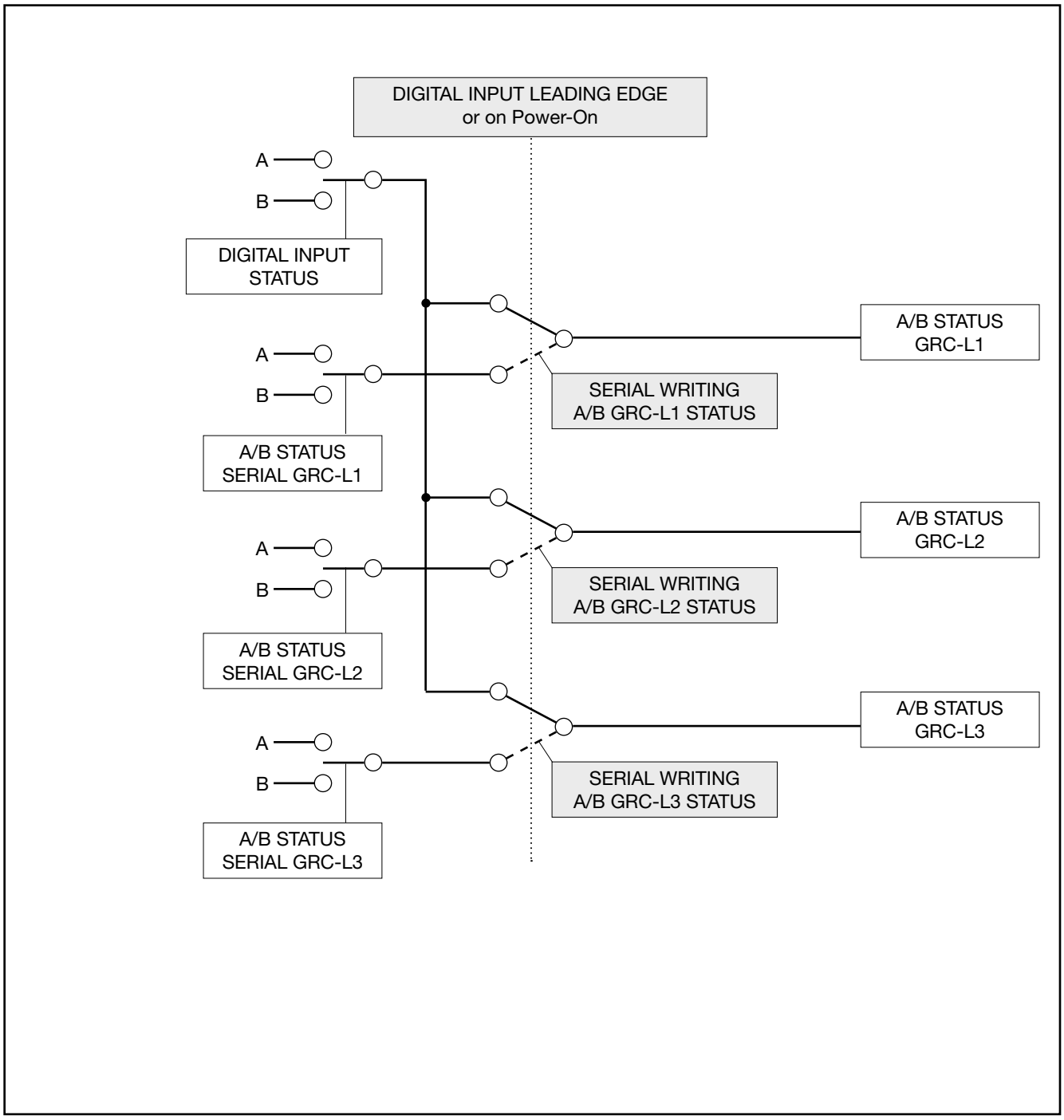
$$HS.Ax = 100 \frac{max_d - min_{in}}{max_{in} - min_{in}}$$

8.2. Using a function associated with the digital input and via serial

At power-on or on the leading edge of digital input 1 or 2 all modules assume the status set by the digital input. This status can be changed, for each individual module, by writing via serial.

For maintenance work on the oven, it may be necessary to check that the heating elements are working properly. In this case the power controller is brought into Manual (MAN) condition, providing (*Man.P*) power test values.

A/B status	Setting	Address for serial writing	
	dIG1 / dIG2 / dIG3 / dIG4	16-bit access	1-bit access
AUTO/MAN controller	1	STATUS_W 305, bit 4	BIT_AUTO_MAN 1
Software ON/OFF	6	STATUS_W 305, bit 4	BIT_SOFT-WARE_ON_OFF 11

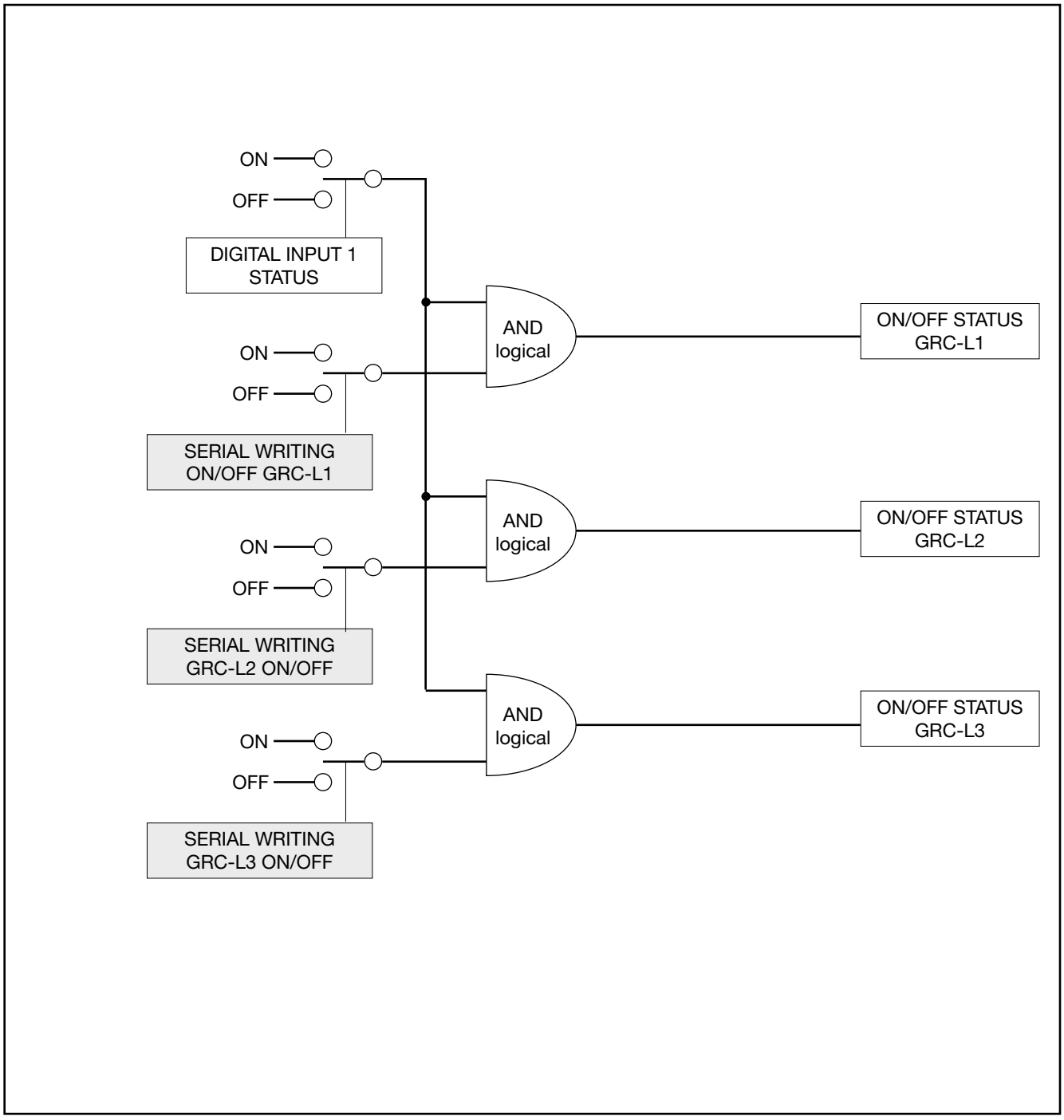


8.3. Using digital input 1 to enable software startup

Software startup (ON) can be configured with the dual enabling condition by digital input and by writing via serial. Enabling by digital input 1 (*dIG.1*) is common to all modules, while enabling by writing via serial is specific to each individual module.

The software startup function (OFF) can be used in fault or emergency conditions by resetting the control of the heating resistors.

	Setting	Address for serial writing	
	dIG.1	16-bit access	1-bit access
Software ON/ OFF	6	STATUS_W 305, bit 3	BIT_SOFT-WARE_ON_ OFF 11

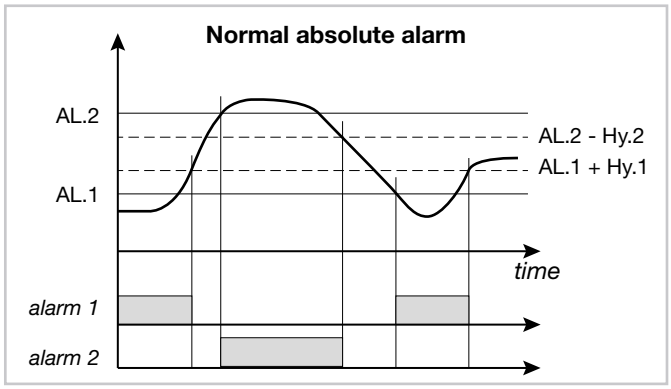


8.4. Alarms

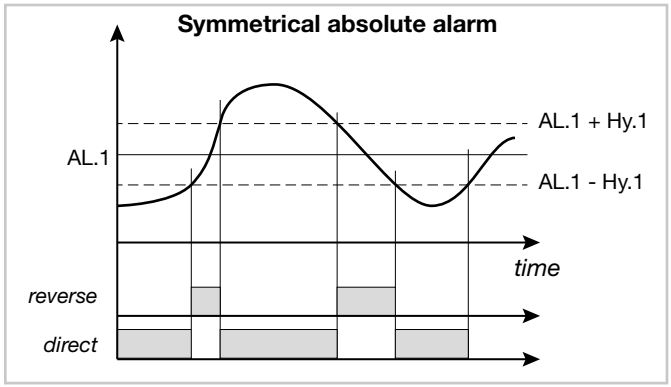
8.4.1. Generic alarms AL1...AL8

Generic alarms *AL1…AL8* can be of 4 main types, shown below:

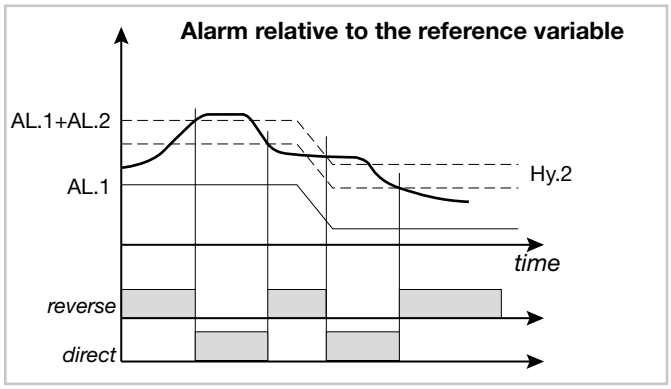
Normal absolute alarm
(*AL*.1 inverse and absolute, *AL.2* direct and absolute).
Two alarm thresholds are set, *AL.1* (lower threshold) and *AL.2* (upper threshold), which correspond to two hysteresis values, *Hy.1* (positive) and *Hy.2* (negative). The alarm is triggered when the measured value remains below *AL.1* or greater than *AL.2* for the set activation delay times.
The alarm condition stops when the measured value is greater than *AL.1* + *Hy.1*, or is less than *AL.2* - *Hy.2*. This avoids repeated alarms caused by slight variations in the measured value.
Any alarm signal at startup, when the equipment is not in normal operation, can be avoided by disabling it when power is turned on.



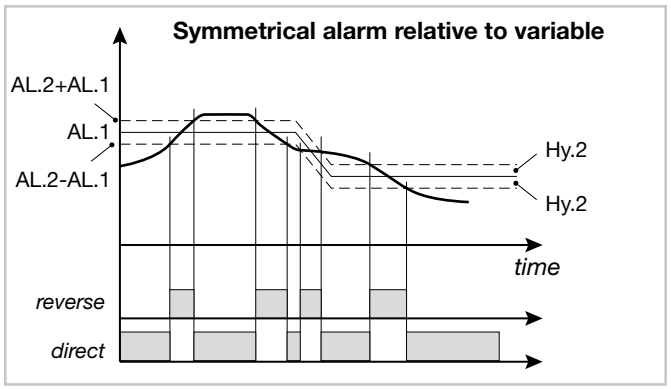
Symmetrical absolute alarm
A single *AL.1* alarm threshold and a single *Hy.1* hysteresis value are set.
With the direct alarm setting, the alarm is triggered when the measured value is less than *AL.1* - *Hy.1* or greater than *AL.1* + *Hy.1* for the set delay activation time.
With the inverse alarm setting, the alarm is triggered when the measured value is greater than *AL.1* - *Hy.1* or less than *AL.1* + *Hy.1* for the set delay activation time.



Normal alarm for the reference variable
A single hysteresis value *Hy.2* (negative), an alarm threshold *AL.2* and the value to which it relates are set. The previous alarm threshold (in this case *AL.1*) is used as the relative value. With the direct alarm setting, the alarm is triggered when the reference value (*A2.r*) is greater than *AL.1* + *AL.2* for the set delay activation time. The alarm condition stops when the measured value is less than *AL.1* + *AL.2* - *Hy.1*.
With the reverse alarm setting, the alarm is triggered when the measured value (*A2.r*) is less than *AL.1* + *AL.2* - *Hy.1*for the set delay activation time. The alarm condition stops when the measured value exceeds *AL.2* + *AL.1*.



Symmetrical alarm relative to the reference variable
A single hysteresis value *Hy.2* (negative), an alarm threshold *AL.2* and the value to which it relates are set. The previous alarm threshold (in this case *AL.1*) is used as the relative value.
With the direct alarm setting, the alarm is triggered when the reference value (*A2.r)* is less than the value *AL.2* -*AL.1*, or is greater than the value *AL.2* + *AL.1*.
With the reverse alarm setting, the alarm is triggered when the measured value is between *AL2* - *AL.2* and *AL.2* + *AL.1*.



8.4.2. HB alarm threshold teach-in function

This function allows teach-in of the alarm threshold. To use this function, it is first necessary to set the *Hb.P* parameter, which defines the percentage of current in relation to the rated load below which the alarm is activated.

The function can be activated by a command from a serial line, a digital input (see paragraph “7.11.3. Digital input function”) or a key (see paragraph “7.33. Key functions”).
When the Teach-in function is activated in ZC, BF and HSC modes, the RMS current value in conduction ON multiplied by the *Hb.P* parameter determines the HB alarm threshold.
When the Teach-in function is activated in PA mode (not in combination with infrared lamps), the RMS current value is shown at 100% power, which, when multiplied by the *Hb.P* parameter, determines the HB alarm threshold. Before activating the function, the module must be switched on with power, which is recommended to be above 50%.

In the case of HSC or PA mode for infrared lamps (see parameter *hd.5* option +128, paragraph “7.24.1. Enabling trigger modes”) the function activates automatic reading of the power/current curve useful for determining the HB alarm threshold.
Automatic reading of the power/current curve takes place in the following sequence:

- softstart at maximum power (default 100%), 5 second delay;
- reduction of power to 50%, 30%, 20%, 15%, 10%, 5%, 3%, 2%, 1%, with a 5-second delay between each value;
- return to normal operation.

Maximum conduction value in this phase can be limited by means of the parameter *PS.Hi*.
If required, it MUST only be activated with *hd.6* = 0 (the desired *hd.6* value can only be set after calibration).
In HSC mode, the HB alarm threshold teach-in function does NOT calibrate at 5%, 3%, 2%, 1% to avoid high peak currents due to low impedance for the low temperature of the IR lamp filament.

8.4.3. Heuristic power control

Note: The function is only available when using GRC model 3PH, with separate control of three individual single-phase loads.

This type of control is used to limit the delivery of total power to the loads in order to avoid input peaks from the single-phase power line.
An example of this type of input occurs during the start phases when the machine is cold; the demand for heating power is almost 100% until temperature values near the threshold are reached.

It is useful to avoid simultaneous conduction even when there is ON-OFF modulation for temperature maintenance.

The cycle time must be unique or identical for all modules; the power percentage of each module is limited to that necessary to maintain current within set limits.

This function acts by enabling the control to search for the most appropriate input combinations.

EXAMPLE
We have three single-phase loads supplied with 380 V:

- GRC-L1 = 32 A,
- GRC-L2 = 16 A,
- GRC-L3 = 25 A.

The maximum current, in the case of simultaneous conduction, is 73 A.
The current limit value set with *I.HEU* is 50 A.

Bearing in mind that combinations without repetitions are equal to

$$\frac{n!}{k!\,(n-k)!}$$

it is seen that the possible combinations of conduction can be:

- I1 + I2 = 48 A
- I1 + I3 = 57 A
- I2 + I3 = 41 A
- I1 + I2 + I3 = 73 A

The combinations corresponding to current values below the current limit value *I.HEU* are therefore:

- I1 + I2 = 48 A
- I2 + I3 = 41 A

Of these, the one with the lowest current is the sum of GRC-L2 and GRC-L3.

In the single cycle for the enabled modules, the delivery of power may be reduced to comply with the maximum current limit.
The time distribution of module activation is calculated at the start of each cycle:

$$Ou.P_{tot} = Ou.P\_1 + (Ou.P\_2^{*} \text{ or } Ou.P\_3^{**})$$

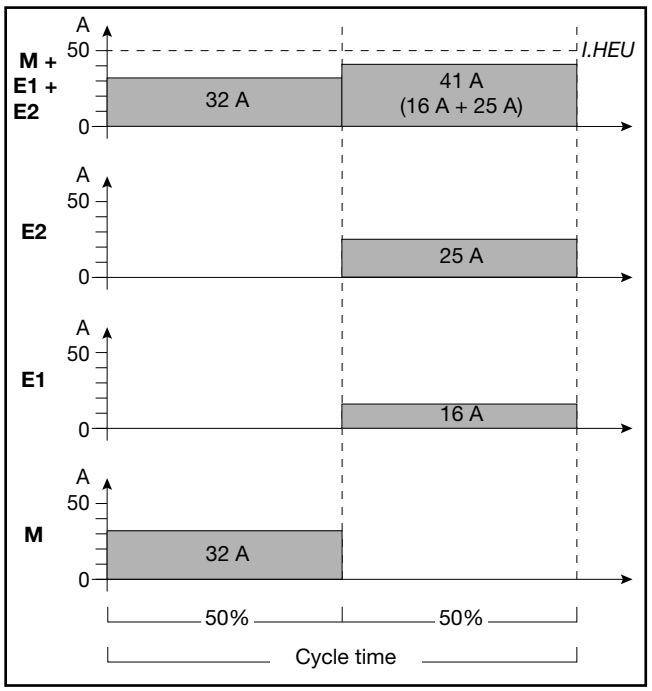
(*) if $Ou.P\_2 > Ou.P\_3$ (**) if $Ou.P\_3 > Ou.P\_2$

For GRC-L2 and GRC-L3, simultaneous operation is permissible because their sum is less than the set current limit.
The percentage of conduction time of the x-module during the cycle is calculated as

$$\%\ \text{conduction time module-x} = \frac{Px}{P_{tot}}\ 100\%$$

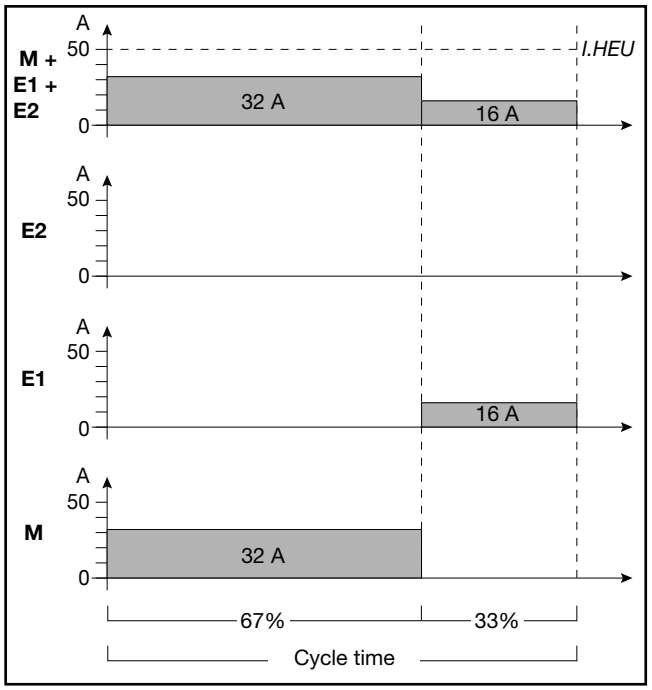
Case 1
If *Ou.P_1* = 100%, *Ou.P_2* = 100% and *Ou.P_3* = 100% we have $Ou.P_{tot}$ = 200%.
As $Ou.P_{tot}$ > 100% we therefore have:

- % time *Ou.P_1* = 0.50 ×100% = 50%.
- % time *Ou.P_2* = 0.50 ×100% = 50%.
- % time *Ou.P_3* = 0.50 ×100% = 50%.



Case 2
If *Ou.P_1* = 100%, *Ou.P_2* = 50% and *Ou.P_3* = 0% we get $Ou.P_{tot}$ = 150%.
As *Ou.Ptot* > 100% rounding up, we there have:

- % time *Ou.P_1* = 0.66 ×100% = 67%.
- % time *Ou.P_2* = 0.66 × 50% = 33%.
- % time *Ou.P_3* = 0.66 × 0% = 0%.



9. DISPLAY

9.1. Integrated display

The GRC can integrate in display to monitor the main variables during operation.

The presence of the display is optional, associated with option “D” in the ordering code.

The display allows page navigation via 4 control buttons:

- “Mini Image of back button” **Back button**: return to previous menu

- “Mini Image of circle key” **Selection button**: allows different actions depending on the page being displayed
- “Mini Image of left key” **Left button**: scrolls to the previous page

- “Mini Image of the right button” **Right button**: scrolls to the next page

Two menus are present:

-Menu Main

-Menu Alarms

9.1.1. Main Menu

The Main menu consists of several pages, visible depending on the hardware configuration in use (1PH, 2PH, 3PH) and the selected wiring/use configuration (3PH with 3-phase load, 3PH with 3 independent loads, etc.).

Example of Main menu page;

On all pages of the Main Menu, a status bar is displayed at the top with the following indications:

- AL : lit when alarms are present
- P/Pt ###.#% : percentage power set on the single phase/three-phase load
- ###.#% : percentage power actually delivered to the load.
- The parameters displayed for each page are listed below:

Note: x:1,2,3 depending on the number of phases present

Page1 Three-phase Load :

Vt :three-phase voltage on the load [V].

It: three-phase current on the load [I]

Pt: three-phase power output [kW]

Page 2,3,4 Single phase load:

Vx: voltage across the load [V] phase x

Ix: current on the load [I] phase x

Px: power output [kW] phase x

Page 5 Load Voltage

V1 : Voltage on load [V] phase 1

V2 : Voltage on load [V] phase 2

V3 : Voltage on load [V] phase 3

Page 6 Load Current

I1 : Current on the load [A] phase 1

I2 : Current on the load [A] phase 2

I3 : Current on load [A] phase 3

Page 7 Load Power

P1 : Power on the load [kW] phase 1

P2 : Power on the load [kW] phase 2

P3 : Power on load [kW] phase 3

Page 8 Line Voltage In

L1 : Line voltage [V] phase 1

L2 : Line voltage [V] phase 2

L3 : Line voltage [V] phase 3

Page 9 Network Setting

IP Address: network IP address, referred to the physical ports ETH0/ETH1

Page 10 Network Setting

MAC Address: MAC address, referenced of the ETH0/ETH1 physical ports

9.1.2. Alarm Menu

The Alarm menu allows you to view active alarms.

In case alarms occur, the display is automatically taken to the Alarm Menu.

Press the back button **“Simbolo XXX”** to return to the Main menu.

To access the Alarm Menu, locate yourself on a page of the Main menu that has the AL indication in the top line (if and only if alarms are present it will be active).

The Alarm menu may consist of one or more pages depending on the number of alarms present; each page describes up to 3 alarms.

The top of the Alarm menu pages shows the total number of pages and the page number being displayed. Use the keys Right **“Simbolo XXX”** and Left **“Simbolo XXX”** to navigate through the pages

9.2. Web Server

The GRC integrates a Web Server that is useful for monitoring the main variables during operation.

The Web Server can be accessed from any browser. To access it, the client device (PC or smartphone) must be able to reach the GRC via an Ethernet network (IP connectivity active on the wired network).

Use only PORT1 physical access ETH0/ETH1.

The default IP address is: 10.80.1.200

Subnet: 255.255.255.0

Gateway: 0.0.0.0

Access to the Web Server is protected by login:

User: admin

Password: gefran.spa1

The side menu allows you to navigate all the thematic pages:

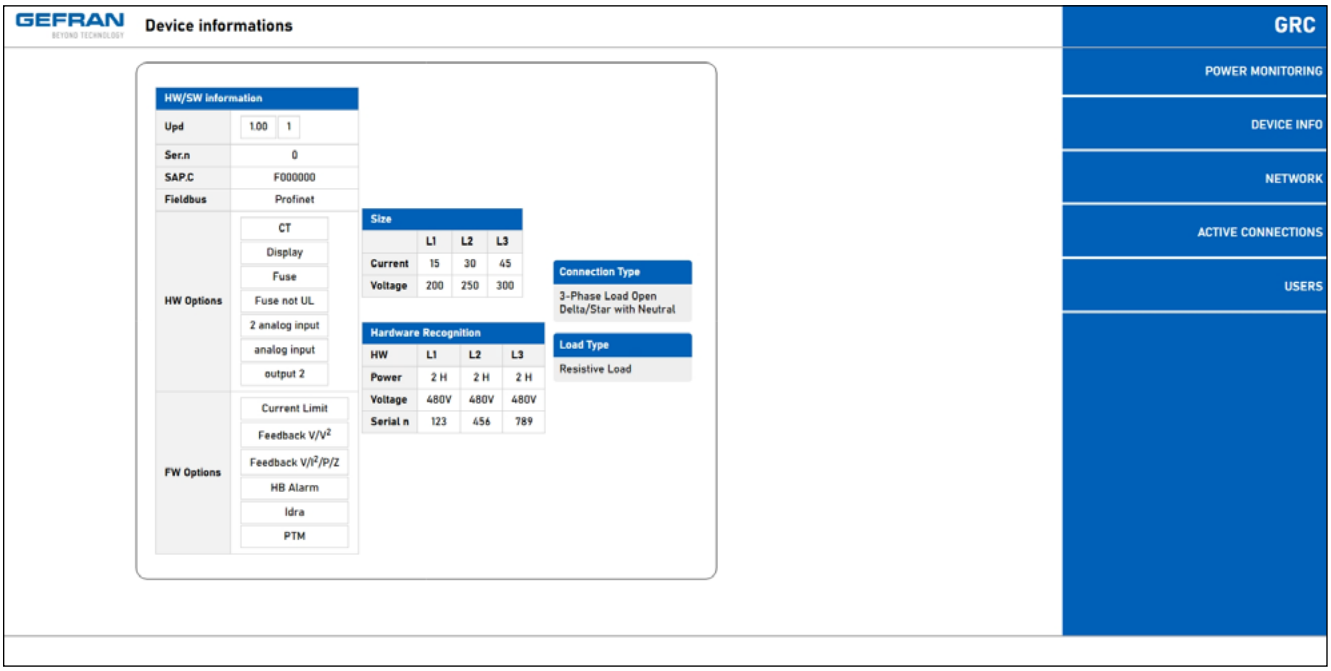
- Power Monitoring:

Allows you to view the main data on the electrical variables of the load and the line, and the status of the alarms.

The view highlights the data for the 3 individual phases (when present) and the three-phase load (if configured as 3PH).

-Device info

Allows you to view technical specifications, options on board the device, type of power modules recognized by the CPU, type of connection, and load settings.



-Network configuration

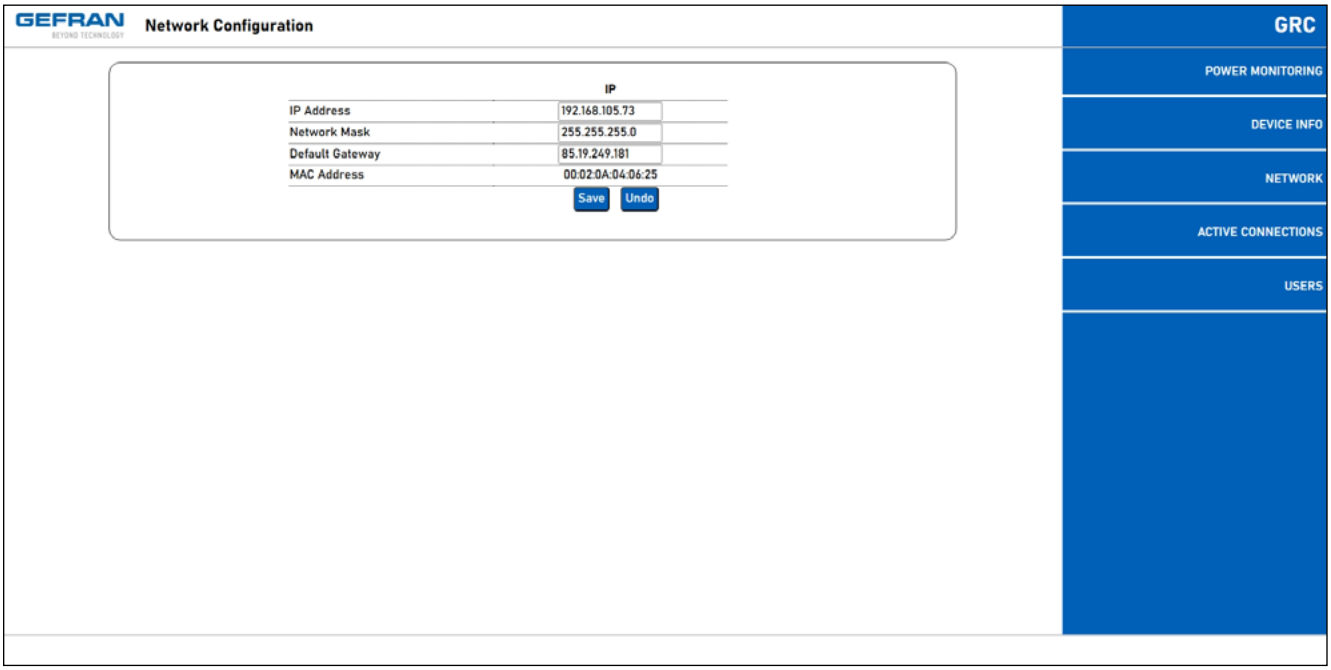
Allows you to view and modify the device's network parameters. Changes are implemented after saving.

NOTES:

-Changing the IP address will result in the loss of communication via the web server. Enter the new IP address in the browser.

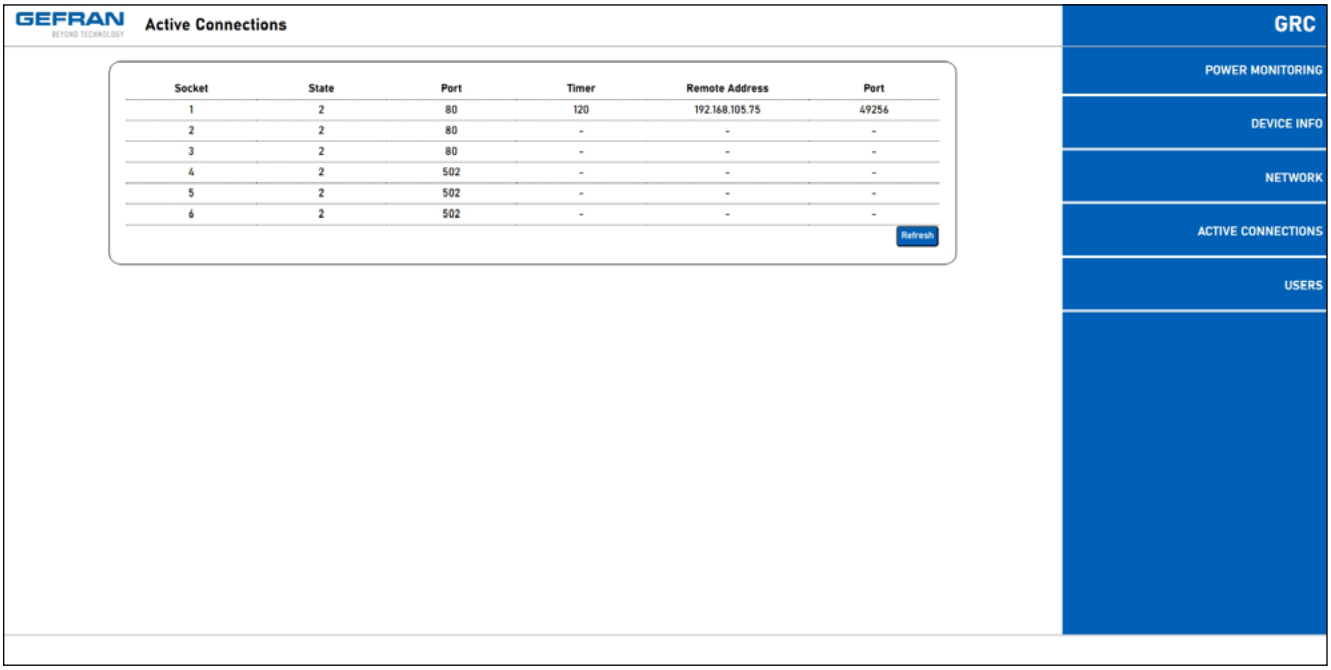
-If writing does not make the device accessible with the set network parameters, use GF_eXpress and the integrated SetIP-Tool tool to reconfigure the network addresses

.



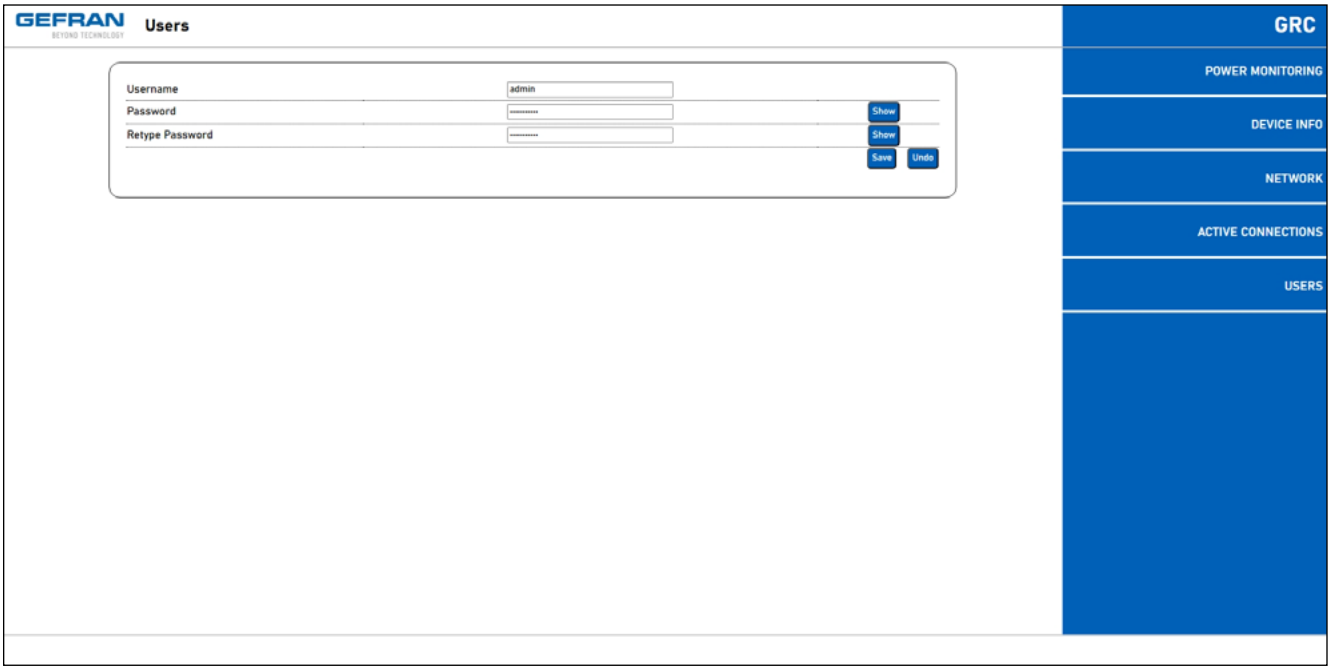
-Active Connections

This page allows you to view all connections currently active on the device connected to PORT1



-Users

The Users page allows you to display your username and password in plain text.



10. TECHNICAL SPECIFICATIONS

INPUT	
AIN1, AIN2 – Control analog input (optional)	
Function	Proportional power control signal reference
Accuracy	1% f.s. ± 1 digit at ambient temperature of 25°C/ 77°F
Thermal drift	< 100 ppm/°C of f.s.
Sampling time	10 ms
Range 0-10V	Input impedance > 500 KΩ
Range 0-5V	Input impedance > 500 KΩ
range 0-20mA or 4-20mA	Externa Shunt resistance: 250 Ω
Potentiometer input	Potentiometer resistance: da 1 KΩ a 47 KΩ Potentiometer power supply: +5V (from GRC, max 10mA)
Input range	0 …. 100.0 %
DIN1, DIN2 – Digital Input (CPU insulation)	
Function	Configurable
Type	Digital Input TYPE 1/3 CEI EN 61131-2
Max voltage	32Vdc
Corrente Tipica a 24V	5mA
Voltage value with “0” condition	< 10,5 V
Voltage value with “1” condition	>12 V
Line voltage value	
Function	Line voltage measure
Voltage reading range (f.s.)	40...530Vac with 480 Vac working voltage model 40...660Vac with 600 Vac working voltage model
Voltage RMS reading value accuracy	+/-0.2% f.s. at ambient temperature of 25°C / 77°F Therma drift: < 200 ppm/°C
Line frequency	50 / 60 Hz
Load current value	
Function	Load current reading True RMS
Current reading range (f.s.)	0 ... 1,1 * model nominal current value
Current RMS reading value accuracy	+/-0.5% f.s. at ambient temperature of 25°C / 77°F Thermal drift: < 200 ppm/°C **Firing FCT-BF/HSC** In the case of power delivery with wave/half-wave On/Off packet modulation, accuracy refers to the current reading during the ON phase, available in the Ion variables. The rms value published in variable I is then recalculated based on the % power delivered Ou.P. **Firing PA** In the case of power delivery with phase angle modulation, accuracy refers to the RMS current value, provided in the I variable. Accuracy is guaranteed with RMS current delivered >=2% of f.s.

OUTPUT	
DO1 Digital output	
Function	Configurable alarm output (default): Partial load break, line fault, thermal alarm.
Type	Output Type Digital output normally off (configurable as normally active). PNP type, output voltage: 0 V…(18 to 32 Vdc) depending on the product's power supply value , Iout max = 20 mA (not protected against short circuit)
C-NO Dry contact (output) (optional)	
Function	Configurable alarm output (default): Partial load break, line fault, thermal alarm..
Type	Voltage free contact (solid state N.O.) max characteristics: 30Vdc/ac max 100mA conduction resistance: ≤ 16 Ω
AO + Analog output (optional)	
Function	Configurable
Type	0…10 V, max 20 mA 2…10 V, max 20 mA 0…20 mA, max resistance 500 Ω 4…20 mA, max resistance 500 Ω
Resolution	12 bit

COMMUNICATION PORT		
PORT 1 (default)		
Function	Ethernet Modbus TCP	
Port	Connection number	2
	Connector type	RJ45
	Type	Ethernet
	Baudrate	10/100 Mbit/s
PORT 2 (option)		
Function	Fieldbus communication	
Type of fieldbus	Profinet	
	Ethercat	
	Modbus RTU	
Profinet option	Connection number	2
	Connector type	RJ45
	Type	Ethernet
Ethercat option	Connection number	2
	Connector type	RJ45
	Type	Ethernet
	Baudrate	100 Mbit/s
Modbus RTU	Connection number	2
	Connector type	PUSH-IN
	Type	RS-485
	Baudrate	1200...115 000 kbit/s
	Line termination	DIP switch (product bottom side accessibility)
	Rotary	2

POWER MODULE									
Category of use (Tab. 2 EN60947-4-3)	AC 51: resistive or low-inductance loads AC 55b: infrared lamps AC56a transformers, resistive loads with high temperature coefficient								
Trigger modes	**FCT- Fixed Cycle Time** - Zero Crossing with constant cycle time (settable in the range 1...200 sec). **BF - Burst Firing** - Optimized minimum variable cycle time (Zero crossing firing). **HSC – Half Single Cycle** - Corresponds to a Burst Firing which handles half on/off cycles (Zero crossing firing). **PA – Phase Angle** - Load management by adjusting the power-on phase angle. It is useful for reducing flickers with short-wave infrared loads								
Feedback and Limits (optional) (Re-calibrating is required each time the Feedback Mode is changed.)	**V, V2**: Voltage feedback, proportional to the true RMS value of the voltage on the load to compensate for possible variations in line voltage. **I, I2**: Current feedback, proportional to the true RMS value of the current in the load to compensate for possible line voltage variations and/or load impedance variations. **P**: Power feedback, proportional to the actual power value on the load to compensate for line voltage variations and/or load impedance variation								
Nominal voltage	480 Vac / 600 Vac base of selected model								
Working voltage range	Model 480 Vac: 40…530 Vac Model 600 Vac: 40…660 Vac								
Non-repetitive voltage (Surge protection level)	Model 480 Vac: 1200 Vp Model 600 Vac: 1600 Vp								
Nominal frequency	50/60Hz with auto-determination								
Nominal current @ 40 °C	Model GRC								
	25	25I	40	40I	60	75	90	120	150
	25A	25A	40A	40A	60A	75A	90A	120A	150A
Non-repetitive current (t=20msec)	620A	1600A	620A	1600A	1600A	1600A	1500A	1500A	2150A
I2t for fuse melting (t=1…10msec) A2s	1800	12800	1800	12800	12800	12800	11250	11250	32000
Critical dv/dt with power output disable	1000 V/µs								
Rated impulse withstand voltage	4kV								
Rated current in short circuit condition	5kA								
Voltage drops over rated current	= < 1,2Vrms								
Dissipated power	Thermal power dissipation is related to load current: Pdissipation = 1,3 W × I_load For models with built-in fuse also consider the power dissipation of the fuse at rated current								
Nominal current AC 56A	Trigger mode allowed	ZC, BF con DT (Delay Triggering), PA with soft start							
	Derating	20% of current nominal value							

OPTION	
Display	- Process variable visualization
Integrate fuses	- Embedded extra rapid fuses, replacement with access under the front cover - Size 1 (25 to 40A) : cylindrical 14 x 51 mm - Size 2 (60 to 150A) : Size 000 DIN80

FEATURES		
Type of load connection and load control	GRC-1PH model	Nr. 1 Mono phase load
	GRC 2PH model	Nr. 2 Mono phase loads Only with ZC and BF trigger mode: Nr. 1 Three phase load, connection closed delta and two legs control Nr. 1 Three phase load, connection star without neutral and two legs control
	GRC 3PH model	Nr. 3 Mono phase loads Nr. 3 Mono phase independent loads open delta connection Nr. 1 Three phase load open delta Nr. 1 Three phase load closed delta Nr. 1 Three phase load star without neutral Nr. 1 Three phase load star with neutral
Control	General	• Power-on soft start time ramp, with or without current peak control • Power-on soft start ramp for Infrared lamps. • Power-off ramp time. • RMC load current limitation • Delay-Triggering 0-90° for inductive load power on with ZC and BF trigger mode control • Calibration by automatic procedure of the HB alarm threshold from the current value in the load.
Diagnostics	Alarms	• SCR short circuit alarm (current presence with control command OFF). • No current due to SCR open / Load break alarm • High temperature alarm. • Total or partial heater break alarm. • Short circuit or overcurrent alarm • No line voltage alarm • Three phase line unbalanced alarm • Three phase load configuration - phase rotation alarm
Energy	Counter	Load energy supplied totalization
	Visualization	Embedded display (option) or remote via fieldbus communication
	Counter reset feature	yes

GENERAL CHARACTERISTICS	
Power supply	24 Vdc ± 10% Power consumption: Min. 15W Max 25 W (Fan active and Fieldbus option present)
LED indication	STATUS (RGB): Multifunction ER (red): System error SCR-ON (Yellow): Power active DI-1 (Green): Digital Input 1 status DI-2 (Green): Digital input 2 status DO (Green): Digital output status
Protection rating	IP20
Working temperature	0…60°C (32 ... 140°F) (see derating curves)
Storage temperature	-20°C - +85°C (-4 ... 185°F) average temperature in a period of 24H not higher than 35°C (95°F) (according to EN 60947-4-3 § 7.1.1)
Maximum relative humidity	90% non-condensing
Environmental conditions of use	Indoor use, maximum altitude 2000m. For higher altitudes consider: -Decreasing 1% of rated current for every 100m (328ft) above elevation 2000m (6562ft). -Decreasing of maximum voltage by correction factor: 0.88 from 2000 (6562ft) to 3000m (9842ft) 0.77 from 3001 (9846ft) to 4000m (13123ft) 0.68 from 4001 (13127ft) to 5000m (16404ft) Example for GRC-..25-60.. at 2800 mslm (9186ft) - 25A nominal derated by 1%*8-->23A - 600Vac nominal, maximum voltage 660Vac derated to 660*0.88=580.8Vac
Installation	Panel mount by screw
Installation requirements	Installation category II, pollution degree 2 Maximum air temperature around the device 40°C / 104°F (for Temperature > 40°C / 104°F see derating curves)

11. CERTIFICATIONS

11.1. certifications

CE	This device conforms to European Union Directive 2014/30/EU and 2014/35/EU as amended with reference to generic standards: EN 61000-6-2 (iammunity in industrial environment) EN 61000-6-4 (emission in industrial environment) - EN 61010-1 (safety regulations).
UL	Conformity C/UL/US file no. **E243386 vol. 1 sez. 12**

12. ACCESSORIES

12.1. Accessories

Accessories	
F103980	KIT FAN GRC 75-150A (60x60x25)
353177	Connector VLINE (2 pin)
353167	Connector J1 (7 pin)
353898	Connector J2 (4 pin)
353144	Connector J3 (6 pin)
353139	Connector J5 (5 pin)

12.2. Fuses

GRC Type	Order Code	Manufacturer Code	Description	Rating current	Rating Voltage	I2t	Power dissipation @In
25, 25I	338416	FWP-40A14F	FUSE 40A 14X51mm aR 690Vac -UL-	40A	690Vac	750 A2s	8W
40, 40I	338417	FWP-50A14F	FUSE 50A 14X51mm aR 690Vac -UL-	50A	690Vac	1800 A2s	9W
60, 75, 90	338934	DN000UB69V125	FUSE 125A/690V 8900 A2s (FUS-125S)	125A	690Vac	8900 A2s	26W
120, 150	338930	DN000UB69V200	FUSE 200A/690V 31500 A2s (FUS-200S)	200A	690Vac	31500 A2s	36W

An external branch circuit protection shall be installed.

12.3. MCB protection

Protection co-ordination (Type 2) with Siemens Miniature Circuit Breaker (MCB / Thermal-Magnetic) 5SY4 series, curve A, 1P/2P/3P						
Current size model (I^2t)	**1P MCB model (MCB Nominal current in A) at 230Vac ***	**Wire cross sectional area (mm^2)**	**Minimum length ***of copper wire conductor (m)**	**2P/3P MCB model (MCB Nominal current in A) at 400Vac ****	**Wire cross sectional area (mm^2)**	**Minimum length*** of copper wire conductor (m)**
GRC-... -25, 40 (1800 A2s)	5SY4110-5 (10)	1,0	6,0	5SY4210-5 (10) 5SY4310-5 (10)	1,0	6,0
		1,5	9,0		1,5	10,0
		2,5	14,0		2,5	14,0
	5SY4116-5 (16)	1,0	6,0	5SY4216-5 (16) 5SY4316-5 (16)	1,0	6,0
		1,5	9,0		1,5	10,0
		2,5	14,0		2,5	14,0
		4,0	15,0		4,0	25,0
	5SY4120-5 (20)	1,5	9,0	5SY4220-5 (20) 5SY4320-5 (20)	1,5	10,0
		2,5	15,0		2,5	21,0
		4,0	30,0		4,0	30,0
	5SY4125-5 (25)	2,5	18,0	5SY4225-5 (25) 5SY4325-5 (25)	2,5	18,0
		4,0	30,0		4,0	30,0
	5SY4132-5 (32)	2,5	21,0	5SY4232-5 (32) 5SY4332-5 (32)	2,5	36,0
		4,0	35,0		-	-
GRC-... -25l, 40l, 60, 75 (12800 A2s)	For MCBs smaller than those indicated in the lines below, there are no section and length constraints					
	5SY4132-5 (32)	2,5	2,0	5SY4232-5 (32) 5SY4332-5 (32)	2,5	2,0
		4,0	4,0		4,0	4,0
		6,0	7,0		6,0	7,0
	5SY4140-5 (40)	4,0	4,0	5SY4240-5 (40) 5SY4340-5 (40)	4,0	4,0
		6,0	7,0		6,0	7,0
		10,0	10,0		10,0	10,0
	5SY4150-5 (50)	6,0	7,0	5SY4250-5 (50) 5SY43250-5 (50)	6,0	7,0
		10,0	10,0		10,0	10,0
		16,0	18,0		16,0	18,0
	5SY4163-5 (63)	6,0	7,0	5SY4263-5 (63) 5SY4363-5 (63)	6,0	7,0
		10,0	10,0		10,0	10,0
		16,0	18,0		16,0	18,0
GRC-... -90,120 (11250 A2s)	For MCBs smaller than those indicated in the lines below, there are no section and length constraints					
	5SY4132-5 (32)	2,5	2,0	5SY4232-5 (32) 5SY4332-5 (32)	2,5	2,0
		4,0	4,0		4,0	4,0
		6,0	7,0		6,0	7,0
	5SY4140-5 (40)	4,0	4,0	5SY4240-5 (40) 5SY4340-5 (40)	4,0	4,0
		6,0	7,0		6,0	7,0
		10,0	10,0		10,0	10,0
	5SY4150-5 (50)	6,0	7,0	5SY4250-5 (50) 5SY4350-5 (50)	6,0	7,0
		10,0	10,0		10,0	10,0
		16,0	18,0		16,0	18,0
	5SY4163-5 (63)	6,0	7,0	5SY4263-5 (63) 5SY4263-5 (63)	6,0	7,0
		10,0	10,0		10,0	10,0
		16,0	18,0		16,0	18,0

* The sizing is valid for a 230Vac phase-neutral line with an assumed short-circuit current of 2,5KA
** The sizing is valid for a 400Vac phase-to-phase line with an assumed short-circuit current of 5KA
*** Between MCB and Load plus return path which goes back to the lines/neutral

The use of MCBs with a **nominal size smaller** than the smallest ones associated with a specific GRC in the table, is allowed without restrictions on the length and section of the cables.
For example, a 25I size GRC can be coupled to a 5SY4116-5 (16) MCB with any cable length or section.

Example, for a GRC-3PH-40I.., with line voltage of 400Vac, controlled load of 30 A nominal, with a section of 4 mm2 of cable, an MCB 5SY4332-5 (32) the minimum length of the cables is 7m (cable length is intended between MCB and load, including return).

GEFRAN

GEFRAN spa
via Sebina, 74
25050 Provaglio d'Iseo (BS) Italy
Tel. +39 0309888.1
Fax +39 0309839063
info@gefran.com
http://www.gefran.com