RGC2P..N, RGC3P..N



3-phase solid state contactors with a communication interface

Communication interface for control of solid state switching device and real-time monitoring



Benefits

- **Labour time savings and reduced inventory.** An all-in-one solution that eliminates the need of additional components, their respective wiring and stock management.
- **Reduced maintenance costs and downtime.** Use of real-time data for prevention of machine stoppages during operation and fast troubleshooting.
- **Better quality end-product.** Analysing data collected from the NRG solid-state relays, system parameters can be optimised to enhance overall performance and output quality. Reduced efforts in troubleshooting.
- **Facilitates energy management.** The wide range of data from the NRG can be analysed for optimised machine efficiency.
- **Precise temperature control.** A variety of switching modes and advanced switching features are available to suit different application needs.
- **Fast installation and set-up.** The solid state relays on the BUS are automatically configured

Description

The new **RGC2/3P..N** series extends the NRG platform to cater for 3-phase loads. This new series consist of 3-phase solid state switching devices that integrate monitoring and a communication interface through which data such as voltage, current, power, energy consumption, SSR and load running hours, is accessible in real-time. Diagnostic information is easily available to facilitate troubleshooting and to improve maintenance plans.

The series includes 3-phase, 2-pole solid state switching devices, **RGC2P..N**, with ratings up to 75 AAC in a compact platform having a maximum product width of 72 mm. The **RGC3P..N**, consists of 3-phase, 3-pole solid state switching devices, with ratings up to 65 AAC. The **RGC2/3P..N** series is available only with a pre-assembled heatsink. Output protection against overvoltage is integrated across the output of the solid state devices.

The **RGC2/3P..N** cannot interface directly with the system controller (PLC) and must be configured in an NRG BUS chain. Each chain supports a mix of 1, 2, or 3-pole solid state switching devices, with a maximum of 32 switched poles. The first relay in the chain connects to the NRG controller (NRGC..) variant depending on the communication protocol, and the last must be terminated with a BUS terminator provided with the controller.

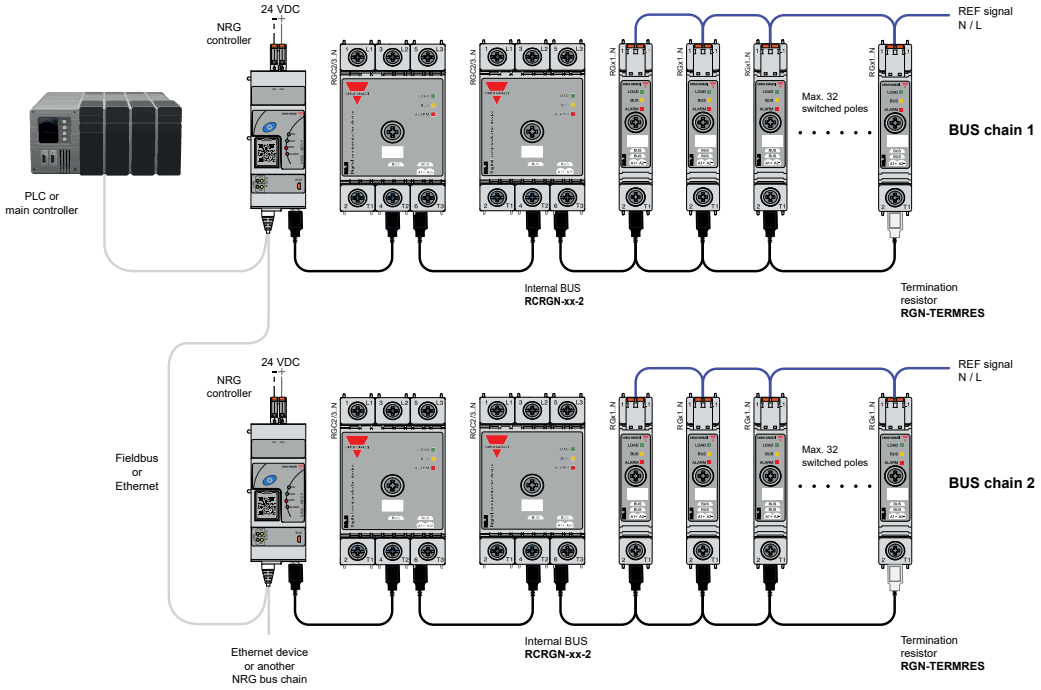
Applications

Any heating application where reliable and precise maintenance of temperatures is crucial to the quality of the end product. Typical applications include plastic machinery such as injection machines, extrusion machines and PET blow moulding machines, packaging machinery, sterilisation machinery, drying tunnels and semiconductor manufacturing equipment.

Main function

- 2-pole and 3-pole AC solid state contactors rated up to 660 VAC, 75 AAC (RGC2) and 65 AAC (RGC3)
- Configurable switching modes: ON/OFF or Power control (Phase angle, Distributed full cycle, Burst, Advanced full cycle)
- Real-time measurements (voltage, current, power, energy, running hours) and diagnostics
- Advanced features: Soft start, Feedback loops (Voltage compensation, True power compensation)

The NRG system



System Overview

The NRG is a system consisting of one or more BUS chains that enable communication between the field devices (such as the solid state relays) and the control devices (such as the machine controller or PLC).

Each NRG BUS chain consists of the following 3 components:

1. the NRG controller (NRGC..)
2. the NRG solid state relay(s) (RG..N)
3. the NRG internal BUS cables (RCRGN-XXX-2)

The NRG controller is the interface to the machine controller and determines the communication protocol used. It is not possible to operate the NRG system without the NRG controller.

The NRG controllers available are:

- **NRGC** - NRG controller with a Modbus RTU interface over RS485.
- **NRGC-PN** - NRG controller with a PROFINET communication interface. The NRGC-PN is identified by a unique MAC address which is printed on the facade of the product. The GSD file can be downloaded from www.gavazziautomation.com
- **NRGC-EIP** - NRG controller with an EtherNet/IP communication interface. The IP address is provided automatically via a BOOTP server. The EDS file can be downloaded from www.gavazziautomation.com
- **NRGC-ECAT** - NRG controller with an EtherCAT communication interface. The ESI file can be downloaded from www.gavazziautomation.com
- **NRGC-MBTCP** - NRG controller with a Modbus TCP communication interface.

The NRG solid state relay is the switching and monitoring component in the NRG system. Each RG..N integrates a communication interface to exchange data with the machine controller (or PLC). The available RG..Ns that can be used in an NRG system are:

- **RG..D..N**

  The RG..D..N are solid state relays for use in an NRG system having the communication interface only for real time monitoring. Control of the RG..N is done via a DC control voltage. It is possible to have max. 48 x RG..D..Ns in one NRG BUS chain.

System Overview (continued)

- **RG..CM..N**

  The RG..CM..N are solid state relays for use in an NRG system having a communication interface for control of the RG..N through the BUS and for real-time monitoring. Different variants of the RG..CM..N can be mixed on the buschain with a maximum limit of 32 switched poles. The variants of the RG..CM..N are:

  - RGx1A..CM..N – 1-pole solid state relay with zero cross switching.
  - RGx1P..CM..N – 1-pole solid state relay with proportional switching.
  - RGC2P..CM..N – 2-pole solid state contactors with proportional switching.
  - RGC3P..CM..N – 3-pole solid state contactor with proportional switching.

For a review of the features and compatibilities across all variants refer to the table below:

Feature		RGx1A..D..N	RGx1A..CM..N	RGx1P..CM..N	RGC2P..N	RGC3P..N
COMMUNICATION PROTOCOLS	Modbus RTU	●	●	●	●	●
	Modbus TCP	-	●	●	●	●
	PROFINET	-	●	●	●	●
	EtherNet/IP	-	●	●	●	●
	EtherCAT	-	●	●	●	●
Max. number of switched poles on BUS		48	32	32	32	32
External control		●	●	-	●	●
Control over BUS		-	●	●	●	●
SWITCHING MODES	ON / OFF	●	●	●	●	●
	Burst	●	●	●	●	●
	Distributed full cycle	●	●	●	●	●
	Advanced full cycle	●	●	●	●	●
	Phase angle	-	-	●	-	●
	Soft start with time*	-	-	●	-	●
	Soft start with current limit *	-	-	●	-	●
	Voltage compensation	-	-	●	●	●
	True power compensation *	-	-	-	●	●
Monitoring of system parameters		●	●	●	●	●
SSR diagnostics		●	●	●	●	●
Load diagnostics		●	●	●	●	●
Over-temperature protection		●	●	●	●	●

* feature currently unavailable for RGC2/3P..N. To be released soon..

Notes:

- **RG..D..N** and **RG..CM..N** devices cannot be mixed in the same bus chain.
- The **NRG internal BUS cables** are proprietary cables to daisychain the RG..Ns on the NRG bus chain and to connect the NRG controller to the first RG..N.
- The **internal BUS terminator** is provided in the same package with the NRG controller and shall be plugged into the last RG..N in the NRG bus chain.

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References

Order code

RGC ☐ P60CM ☐ ☐ EN

Enter the code entering the corresponding option instead of ☐

Code	Option	Description	Notes
RG	-	Solid State Relay (RG)	
C	-	Version with integrated heatsink	
☐	2	Number of poles	
	3		
P	-	Switching mode: Proportional	
60	-	Rated voltage: 73-660 VAC, 1200 Vp	
CM	-	Control through the communication interface	
☐	20	Rated current - 20 AAC	3-P variant
	25	Rated current - 25 AAC	2-P variant
	30	Rated current - 30 AAC	3-P variant
	40	Rated current - 40 AAC	2-P variant
	65	Rated current - 65 AAC	3-P variant
	75	Rated current - 75 AAC	2-P variant
☐	K	Screw connection for power terminals	
	G	Box clamp connection for power terminals	
E	-	Contactor configuration	
N	-	For integration in an NRG system	

Selection guide - 2-pole switching, 1-pole direct (RGC2)

Rated voltage	Connection power	Rated operational current @ 40°C		
		25 AAC (1800 A²s)	40 AAC (6600 A²s)	75 AAC (15000 A²s)
		Product width		
		54 mm	70 mm	70 mm + fan
600 VAC	Screw	RGC2P60CM25KEN	-	-
	Box clamp	-	RGC2P60CM40GEN	RGC2P60CM75GEN

Selection guide - 3-pole switching (RGC3)

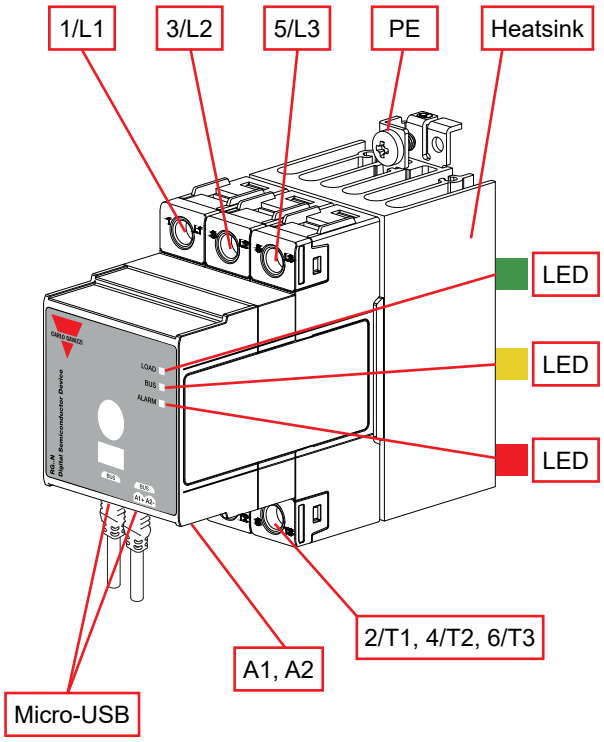
Rated voltage	Connection power	Rated operational current @ 40°C		
		20 AAC (1800 A²s)	30 AAC (6600 A²s)	65 AAC (15000 A²s)
		Product width		
		54 mm	70 mm	70 mm + fan
600 VAC	Screw	RGC3P60CM20KEN	-	-
	Box clamp	-	RGC3P60CM30GEN	RGC3P60CM65GEN

Carlo Gavazzi compatible components

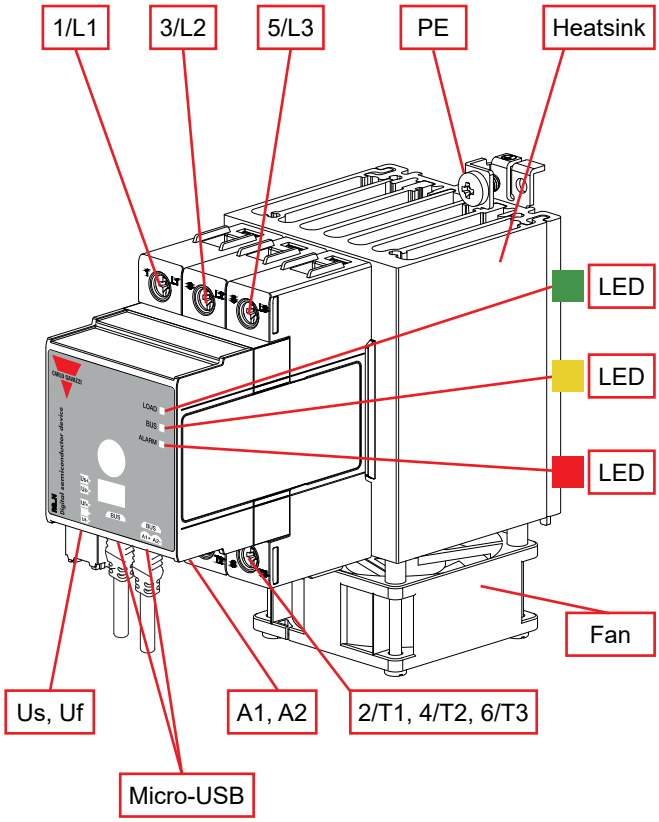
Description	Component code	Notes
NRG controller	NRGC..	• **NRGC:** NRG controller with Modbus communication. • **NRGC-PN:** NRG controller with PROFINET communication. • **NRGC-EIP:** NRG controller with EtherNet/IP communication. • **NRGC-ECAT:** NRG controller with EtherCAT communication. • **NRGC-MBTCP:** NRG controller with Modbus TCP communication. 1x RGN-TERMRES is included in the NRGC.. packaging. The RGN-TERMRES is to be mounted on the last RG..N on the bus chain.
NRG Internal BUS cables	RCRGN-010-2	10cm cable terminated at both ends with a microUSB connector. Packed x4 pcs.
	RCRGN-025-2	25cm cable terminated at both ends with a microUSB connector. Packed x1 pc.
	RCRGN-075-2	75cm cable terminated at both ends with a microUSB connector. Packed x1 pc.
	RCRGN-150-2	150cm cable terminated at both ends with a microUSB connector. Packed x1 pc.
	RCRGN-350-2	350cm cable terminated at both ends with a microUSB connector. Packed x1 pc.
	RCRGN-500-2	500cm cable terminated at both ends with a microUSB connector. Packed x1 pc.
Termination resistor	RGN-TERMRES	Internal BUS chain terminator. 1 pc. is included in the NRGC.. packaging
Plugs	RGM25	Spring plug labelled 'A1 A2'. Packed x10 pcs. (not applicable for RGx1P..CM..N)

Structure

RGC2..25/30..N, RGC3..20/40..N



RGC2..75..N, RGC3..65..N



Element	Component	Function
1/L1, 3/L2, 5/L3	Power connection	Mains connection
2/T1, 4/T2, 6/T3	Power connection	Load connection
A1, A2	Control connection	Terminal for control voltage in case of external control. RGM25 plug is required
Green LED	LOAD indicator	Indicates status of RG..N output
Yellow LED	BUS indicator	Indicates ongoing communication
Red LED	ALARM indicator	Indicates presence of an alarm condition
Us	Supply connection	Terminals for supply voltage
Uf	Fan connection	Terminals for fan supply voltage. Connection terminated by manufacturer
Micro-USB	Micro-USB ports for internal BUS	Interface for RCRGN cable connection for the internal BUS communications line
Heatsink	Integrated heatsink	DIN rail mounting
PE	Protective Earth	Connection for Protective Earth

Features

General data

Material	PA66 or PA6 (UL94 V0), RAL7035 850°C, 750°C/2s according to GWIT and GWFI requirements of EN 60335-1	
Mounting	DIN rail	
Touch Protection	IP20	
Overvoltage Category	III, 6kV (1.2/50µs) rated impulse withstand voltage	
Isolation	Input to Output: 2500 Vrms Input and Output to heatsink: 4000 Vrms	
Weight	RGC2..25, RGC3..20: RGC2..40, RGC3..30: RGC2..75, RGC3..65:	 approx. 570 g approx. 855 g approx. 925 g
Compatibility	NRGC (NRG controller with Modbus RS485 interface) NRGC-PN (NRG controller with PROFINET interface) NRGC-EIP (NRG controller with EtherNet/IP interface) NRGC-ECAT (NRG Controller with EtherCAT interface) NRGC-MBTCP (NRG Controller with Modbus TCP interface)	

Performance

RGC2.. Output

	RGC2..25	RGC2..40	RGC2..75
Operational voltage range, Ue Line to line voltage, L1/L2/L3	73-660 VAC		
Permissible voltage unbalance	10% between L1/L2/L3		
Blocking voltage	1200 Vp		
Max. operational current per pole[1]: AC-51 @ Ta=25°C	32 AAC	50 AAC	85 AAC
Max. operational current per pole[1]: AC-51 @ Ta=40°C	27 AAC	40 AAC	75 AAC
Max. operational current per pole[2]: AC-55b @ Ta=40°C	27 AAC	40 AAC	75 AAC
Output power	0 to 100%		
Operational frequency range	45 to 65 Hz		
Output protection	Integrated varistor across each pole		
Leakage current @ rated voltage	5 mAAC per pole		
Minimum operational current	500 mAAC	1 AAC	1 AAC
Repetitive overload current, PF= 0.7, UL508: Ta=40°C, t_{ON}=1 s, t_{OFF}=9 s, 50 cycles	61 AAC	107 AAC	154 AAC
Non-repetitive surge current (I_{TSM}), t=10 ms	600 Ap	1150 Ap	1750 Ap
I^2t for fusing (t=10 ms), minimum	1800 A^2s	6600 A^2s	15000 A^2s
Power factor	> 0.9 @ rated voltage		
Critical dV/dt (@Tj init = 40°C)	1000 V/µs		

1. Refer to Current derating curves
2. For this category use soft start with time or soft start with current limit.

RGC3.. Output

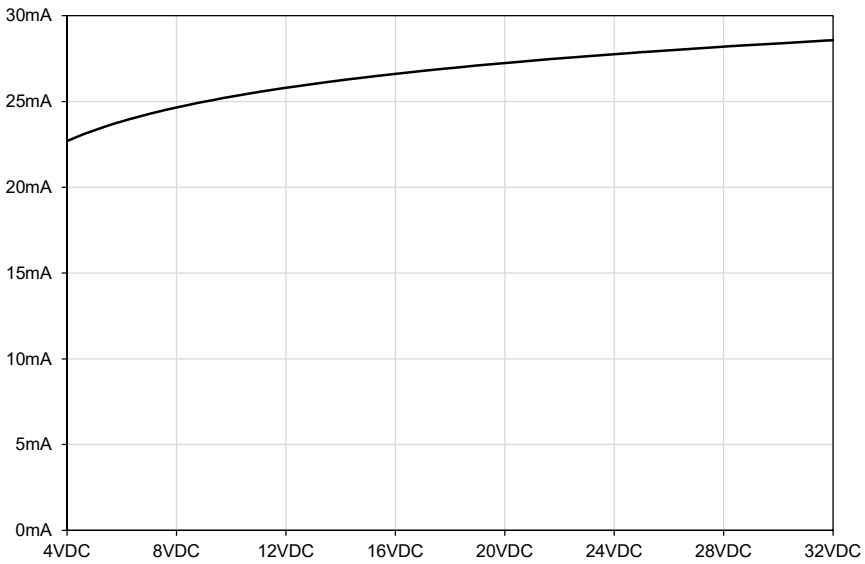
	RGC3..20	RGC3..30	RGC3..65
Operational voltage range, Ue Line to line voltage, L1/L2/L3	73-660 VAC		
Permissible voltage unbalance	10% between L1/L2/L3		
Blocking voltage	1200 Vp		
Max. operational current per pole[3]: AC-51 @ Ta=25°C	25 AAC	37 AAC	71 AAC
Max. operational current per pole[3]: AC-51 @ Ta=40°C	20 AAC	30 AAC	66 AAC
Max. operational current per pole[4]: AC-55b @ Ta=40°C	20 AAC	30 AAC	66 AAC
Output power	0 to 100%		
Operational frequency range	45 to 65 Hz		
Output protection	Integrated varistor across each pole		
Leakage current @ rated voltage	5 mAAC per pole		
Minimum operational current	500 mAAC 1 AAC (phase angle)	1 AAC	1 AAC
Repetitive overload current, PF= 0.7, UL508: Ta=40°C, t_{ON}=1 s, t_{OFF}=9 s, 50 cycles	61 AAC	107 AAC	154 AAC
Non-repetitive surge current (I_{TSM}), t=10 ms	600 Ap	1150 Ap	1750 Ap
I^2t for fusing (t=10 ms), minimum	1800 A^2s	6600 A^2s	15000 A^2s
Power factor	> 0.9 @ rated voltage		
Critical dV/dt (@Tj init = 40°C)	1000 V/µs		

3. Refer to Current derating curves
4. For this category use soft start with time or soft start with current limit.

Inputs

Control voltage range, Uc: A1, A2	4-32 VDC
Pick-up voltage	3.8 VDC
Drop-out voltage	1 VDC
Maximum reverse voltage	32 VDC
Maximum response time pick-up	½ cycle
Response time drop-out	½ cycle
Input current @ 40°C	See diagram below

Input current vs input voltage



Note 1: Switching of A2 (-) is not possible, only A1 (+) can be switched.
Note 2: Control voltage via A1, A2 is only required for external control switching mode. For further information on other switching modes refer to 'Switching Modes' section.

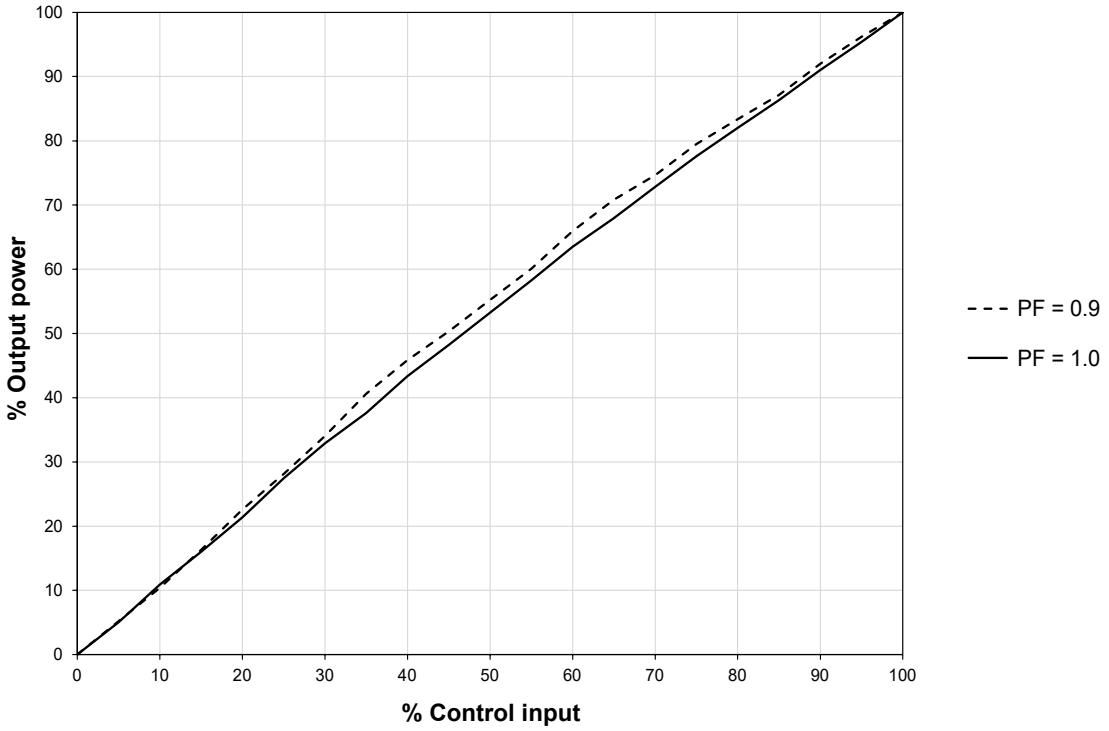
FAN power supply specifications

	RGC2..75..N, RGC3..65..N
Supply voltage range, Us	24 VDC, -15% / +20%
Overvoltage protection	Up to 32 VDC for 30 seconds
Reverse polarity protection	Yes
Max. supply current	90 mA

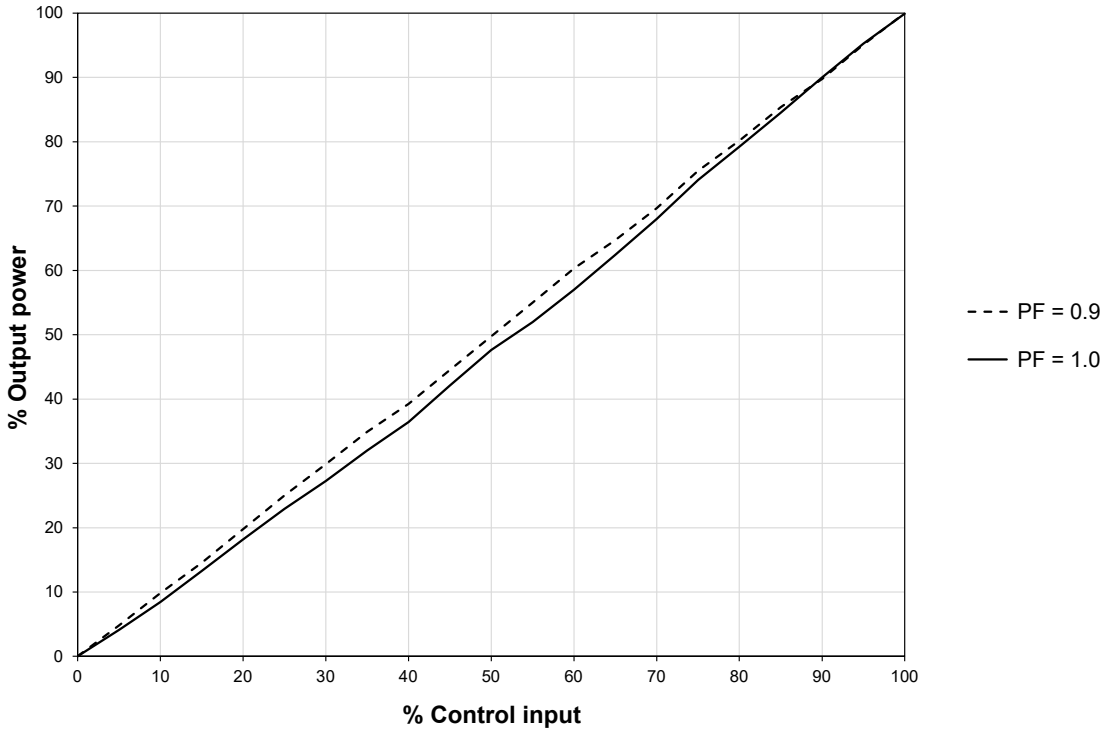
Transfer characteristics

Full cycle switching

3-wire, Delta configuration



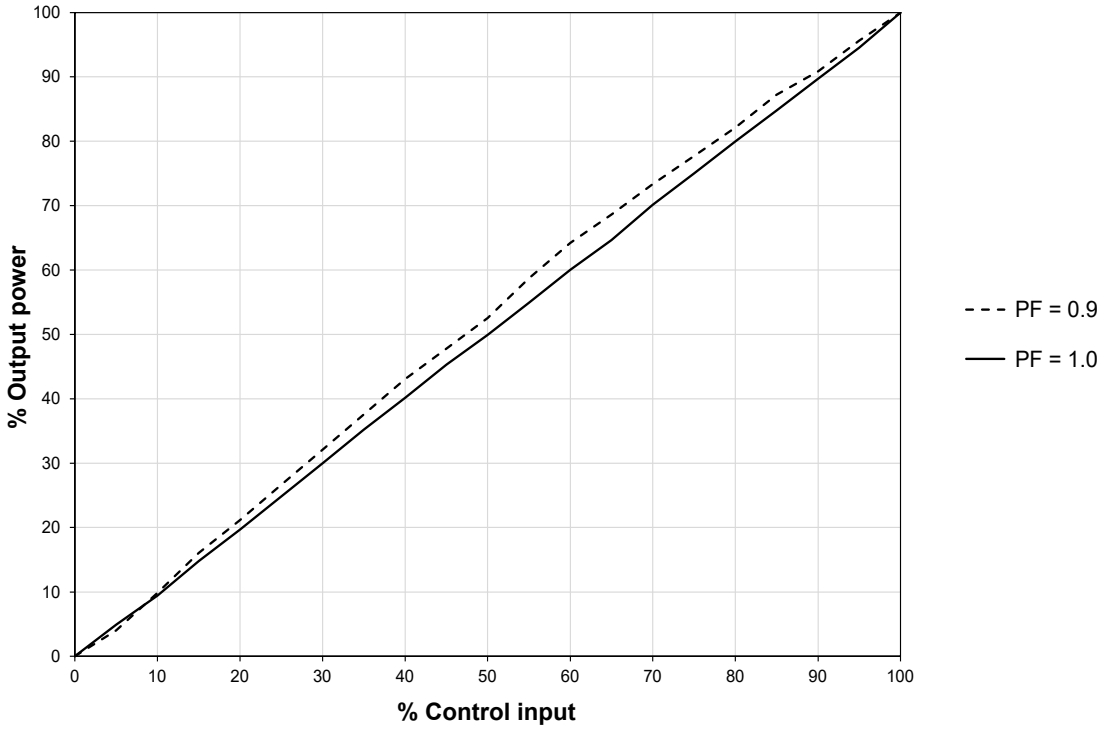
3-wire, Star configuration



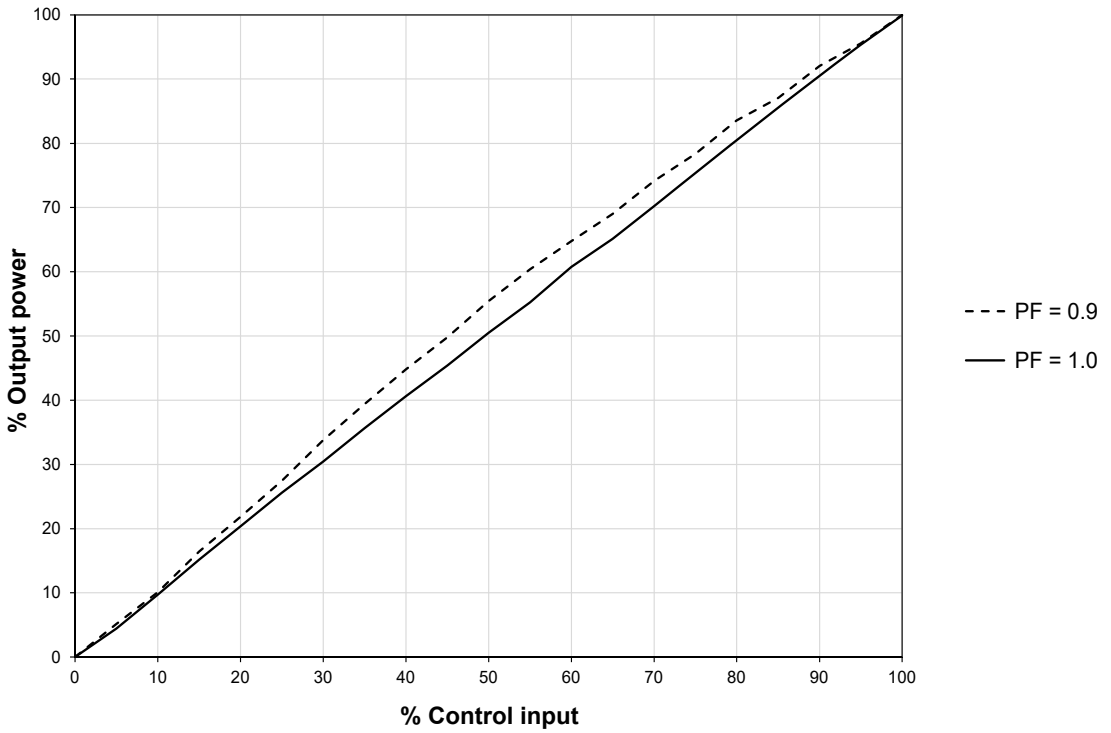
Transfer characteristics (continued)

Full cycle switching (continued)

2-wire, L1-L2 or L2-L3



2-wire, L3-L1

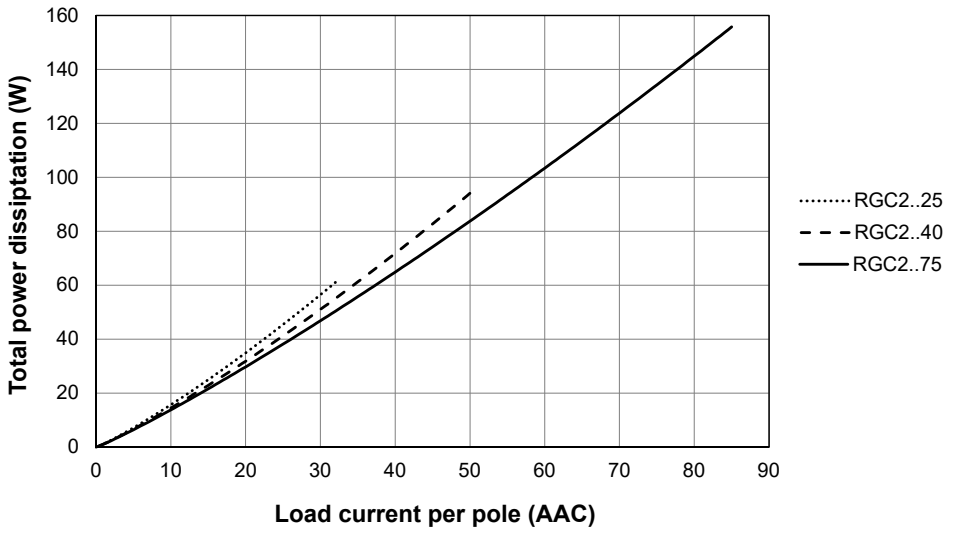


Internal bus

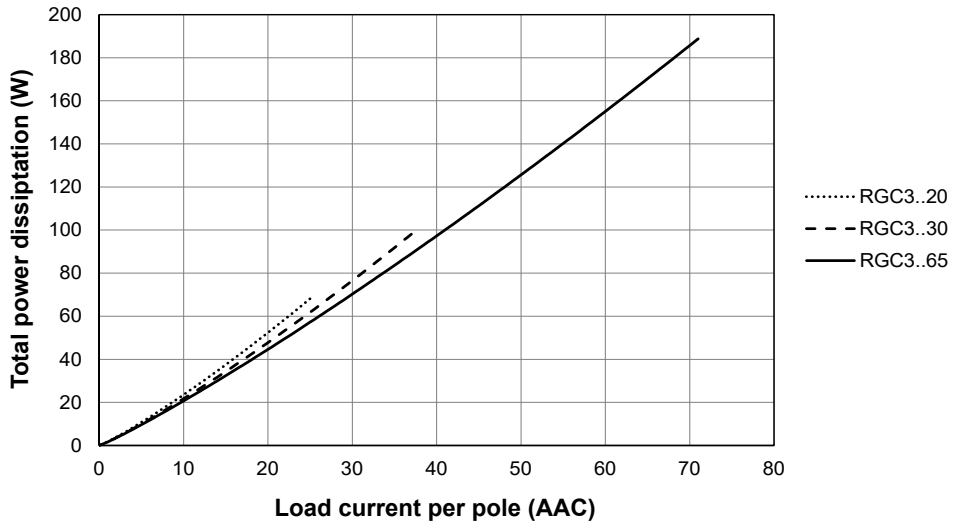
Supply voltage	Supplied through 2 wires of the RCRGN bus cable when connected to a powered NRG controller
BUS termination	**RGN-TERMRES** on last device in the bus chain
Max. no. of RG..Ns in a bus chain	32 switched poles. NRG bus chain can be mixed with different variants. RGx1A/P..N (1-pole), RGC2P..N (2-poles) / RGC3P..N (3-poles)
LED indication - BUS	Yellow, ON during ongoing communication
ID for RG..Ns	Automatic through Autoconfiguring (Modbus), Auto-addressing (ethernet protocols), (refer to respective User Manuals for further details). Communication is only possible with RG..Ns that are configured correctly, i.e., they have a valid ID.

Output power dissipation

RGC2

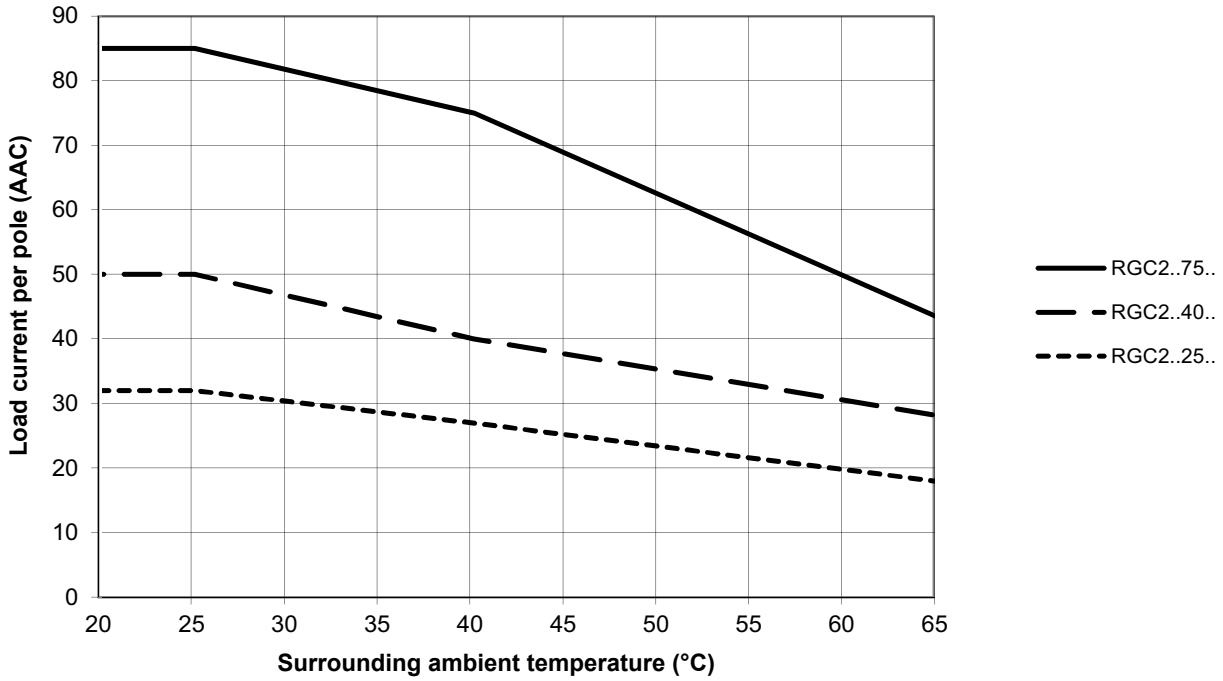


RGC3

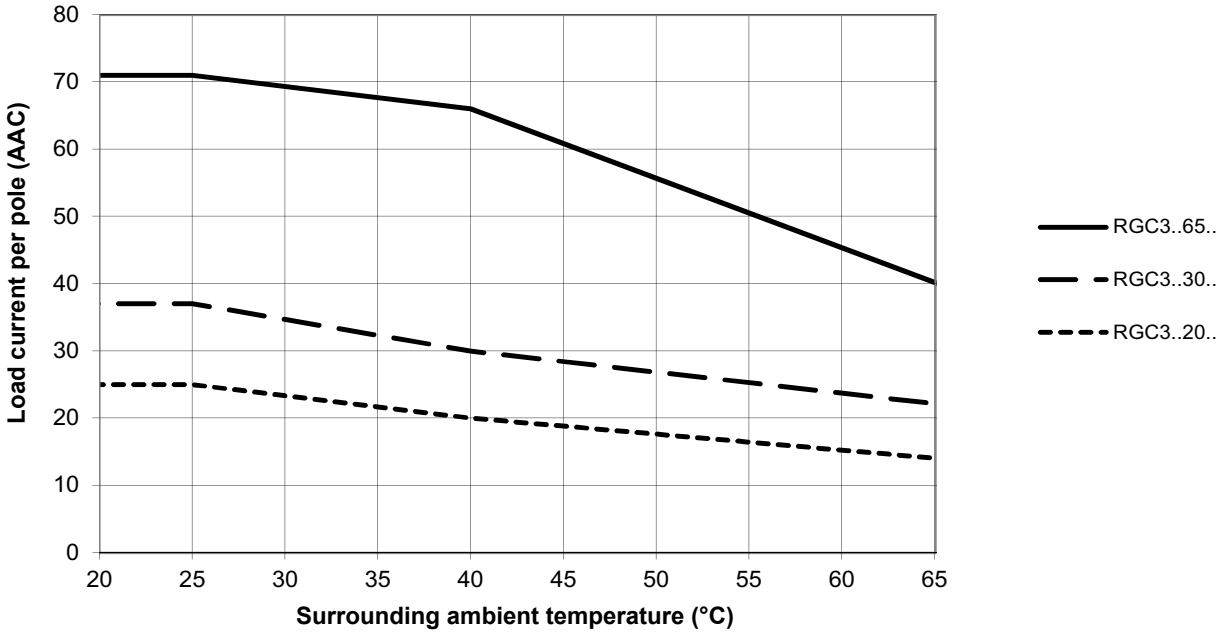


Current derating

RGC2

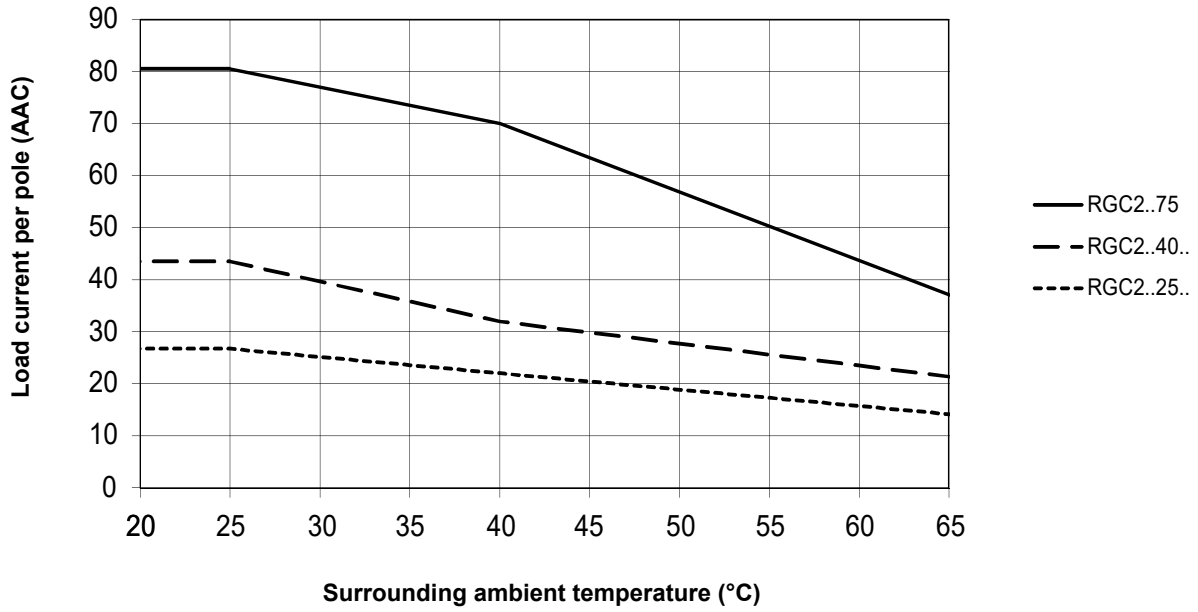


RGC3

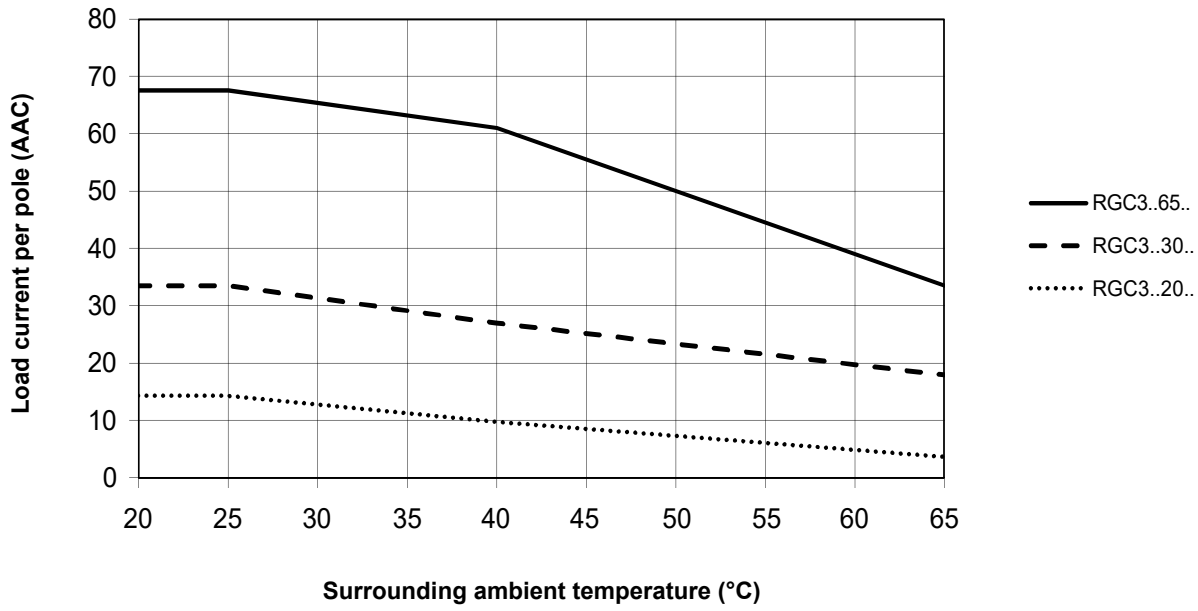


Current derating with 0 mm spacing

RGC2



RGC3



Compatibility and conformance

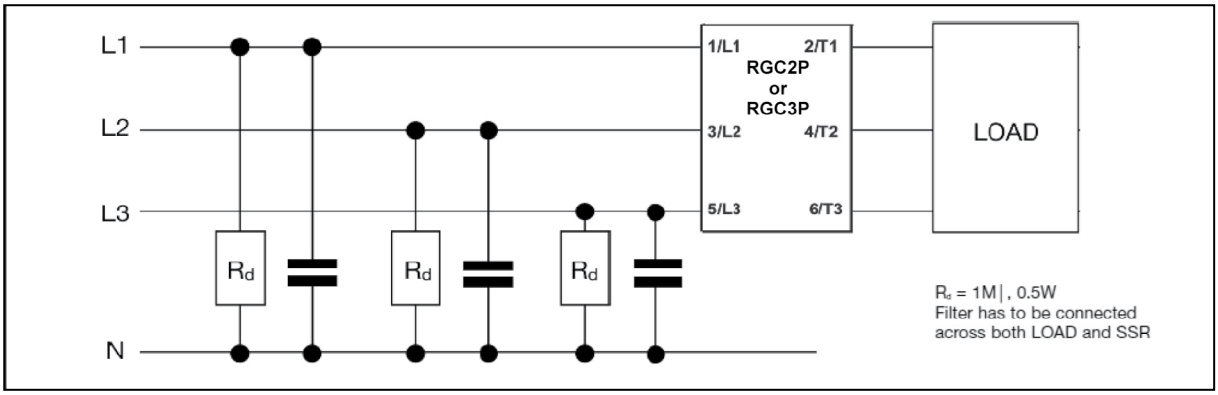
Approvals	CE cULus LISTED EAC
Standards compliance	LVD: EN 60947-4-3 EMCD: EN 60947-4-3 UL: UL508 (E172877), NMFT cUL: C22.2 No. 14 (E172877), NMFT7
UL short circuit current rating	100k Arms (refer to short circuit protection section, Type 1 – UL508)

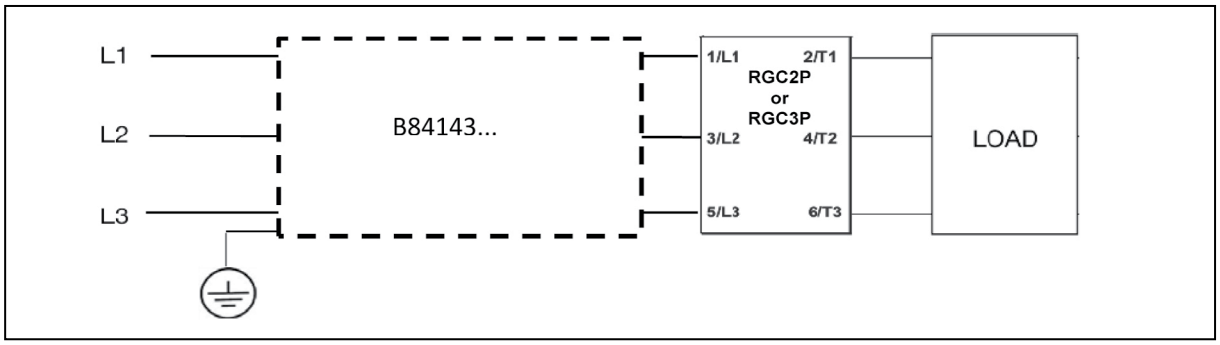
Electromagnetic compatibility (EMC) - Immunity	
Electrostatic discharge (ESD)	EN/IEC 61000-4-2 8 kV air discharge, 4 kV contact (PC2)
Radiated radio frequency[5]	EN/IEC 61000-4-3 10 V/m, from 80 MHz to 1 GHz (PC1) 10 V/m, from 1.4 to 2 GHz (PC1) 3 V/m, from 2 to 2.7 GHz (PC1)
Electrical fast transient (burst)	EN/IEC 61000-4-4 Output: 2 kV, 5 kHz & 100 kHz (PC2) Input, BUS: 1 kV, 5 kHz & 100 kHz (PC2)
Conducted radio frequency[5]	EN/IEC 61000-4-6 10 V/m, from 0.15 to 80 MHz (PC1)
Electrical surge	EN/IEC 61000-4-5 Output, line to line: 1 kV (PC2) Output, line to earth: 2 kV (PC2) BUS (Supply), line to line: 500 V (PC2) BUS (Supply), line to earth: 500 V (PC2) BUS (Data), A1-A2, line to earth: 1 kV (PC2)[6]
Voltage dips	EN/IEC 61000-4-11 0% for 0.5, 1 cycle (PC2) 40% for 10 cycles (PC2) 70% for 25 cycles (PC2) 80% for 250 cycles (PC2)
Voltage interruptions	EN/IEC 61000-4-11 0% for 5000ms (PC2)

5. Under the influence of RF, a reading error of ± 10% was allowed for load currents > 500 mA and ± 20% for load currents < 500 mA.
6. Not applicable to shielded cables < 10 m. Additional suppression on data lines may be required if shielded cables are not used.

Electromagnetic compatibility (EMC) - Emissions	
Radio interference field emission (radiated)	EN/IEC 55011 Class A: from 30 to 1000 MHz
Radio interference voltage emissions (conducted)	EN/IEC 55011 Class A: from 0.15 to 30 MHz (External filter may be required - refer to Filtering section)

Filter connection diagram





Filtering

Part number	Suggested filter for EN 55011 Class A compliance				Maximum heater current [AAC]
	ON / OFF & Ext. control	Phase angle (RGC3P..N only)	Full cycle switching	Burst	
RGC2P60CM25KEN RGC3P60CM20KEN	1.0 uF	EPCOS B84143D0050R127	EPCOS B84143A0050R105	2.2 uF	20
RGC2P60CM40GEN RGC3P60CM30GEN	1.0 uF	EPCOS B84143D0050R127	EPCOS B84143A0050R105	2.2 uF	20
RGC2P60CM75GEN RGC3P60CM65GEN	1.0 uF	EPCOS B84143D0050R127	EPCOS B84143A0050R105	2.2 uF	28

Note:

- Control input lines must be installed together to maintain products' susceptability to Radio Frequency interference.
- Use of AC solid state relays may, according to the application and the load current, cause conducted radio interferences. Use of mains filters may be necessary for cases where the user must meet E.M.C requirements. The capacitor values given inside the filtering specification tables should be taken only as indications, the filter attenuation will depend on the final application.
- Performance Criteria 1 (PC1): No degradation of performance or loss of function is allowed when the product is operated as intended.
- Performance Criteria 2 (PC2): During the test, degradation of performance or partial loss of function is allowed. However when the test is complete the product should return operating as intended by itself.
- Performance Criteria 3 (PC3): Temporary loss of function is allowed, provided the function can be restored by manual operation of the controls.

Environmental specifications

Operating temperature	-20 to +65 °C (-4 to +149 °F)
Storage temperature	-20 to +65 °C (-4 to +149 °F)
Relative humidity	95% non-condensing @ 40°C
Pollution degree	2
Installation altitude	0-1000m Above 1000 m derate linearly by 1% of FLC per 100m up to a maximum of 2000 m
Vibration resistance	2g/ axis (2-100Hz, IEC60068-2-6, EN 50155)
Impact resistance	15/11 g/ms (EN 50155)
EU RoHS compliant	Yes
China RoHS	

The declaration in this section is prepared in compliance with People's Republic of China Electronic Industry Standard SJ/T11364-2014: Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products.

Part Name	**Toxic or Harardous Substances and Elements**					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Power Unit Assembly	x	O	O	O	O	O

O: Indicates that said hazardous substance contained in homogeneous materials for this part are below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

这份申明根据中华人民共和国电子工业标准
SJ/T11364-2014：标注在电子电气产品中限定使用的有害物质

零件名称	有毒或有害物质与元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴化联苯 (PBB)	多溴联苯醚 (PBDE)
功率单元	x	O	O	O	O	O

O:此零件所有材料中含有的该有害物低于GB/T 26572的限定。

X: 此零件某种材料中含有的该有害物高于GB/T 26572的限定。

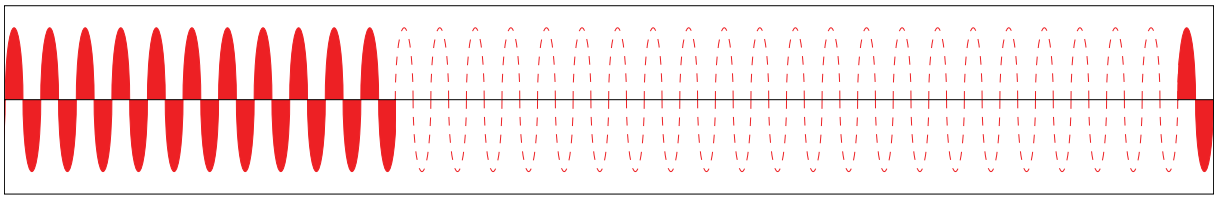
Switching modes

ON-OFF mode
The ON-OFF mode controls the solid state relays at the user's command. All the RG..Ns on the bus chain can be controlled at the same time.

The advantages of this mode are:
- It is effectively a direct replacement of the A1-A2, i.e. for existing systems, the control algorithm within the PLC can be left relatively untouched and the output is redirected via the communication interface instead of the PLC output modules.
- One command can set the state of the whole bus chain.

Burst firing mode
The burst firing mode works with a control level and a time-base which can be varied by user from 0.1 seconds to 10 seconds. The percentage ON time is then determined by the control level. Therefore, with a control level of 10% ;10% of the time-base will be ON and 90% will be OFF. The figure below shows example waveforms of this firing mode at different control levels. In this example the time base was set to 1 second. The percentage control resolution depends on the timebase set by the user. To achieve a 1% resolution, the time base has to be a minimum of 2 sec for 50 Hz and 1.7 sec for 60 Hz.

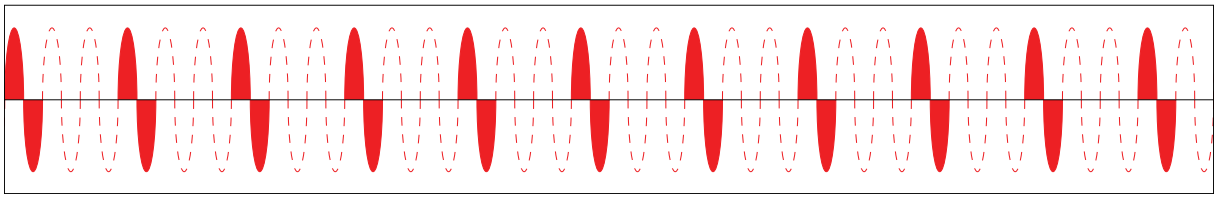
Output with burst firing mode @ 33% control level:



Distributed firing mode (1x full cycle switching)
The distributed firing mode works with a control level and a fixed time-base of 100 full cycles (2 seconds for 50 Hz). This mode operates with full cycles and it distributes the ON cycles as evenly as possible over the time base. In this mode, since the resolution is 1% and the time base is of 100 full cycles, the control level is equal to the number of full cycles over the whole time base.

1% = 1 full cycle every 100 cycles
2% = 2 full cycles every 100 cycles = 1 full cycle every 50 cycles

Output with distributed firing mode @ 33% control level:



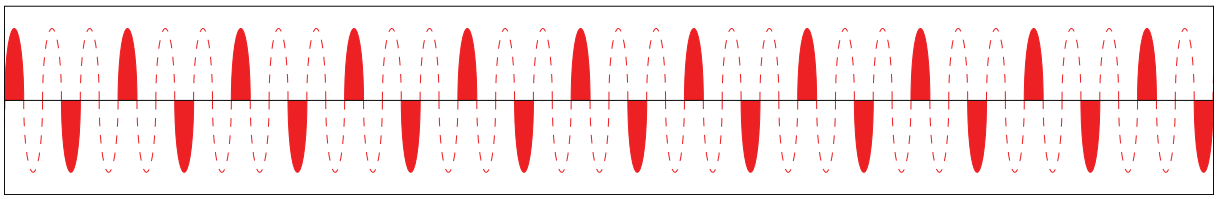
The advantage of distributed over burst is the reduction in thermal cycling. On the other hand, distributed suffers from worse harmonics/emissions than burst.

Switching modes (continued)

Advanced full cycle firing
Advanced full cycle (AFC) firing works on the same concept as distributed but rather than distributing full cycles, half cycles are distributed. This mode also works over a time base of 100 full cycles (200 half cycles). In this mode, since the resolution is 1% and the time base is of 100 full cycles, the control level is equal to the number of full cycles over the whole time base.

1% = 2 half cycles every 200 half cycles = 1 half cycle every 100 half cycles
2% = 4 half cycles every 200 half cycles = 1 half cycle every 50 half cycles

Output with advanced full cycle firing mode @ 33% control level:

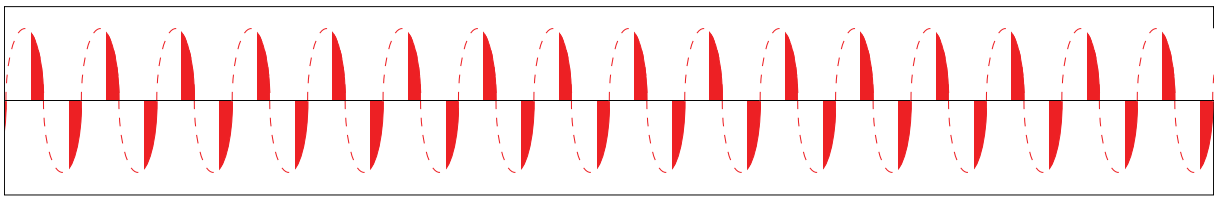


The advantage of AFC over burst is the reduction in thermal cycling. Another advantage of AFC is that visual flicker is less noticeable than distributed thus making it suitable for shortwave infrared heater applications.

AFC has the disadvantage of worse harmonics/emissions than burst and also slightly worse than distributed.

Phase angle mode (available on RGC3P..N only)
The phase angle switching mode works in accordance with the phase angle control principle. The power delivered to the load is controlled by the firing of the thyristors over each half mains cycle. The firing angle depends on the control level that determines the ouput power to be delivered to the load. The power to the load is varied linearly with the control level.

Output with phase angle firing mode @ 33% control level:

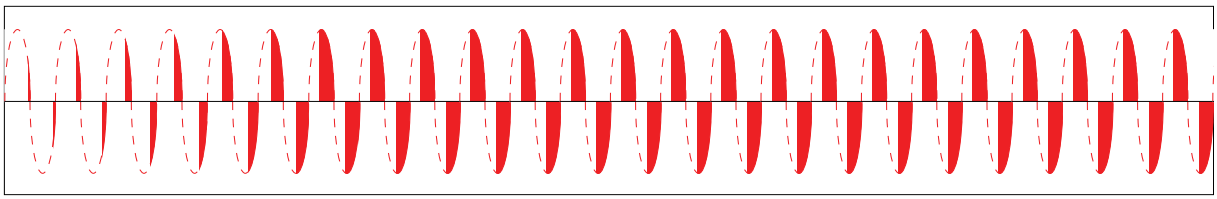


The advantage of phase angle over the other switching modes is its precise resolution of power. However, phase angle generates excessive harmonics vs other switching modes. With phase angle control, the flickering of IR heaters is eliminated completely.

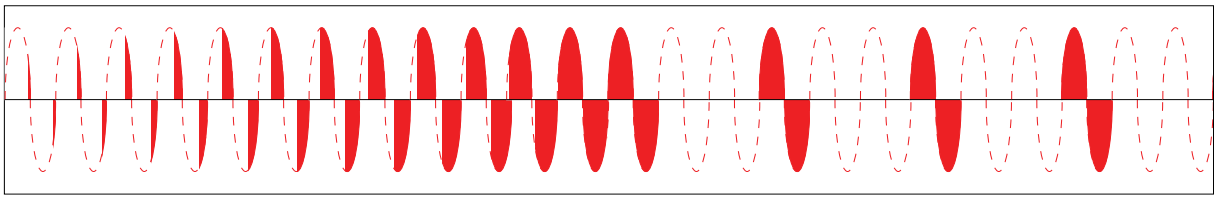
Switching modes (continued)

Soft starting (available on RGC3P..N only)
Soft starting is utilised to reduce the start-up current of loads having a high cold-to-hot resistance ratio such as short wave infrared heaters. The thyristor firing angle is gradually increased in order to apply the power to the load smoothly. Soft start can be applied with all the other available switching modes: ON/OFF, Burst, Distributed full cycle, Advanced full cycle and Phase angle. When applied with phase angle, the soft start will stop at the set control level whereas for the other switching mode the soft start will stop when fully ON. Soft start shall be applied upon power up (i.e. on first application of the control signal) and after a number of non-firing cycles settable by the user (i.e. re-applying the control signal after the output is switched OFF for a period of time > OFF time to soft start setting). Check the User manuals for each communication protocol for more information.

Soft start with phase angle



Soft start with ON/OFF, burst, distributed full cycle and advanced full cycle



There are two type of soft start modes:

Soft start with time mode

This soft start mode will apply the power smoothly to the load over a time period of maximum 25.5s (settable by the user via the communication). Check the user manual of each available communication protocol for more information.

Soft start with current limit mode

This soft start mode works with a current limit set by the user via the communication. The soft start time will adapt such that the set current limit is not exceeded and the soft start occurs in the shortest amount for time. The recommended setting for the current limit is 1.2 - 1.5 times the nominal current. The maximum settable current limit is 2 times the rated current of the RG..CM..N variant used. If the current limit is set too low and is reached before soft start is completed, a warning will be notified via the communication. Check the user manual of each available communication protocol for more information.

Voltage compensation

When voltage compensation is utilised, the output power on the output of the solid state relay will remain balanced despite any voltage deviations from normal readings. The algorithm uses a reference voltage set by the user via the communication to compute the compensation factor. A new control level is calculated by applying the compensation factor on the control level from the main controller. For further information refer to the respective NRG user manual for each communication protocol.

True power compensation

When true power compensation is utilised, the output power on the output of the solid state relay will remain balanced despite any voltage deviations and changes in resistance of the load. The algorithm uses a reference power set by the user via the communication to compute the compensation factor. A new control level is calculated by applying the compensation factor on the control level from the main controller. For further information refer to the respective NRG user manual for each communication protocol.

Measurements

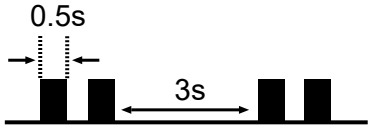
Parameter	Description
Current RMS L1	Measured RMS current (L1)
Current RMS L2	Measured RMS current (L2)
Current RMS L3	Measured RMS current (L3)
Hold current L1	Average current of last 16 ON cycles (L1)
Hold current L2	Average current of last 16 ON cycles (L2)
Hold current L3	Average current of last 16 ON cycles (L3)
Voltage RMS L1-L2	Supply voltage across L1-L2
Voltage RMS L2-L3	Supply voltage across L2-L3
Voltage RMS L3-L1	Supply voltage across L3-L1
Frequency	This reports the measured line frequency.
Apparent power	This reports the accumulated individual phase power values. Measurement is based on the multiplication of RMS voltage and RMS current.
Real power	This reports the accumulated individual phase real power values. Measurement is based on the multiplication of instantaneous voltage and current
SSR Running hours	This is a count of the time during which the SSR output is ON. On switch ON, this parameter reports the recorded value at the last switch OFF.
Load Running hours	This is a count of the time during which the output of SSR is ON. On switch ON, this parameter reports the last value before switch OFF. This measurement can be modified in case of a load or SSR replacement.
Energy Consumption	This reports the energy reading in kWh. On switch ON, this parameter reports the recorded value at the last switch OFF.

Note: For further information refer to the respective NRG user manual for each communication protocol.

LED indicators

LOAD	Green	The Load LED reflects the status of the load depending on the presence of the control signal. During an over-temperature condition, the LOAD LED will behave according to the indications in the table "LOAD LED indications in over-temperature condition" below	
BUS	Yellow	ON:	During a response from the RG..N to the NRGC..
		OFF:	Communication between the NRGC.. and RG..Ns is idle or during the transmission of a command from the NRGC.. to the RG..N
ALARM	Red	ON:	Fully ON or flashing when alarm condition is present. Refer to Alarm Management section
		OFF:	No alarm condition

Alarm management

Alarm condition present	• The state of the Red LED of the respective RG..N is ON with a specific flashing rate • All alarms are accessible via the communication interface. For further information refer to the respective NRG user manual for each communication protocol.	
Alarm types	**No. of flashes**	**Description of fault**
	100% ON	**Over-temperature:** - The RG..N is operating outside its operating range causing the junction to overheat - The output of the RG..N is switched OFF (irrespective of the control presence) to prevent damage to the RG..N - The alarm is restored automatically after the cooling-off period
	1	**Load deviation:** Load deviation is activated if the values of the Voltage Reference and Current Reference are > 0 either through a 'TEACH' command or updated manually. This alarm is issued if a change in current > than the Percentage Deviation is detected. This alarm is issued only if a change in current is irrespective of a change in voltage. For further information refer to the respective NRG user manual for each communication protocol.
	2	**Mains loss:** Voltage and current signals are missing from any of the 3 lines (L1, L2 & L3)
	3	**Load loss / SSR open circuit:** Load on one of the lines is not switching ON, when control signal is present, alarm will trigger. If a 1-phase load is connected to the RGC2/3P..N, only the respective lines used for the load configuration will be checked. Unused lines will be ignored. It is important to select the correct load configuration for the RGC2/3P..N via the 'Load Configuration Type' parameter.
	4	**SSR short circuit:** Current flowing through the RG..N output in the absence of a control signal
	5	**Frequency Out of Range:** - The RG..N is operated outside the range set by the Over Frequency and Under Frequency Limit settings. - Default range is 0 – 65535 - The RG..N will not stop operating if the frequency measured is out of the set range. The alarm is restored automatically when the frequency is back within the expected range - Alarm is deactivated by default
	6	**Current Out of Range:** - The RG..N is operated outside the range set by the Over Current and Under Current Limit settings on any of the 3 lines. - Default range is 0 - 65535 - The RG..N will not stop operating if the current measured is out of the set range. The alarm is restored automatically when the current is back within the expected range - Alarm is deactivated by default
	7	**Voltage Out of Range:** - The RG..N is operated outside the range set by the Over Voltage and Under Voltage Limit settings. - Default range is 65535 - The RG..N will not stop operating if the voltage measured is out of the set range. The alarm is restored automatically when the voltage is back within the expected range - Alarm is deactivated by default
	8	**Communication error (BUS):** An error in the communication link (internal bus) between the NRGC.. and RG..Ns
	9	**Internal error:** Bus supply out of range, hardware damage or detection of abnormal conditions
Flashing rate		

Short circuit protection

Protection Co-ordination, Type 1 vs Type 2:

Type 1 protection implies that after a short circuit, the device under test will no longer be in a functioning state. In Type 2 co-ordination the device under test will still be functional after the short circuit. In both cases, however the short circuit has to be interrupted. The fuse between enclosure and supply shall not open. The door or cover of the enclosure shall not be blown open. There shall be no damage to conductors or terminals and the conductors shall not separate from terminals. there shall be no breakage or cracking of insulating bases to the extent that the integrity of the mounting of live parts is impaired. Discharge of parts or any risk of fire shall not occur.

The product variants listed in the table hereunder are suitable for use on a circuit capable of delivering not more than 100,000 Arms Symmetrical Amperes, 600 Volts maximum when protected by fuses. Tests at 100,000 A were performed with Class J fuses, fast acting; please refer to the table below for maximum allowed ampere rating of the fuse. Use fuses only. Tests with Class J fuses are representative of Class CC fuses.

Protection co-ordination Type 1 according to UL 508				
Part number	**Prospective short circuit current [kArms]**	**Max fuse size [A]**	**Class**	**Voltage [VAC]**
RGC2..25 RGC3..20	100	30	J or CC	Max. 600
RGC2..40 RGC3..30		40	J	
RGC2..75 RGC3..65		60[3]	J	

3. Consult a Carlo Gavazzi sales representative for use of 70 A class J fuses

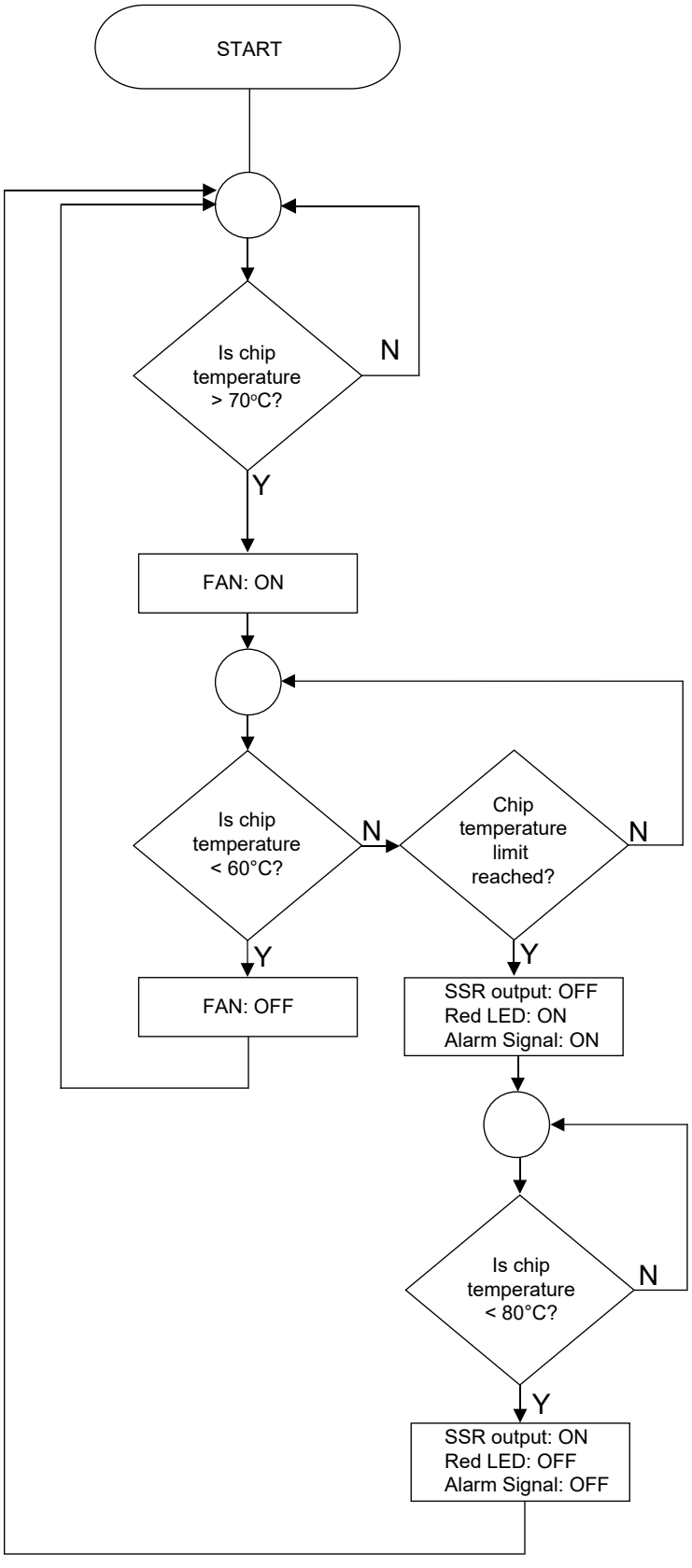
Protection co-ordination Type 2						
Part number	**Prospective short circuit current [kArms]**	**Ferraz Shawmut (Mersen)**		**Siba**		**Voltage [VAC]**
		Max fuse size [A]	**Part number**	**Max fuse size [A]**	**Part number**	
RGC2..25	10	40	660 URC 14x51/40	32	50 142 06 32	600
			6.9xx gRC URD 22x58/40			
	100		660 URD 22x58/40			
			A70QS40-4			
RGC2..40	10	63	6.9xx gRC URC 14x51/63	63	50 194 20 63	
	100	63	6.9xx gRC URD 22x58/63			
		60	A70QS60-4			
RGC2..75	10	100	6.9xx gRC URD 22x58/100	125	50 196 20 125	
	100		660 URQ 27x60/100			
			A70QS100-4			
RGC3..20	10	32	6.9xx gRC URC 14x51/32	32	50 142 06 32	
	100	32	6.9xx gRC URC 14x51/32			
		40	A70QS40-4			
RGC3..30	10	40	6.9xx gRC URC 14x51/40	40	50 194 20 40	
	100		6.9xx gRC URC 14x51/40			
			A70QS40-4			
RGC3..65	10	100	6.9xx gRC URC 22x58/100	125	50 196 20 125	
	100	90	660 URD 22x58/90			
		100	A70QS100-4			

Protection co-ordination Type 2 with Miniature Circuit Breakers (M.C.B.s)				
Solid State Relay type	**ABB Model no. for Z - type M. C. B. (rated current)**	**ABB Model no. for B - type M. C. B. (rated current)**	**Wire cross sectional area [mm²]**	**Minimum length of Cu wire conductor [m][7]**
RGC2..25 RGC3..20 (1800 A²s)	S203 - Z10 (10 A)	S203 - B4 (4 A)	1.0 1.5 2.5	7.6 11.4 19.0
	S203 - Z16 (16 A)	S203 - B6 (6 A)	1.0 1.5 2.5 4.0	5.2 7.8 13.0 20.8
	S203 - Z20 (20 A)	S203 - B10 (10 A)	1.5 2.5	12.6 21.0
	S203 - Z25 (25 A)	S203 - B13 (13 A)	2.5 4.0	25.0 40.0
RGC2..40 RGC3..30 (6600 A²s)	S203 - Z20 (20 A)	S203 - B10 (10 A)	1.5 2.5 4.0	4.2 7.0 11.2
	S203 - Z32 (32 A)	S203 - B16 (16 A)	2.5 4.0 6.0	13 20.8 31.2
RGC2..75 RGC3..65 (15000 A²s)	S203 - Z25 (25 A)	S203 - B16 (16 A)	2.5 4.0 6.0	3.1 5.0 7.5
	S203 - Z50 (50 A)	S203 - B25 (25 A)	4.0 6.0 10.0 16.0	8.0 12.0 20.0 32.0
	S203 - Z63 (63 A)	S203 - B32 (32 A)	6.0 10.0 16.0	11.3 18.8 30.0

7. Between MCB and Load (including return path which goes back to the mains)

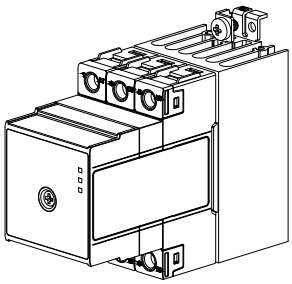
Note: A prospective current of 6 kA and a 230 / 400 V power supply is assumed for the above suggested specifications. For cables with different cross section than those mentioned above please consult Carlo Gavazzi's Technical Support Group.

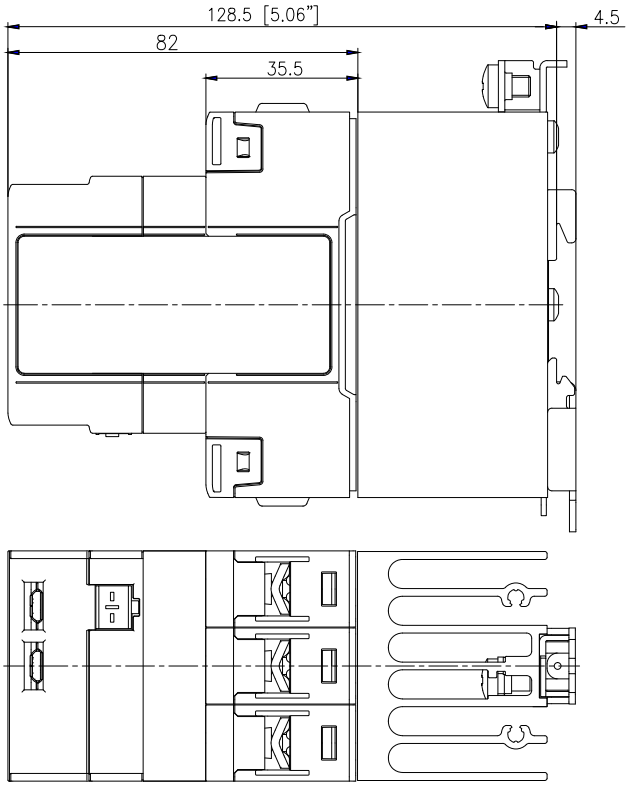
Fan operation for versions with integrated fan

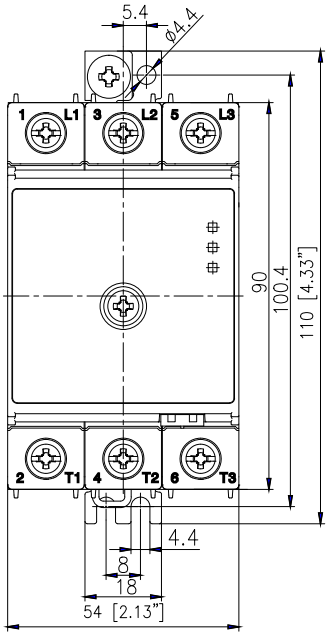


Dimensions

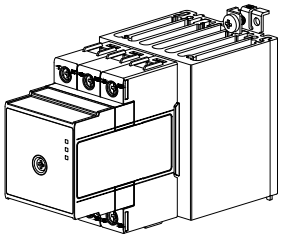
RGC2..25, RGC3..20

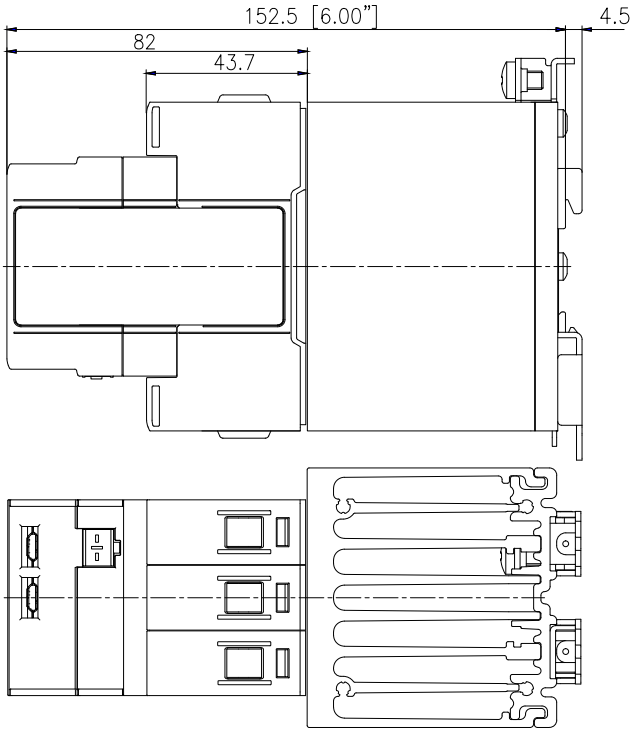


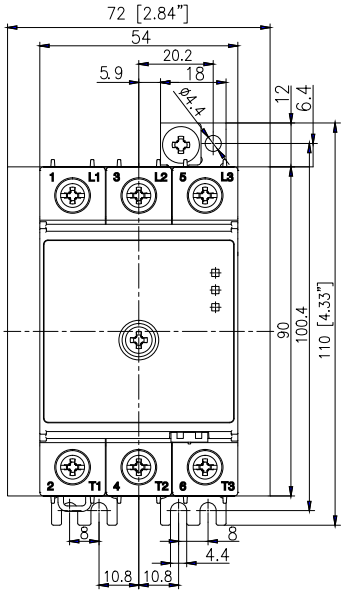




RGC2..40, RGC3..30



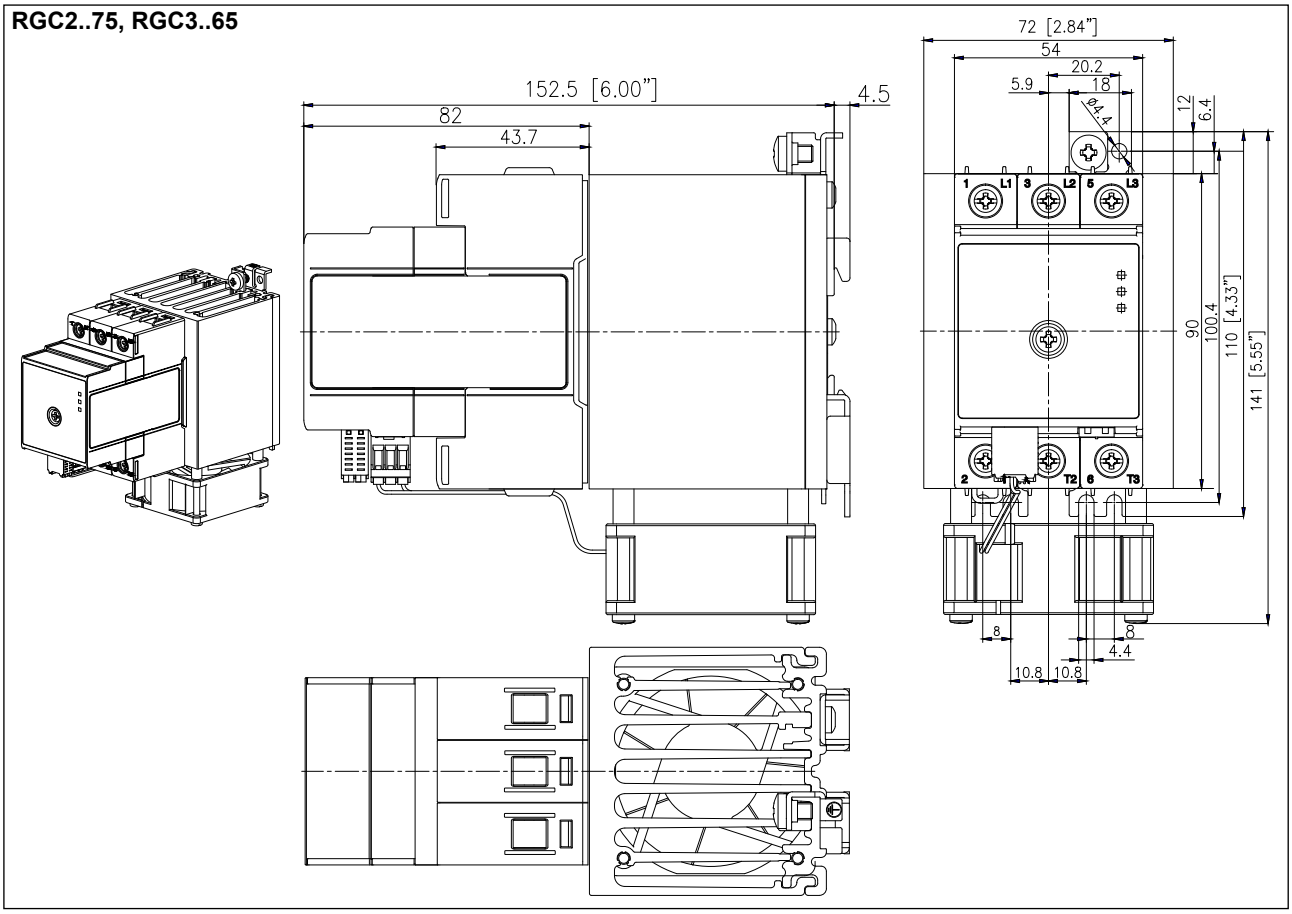




Housing width tolerance +0.5 mm, -0mm as per DIN 43880. All other tolerances +/- 0.5 mm. Dimensions in mm.

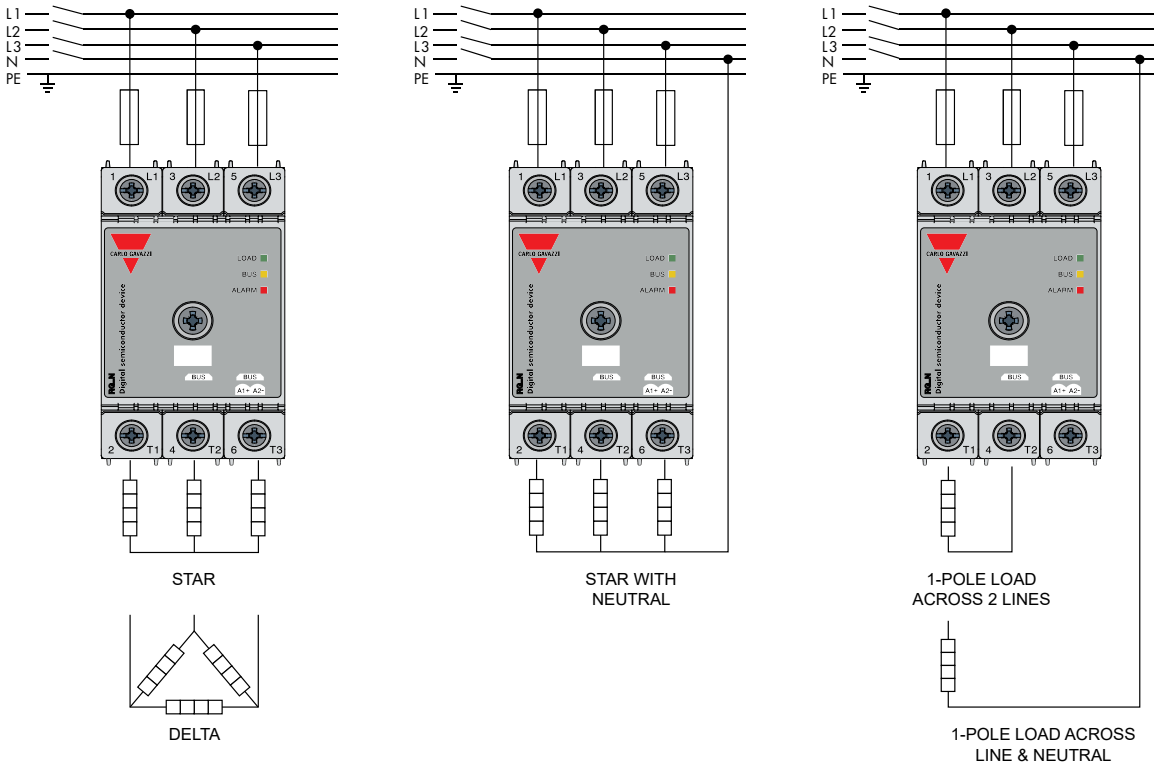
Dimensions (continued)

RGC2..75, RGC3..65

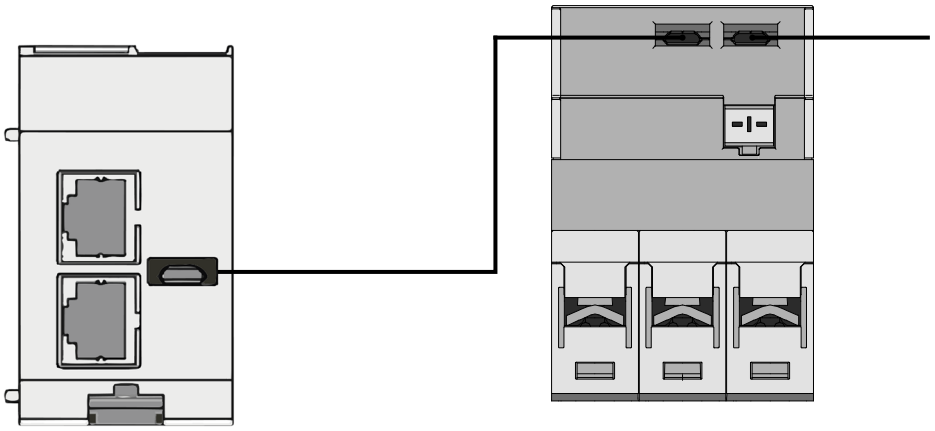


Housing width tolerance +0.5 mm, -0mm as per DIN 43880. All other tolerances +/- 0.5 mm. Dimensions in mm.
Note: Images are for illustrative purposes only

Load connection diagram



BUS connection diagram

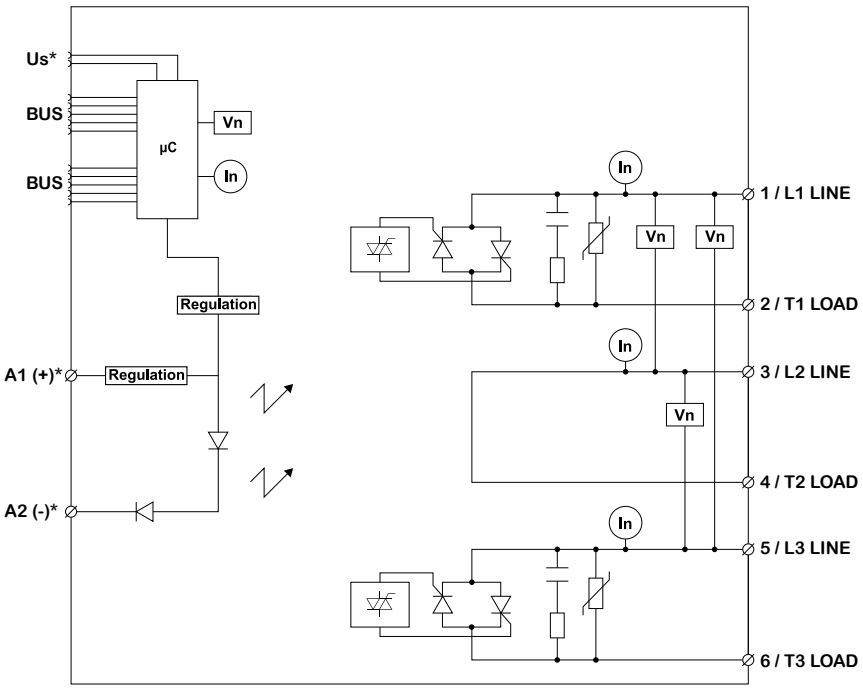


To another RG..N or termination resistor **RGN-TERMRES** in case of the last RG..N on the BUS chain

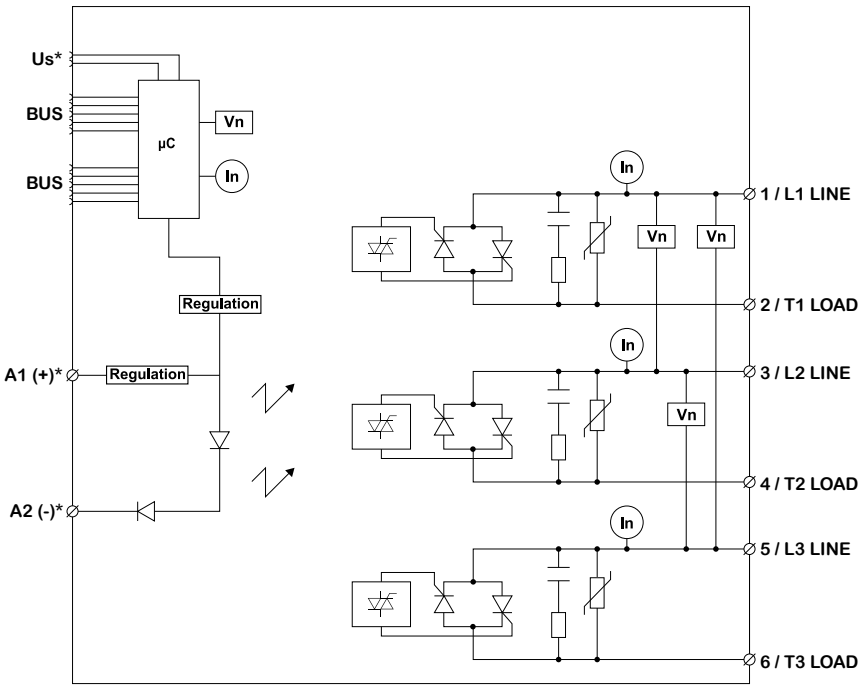
NRGC..

Functional diagram

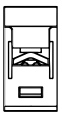
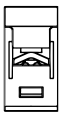
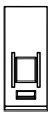
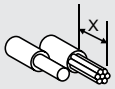
RGC2..



RGC3..

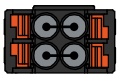


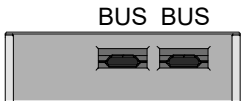
Connection specifications

Power connection			
Terminal	1/L1, 3/L2, 5/L3, 2/T1, 4/T2, 6/T3		
Conductors	Use 75°C copper (Cu) conductors		
	RGC2..25 **RGC3..20**		**RGC2..40, RGC2..75** **RGC3..30, RGC3..65**
			
Stripping length	12 mm		11 mm
Connection type	M4 screw with captivated washer		M5 screw with box clamp
Rigid (solid & stranded) **UL/cUL rated data** 	2 x 2.5 – 6.0 mm² 2 x 14 – 10 AWG	1 x 2.5 – 6.0 mm² 1 x 14 – 10 AWG	1 x 2.5 – 25.0 mm² 1 x 14 – 3 AWG
Flexible with end sleeve 	2 x 1.0 – 2.5 mm² 2 x 2.5 – 4.0 mm² 2 x 18 – 14 AWG 2 x 14 – 12 AWG	1 x 1.0 – 4.0 mm² 1 x 18 – 12 AWG	1 x 2.5 – 16.0 mm² 1 x 14 – 6 AWG
Flexible without end sleeve 	2 x 1.0 – 2.5 mm² 2 x 2.5 – 6.0 mm² 2 x 18 – 14 AWG 2 x 14 – 10 AWG	1 x 1.0 – 6.0 mm² 1 x 18 –10 AWG	1 x 4.0 – 25.0 mm² 1 x 12 –3 AWG
Torque specifications 	Pozidriv bit 2 UL: 2.0 Nm (17.7 lb-in) IEC: 1.5 – 2.0 Nm (13.3 – 17.7 lb-in)		Pozidriv bit 2 UL: 2.5 Nm (22 lb-in) IEC: 2.5 – 3.0 Nm (22 – 26.6 lb-in)
Aperture for termination lug (fork or ring)	12.3 mm		n/a
Protective Earth (PE) connection	M5, 1.5 Nm (13.3 lb-in) M5 PE screw is not provided with the solid state relay. PE connection is required when product is intended to be used in Class 1 applications according to EN/IEC 61140		

Control connection	
Terminals	A1+/A2- for external control (plug not provided *)
	
Conductors	Use 60/75°C copper (Cu) conductors
Stripping length	11 – 12 mm
Connection type	Spring plug, pitch 5.08 mm
Rigid (solid & stranded) **UL/cUL rated data**	0.2 – 2.5 mm² 26 – 12 AWG
Flexible with end sleeve	0.25 – 2.5 mm²
Flexible without end sleeve	0.25 – 2.5 mm²
Flexible with end sleeve using TWIN ferrules	0.5 – 1.0 mm²

*A1+/A2- plug is available with order code RGM25

Supply and fan connection	
Terminals	Us, Uf  Us connector
Conductors	Use 60/75°C copper (Cu) conductors
Stripping length	9 – 10 mm
Connection type	Spring plug, pitch 3.50 mm
Rigid (solid & stranded) **UL/cUL rated data**	0.2 – 1.5 mm^2 26 – 16 AWG
Flexible with end sleeve	0.25 – 0.75 mm^2
Flexible without end sleeve	0.5 – 1.5 mm^2
Flexible with end sleeve using TWIN ferrules	0.5 – 0.75 mm^2

BUS connection	
Terminal	BUS (x2) 
Type	RCRGN-xxx (where xxx refers to the length in cm) 5-way terminated with micro USB connector Cable lengths available: 10 cm **RCRGN-010-2** 25 cm **RCRGN-025-2** 75 cm **RCRGN-075-2** 150 cm **RCRGN-150-2** 350 cm **RCRGN-350-2** 500 cm **RCRGN-500-2**
Conductors	+24 V, GND, Data, Data, Autoconfigure line

Further reading

Information	Where to find it	
NRG ModbusRTU user manual	https://gavazziautomation.com/images/PIM/MANUALS/ENG/SSR_UM_NRG.pdf	
NRG PROFINET user manual	https://gavazziautomation.com/images/PIM/MANUALS/ENG/SSR_UM_NRG_PN.pdf	
NRG EtherNet/IP user manual	https://gavazziautomation.com/images/PIM/MANUALS/ENG/SSR_UM_NRG_EIP.pdf	
NRG EtherCAT user manual	https://gavazziautomation.com/images/PIM/MANUALS/ENG/SSR_UM_NRG_ECAT.pdf	
NRG Modbus TCP user manual	https://gavazziautomation.com/images/PIM/MANUALS/ENG/SSR_UM_NRG_MBTCP.pdf	
Datasheet NRG Controller with Modbus RTU	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_NRGC.pdf	
Datasheet NRG Controller with PROFINET	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_NRGC_PN.pdf	
Datasheet NRG Controller with EtherNet/IP	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_NRGC_EIP.pdf	
Datasheet NRG Controller with EtherCAT	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_NRGC_ECAT.pdf	
Datasheet NRG Controller with Modbus TCP	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_NRGC_MBTCP.pdf	
Datasheet RG..CM..N solid state relay with real-time monitoring via bus	https://gavazziautomation.com/images/PIM/DATASHEET/ENG/SSR_RG_CM_N.pdf	

RCRGN..

NRG internal BUS cable



Main features

- Cables available at various lengths for the internal BUS of the NRG system
- Cables terminated at both ends with a microUSB plug
- Connects the NRG controller to the RG..N solid state relay and respective RG..N solid state relays

Description

The **RCRGN** cables are proprietary cables that must be used with the NRG system for the internal BUS. These cables are 5-way cables carrying the communication, supply and autoconfiguration / auto-addressing lines. By means of autoconfiguration / auto-addressing, the RG..Ns are assigned a unique ID based on the physical location and on the internal BUS.

Carlo Gavazzi compatible components

Description	Component code	Notes
NRG Controller	NRGC..	NRG controllers: Modbus, Modbus TCP, Profinet, EtherNet/IP, EtherCat 1x **RGN-TERMRES** is included in the NRGC.. packaging. The RGN-TERMRES is to be mounted on the last RG..N on the bus chain.
Solid state relays	RG..N	NRG solid state relays

Order code

RCRGN - ☐ - 2

Enter the code entering the corresponding option instead of ☐

Code	Option	Description	Notes
RCRGN	**-**	Cables suitable for the NRG system	
☐	**010**	10 cm cable length	packed x 4 pcs.
	025	25 cm cable length	packed x 1 pc.
	075	75 cm cable length	packed x 1 pc.
	150	150 cm cable length	packed x 1 pc.
	350	350 cm cable length	packed x 1 pc.
	500	500 cm cable length	packed x 1 pc.
2	**-**	Terminated at the both ends with a microUSB connector	

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