# NRGC

## NRG controller with Modbus RTU over RS485

**CARLO GAVAZZI**

### Main features

- **Communication interface.** The NRG controller bridges the field level devices to the control level to allow exchange of data in real-time with the NRG solid state relays.
- **Reduced maintenance costs and downtime.** Use of real-time data for prevention of machine stoppages during operation.
- **Good quality products and low scrap rates.** Real-time monitoring allows timely decisions for better machine and process management.
- **Reduced efforts in troubleshooting.** A number of faults can be distinguished to facilitate and reduce troubleshooting time.
- **Fast installation and set-up.** The solid state relays on the BUS are configured by AutoConfiguration for fast set-up and prevention of incorrect settings.
- **Compact dimensions.** One controller with a product width of 35 mm can handle up to 32 RG..CM..N or 48 RG..D..N NRG solid state relays.

### Description

The **NRGC** is the NRG controller in the NRG BUS chain.

The **NRGC** interfaces directly with the main controller of the system through Modbus RTU on an RS485 interface. Each **NRGC** in the system is identified by a unique Modbus address that can be set either manually via a front selector switch that allows only Modbus addresses 1 to 15 or through dedicated registers for addresses 1 to 247. The default Modbus communication settings can also be modified via dedicated registers.

The **NRGC** acts as a master of the respective NRG BUS chain when it is requested by the main controller to carry out actions on the specific NRG BUS chain. Otherwise, the **NRGC** is just a facilitator of the communication between the main controller and each individual **RG..N** solid state relay in the system.

The **NRGC** needs to be supplied with 24 VDC. It is equipped with a configurable digital output that is set as an **NRGC** alarm indication as the default setting. LEDs on the front facade give a visual indication of the status of the NRGC, of any ongoing communication with the main controller (COM) and the RG..Ns on the BUS chain (BUS) and of any alarm condition related specifically to the **NRGC**.

Specifications are noted at 25°C unless otherwise specified.

### 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

- Communication interface: Modbus over RS485
- Connects up to 48 **RG..D..Ns** or 32 switched poles (**RG..CM..N)**
- Selector switch for Modbus addresses 1-15 (Modbus addresses 1-247 through comms)
- Supply voltage 24 VDC +/-20%

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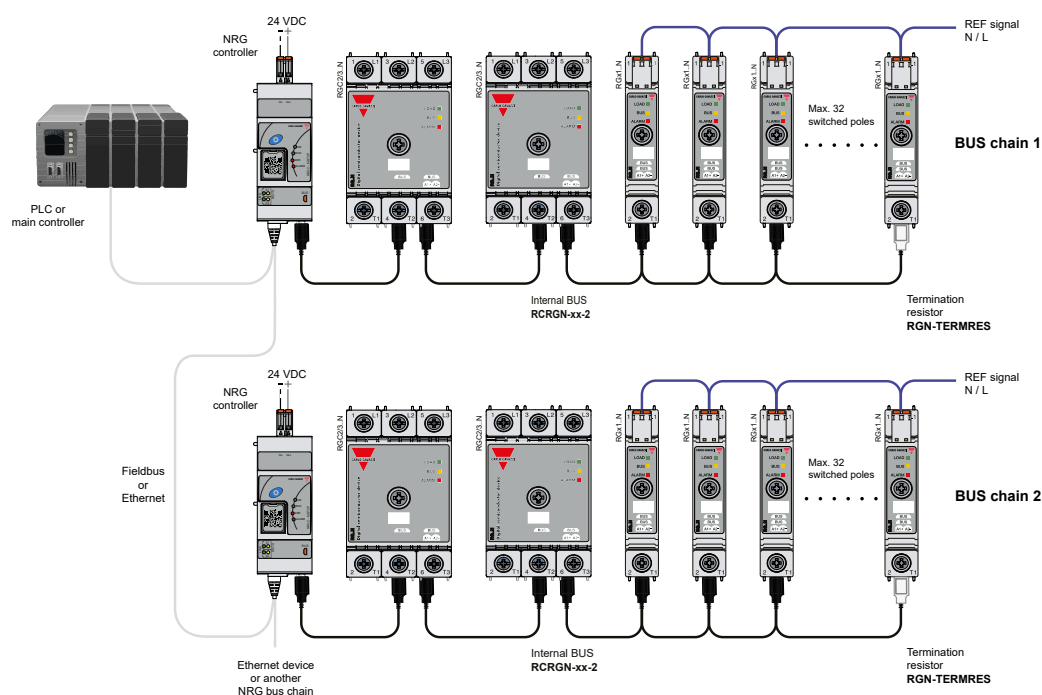
## The NRG system

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.

## NRGC



### List of contents

# References

▶ **Order code**

👉 **NRGC**

▶ **Carlo Gavazzi compatible components**

| Description | Component code | Notes |
|---|---|---|
| Solid state relays | RG..N | NRG solid state relays<br>• **RG..D..N:** Communication interface for real time monitoring, DC control for switching ON/OFF the RG..N.<br>Maximum 48x RG..D..N in one BUS chain.<br>• **RG..CM..N:** Communication interface for control of the RG..N and for real time monitoring.<br>Maximum 32x switched poles in one BUS chain. |
| NRG Internal BUS cables | RCRGN-010-2 | 10 cm cable terminated at both ends with a microUSB connector.<br>Packed x4 pcs. |
| | RCRGN-025-2 | 25 cm cable terminated at both ends with a microUSB connector.<br>Packed x1 pc. |
| | RCRGN-075-2 | 75 cm cable terminated at both ends with a microUSB connector.<br>Packed x1 pc. |
| | RCRGN-150-2 | 150 cm cable terminated at both ends with a microUSB connector.<br>Packed x1 pc. |
| | RCRGN-350-2 | 350 cm cable terminated at both ends with a microUSB connector.<br>Packed x1 pc. |
| | RCRGN-500-2 | 500 cm cable terminated at both ends with a microUSB connector.<br>Packed x1 pc. |

▶ **Further reading**

| Information | Where to find it | |
|---|---|---|
| User manual NRGC Modbus RTU | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/SSR_UM_NRG.pdf | |
| Datasheet RGx1..D..N (1-pole SSR with real-time monitoring via BUS) | https://www.gavazziautomation.com/fileadmin/images/PIM/DATASHEET/ENG/SSR_RG_D_N.pdf | |
| Datasheet RGx1..CM..N (1-pole SSR with control and real-time monitoring via BUS) | https://www.gavazziautomation.com/fileadmin/images/PIM/DATASHEET/ENG/SSR_RG_CM_N.pdf | |

# Structure
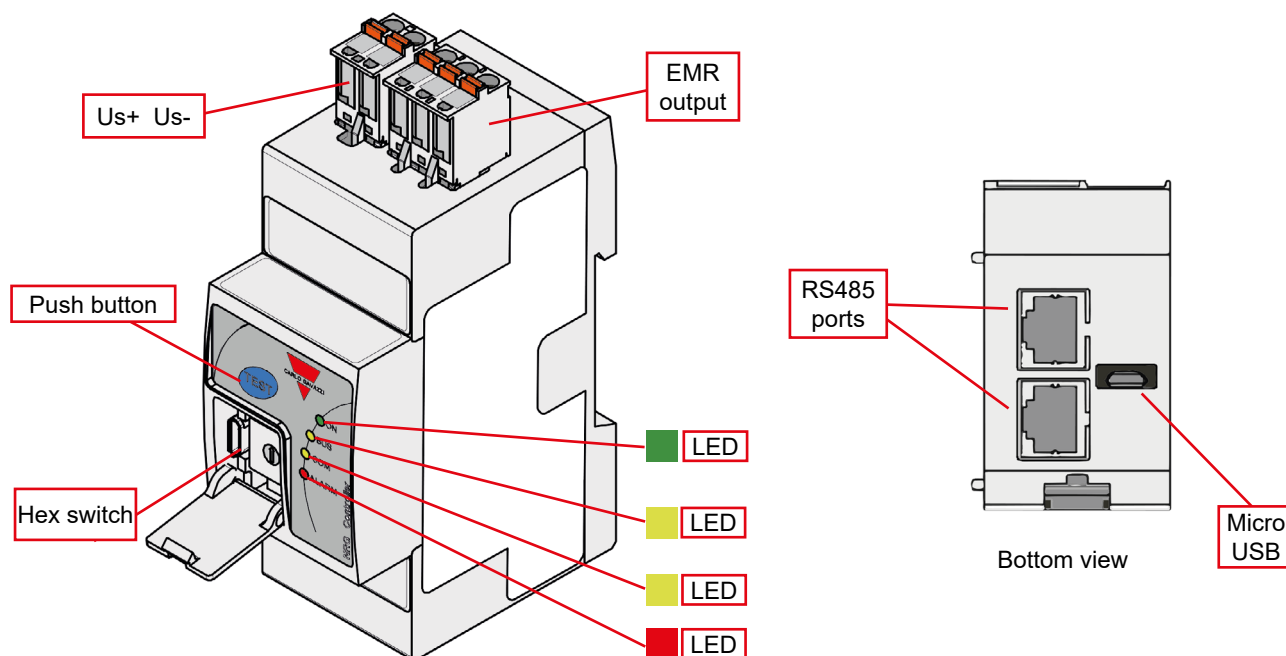


| Element | Component | Function |
|---|---|---|
| **Us+ Us-** | Supply connection | 2 position spring plug - Us+, Us- connection for powering the NRGC |
| **Push button** | Communications check button | Enables and disables a Communications Check function of the BUS chain (link between NRGC and RG..Ns) by pressing front button between 2 to 5 seconds |
| **Hex Switch** | NRGC ID hex switch | Sets ID 1 to 15 of the NRGC through a hex switch located behind a door flap that can be opened by a flat screwdriver. Default shipping position = 0 (i.e., internal NRGC ID = 1) |
| **EMR output** | Auxiliary Electromechanical relay | 3 position electromechanical relay (11, 12, 14) that can function as an Alarm EMR or a general purpose EMR Default shipped function = Alarm EMR |
| **Green LED** | ON indicator | Indicates presence of Supply voltage on NRGC |
| **Yellow LED** | BUS indicator | Indicates ongoing communication with RG..Ns |
| **Yellow LED** | COM indicator | Indicates ongoing communication with main controller |
| **Red LED** | ALARM indicator | Indicates presence of an Alarm condition |
| **RS485 ports** | RS485 internal communication ports | 2x RJ45 (loopable) plugs for RS485 communications line |
| **Micro USB** | Micro-USB port – internal BUS | RCRGN cable connection for the internal BUS communications line |

# Features

### General data

| | |
|---|---|
| **Material** | Noryl (UL94 V0), RAL7035 |
| **Mounting** | DIN rail |
| **Dimensions** | 2-DIN |
| **Touch protection** | IP20, IP00 with door flap on front facade open |
| **Weight** | 135 g |
| **Compatibility** | RGC..N solid state contactors (RG end-devices)<br>RGS..N solid state relays (RG end-devices) |

### Dimensions
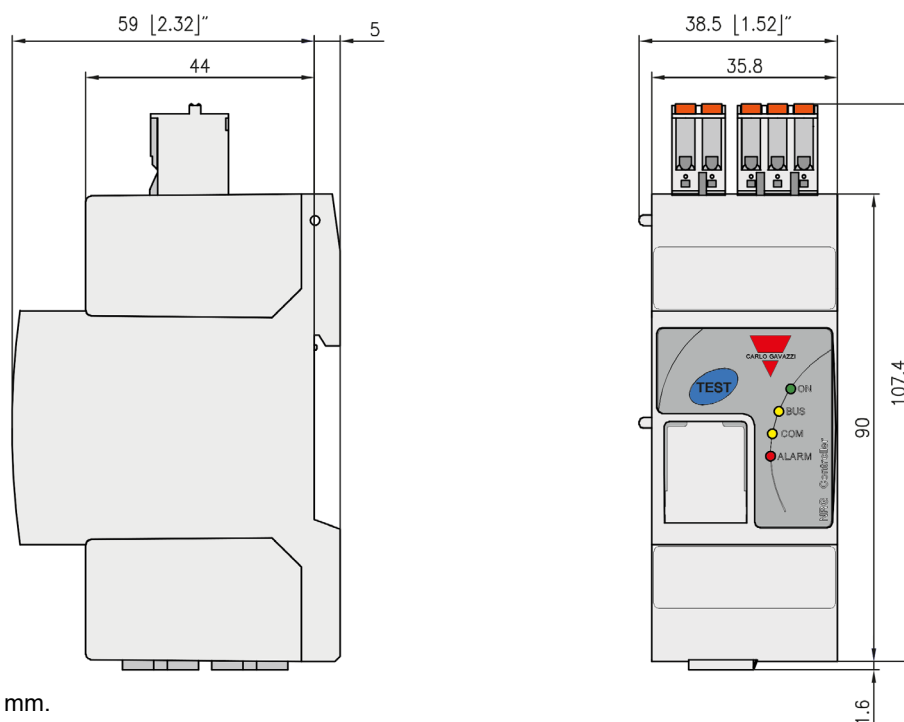


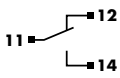All dimensions in mm.
Tolerances +/- 0.5 mm.

# Performance

### Power supply specifications

| | |
|---|---|
| **Supply port rating, Us** | 24 VDC |
| **Supply voltage range, Us** | 19.2 – 32 VDC* |
| **Reverse polarity protection** | Yes |
| **Consumption** | < 12 W |
| **LED Indication, Supply ON** | Green LED |
| **Power on, Power off delay** | <500 ms. No messages are accepted during this time |

\* Supply voltage is to be provided either using a class 2 power source or by a Limited Voltage Limited Current (LV LC) source. LV LC can be achieved by using of a fuse that complies with UL248 rated:
- for supply range 0 - 28.3 Vpeak = max. 5A
- for supply range >28.3 - 32 Vpeak = max. (100/max. open circuit voltage) A

## Auxiliary relay specifications

| | |
|---|---|
| Function | Alarm EMR (default setting):<br>operates in case of an Alarm condition present on the NRGC or<br><br>General Purpose EMR:<br>operation controlled through ModBus<br><br>This is configurable via the Relay Configuration Register - refer to NRG User Manual for further details |
| Output type | EMR, 1 Form C<br>Normally closed (11 - 12)<br>Normally open (11 - 14) |
| Contact rating | 2A @ 250 VAC  /30 VDC |
| Isolation | 11, 12, 14 to Us: 1.5k VAC |

## RS485

| | |
|---|---|
| Communication protocol to Main Controller | ModBus RTU |
| Type | 2-wire, half duplex |
| NRGC typology | - ModBus slave using standard Modbus function codes<br>- Byte repeater when main controller addresses RG..Ns directly through the use of a special function code |
| Baud rate | Default: 115200 bits/s<br>Selectable via ModBus: 9600, 19200, 38400, 57600 and 115200 bits/s |
| Data Format | Data bits: 8<br>Parity: Even (Default)<br>Stop bit: 1<br>Selectable via ModBus: Even, Odd, No parity |
| Address | Default: 1 (Hex switch position 0)<br>Selectable: 1 to 15 via hex switch<br>Selectable: 1 to 247 via Modbus (with Hex switch position set to 0) |
| Max. number of NRGCs in the system | 247 |
| Connection to main controller | 2x shielded RJ45 plugs;<br>1 plug for interfacing to PLC / main controller<br>1 plug for looping to another NRGC |
| LED indication - COM | Yellow, ON indicating ongoing communication with the main controller |

## Internal Bus

| | |
|---|---|
| Max. number of RG..Ns connected to NRGC | 48x RG..D..N<br>32x RG..CM..N |
| Connection to RG..Ns | RCRGN-xx 5-way cable terminated with micro-USB connection |
| BUS termination | RGN-TERMRES (1x pc. provided with 1x NRGC) to be plugged on the last RG..N on the BUS chain to terminate the internal BUS |
| LED indication - BUS | Yellow, ON indicating ongoing communication with the RG end-devices |

## Compatibility and Conformance

| Approvals (pending) | CE, cULus LISTED, EAC, UKCA |
|---|---|
| **Standards compliance** | LVD:  EN 60947-5-1<br>EMCD:  EN 60947-5-1<br>EE:  EN 60947-5-1<br>EMC:  EN 60947-5-1<br>UL:  UL508 (E172877), NMFT<br>cUL:  C22.2 No. 14 (E172877), NMFT7 |

| Electromagnetic compatibility (EMC) - Immunity | |
|---|---|
| **Electrostatic discharge (ESD)** | EN/IEC 61000-4-2<br>8 kV air discharge, 4 kV contact (PC1) |
| **Radiated radio frequency** | EN/IEC 61000-4-3<br>10 V/m, from 80 MHz to 1 GHz (PC1)<br>10 V/m, from 1.4 to 2 GHz (PC1)<br>3 V/m, from 2 to 2.7 GHz (PC1) |
| **Electrical fast transient (burst)** | EN/IEC 61000-4-4<br>Output: 2 kV, 5 kHz & 100 kHz (PC1)<br>Input: 1 kV, 5 kHz & 100 kHz (PC1) |
| **Conducted radio frequency** | EN/IEC 61000-4-6<br>10 V/m, from 0.15 to 80 MHz (PC1) |
| **Electrical surge** | EN/IEC 61000-4-5<br>DC Output / Input, line to line: 500 V (PC2)<br>DC Output / Input, line to earth: 500 V (PC2)<br>Signal, line to earth 1 kV (PC2)[1] |
| **Voltage dips and interruptions** | EN/IEC 61000-4-11<br>0% @ 5000 ms (PC2)<br>40% @ 200 ms (PC2)<br>60% @ 10, 30, 100, 300, 1000 ms (PC2) |
| **Voltage dips and interruptions on input lines** | EN/IEC 61000-4-29<br>0% @ 1, 3, 10, 30, 100, 300, 1000 ms (PC2)<br>30% @ 10, 30, 100, 300, 1000 ms (PC2)<br>70% @ 10, 30, 100, 300, 1000 ms (PC2)<br>80% @ 10, 30, 100, 300, 1000 ms, 3 s, 10 s (PC2)<br>120% @ 10, 30, 100, 300, 1000 ms, 3 s, 10 s (PC2) |

1.  Not applicable to shielded cables <10m. Additional suppression on data lines may be required if shielded cables are not used.

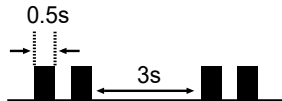| Electromagnetic compatibility (EMC) - Emissions | |
|---|---|
| **Radio interference field emission (radiated)** | EN/IEC 55011<br>Class A: from 30 to 1000 MHz |
| **Radio interference voltage emissions (conducted)** | EN/IEC 55011<br>Class B: from 0.15 to 30 MHz |

## 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 - 2000m |
| **EU RoHS compliant** | Yes |
| **China RoHS** | |

## LED indicators

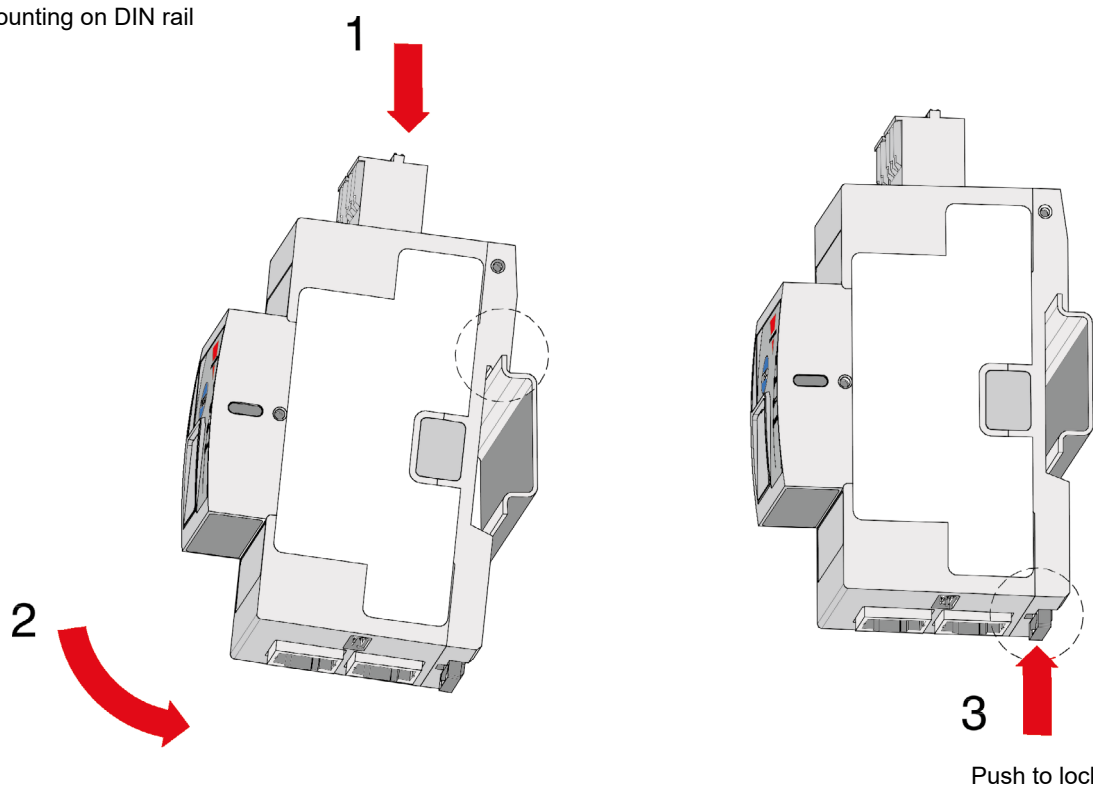| | | | |
|---|---|---|---|
| **ON** | Green 🟩 | ON: | Us is present at terminals Us+, Us- |
| | | OFF: | Us is not present at terminals Us+, Us- |
| **BUS** | Yellow 🟨 | ON: | During transmission of messages from NRGC to RG..Ns |
| | | OFF: | Idle bus between the NRGC and RG..Ns and when NRGC is receiving data from RG..Ns |
| **COM** | Yellow 🟨 | ON: | During transmission of a reply from the NRGC to the main controller |
| | | OFF: | Idle bus between the main controller and NRGC and when NRGC is receiving data from the main controller |
| **ALARM** | Red 🟥 | ON: | Flashing when alarm condition is present. Refer to Alarm management section |
| | | OFF: | No alarm condition |

### Alarm management

| Alarm condition present | • Red LED ON with a specific flashing rate<br>• Any of the error flags in NRGC status register (**CTRSR**) is set<br>• Auxiliary relay operates if:<br>    - It is set as an Alarm relay (shipped default operation)<br>    - Respective alarm bit is not masked in the Relay Configuration<br>      Register (**RLYCR**). Refer to NRG user manual for further details | |
|---|---|---|
| **Alarm types** | **No. of flashes** | **Description of fault** |
| | 2 | Configuration Error:<br>The number of RG..Ns connected to the bus chain is not correct<br>    - The number of RG..Ns on the bus chain is >48 for RG..D..N or >32 for RG..CM..N (Device Limit Error)<br>    - The number of RG..Ns on bus chain is not as expected (Device Mismatch Error). This alarm is not generated automatically but can be optionally set by the user |
| | 3 | Communication Error (COM):<br>An error in the communication link (RS485) between the main controller and the NRGC |
| | 8 | Communication Error (BUS):<br>An error in the communication link (internal BUS) between the NRGC and RG..Ns |
| | 9 | Internal Error:<br>Supply out of range or detection of abnormal conditions |
| | 10 | Termination (BUS) Error:<br>Internal BUS chain not terminated |
| **Flashing rate** | 0.5s<br>3s | |

### Connection diagram



RS485 from PLC/IPC

To another NRGC or Modbus terminating resistor

NRGC      NRGC      NRGC
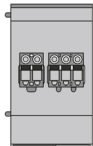
## Mounting

Mounting on DIN rail

**1**

**2**

**3**

Push to lock
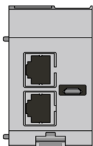
Dismounting from DIN rail

**2**

**1**

Unlock
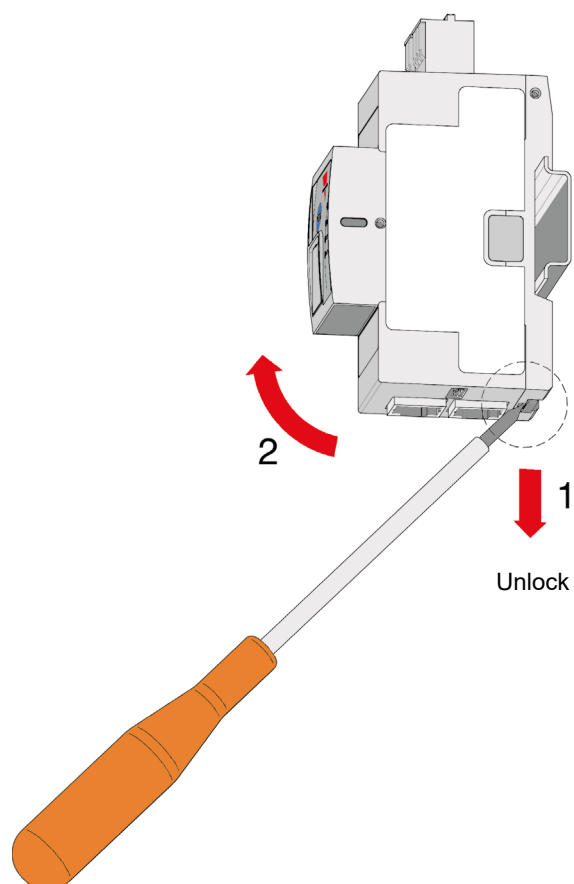
## Connection specifications

### Power connection

| | |
|---|---|
| **Terminal** | Supply: Us+, Us-<br>Auxiliary EMR: 11, 12, 14 |
| | <br>Top<br>view |
| **Conductors** | Use 60/75°C copper (Cu) conductors |
| **Stripping length** | 12 - 13 mm |
| **Connection type** | Spring plug, pitch 5.08 mm<br>2-pole for Supply<br>3-pole for Auxiliary EMR (11 Common, 12 Normally Closed, 14 Normally Open) |
| **Rigid (solid & stranded) UL/CSA 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 |

### Communication - connection

| | |
|---|---|
| **Terminal** | COM: RJ45 (x2)<br>BUS: RCRGN-xxx-2 |
| | <br>Bottom<br>view |
| **ModBus RS485 connection** | RJ45 shielded plugs, x2 to allow looping |
| **Cable for ModBus** | Not provided. Shielded CAT-5e cables are recommended. Connection should be straight, i.e., pin 1 at one end should be connected to pin 1 at the other end. Refer to NRG user manual for further details for the RJ45 connection pin connections. |
| **Max. length of RS485 cable** | 25 mtrs (this covers the total cable length from the main controller to the last NRGC in the ModBus chain |
| **Cable for Internal Bus** | RCRGN-xxx-2: 5-way USB micro connection<br>- +24 supply line for RG..Ns<br>- GND<br>- RS485A<br>- RS485B<br>- Autoconfig line |

# RCRGN..

**CARLO GAVAZZI**

## 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<br>1x **RGN-TERMRES** is included in the NRGC.. packaging.<br>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 | |