



**NRG: Solid state relays with real-time monitoring**

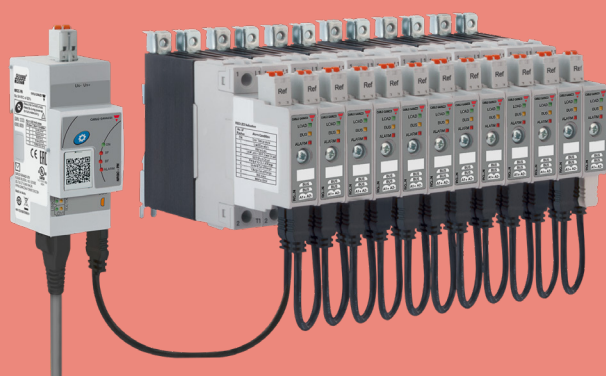
**Switches**

# NRG series

## Digital solid state relays

In order for machine builders to make informed decisions, solve urgent problems on short notice and develop machines that are more autonomous, data from the various components within the machine needs to be collected and analysed. The **NRG** has been developed to fit this purpose. Through the added communication interface, the solid state relays (SSRs) can exchange data with the machine controller in real-time. The switching of the SSRs can be controlled through this communication interface.

The **NRG** is a platform consisting of bus chains. Each bus chain is made up of an NRG controller daisy chained to a number of SSRs. The NRG controller interfaces with the machine controller (or PLC) and is available in Modbus RTU, PROFINET, EtherNet/IP™ or EtherCAT.



EtherNet/IP



EtherCAT

## Reduced unplanned downtime with real-time monitoring

### Predictive and better preventive maintenance plans

Condition based monitoring is essential to reduce unplanned machine stoppages. The NRG Load deviation alarm alerts of potential load failures prior to these happening. The SSR and Load running hours data helps maintainers schedule better preventive maintenance plans.

### Versatility and flexibility

Monitoring solutions external to the SSR are limited in the data they can provide. The NRG provides a much more complete status that enables process improvements and can also be used to optimise energy management plans.

### Precise temperature control

Specific applications may necessitate a very fine switching resolution. With power control mode a 1% resolution is possible, whilst with ON/OFF mode, SSRs can be switched every half mains cycle.

### Panel space savings

With integrated switching, monitoring and diagnostics in the smallest solid state relay platform on the market, the NRG solution saves on valuable panel space. Compared to other monitoring solutions it eliminates the need of external current transformers, PLC analogue and digital cards.

### Time labour savings in wiring

In the NRG system, all data transfer, error monitoring as well as load switching is done via the communication network thus eliminating all the extensive wiring required to connect external monitoring components and PLC cards.

### Ready for IIoT

Through digitalization, machines can be accessed from any remote location. The communication interface on the NRG enables remote access down to the SSR level.

## Applications

The NRG is the ideal switching solution when monitoring of the field level devices is required to minimise expensive downtimes. In addition to the switching function, the NRG integrates monitoring circuitry, in the same footprint, to enable exchange of data with the machine controller. The NRG solid state relays are suited for heating applications. Typical applications include:

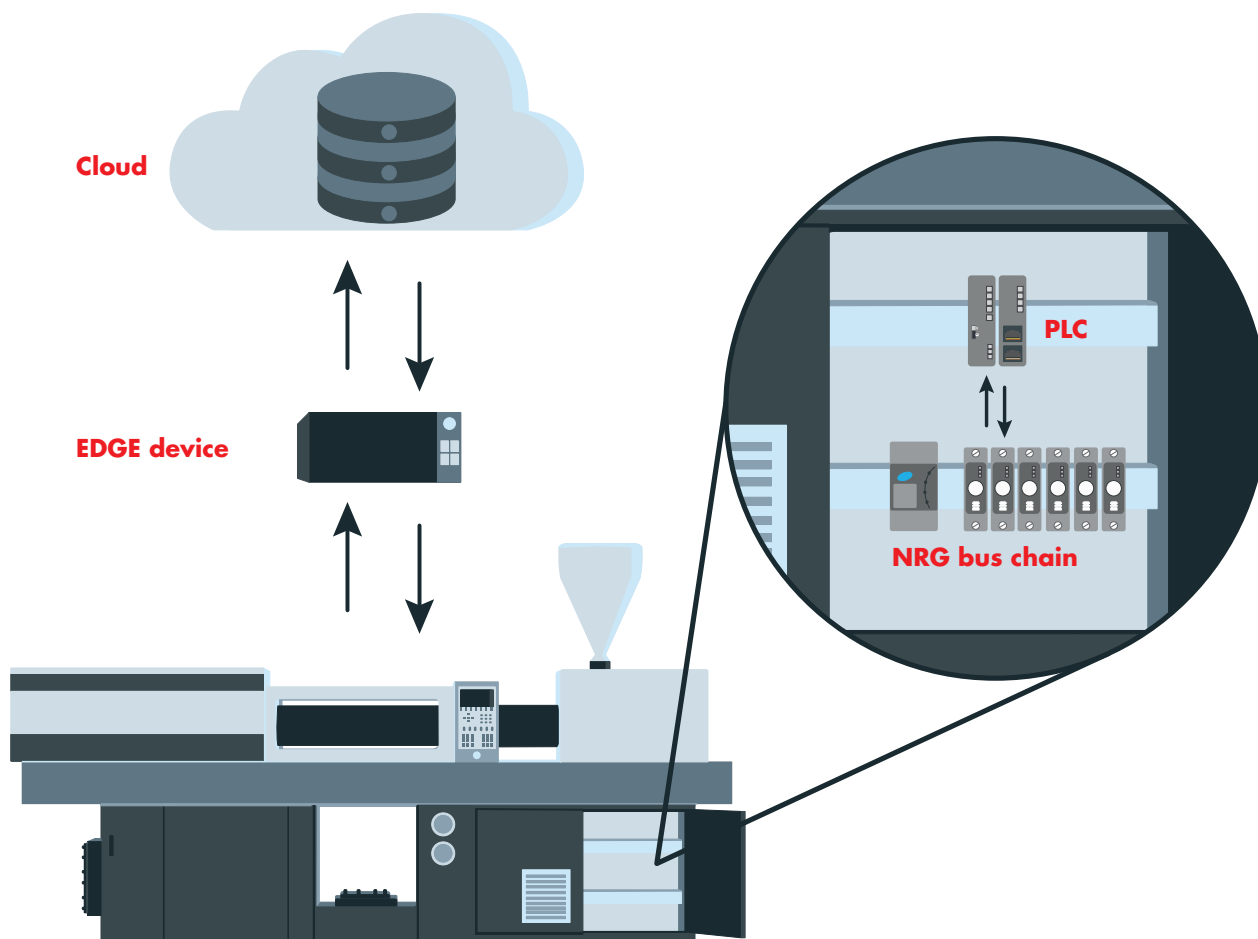
- Plastic injection machines
- PET blow moulding machines
- Packaging machines
- Semiconductor manufacturing machinery
- Glass tempering machines



## Digital solid state relays tailored for an IIoT environment

The industrial automation industry is at the outset of a new era of innovation with the hype of Industry 4.0. Data is at the core of this revolution and the NRG system of solid state relays fits right in the digital thread of information. On top of switching capabilities, the NRG digital solid state relays can

exchange monitoring and diagnostic data with the machine controller via the communication interface. This data can be further processed and analysed in a cloud system which would inflict a new horizon of opportunities for enhanced process automation, optimisation and part quality.



# NRG series

An all-in-one cost-effective switching and monitoring

## Compact

Minimum product width of 17.8 mm for a 37 AAC SSR that integrates both switching and monitoring

## Data

A number of parameters accessible in real-time from each SSR enable process improvements

## Connectivity

Use of common industrial protocols enable easy integration in industrial machinery

## Reduced hardware

No additional components for monitoring; the bus eliminates PLC output and input cards

## Flexibility

Various power control modes are available for all application requirements

## Predictive maintenance

Possible via SSR running hours and Load resistance monitoring

## Quick setup

Automatic addressing of all solid state relays on the NRG bus chain

## Fast troubleshooting

Detailed system and network fault analysis via the communication system

## Common

Available in: PROFINET, Modbus





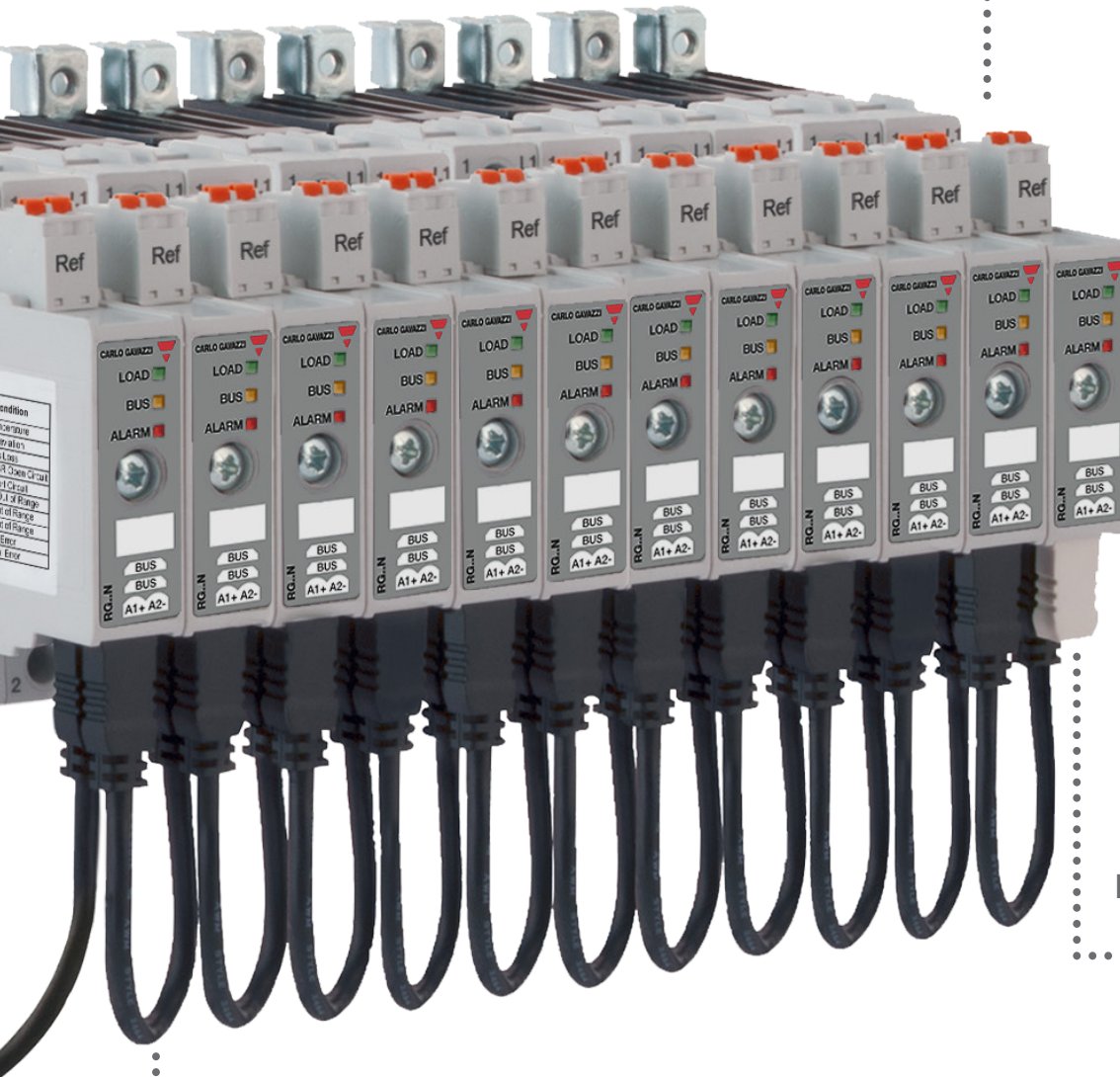
# ing solution

## ication

RTU, EtherNet/IP™, EtherCAT

## Switching

Up to 90 AAC, 600 VAC



## Diagnostics

Immediate system and SSR fault detection

## Real-time monitoring

of Current, Voltage, Power,  
Energy consumption and Running hours

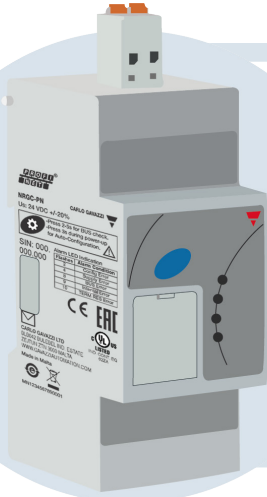
# NRG series

## Features

### The NRG bus chain components

The NRG is a sub-system that consists of one or more BUS chains that interact with the main controller or PLC in the machine via the communication interface. The NRG bus chain can have a maximum of 32 NRG solid state relays. The communication link between the NRG controller and the relays is the Internal BUS.

When more solid state relays are needed in a system, multiple BUS chains can be utilised. Standard protocol topologies can be adopted depending on the communication interface in use.

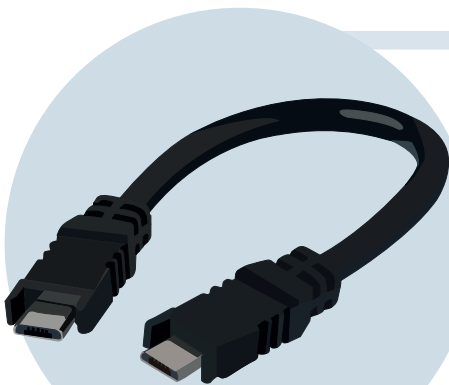
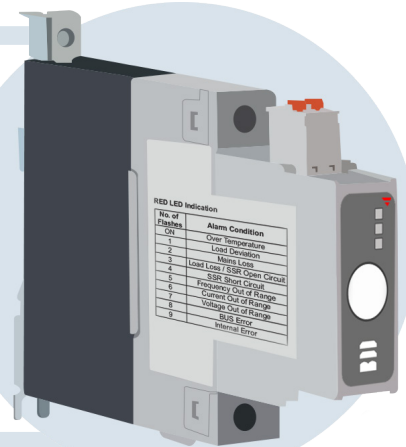


#### NRG Controller

The NRG controller is the main interface between the PLC and the NRG solid state relays. The NRG also performs internal operations related to the setup and maintenance of the NRG bus chain as well as monitoring the communication status. To facilitate communication via different communication protocols, the NRG Controller is currently available with a Modbus RTU interface for serial networks, PROFINET, EtherNet/IP™ or EtherCAT for ethernet based networks.

#### NRG Solid State Relays

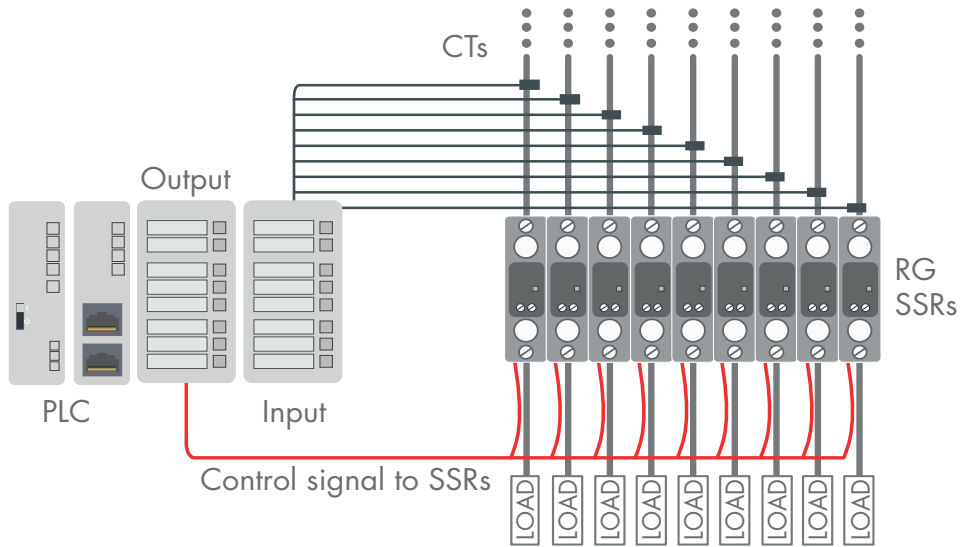
The NRG solid state relays are the switching devices that integrate monitoring circuitry and a communication interface through which measurement data and diagnostics can be exchanged with the machine controller. They are available with and without heatsink. Each NRG solid state relay on the bus chain is uniquely identified and automatically addressed on initial start-up.



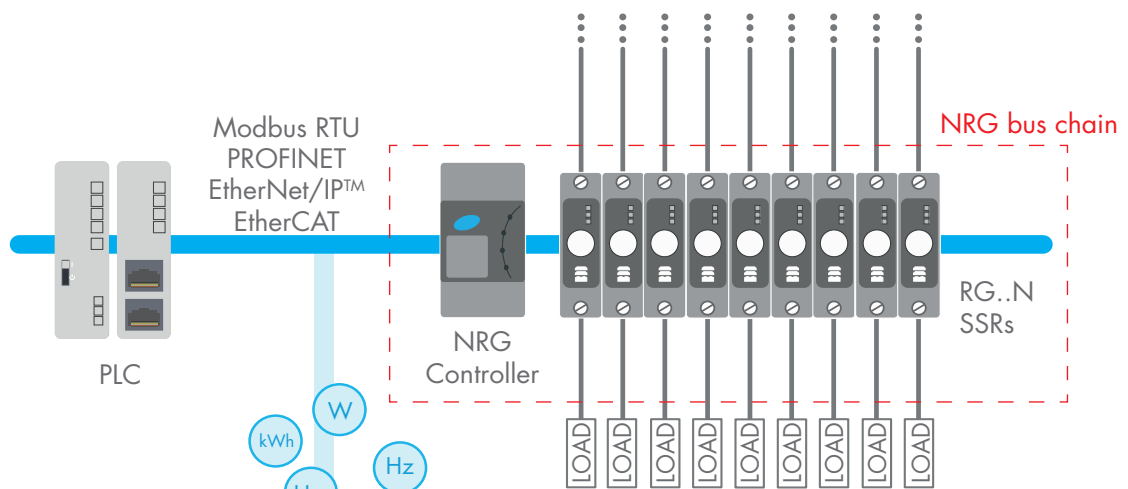
#### NRG Bus Cable

The NRG bus cable is a 5-way proprietary cable used for the internal BUS between the NRG controller and the NRG solid state relays on the bus chain. Apart from the data and supply lines, the NRG cable is equipped with an additional wire utilised for the auto-addressing of the NRG solid state relays on the bus chain.


**Monitoring and load switching - A traditional system setup**




**Real-time monitoring and load switching with the NRG**



- Current Transformers (CTs) redundant
- Reduced Output modules
- Reduced Input modules
- Faster machine integration

**Richer real-time data** 

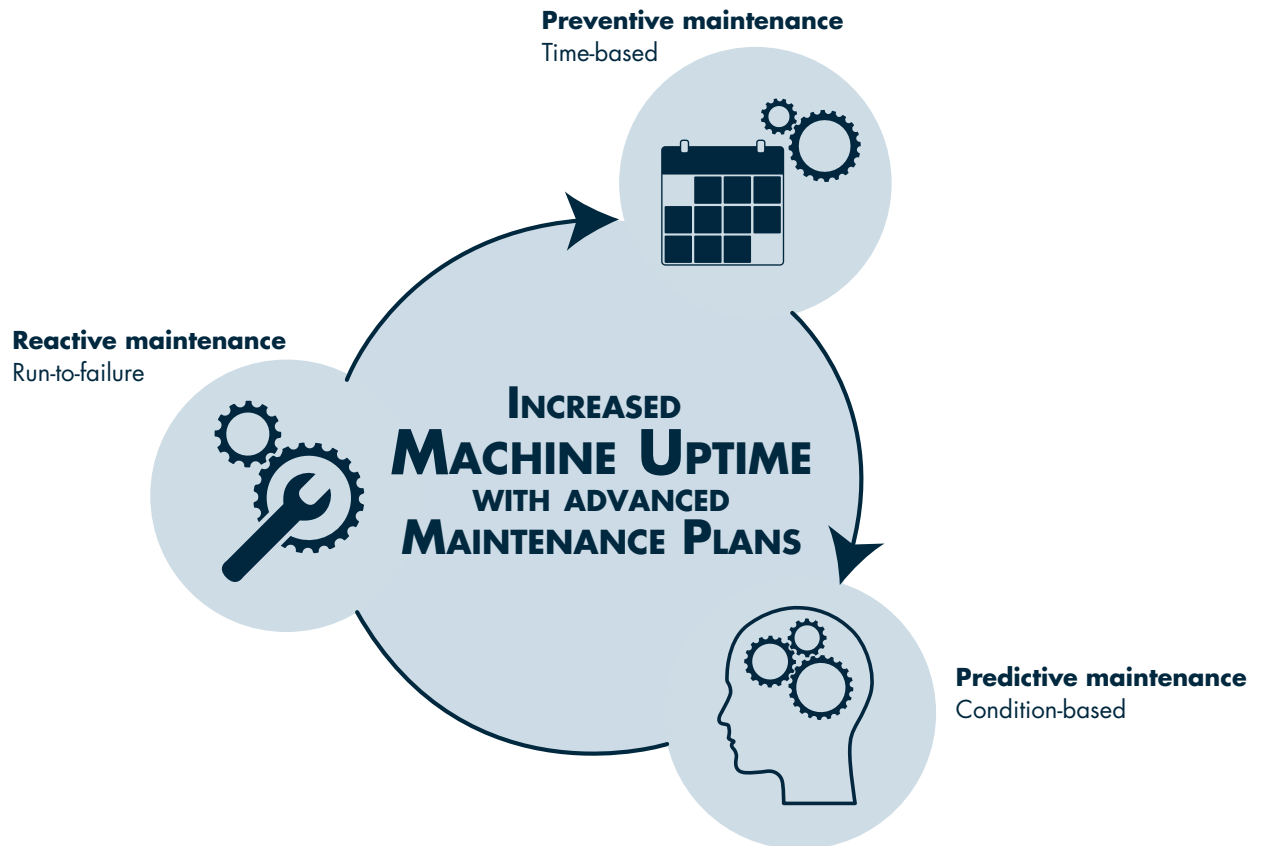
**Optimised system cost** 

# NRG series

## Features

### Diagnostics available with the NRG

If a failure occurs, it may not be possible for the automated process to maintain the set temperature profile. Quality of goods being produced is compromised and the machine must be shut down. Machine downtime related to these failures can be eliminated or reduced by utilizing NRG parameters associated to the status of the solid state relay and other relevant accessible data.



#### Reactive maintenance

To cater for sudden unpredictable failures, the NRG solid state relays are equipped with a number of alarms that monitor the system, the load, the SSR and also the communication system. These include:

- Load loss
- Mains loss
- SSR short circuit
- SSR open circuit
- Overtemperature
- SSR internal error
- Communication error

#### Preventive maintenance

The NRG solid state relays also offers a number of alarms to track system parameters which land themselves well into an efficient machine preventive maintenance plan. Such information includes:

- Current out of range
- Voltage out of range
- Frequency out of range
- Over temperature pre-warning
- Load running hours
- SSR running hours

#### Predictive maintenance

A possible way to predict a heater failure is through the change in resistance over its lifetime. With the NRG it is possible to continuously monitor the heater resistance by using accessible current and voltage measurements from the solid state relay and alert the machine controller if the measured resistance deviation is out of the set bounds via the

- Load Deviation alarm

The reference voltage and current to be used for the resistance monitoring can be recorded automatically via a 'TEACH' command and stored in the solid state relay

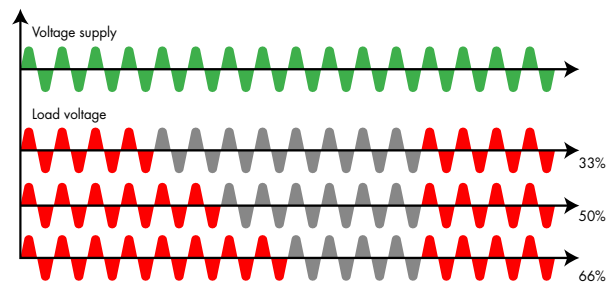


## Selectable switching modes

The various NRG switching modes are selectable via the communication interface. The ON/OFF mode is a direct replacement of the PLC output modules whereby minimal changes are required to the temperature control algorithm when replacing standard solid state relays. NRG solid state relays can also be controlled externally via an input terminal. Various power control modes are also available for all application needs, eliminating the need for the output to be pulse width modulated.

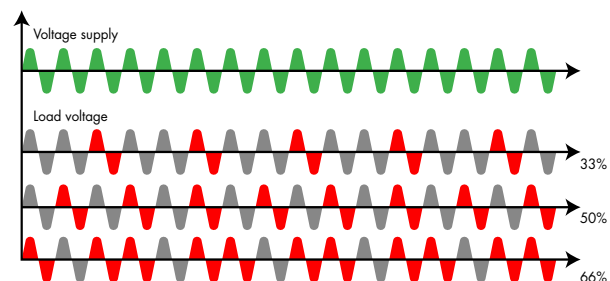
### Burst switching

Burst switching offers the flexibility to change the switching timebase according to the application requirements. The percentage ON time is the portion of the timebase that the SSR will be ON. The switching resolution depends on the selected timebase. Burst switching mitigates harmonics / emissions.



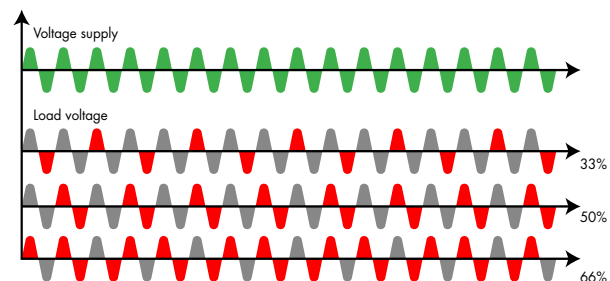
### Distributed full cycle switching

Distributed full cycle switching mode works with a fixed timebase whereby the % control level from the PLC translates to an even distribution of ON cycles over the time base. Distributing ON cycles results in less thermal overshoots which can be detrimental to the lifetime of both the heater and the SSR.



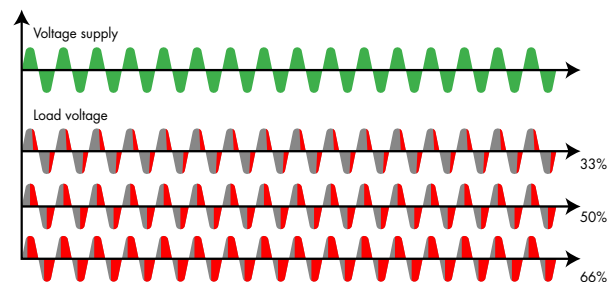
### Advanced full cycle switching

Utilising the same principle as Distributed switching, the Advanced full cycle switching mode distributes half cycles evenly according to the % control level from the PLC. This switching mode is ideal to reduce visual flickering synonymous with infrared heaters.



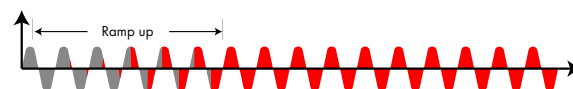
### Phase angle switching

Phase angle switching delivers the power to the load by controlling the thyristor firing over each half mains cycle. Phase angle is widely used due to its precise resolution of power. Despite the higher level of harmonics and electromagnetic disturbances generated vs. other switching modes, phase angle is the only switching mode that completely eliminates visual flickering of infrared heaters.



### Soft starting

Soft start ramping limits the inrush current of low cold resistance heaters. The soft starting function can be applied either via a settable time period or via a settable current limit and can be utilised with all switching modes.

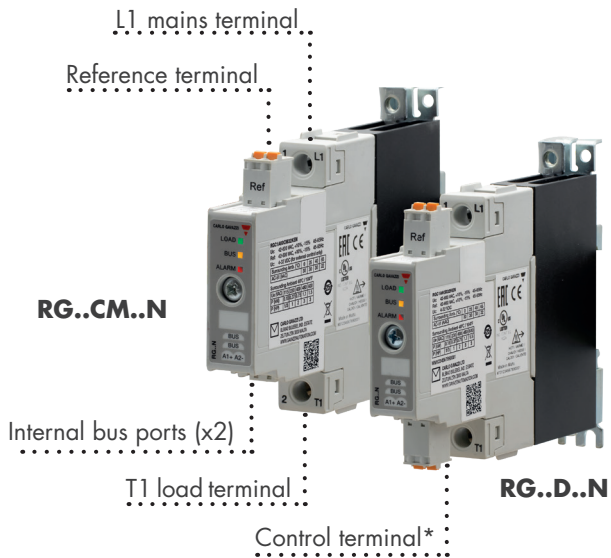


# NRG series

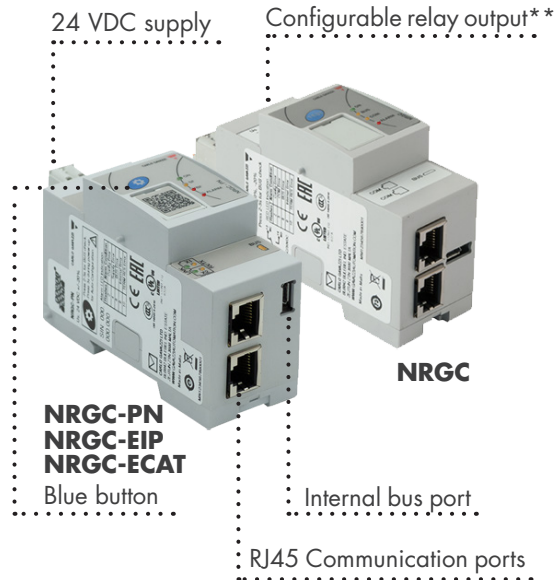
## Overview

### Product structure

#### NRG Solid State Relay



#### NRG Controller



The heatsink is integrated in the RGC version only

\* Available with RG..D..N only

\*\* NRG only

Dimensions: Refer to Selection guide

Dimensions (W x H x D mm) : 36 x 108 x 64

### NRG bus chain possible combinations

**Modbus**

**NRG Controller**

NRGC

**NRG Solid State Relay**

RG..D..N (max. 48)  
RG..CM..N (max. 32)

**PROFINET**

**NRG Controller**

NRGC-PN

**NRG Solid State Relay**

RG..CM..N (max. 32)

**PIV CERTIFIED**  
PROFIBUS • PROFINET

**EtherNet/IP**

**NRG Controller**

NRGC-EIP

**NRG Solid State Relay**

RG..CM..N (max. 32)

**ODVA CONFORMANT**

**EtherCAT**

**NRG Controller**

NRGC-ECAT

**NRG Solid State Relay**

RG..CM..N (max. 32)

**EtherCAT Conformance tested**

## Selection guide

### NRG Solid State Relay

<b>Switching</b>	External control	•	•	
	Switching via communication		•	•
	ON / OFF		•	•
	Distributed full cycle		•	•
	Advanced full cycle		•	•
	Phase angle			•
	Soft start			•
<b>Diagnostics</b>	Voltage compensation			•
	Load deviation monitoring		•	•
	Load loss alarm	•	•	•
	System diagnostics	•	•	•
	SSR diagnostics	•	•	•
	Parameters out of range	•	•	•
<b>Measurement</b>	Over temperature protection	•	•	•
	Current measurement (A)	•	•	•
	Voltage measurement (V)	•	•	•
	Frequency measurement (Hz)	•	•	•
	Power measurement (W, VA)	•	•	•
	SSR running hours (Hours)	•	•	•
	Load running hours (Hours)		•	•
<b>References</b>	Energy consumption (kWh)	•	•	•
	Versions w. integrated heatsink			
	25 AAC @ 40°C	<b>RG1A60D25KEN</b>	<b>RG1A60CM25KEN</b>	<b>RG1P60CM25KEN</b>
	32 AAC @ 40°C	<b>RG1A60D32KEN</b>	<b>RG1A60CM32KEN</b>	<b>RG1P60CM32KEN</b>
	37 AAC @ 40°C	<b>RG1A60D32GEN</b>	<b>RG1A60CM32GEN</b>	<b>RG1P60CM32GEN</b>
	43 AAC @ 40°C	<b>RG1A60D42GEN</b>	<b>RG1A60CM42GEN</b>	<b>RG1P60CM42GEN</b>
	65 AAC @ 40°C	<b>RG1A60D62GEN</b>	<b>RG1A60CM62GEN</b>	<b>RG1P60CM62GEN</b>
	Versions without heatsink			
	50 AAC	<b>RGS1A60D50KEN</b>	<b>RGS1A60CM50KEN</b>	<b>RGS1P60CM50KEN</b>
	90 AAC	<b>RGS1A60D92XEN</b>	<b>RGS1A60CM92XEN</b>	<b>RGS1P60CM92XEN</b>
<b>BUS</b>	Max. number of RG..Ns on bus chain	48	32	32
	Max. rated voltage	660 VAC	660 VAC	660 VAC
	I <sup>2</sup> t rating	up to 18000 A <sup>2</sup> s	up to 18000 A <sup>2</sup> s	up to 18000A <sup>2</sup> s
<b>Specifications</b>	Dimensions (W x H x D mm)			
	RG1..25, 32	17.8 x 110 x 134	17.8 x 110 x 134	17.8 x 110 x 134
	RG1..42	35 x 110 x 172	35 x 110 x 172	35 x 110 x 172
	RG1..62	70 x 110 x 172	70 x 110 x 172	70 x 110 x 172
	RGS..	17.8 x 90 x 82	17.8 x 90 x 82	17.8 x 90 x 82
<b>Certifications</b>	CE - cULus - UR - CSA - EAC - UKCA			

### NRG Controller

<b>Features</b>	Communication interface	Modbus RTU	PROFINET	EtherNet/IP™	EtherCAT
	Power supply	24 VDC	24 VDC	24 VDC	24 VDC
	Auxiliary digital output (EMR)	•			
	References	<b>NRGC</b>	<b>NRGC-PN</b>	<b>NRGC-EIP</b>	<b>NRGC-ECAT</b>
<b>Certifications</b>	CE - cULus - EAC - UKCA				

### NRG Internal Bus cables

References	Cable length
	10 cm
	75 cm
	150 cm
	350 cm
	500 cm

XEN = KEN for screw power terminals

XEN = GEN for box clamp power terminals

\*Packed by 4 pcs. Further details are available on online datasheets at [www.gavazziautomation.com](http://www.gavazziautomation.com)

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## OUR SALES NETWORK IN EUROPE

### AUSTRIA

Carlo Gavazzi GmbH  
Ketzergasse 374,  
A-1230 Wien  
Tel: +43 1 888 4112  
Fax: +43 1 889 10 53  
office@carlogavazzi.at

### BELGIUM

Carlo Gavazzi NV/SA  
Mechelsesteenweg 311,  
B-1800 Vilvoorde  
Tel: +32 2 257 4120  
sales@carlogavazzi.be

### DENMARK

Carlo Gavazzi Handel A/S  
Over Hadstensevej 40,  
DK-8370 Hadsten  
Tel: +45 89 60 6100  
Fax: +45 86 98 15 30  
handel@gavazzi.dk

### FINLAND

Carlo Gavazzi OY AB  
Ahventie, 4 B  
FI-02170 Espoo  
Tel: +358 9 756 2000  
myynti@gavazzi.fi

### FRANCE

Carlo Gavazzi Sarl  
Zac de Paris Nord II, 69, rue de la Belle Etoile,  
F-95956 Roissy CDG Cedex  
Tel: +33 1 49 38 98 60  
Fax: +33 1 48 63 27 43  
french.team@carlogavazzi.fr

### GERMANY

Carlo Gavazzi GmbH  
Pfnorstr. 10-14  
D-64293 Darmstadt  
Tel: +49 6151 81000  
Fax: +49 6151 81 00 40  
info@gavazzi.de

### GREAT BRITAIN

Carlo Gavazzi UK Ltd  
4.4 Frimley Business Park,  
Frimley, Camberley, Surrey GU16 7SG  
Tel: +44 1 276 854 110  
Fax: +44 1 276 682 140  
sales@carlogavazzi.co.uk

### ITALY

Carlo Gavazzi SpA  
Via Milano, 13,  
I-20045 Lainate  
Tel: +39 02 931 761  
Fax: +39 02 931 763 01  
info@gavazziacbu.it

### NETHERLANDS

Carlo Gavazzi BV  
Wijkermeerweg 23,  
NL-1948 NT Beverwijk  
Tel: +31 251 22 9345  
Fax: +31 251 22 60 55  
info@carlogavazzi.nl

### NORWAY

Carlo Gavazzi AS  
Melkeveien 13,  
N-3919 Parsgrunn  
Tel: +47 35 93 0800  
Fax: +47 35 93 08 01  
post@gavazzi.no

### PORTUGAL

Carlo Gavazzi Lda  
Rua dos Jerónimos 38-B,  
P-1400-212 Lisboa  
Tel: +351 21 361 7060  
Fax: +351 21 362 13 73  
carlogavazzi@carlogavazzi.pt

### SPAIN

Carlo Gavazzi SA  
Avda. Iparraguirre, 80-82,  
E-48940 Leioa (Bizkaia)  
Tel: +34 94 480 4037  
Fax: +34 94 431 6081  
gavazzi@gavazzi.es

### SWEDEN

Carlo Gavazzi AB  
V:a Kyrkogatan 1,  
S-652 24 Karlstad  
Tel: +46 54 85 1125  
Fax: +46 54 85 11 77  
info@carlogavazzi.se

### SWITZERLAND

Carlo Gavazzi AG  
Verkauf Schweiz/Vente Suisse  
Sumpfstrasse 3,  
CH-6312 Steinhausen  
Tel: +41 41 747 4535  
Fax: +41 41 740 45 40  
info@carlogavazzi.ch

## OUR SALES NETWORK IN THE AMERICAS

### USA

Carlo Gavazzi Inc.  
750 Hastings Lane,  
Buffalo Grove, IL 60089, USA  
Tel: +1 847 465 6100  
Fax: +1 847 465 7373  
sales@carlogavazzi.com

### CANADA

Carlo Gavazzi Inc.  
2660 Meadowvale Boulevard,  
Mississauga, ON L5N 6M6, Canada  
Tel: +1 905 542 0979  
Fax: +1 905 542 22 48  
gavazzi@carlogavazzi.com

### MEXICO

Carlo Gavazzi Mexico S.A. de C.V.  
Circuito Puericultores 22, Ciudad Satelite  
Naucalpan de Juarez, Edo Mex. CP 53100  
Mexico  
T +52 55 5373 7042  
F +52 55 5373 7042  
mexicosales@carlogavazzi.com

### BRAZIL

Carlo Gavazzi Automação Ltda.  
Av. Francisco Matarazzo, 1752  
Conj 2108 - Barra Funda - São Paulo/SP  
Tel: +55 11 3052 0832  
Fax: +55 11 3057 1753  
info@carlogavazzi.com.br

## OUR SALES NETWORK IN ASIA AND PACIFIC

### SINGAPORE

Carlo Gavazzi Automation Singapore Pte. Ltd.  
61 Tai Seng Avenue #05-06  
Print Media Hub @ Paya Lebar iPark  
Singapore 534167  
Tel: +65 67 466 990  
Fax: +65 67 461 980  
info@carlogavazzi.com.sg

### MALAYSIA

Carlo Gavazzi Automation (M) SDN. BHD.  
D12-06-G, Block D12,  
Pusat Perdagangan Dana 1,  
Jalan PJU 1A/46, 47301 Petaling Jaya,  
Selangor, Malaysia.  
Tel: +60 3 7842 7299  
Fax: +60 3 7842 7399  
sales@gavazzi-asia.com

### CHINA

Carlo Gavazzi Automation  
(China) Co. Ltd.  
Unit 2308, 23/F.,  
News Building, Block 1, 1002  
Middle Shennan Zhong Road,  
Shenzhen, China  
Tel: +86 755 83699500  
Fax: +86 755 83699300  
sales@carlogavazzi.cn

### HONG KONG

Carlo Gavazzi Automation  
Hong Kong Ltd.  
Unit No. 16 on 25<sup>th</sup> Floor, One Midtown,  
No. 11 Hoi Shing Road, Tsuen Wan,  
New Territories, Hong Kong  
Tel: +852 26261332 / 26261333  
Fax: +852 26261316

### TAIWAN

Branch of Carlo Gavazzi Automation  
Singapore Pte. Ltd.  
22F-1, No. 500 Shinzheng Rd,  
Xitun Dist, Taichung City,  
Taiwan, China  
Tel. +886 4 2258 4001  
Fax +886 4 22584 4002

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Carlo Gavazzi Industri A/S  
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Uab Carlo Gavazzi Industri Kaunas  
Kaunas

### CHINA

Carlo Gavazzi Automation (Kunshan) Co., Ltd.  
Kunshan

## HEADQUARTERS

Carlo Gavazzi Automation SpA  
Via Milano, 13  
I-20045 - Lainate (MI) - ITALY  
Tel: +39 02 931 761  
info@gavazziautomation.com

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