



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

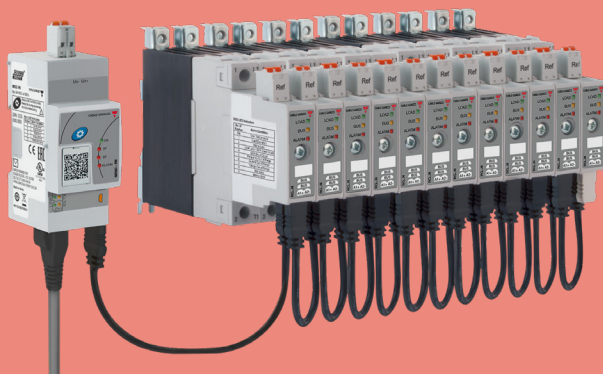
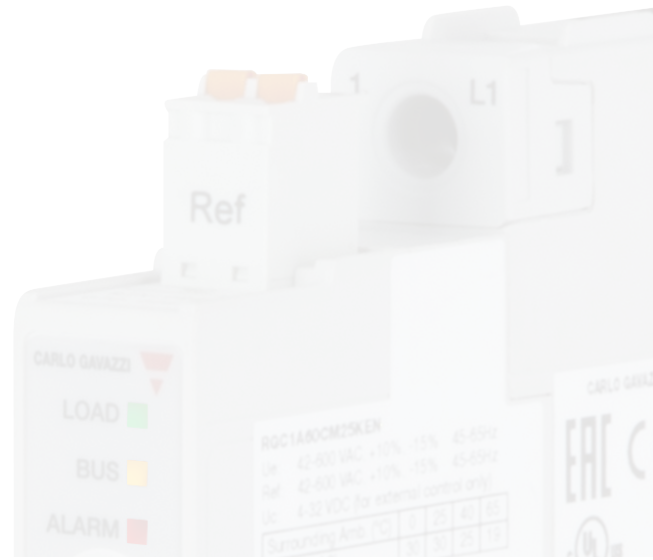
**Switches**

# 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, Modbus TCP, 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:

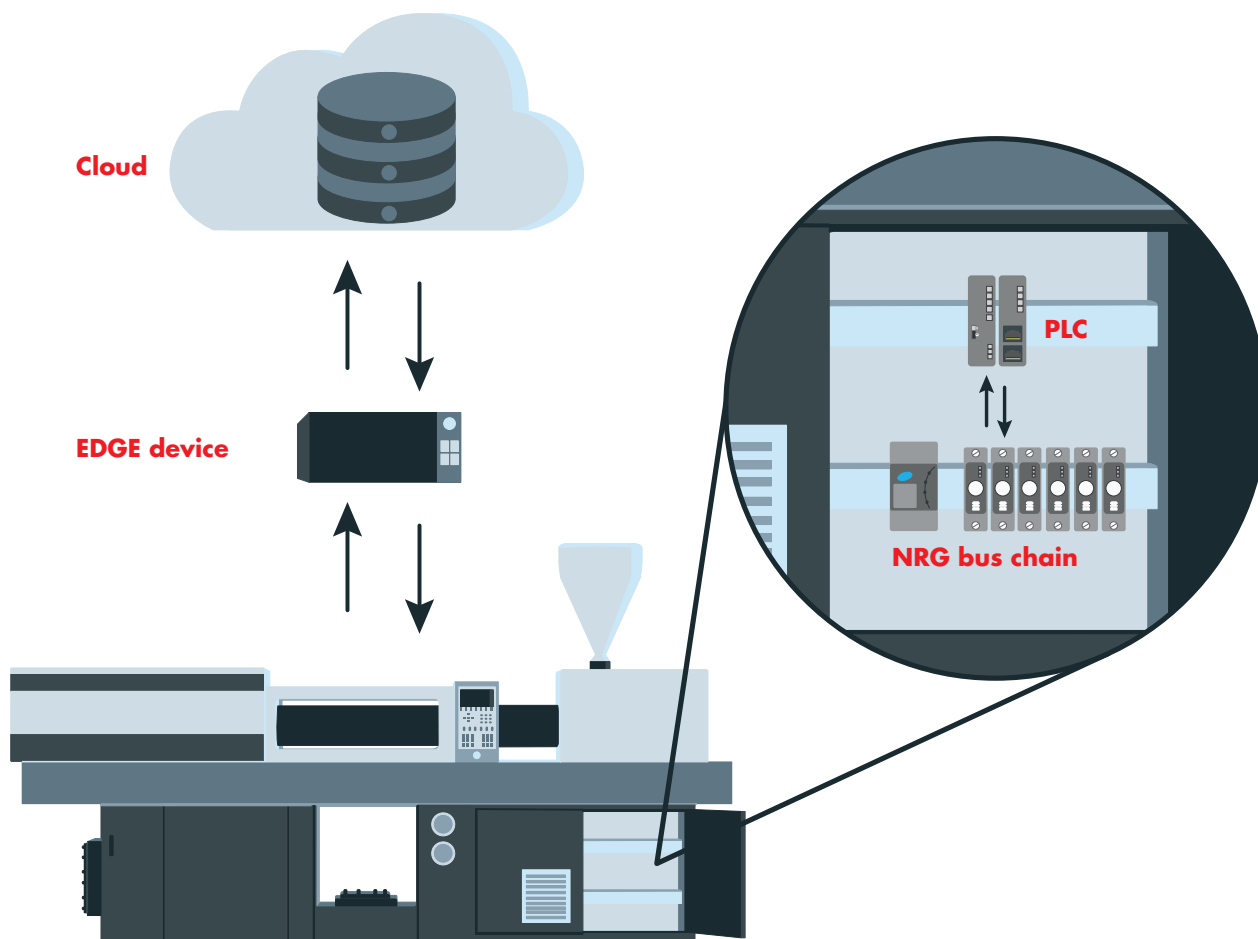
- Plastic injection machines
- PET blow moulding machines
- Packaging machines
- Semiconductor manufacturing machinery
- Glass tempering machines



## 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



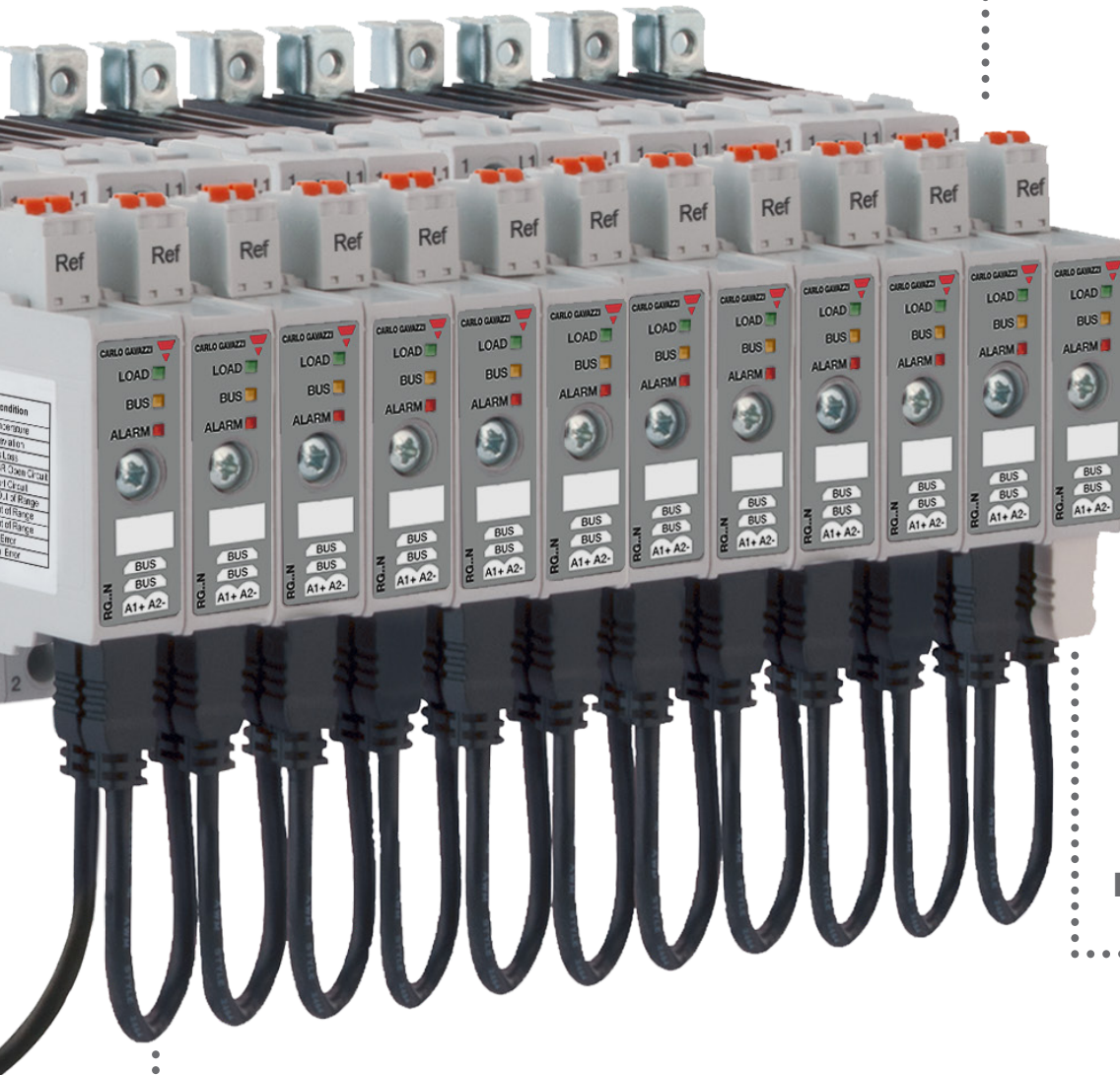
# ing solution

## unication

RTU/TCP, 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

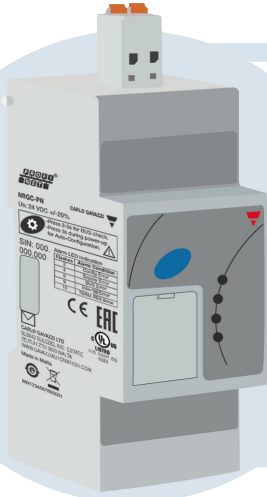
# NRG series

## 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.

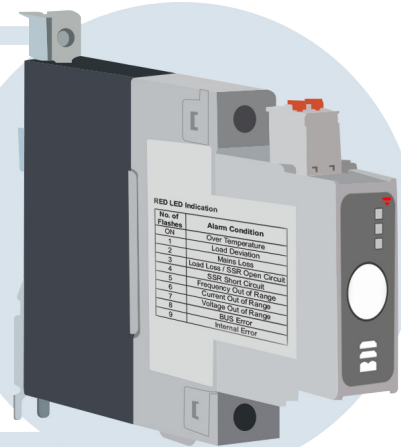


#### NRG Controller

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™, EtherCAT or Modbus TCP for ethernet based networks.

#### NRG Solid State Relays

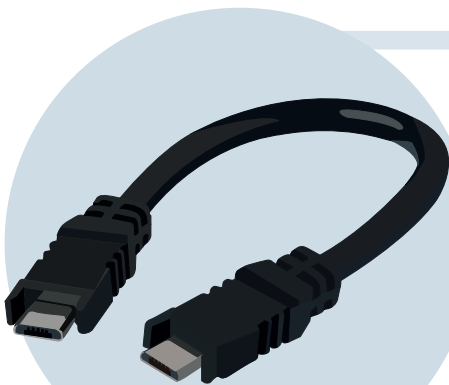
The NRG solid state relays are the switching devices that integrate monitoring circuitry and a communication interface through which measurement data and diagnostics can be exchanged with the machine controller. They are available with and without heatsink. Each NRG solid state relay on the bus chain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



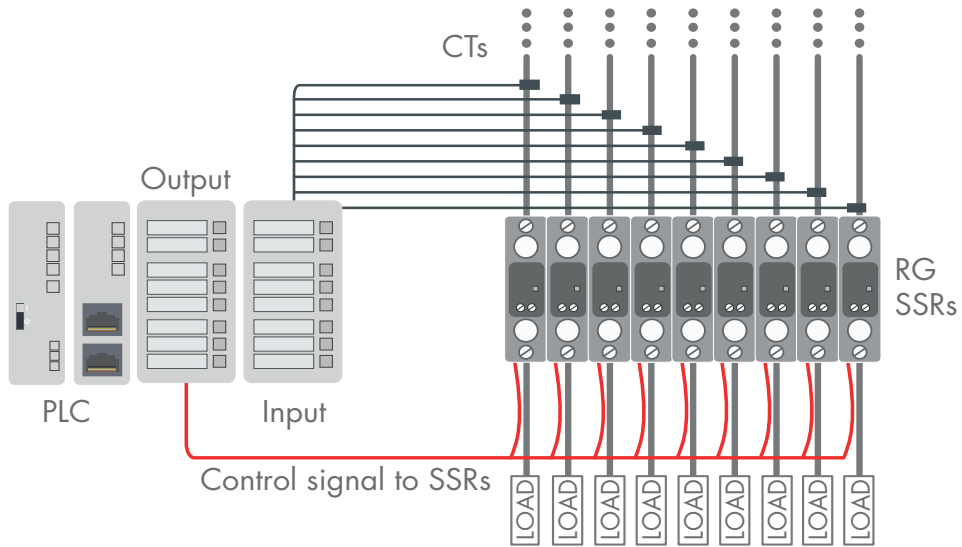
No. of Flashes	Alarm Condition
1	Over Temperature
2	Load Deviation
3	Missed Load
4	Load Loss / SSR Open Circuit
5	SSR Short Circuit
6	Frequency Out of Range
7	Current Out of Range
8	Voltage Out of Range
9	BUS Error Internal Error

#### NRG Bus Cable

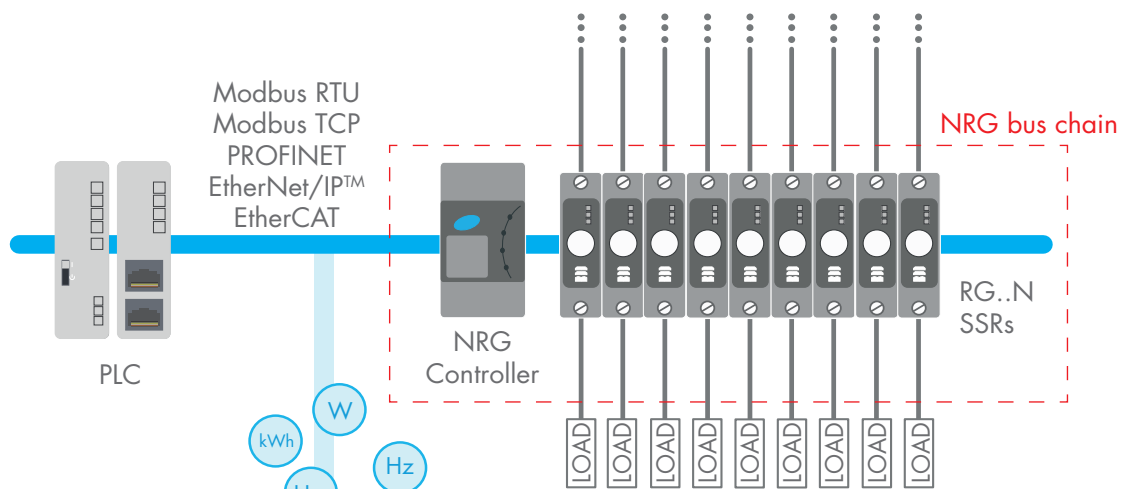
The NRG bus cable is a 5-way proprietary cable used for the internal BUS between the NRG controller and the NRG solid state relays on the bus chain. Apart from the data and supply lines, the NRG cable is equipped with an additional wire utilised for the auto-addressing of the NRG solid state relays on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

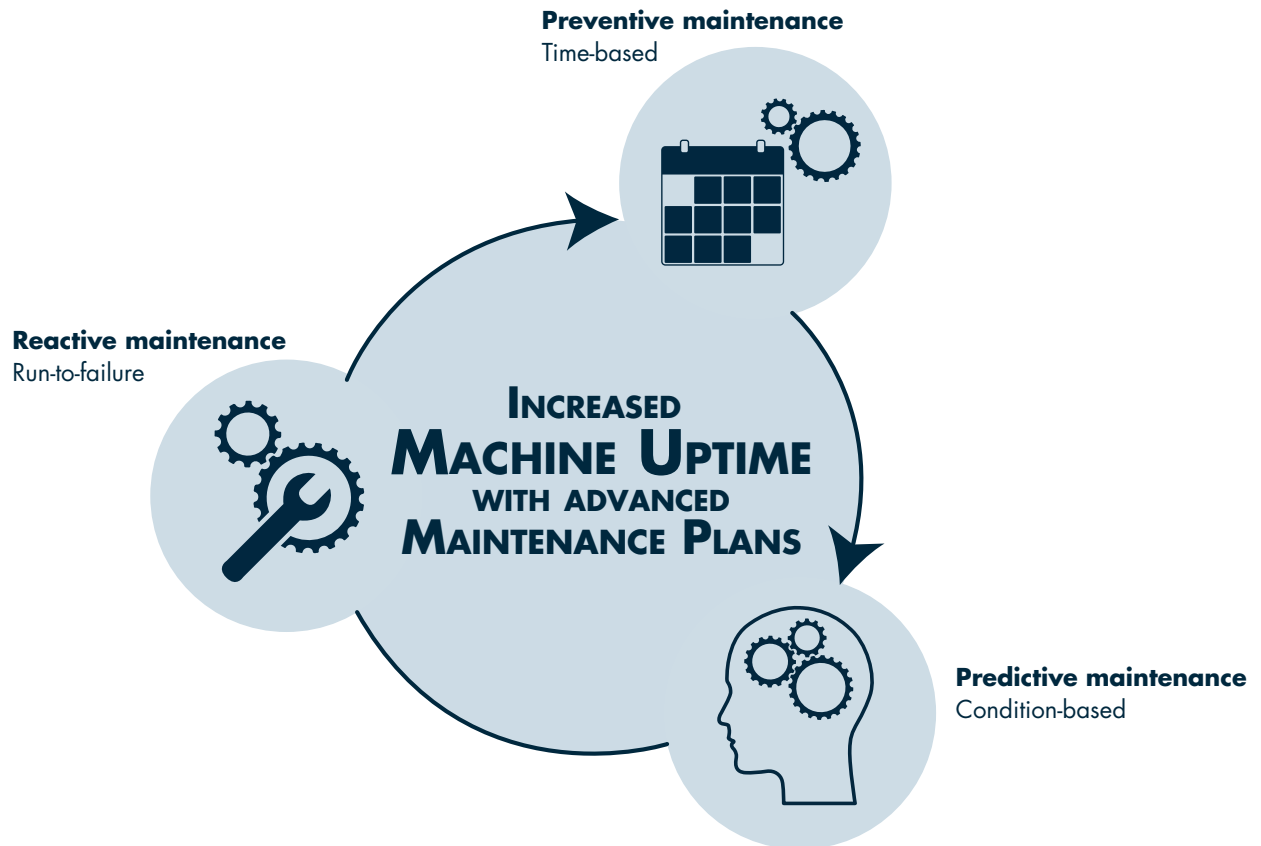
**Optimised system cost** 

# 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

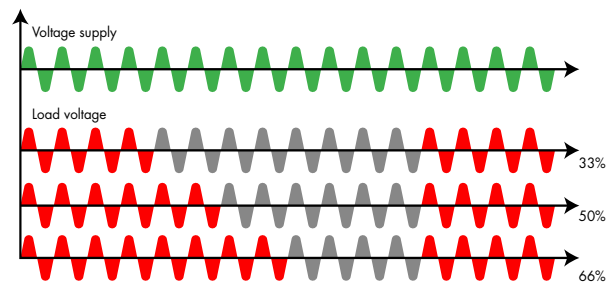


## Selectable switching modes

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.

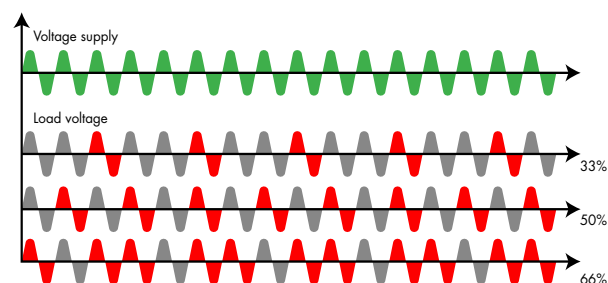
### Burst switching

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.



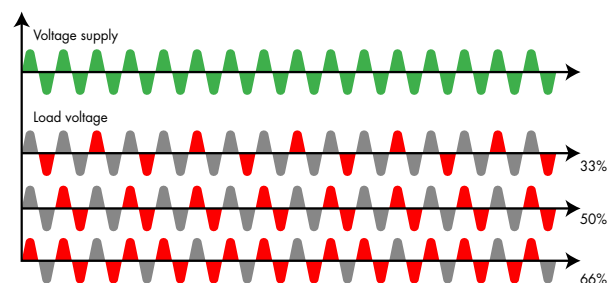
### Distributed full cycle switching

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.



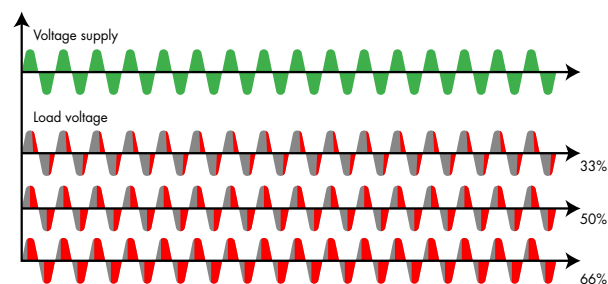
### Advanced full cycle switching

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.



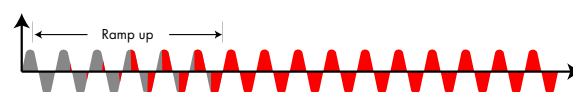
### Phase angle switching

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.

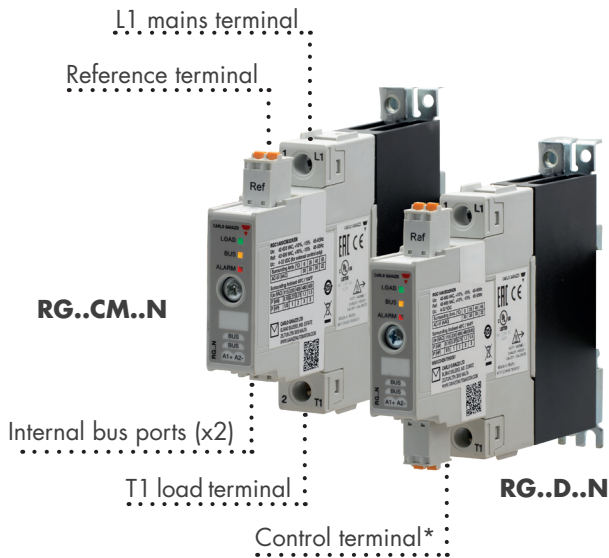


# NRG series

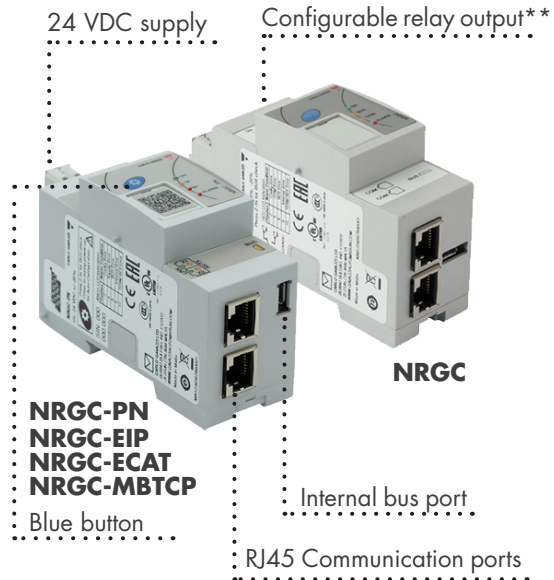
## Overview

### Product structure

#### NRG Solid State Relay



#### NRG Controller



The heatsink is integrated in the RGC version only

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

\*\* NRGC 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 (RTU)  
NRGC-MBTCP (TCP)

**NRG Solid State Relay**

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

*\*for NRGC only*

**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			•
	Voltage compensation			•
<b>Diagnostics</b>	Load deviation monitoring		•	•
	Load loss alarm	•	•	•
	System diagnostics	•	•	•
	SSR diagnostics	•	•	•
	Parameters out of range	•	•	•
	Over temperature protection	•	•	•
<b>Measurement</b>	Current measurement (A)	•	•	•
	Voltage measurement (V)	•	•	•
	Frequency measurement (Hz)	•	•	•
	Power measurement (W, VA)	•	•	•
	SSR running hours (Hours)	•	•	•
	Load running hours (Hours)		•	•
	Energy consumption (kWh)	•	•	•
	<b>References</b>	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
	Max. rated voltage	660 VAC	660 VAC	660 VAC
<b>Specifications</b>	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
	Dimensions (W x H x D mm)			
	RGC..25, 32	17.8 x 110 x 134	17.8 x 110 x 134	17.8 x 110 x 134
	RGC..42	35 x 110 x 172	35 x 110 x 172	35 x 110 x 172
	RGC..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 - CCC			

### NRG Controller

<b>Features</b>	Communication interface	Modbus RTU	PROFINET	EtherNet/IP™	EtherCAT	Modbus TCP
	Power supply	24 VDC	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>NRGC-MBTCP</b>
<b>Certifications</b>	CE - cULus - EAC - UKCA					

### NRG Internal Bus cables

<b>References</b>	Cable length	10 cm	25 cm	75 cm	150 cm	350 cm	500 cm
		<b>RCRGN-010-2*</b>	<b>RCRGN-025-2</b>	<b>RCRGN-075-2</b>	<b>RCRGN-150-2</b>	<b>RCRGN-350-2</b>	<b>RCRGN-500-2</b>

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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