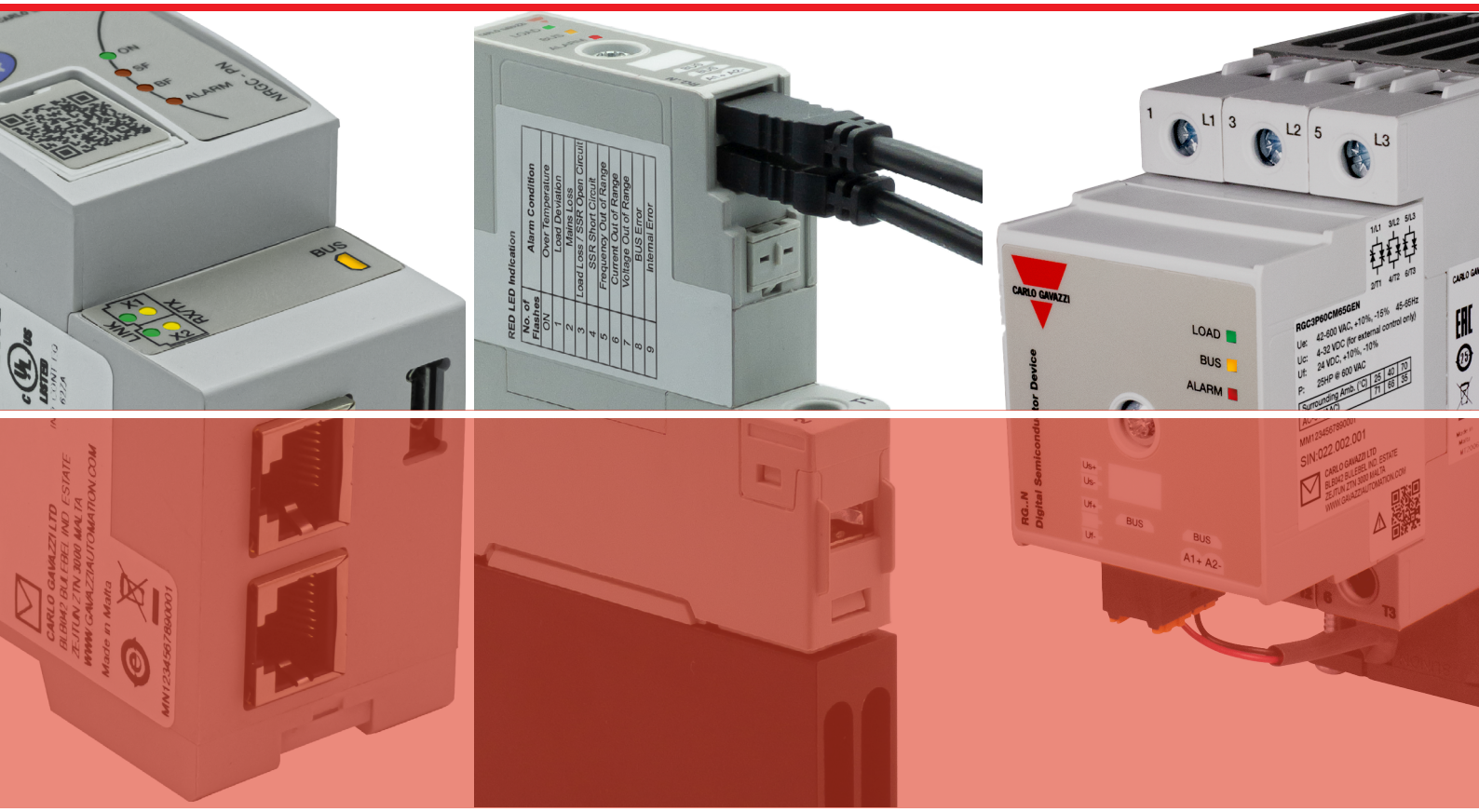
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Automation Components

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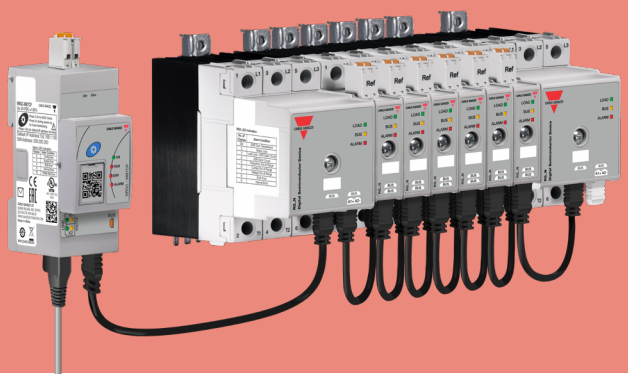
NRG: Solid state relays with real-time monitoring

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.



Modbus
EtherNet/IP
PROFINET
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 sytem, 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.

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Applications

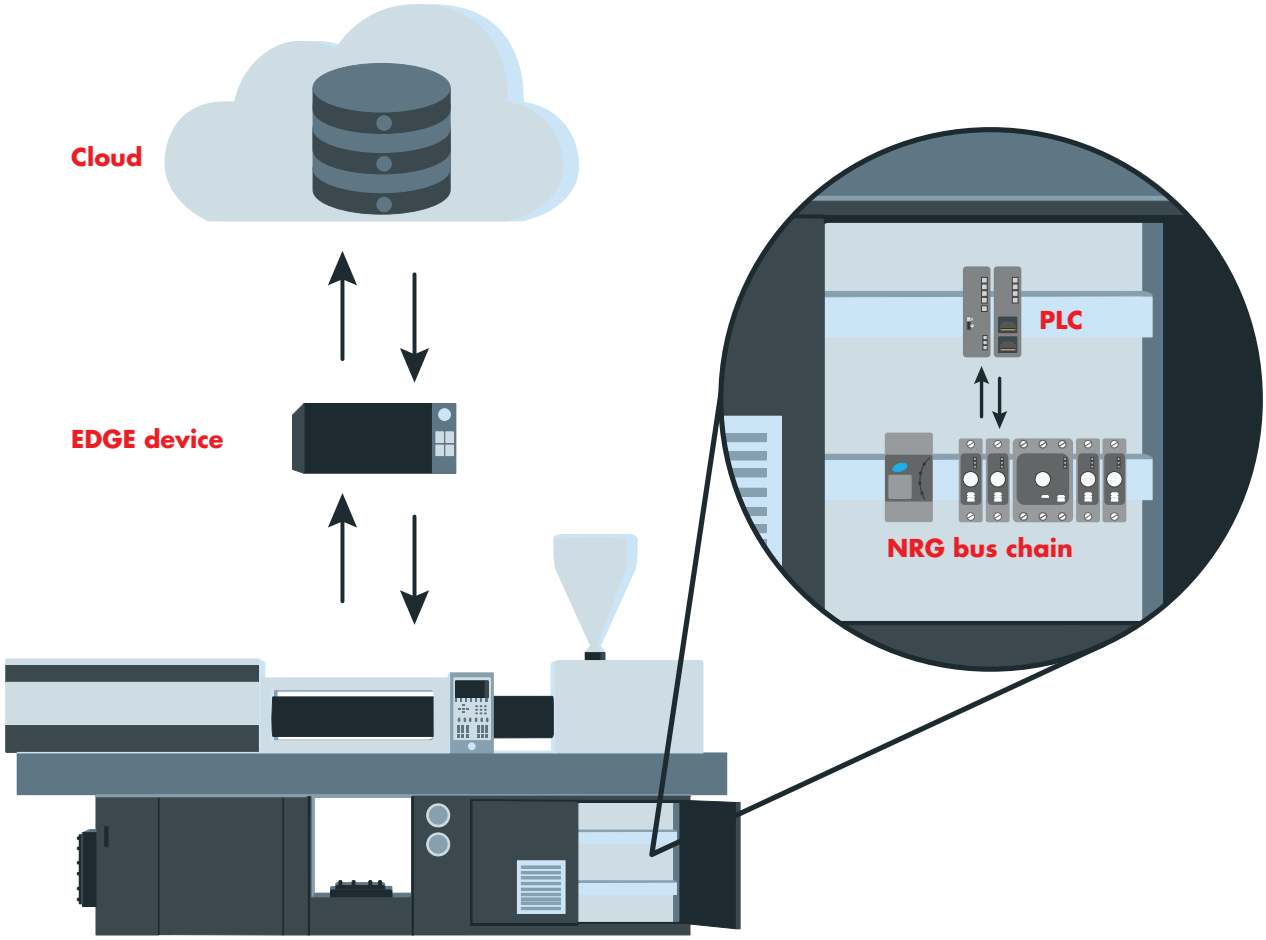
The NRG is the ideal switching solution when monitoring of the field level devices is required to minimise expensive downtimes. In addition to the switching function, the NRG integrates monitoring circuity, in the same footprint, to enable exchange of data with the machine controller. The NRG solid state 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 monitori

Compact
Minimum product width of 17.8 mm for a 37 AAC 1-pole 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

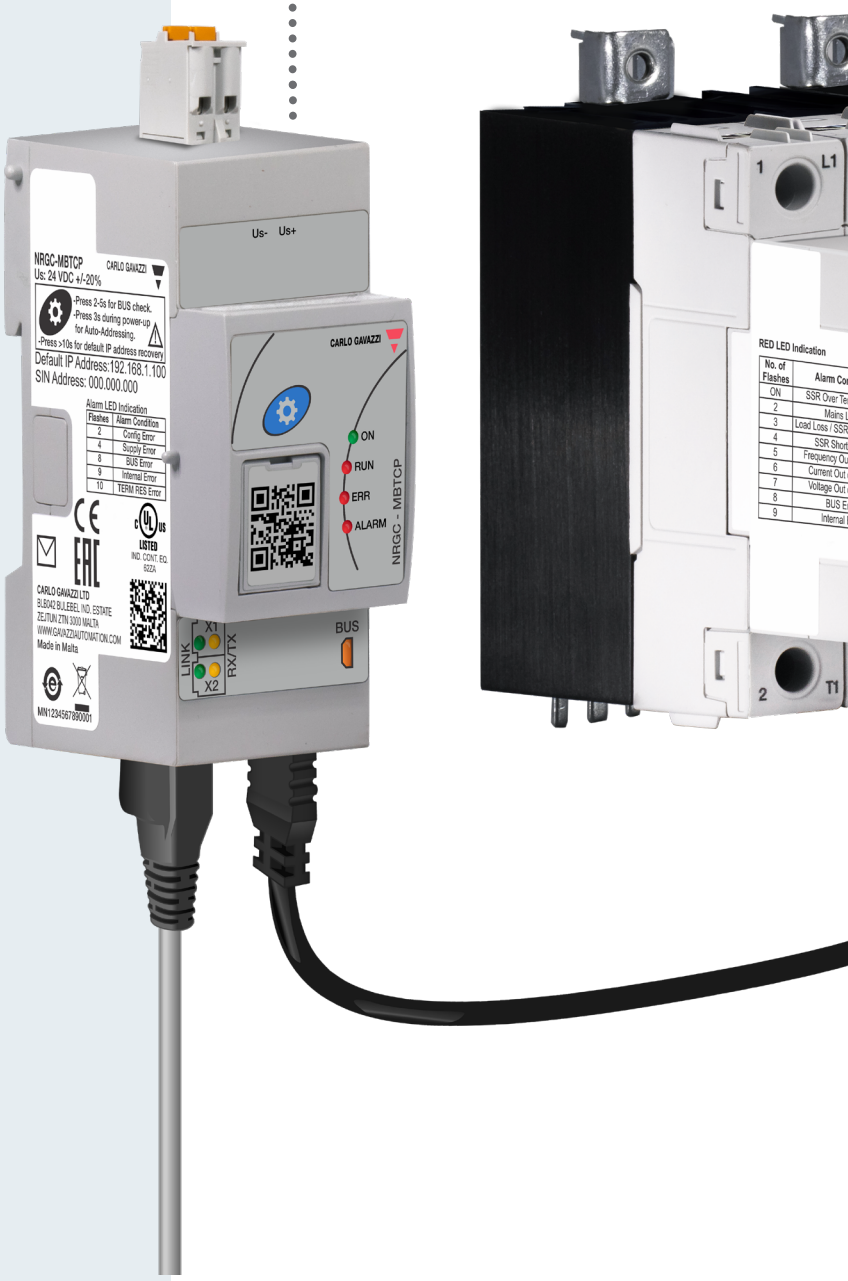
Versatility
Possibility to control 1-phase and 3-phase loads with a combination of 1-pole, 2-pole, and 3-pole SSRs

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

Commu
Available in: PROFINET, Modbus



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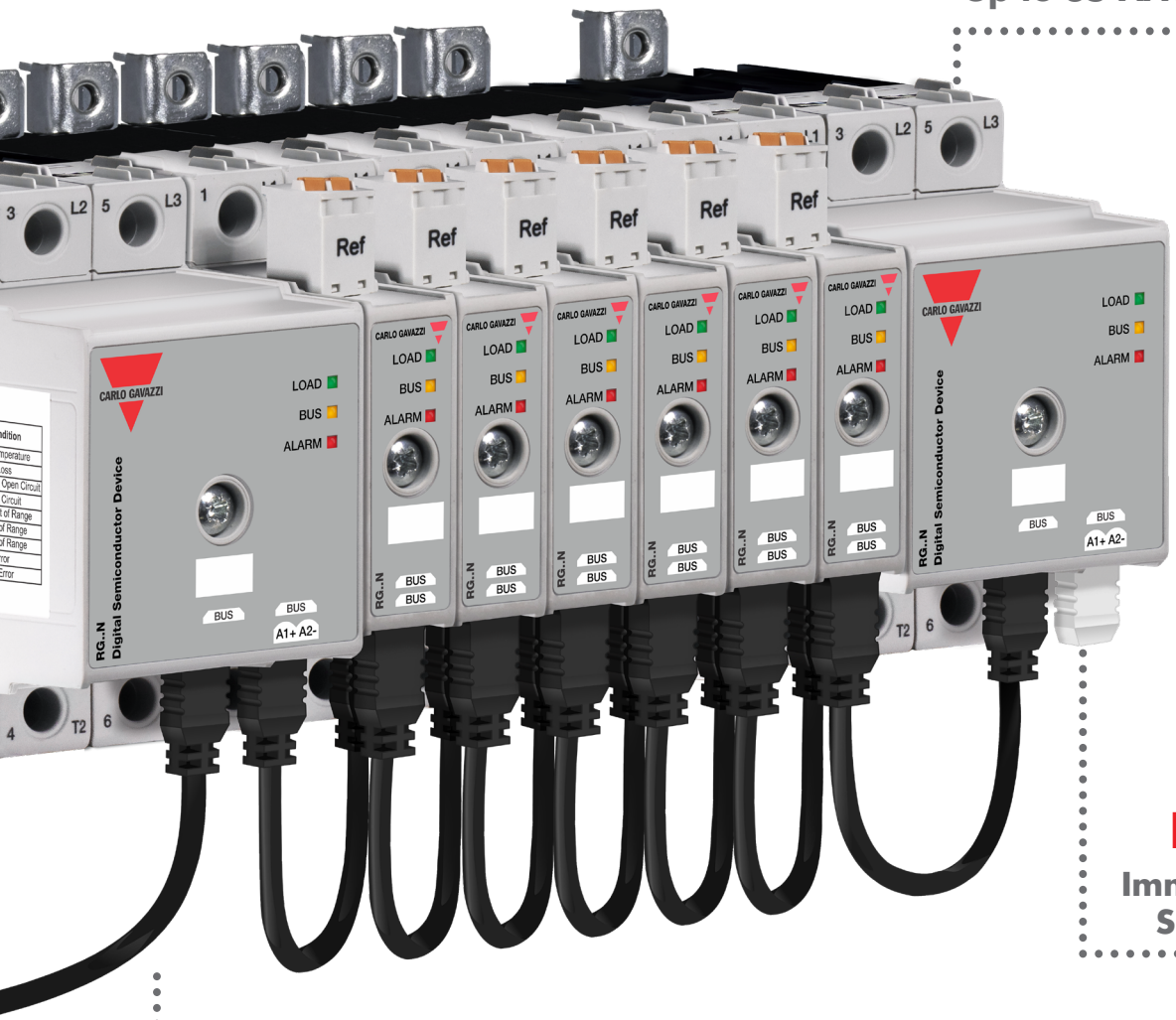
ng solution

unication

RTU/TCP, EtherNet/IP™, EtherCAT

Switching

Up to 90 AAC, 600 VAC (1-pole)
Up to 75 AAC, 600 VAC (2-pole)
Up to 65 AAC, 600 VAC (3-pole)



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 modular subsystem comprising one or more BUS chains that communicate with the machine's main controller or PLC via a dedicated communication interface. Each NRG bus chain can include a combination of single-phase and two/three-phase solid state relays, supporting up to 32 switched poles per chain.

Communication between the NRG controller and the relays is managed through an internal BUS. For systems requiring a higher number of relays, multiple BUS chains can be implemented. The system supports various standard protocol topologies, adaptable to the specific communication interface in use.

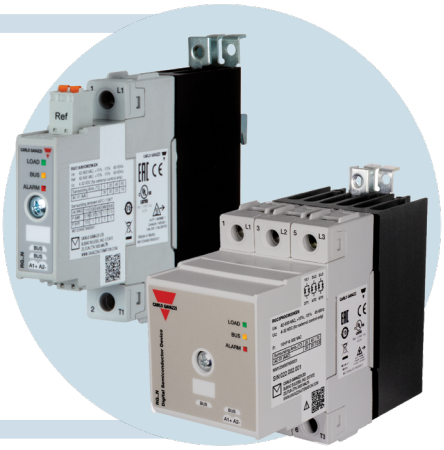


NRG Controller

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.
Single-phase relays include both zero-cross and proportional control variants. These are available with and without heatsink. The NRG solid state relay range includes also three-phase switching solutions which caters for both 3-pole and also economy (2-pole) switching.



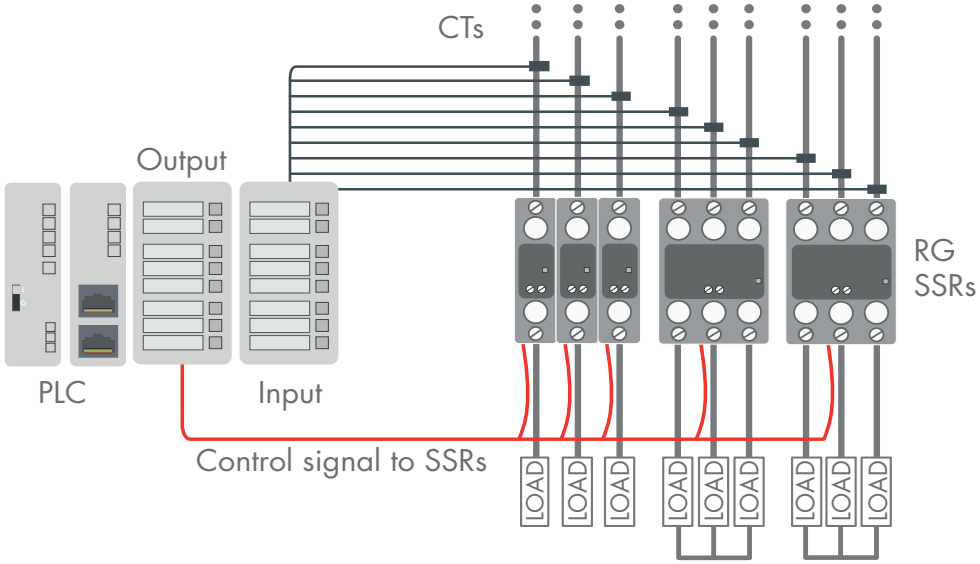


NRG Bus Cable

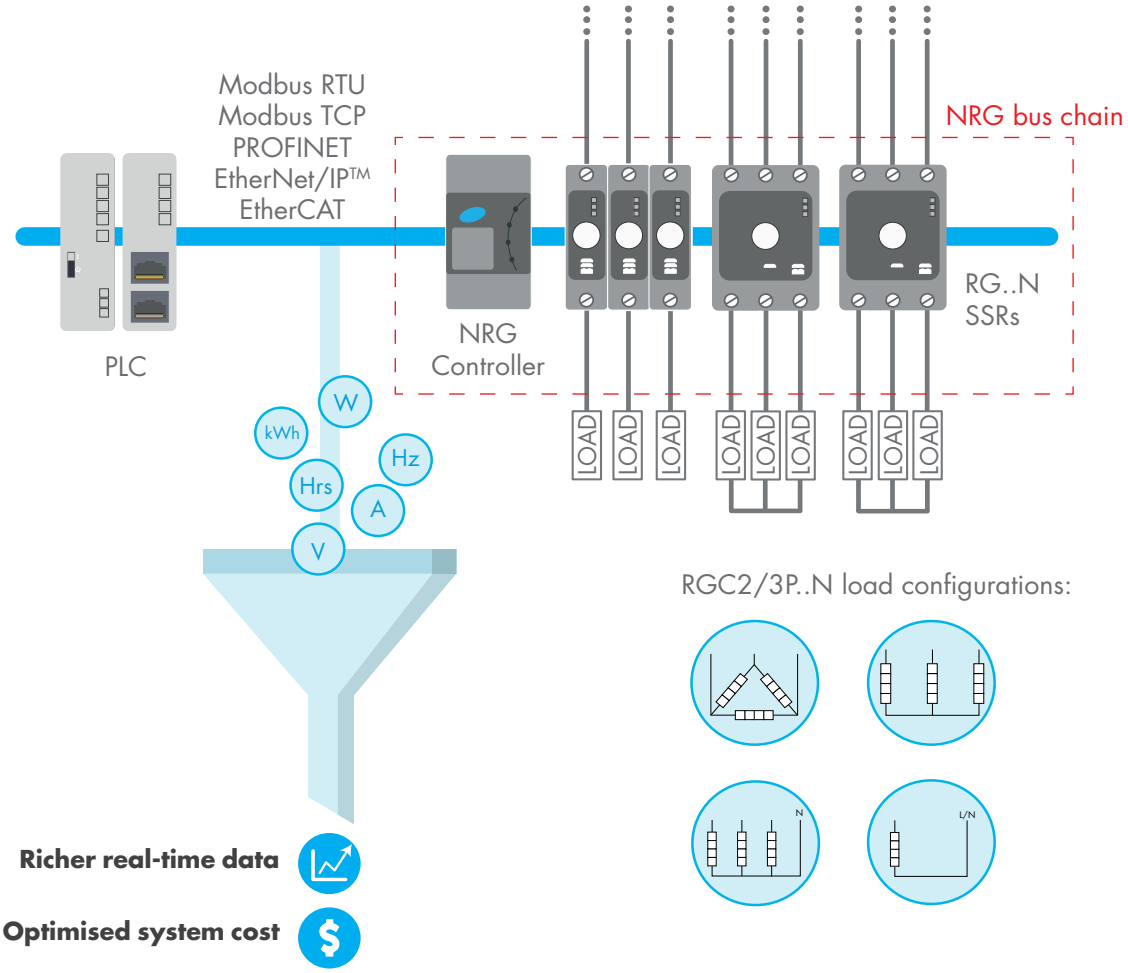
The NRG bus cable is a 5-way proprietary cable used for the internal BUS between the NRG controller and the NRG solid state relays on the bus chain. Apart from the data and supply lines, the NRG cable is equipped with an additional wire utilised for the auto-addressing of the NRG solid state relays on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

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Monitoring and load switching - A traditional system setup



Real-time monitoring and load switching with the NRG

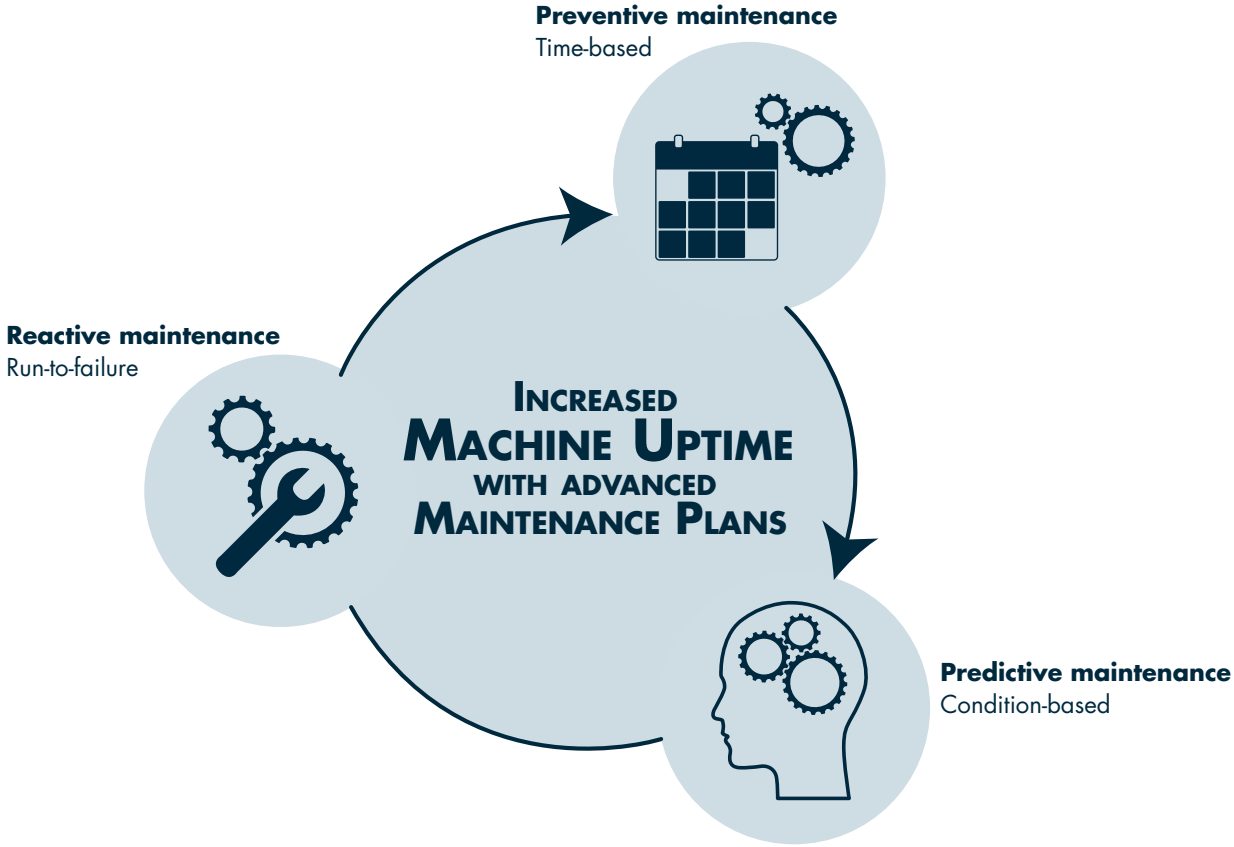


- Current Transformers (CTs) redundant
- Faster machine integration
- Reduced Input/Output modules

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 maintance 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

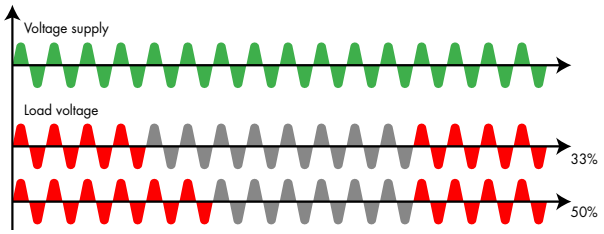
CARLO GAVAZZI Automation Components. Specifications are subject to change without notice. Illustrations are for example only.

Selectable switching modes and advanced features

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.

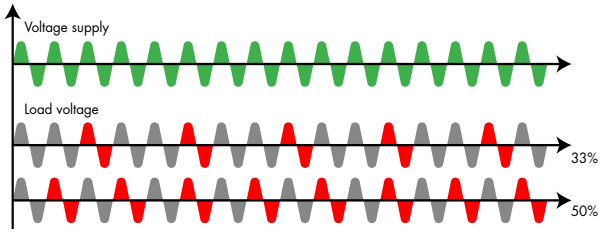
Burst switching

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.



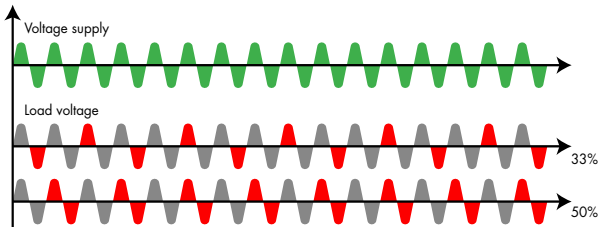
Distributed full cycle switching

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 detremental to the lifetime of both the heater and the SSR.



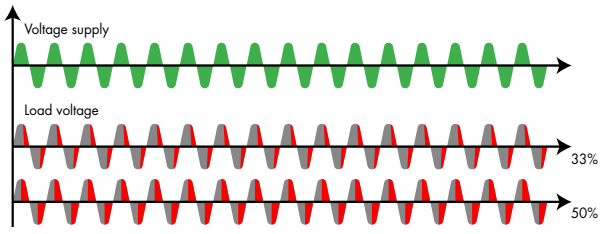
Advanced full cycle switching

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



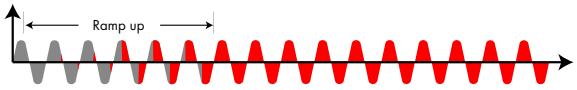
Phase angle switching

Phase angle switching delivers the power to the load by controlling the tyristor 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.



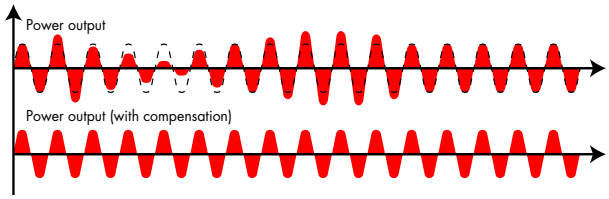
Soft starting

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.



Advanced feedback loops for power stability

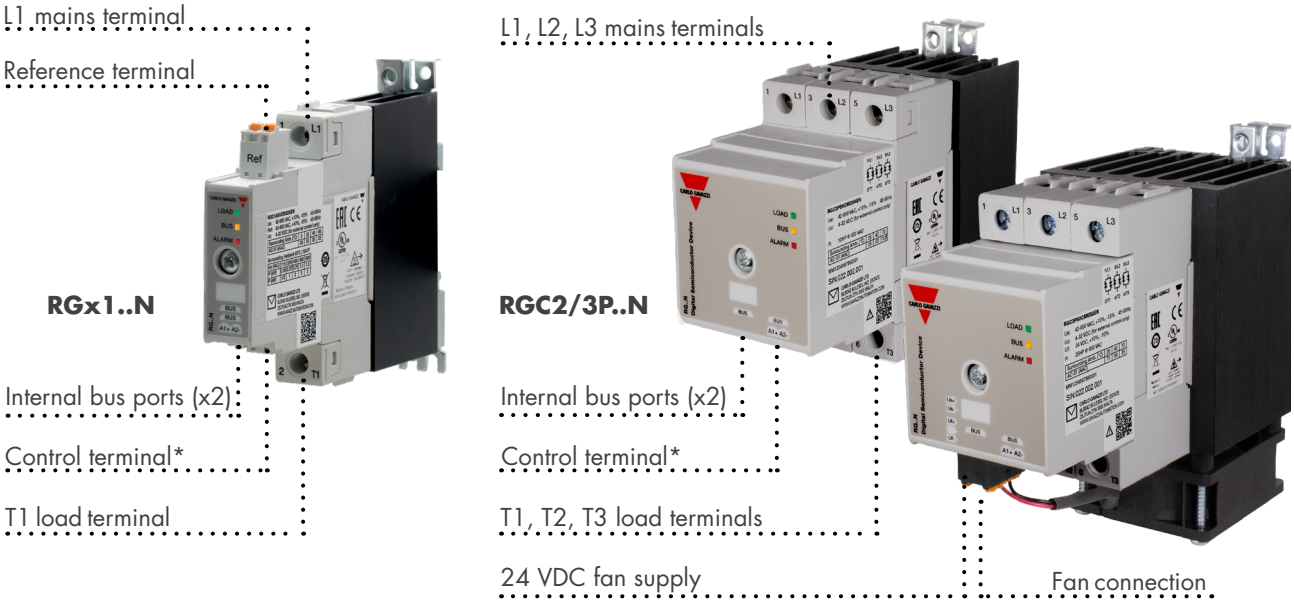
Through voltage compensation and true power compensation algorithms available on the NRG SSRs, mains voltage fluctuations and changes in heater resistance can be compensated to ensure a stable power output and therefore a higher quality end product.



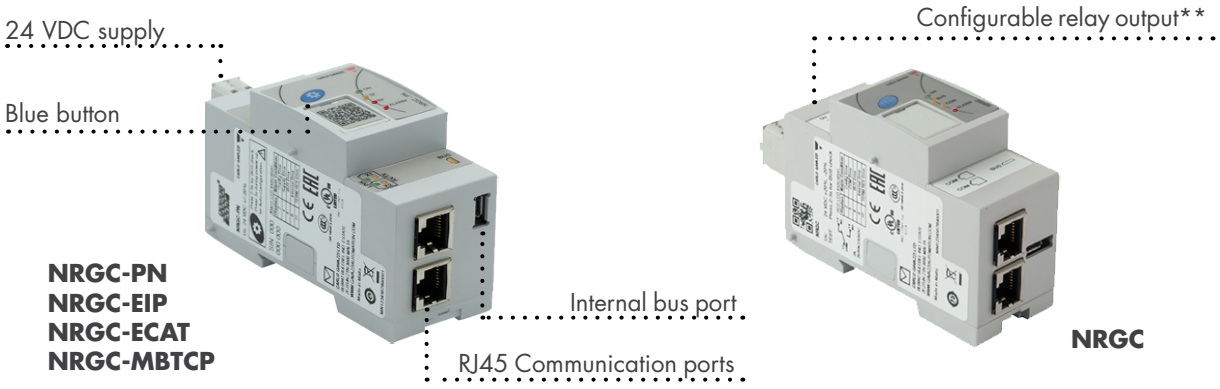
NRG series
Overview

Product structure

NRG Solid State Relay

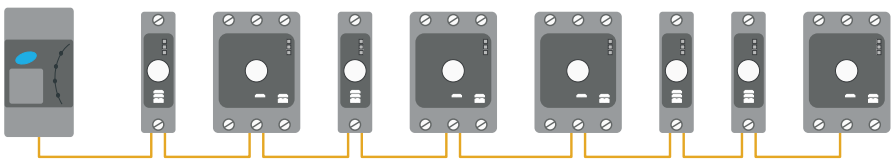


NRG Controller

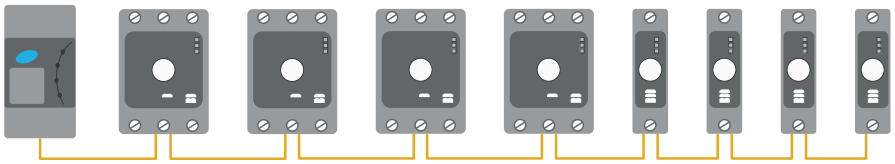


The heatsink is integrated in the RGC version only
* Used for external control, **NRGC only

NRG bus chain possible combinations



PROFINET®
EtherCAT®
Modbus TCP & RTU



EtherNet/IP

Max. 32 switched poles with a single NRGC..
The RGx1..D..N is compatible with the NRGC (Modbus RTU) only
For EtherNET/IP, the RGC2/3P SSRs have to be placed as the first devices on the NRG bus chain

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Selection guide

NRG Solid State Relay

Switching	No. of switching poles	1	1	2	3
	External control	•		•	•
	Switching via communication	•	•	•	•
	ON / OFF	•	•	•	•
	Distributed full cycle	•	•	•	•
	Advanced full cycle	•	•	•	•
	Phase angle		•		•
	Soft start with time mode		•		•
	Soft start with current limit		•		•
	Voltage compensation		•	•	•
	True power compensation			•	•
Diagnostics	Load deviation monitoring	•	•	•	•
	Load loss alarm	•	•	•	•
	System diagnostics	•	•	•	•
	SSR diagnostics	•	•	•	•
	Parameteres out of range	•	•	•	•
	Over temperature protection	•	•	•	•
Measurement	Current measurement (A)	•	•	•	•
	Voltage measurement (V)	•	•	•	•
	Frequency measurement (Hz)	•	•	•	•
	Power measurement (W, VA)	•	•	•	•
	SSR running hours (Hours)	•	•	•	•
	Load running hours (Hours)	•	•	•	•
	Energy consumption (kWh)	•	•	•	•
References	Versions w. integrated heatsink				
	20 AAC @ 40°C				**RGC3P60CM20KEN**
	25 AAC @ 40°C	**RGC1A60CM25KEN**	**RGC1P60CM25KEN**	**RGC2P60CM25KEN**	
	30 AAC @ 40°C				**RGC3P60CM30GEN**
	32 AAC @ 40°C	**RGC1A60CM32KEN**	**RGC1P60CM32KEN**		
	37 AAC @ 40°C	**RGC1A60CM32GEN**	**RGC1P60CM32GEN**		
	40 AAC @ 40°C			**RGC2P60CM40GEN**	
	43 AAC @ 40°C	**RGC1A60CM42GEN**	**RGC1P60CM42GEN**		
	65 AAC @ 40°C	**RGC1A60CM62GEN**	**RGC1P60CM62GEN**		**RGC3P60CM65GEN**
	75 AAC @ 40°C			**RGC2P60CM75GEN**	
	Versions without heatsink				
	50 AAC	**RGS1A60CM50KEN**	**RGS1P60CM50KEN**		
	90 AAC	**RGS1A60CM92XEN**	**RGS1P60CM92XEN**		
Specifications	Max. rated voltage	660 VAC	660 VAC	660 VAC	660 VAC
	I^2t rating	up to 18000 A^2s	up to 18000A^2s	up to 15000 A^2s	up to 15000A^2s
Certifications		CE - cULus - UR - CSA - EAC - CCC*			

NRG Controller

Features	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	**NRGC**	**NRGC-PN**	**NRGC-EIP**	**NRGC-ECAT**	**NRGC-MBTCP**
Certifications		CE - cULus - EAC				

NRG Internal Bus cables

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

XEN = KEN for screw power terminals
XEN = GEN for box clamp power terminals

*CCC certification applicable only to RGx1..N
**Packed by 4 pcs. Further details are available on online datasheets at www.gavazziautomation.com

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