NRG Series

Solid State Relays with EtherNet/IP, PROFINET and Modbus Communication, for Real-Time Monitoring and Predictive Maintenance

Launch Presentation

March 2021

Contents

NRG Series

- Controllers with EtherNet/IP, PROFINET and Modbus Communication Interfaces
- Diagnostic Solid State Relays

Launch Presentation

Contents

NRGC-EIP

NRGC-PN

NRGC

RGS..CM..N

RGC..CM..N

Introduction

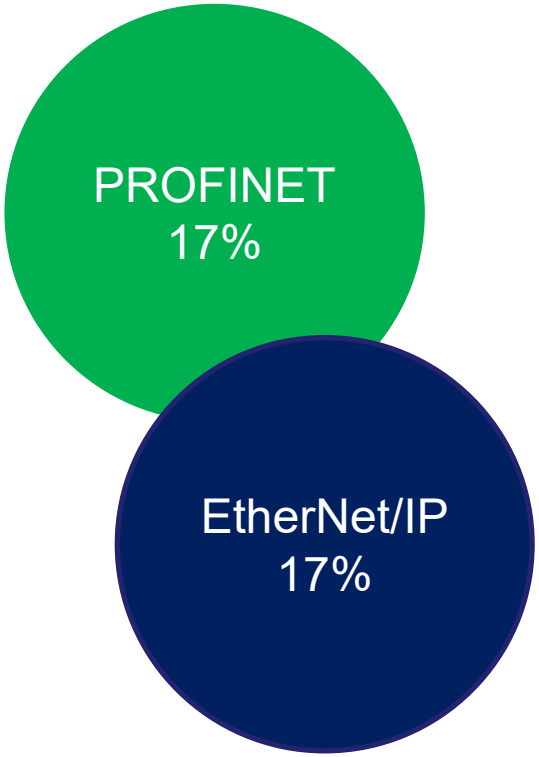
Why this launch?

- In order to remain competitive, many OEMs are turning to advanced industrial automation to maximise productivity. Thus, industrial network communications have become critical, with industrial ethernet protocols in particular growing in demand due to their higher speeds and scalability.

- With the launch of the NRG Series, we are introducing NRGC controllers with EtherNet/IP, PROFINET and Modbus RTU communication.

- According to the latest HMS study on the market share of industrial communication protocols, EtherNet/IP and PROFINET cumulatively make up 34% of the market share.

- EtherNet/IP is dominant in the North American market whereas PROFINET is more dominant in Europe



Introduction

Industrial Ethernet Protocols

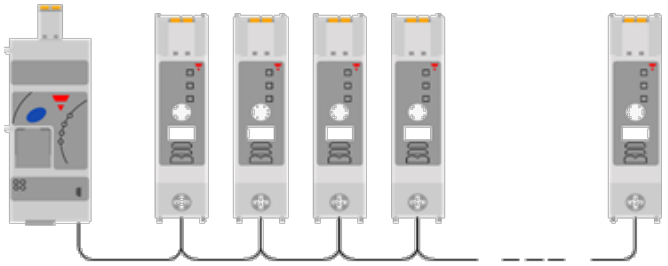
- EtherNet/IP and PROFINET are two of the leading industrial ethernet protocols and can reach fast data transfer speeds up to 100mpb/s.
- EtherNet/IP is an open industrial standard based on the already established Common Industrial Protocol (CIP) and adapted to ethernet.
- The EtherNet/IP together with other CIP technologies are managed by ODVA which are also responsible for certifying EtherNet/IP products.
- PROFINET is one of the leading industrial ethernet standards. This technology is supported by many vendors which explains its wide usage but is mainly supported by Siemens.
- Modbus is an openly-published and royalty-free protocol which is commonly available in the market

Introduction

Expectations

- The adoption of Industry 4.0 requires data to be collected, transmitted and analysed which requires an infrastructure to support it. The infrastructure adopted by the industry is the industrial internet of things (IIoT) whereby all the components in the machine have to able to communicate with each other.

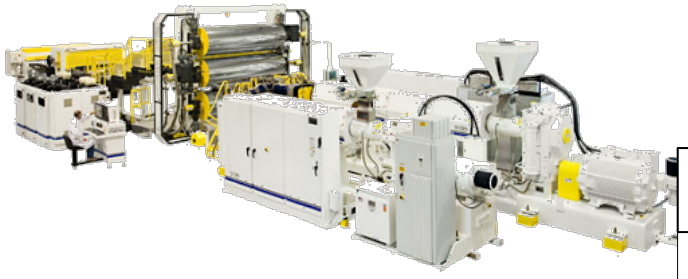
- NRG Series Ethernet/IP, PROFINET and Modbus controllers allow Carlo Gavazzi to better serve OEMsby making use of these protocols through quick and easy integration of the NRG solution in their machines.



Introduction

Markets of Interest

25 – Plastic and Rubber



07 – Glass and Ceramics

Ovens and Furnaces

11 – Semiconductor

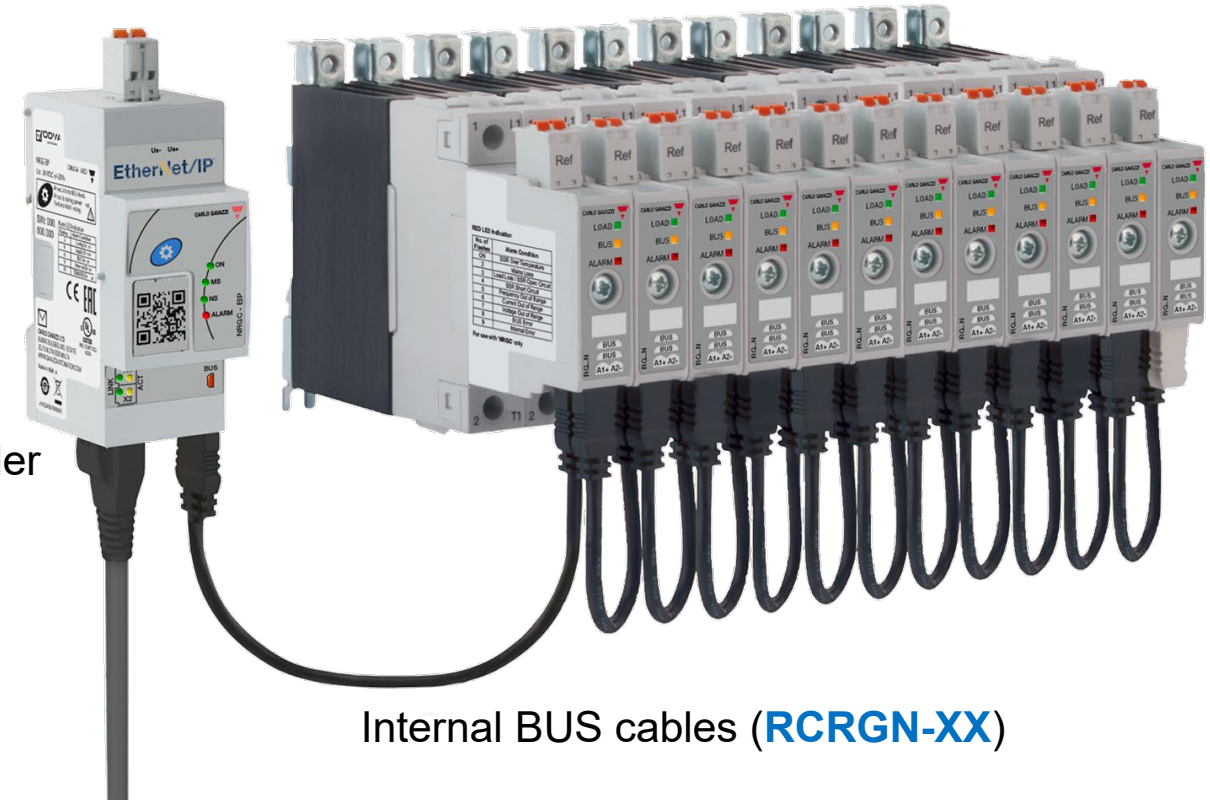
23 – Packaging and Wrapping

Product Overview

The same NRG bus concept for the NRG with **EtherNet/IP**:

NRG EtherNet/IP BUS chain

Up to 32 NRG solid state relays (**RG..CM..N**)



1x NRG EtherNet/IP Controller (**NRGC-EIP**)

Bus termination (**RGN-TERMRES**)

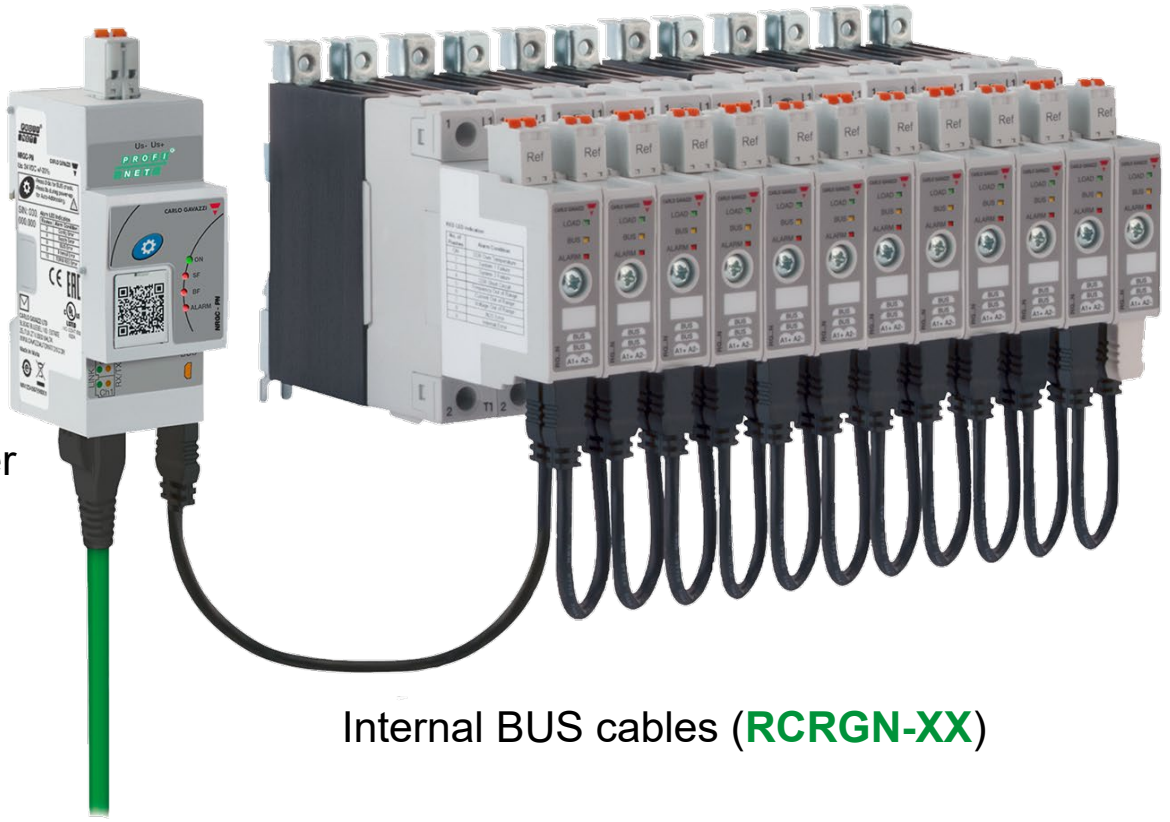
Internal BUS cables (**RCRGN-XX**)

Product Overview

The same NRG bus concept remains for the NRG with **PROFINET**:

NRG PROFINET BUS chain

Up to 32 NRG solid state relays (**RG..CM..N**)



1x NRG PROFINET Controller (**NRGC-PN**)

Bus termination (**RGN-TERMRES**)

Internal BUS cables (**RCRGN-XX**)

Product Overview

The same NRG concept is similar for the NRG with **Modbus**:

NRG Modbus chain

Up to 32 **RG..CM..N** solid state relays or
Up to 48 **RG..D..N** solid state relays

1x NRG
Modbus Controller
(**NRGC**)

Internal BUS cables (**RCRGN-XX**)

Bus termination
(**RGN-TERMRES**)

The products

Product Overview – RGC..D..N and RGC..CM..N Family Overview

17.8 mm wide platform

RGC..25KEN: **25** AAC, 1800 A²s

RGC..32KEN: **30** AAC, 18000 A²s

RGC..32GEN: **37** AAC, 18000 A²s

35 mm wide platform

RGC..42GEN: **43** AAC, 18000 A²s

70 mm wide platform

RGC..62GEN: **65** AAC, 18000 A²s

The products

Product Overview – Part Numbering (version without heatsink)

RGS 1 A 60 CM 50 K E N

- **RGS** — SSR series: RG without heatsink
- **1** — No. of phases: **1:** 1
- **A** — Switching mode: **A:** zero cross
- **60** — Output voltage: **60:** 42-660 VAC
- **CM** — Control: **D:** 4-32 VDC control; **CM:** through comms
  - **Note: 'D' changes to 'CM' for RG..N variants that can be controlled via bus**
- **50** — Max. rated current: **50:** 50 AAC, 1800 A^2s; **92:** 90 AAC, 18000 A^2s
- **K** — Output terminal: **K:** Screw (RGS..50, 92); **G:** Box (RGS..92)
- **E** — Configuration: **E:** Contactor
- **N** — Version: **N:** suited for NRG

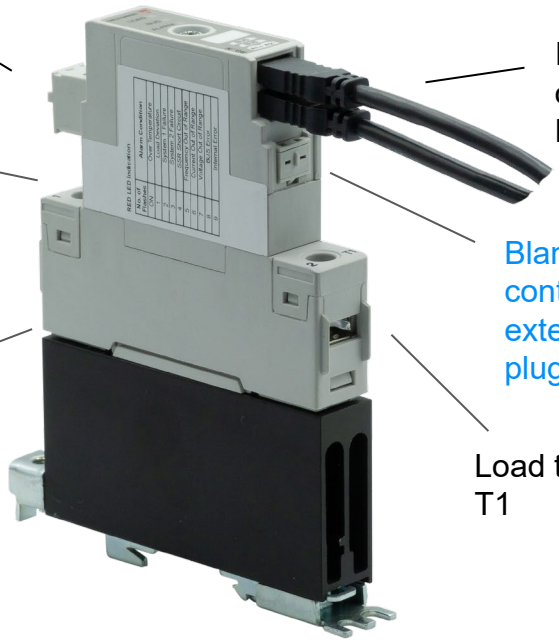
The products

Product Overview – User Interface

Mains reference
Ref*
(Neutral/Phase)

Mains terminal
L1

RGC..N = with heatsink
RGS..N = without heatsink



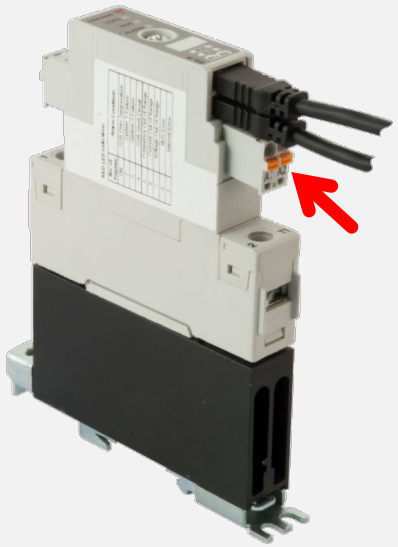
LEDs for ON, BUS, ALARM

Internal BUS cable
or BUS termination for last
RG..N in the BUS chain

Blanking cover concealing the control terminals. Can be removed if external control is required. Control plug is not provided.

Load terminal
T1

* Optional connection - Required for voltage measurement



RG..D..N:
Same hardware as the **RG..CM..N** apart from the control plug that is provided for external control on the **RG..D..N**

The products

NRG Series Product Overview – System Components

NRG controllers

NRGC-EIP EtherNet/IP

- NRG Controller with an EtherNet/IP interface

NRGC-PN PROFINET

- NRG Controller with a PROFINET interface

NRGC Modbus

- NRG Controller with a Modbus RTU interface

NRG internal BUS cables

- Proprietary cables for the internal BUS (5-core cables) available at different lengths connecting the NRG controller to the NRG solid state relay and respective solid state relays
- 1x internal BUS termination resistor (that has to be connected to the last SSR in the BUS chain) is provided with each NRG controller

NRG solid state relays

RG..D..N

- NRG solid state relays with onboard monitoring to provide measurement and diagnostic data. Control is provided via A1-A2 (4-32VDC)

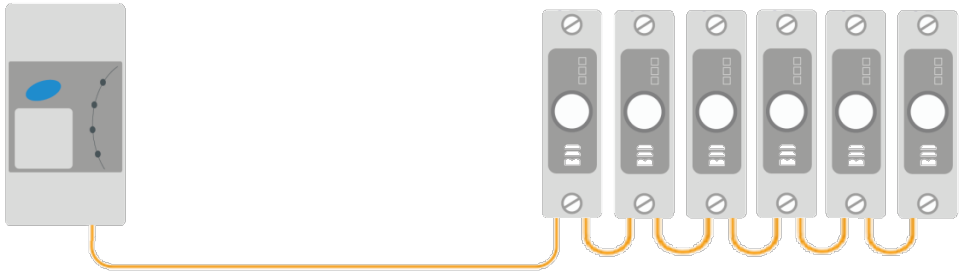
RG..CM..N

- NRG solid state relays with control, monitoring and diagnostics via the communication interface

The products

Product Overview – Compatibility amongst the different NRG modules

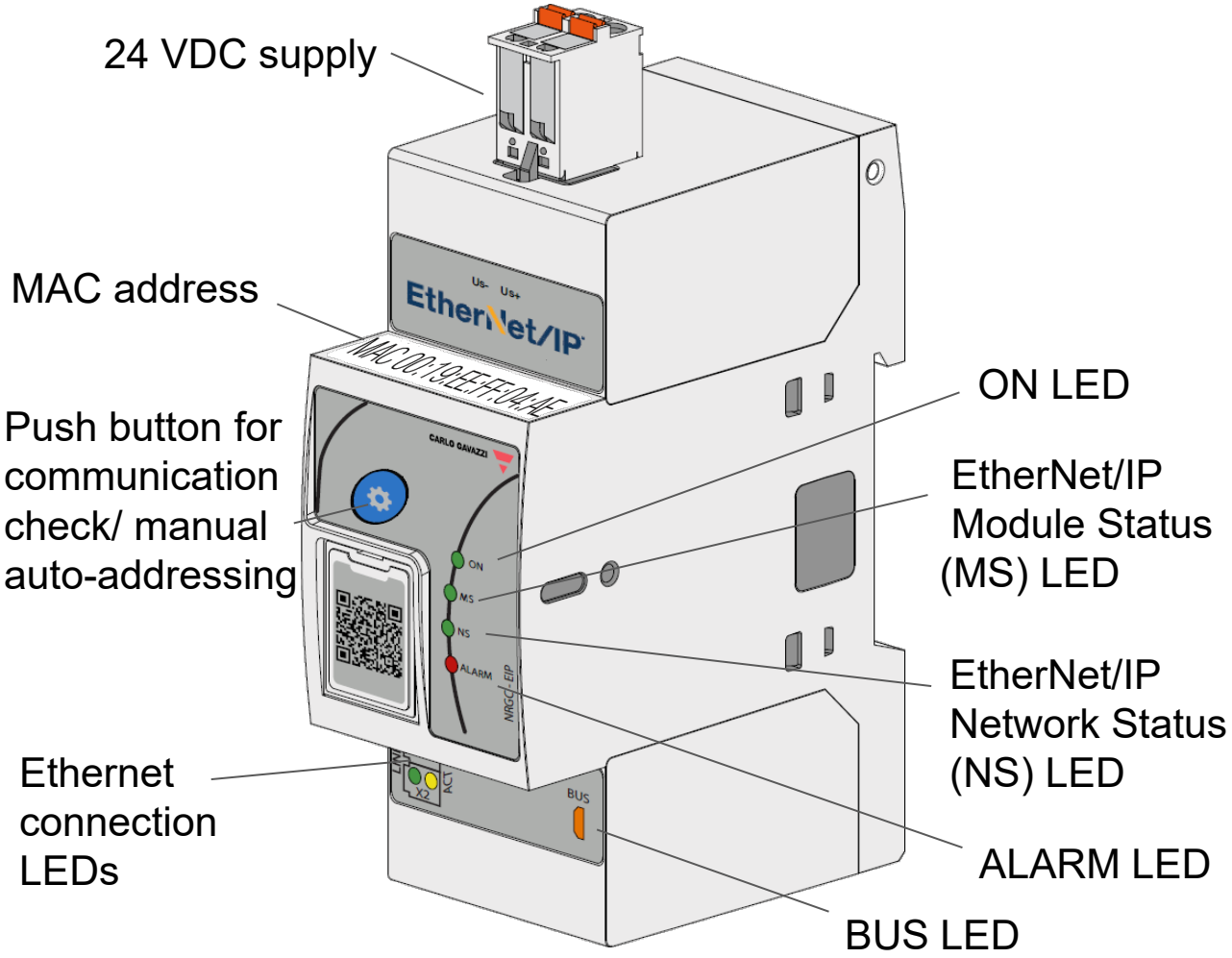
The NRG Bus chain:

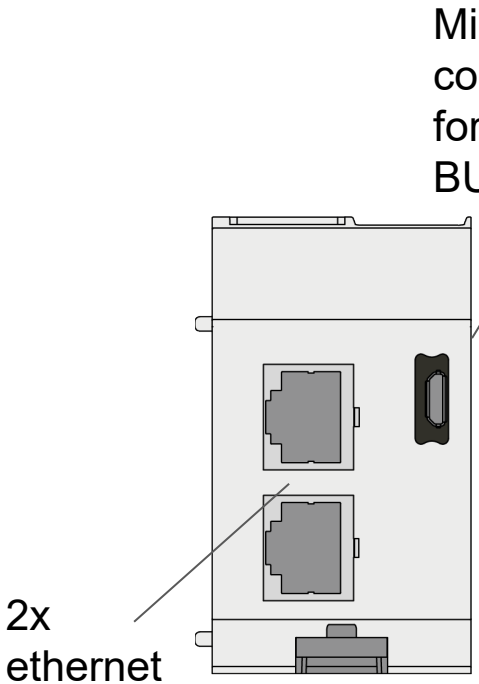


NRG controller	NRG Switch	
Focus on interfacing to the Control level (PLC)	Focus on features of the NRG Switch	
NRG Controller 	**RG..D..N** external control 	**RG..CM..N** control via BUS 
NRGC-EIP (EtherNet/IP)	Not compatible	Compatible
NRGC-PN (PROFINET)	Not compatible	Compatible
NRGC (Modbus RTU)	Compatible	Compatible

The products

Product Overview – NRGC-EIP/PN user interface





Bottom view of the NRGC-EIP/PN

Relevant Product Data: NRGC-EIP

- Certified from an ODVA approved laboratory
- 24VDC power supply which powers all the solid state relays on the bus chain
- Can be configured in a line, ring or star topology
- Supports Device Level Ring protocol for ring configuration
- Can handle up to 32 RG..CM..N solid state relays
- NRG solid state relay are automatically addressed by the NRGC-EIP upon initial start-up. Re-addressing is required in case of any changes to the bus e.g RG..N replacement

The products

Relevant Product Data: NRGC-PN

- PROFINET certified from a PI certified laboratory
- 24 VDC power supply which powers all the solid state relays on the bus chain
- Can be configured in a line, ring or star topology
- Supports Media Redundancy protocol for ring configuration
- Can handle up to 32 RG..CM..N solid state relays
- Supports auto-addressing of sub-modules (RG..CM..Ns)
- Quick identification of system and communication faults

The products

Relevant Product Data: NRGC

- Modbus is an openly published communication protocol
- 24 VDC power supply which powers all the solid state relays on the bus chain
- Communication interface: Modbus over RS485
- Can handle up to 32 RG..CM..N or 48 RG..D..N solid state relays
- Quick identification of system and communication faults

The products

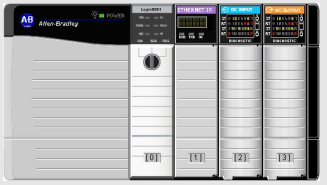
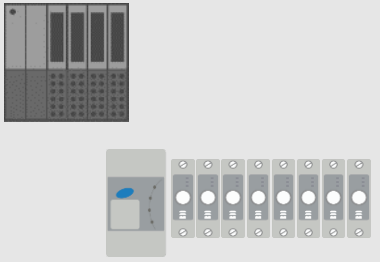
EtherNet/IP vs PROFINET

- Industrial ethernet protocols follow a similar procedure for both device configuration and data exchange.

	PROFINET	EtherNet/IP
Configuration file	GSD file	EDS file
Real time data	Cyclic data	Implicit messages
Request / Response data	Acyclic data	Explicit messages

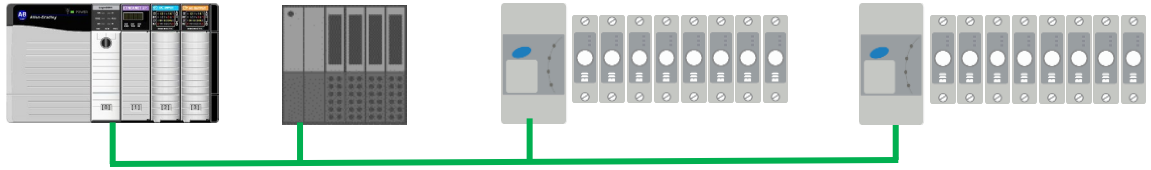
Integrating the NRG System in an EtherNet/IP Network

- An EtherNet/IP network is made up of 2 main components, the EtherNet/IP scanner and the EtherNet/IP adapter.

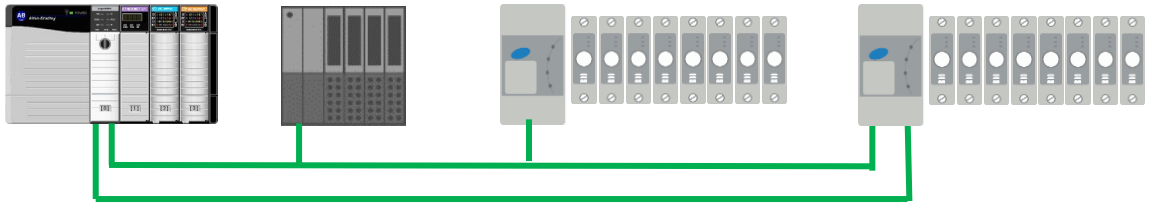
EtherNet/IP scanner	An I/O scanner initiates communications with I/O adapter devices. It is in charge of the configuration and establishing connections. An example of an EtherNet/IP scanner is a PLC.	
EtherNet/IP adapter	An I/O adapter receives communication connection requests from an I/O scanner then produces its I/O data at the requested rate.. The NRG is an EtherNet/IP adapter device.	

Integrating the NRG System in an EtherNet/IP Network

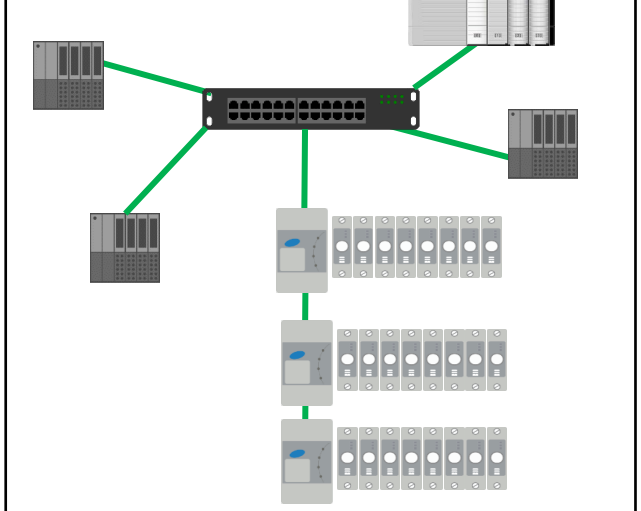
- Similar to the NRG bus chain can be configured in a line, ring or star EtherNet/IP network depending on the application requirements



Line configuration



Ring configuration



Star configuration

NRG system configuration in EtherNet/IP scanner

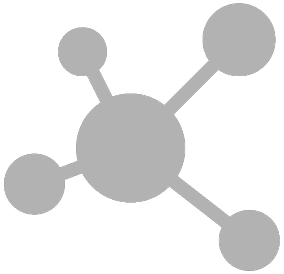
- An EtherNet/IP scanner identifies an EtherNet/IP adapter via an **IP address**. The NRGC-EIP obtains its IP address via a DHCP server

- An **EDS file** is required to setup an EtherNet/IP adapter device in the engineering tool. The EDS file for the NRG system is available at www.gavazziautomation.com

- For data exchange to initiate, the Ethernet/IP scanner has to establish a connection with the EtherNet/IP adapter. There are 2 types of connections with the NRG:

  Exclusive owner connection – connection to control and read parameters from each NRG SSR [required]

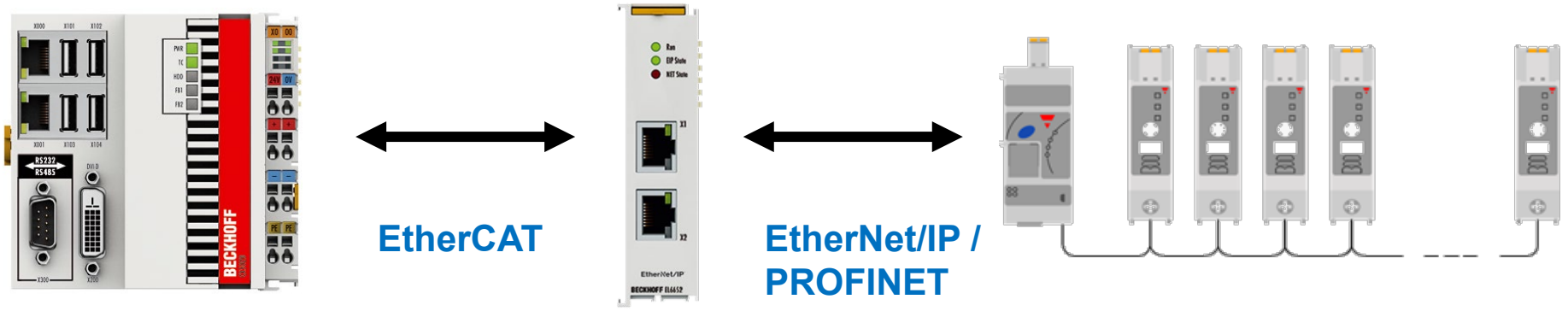
  Input only connection – connection to transfer the status and the alarming data from each NRG SSR



The products

NRG system configuration in other industrial ethernet protocols

- With PROFINET and EtherNet/IP being the 2 most widely used industrial ethernet protocols, gateways are commercially available to translate PROFINET / EtherNet/IP communication into other protocols. This renders the NRG usable in a versatile number of applications including systems utilizing alternative ethernet protocols such as EtherCAT and Powerlink.



The products

NRG system with EtherNet/IP or PROFINET

SWITCHING

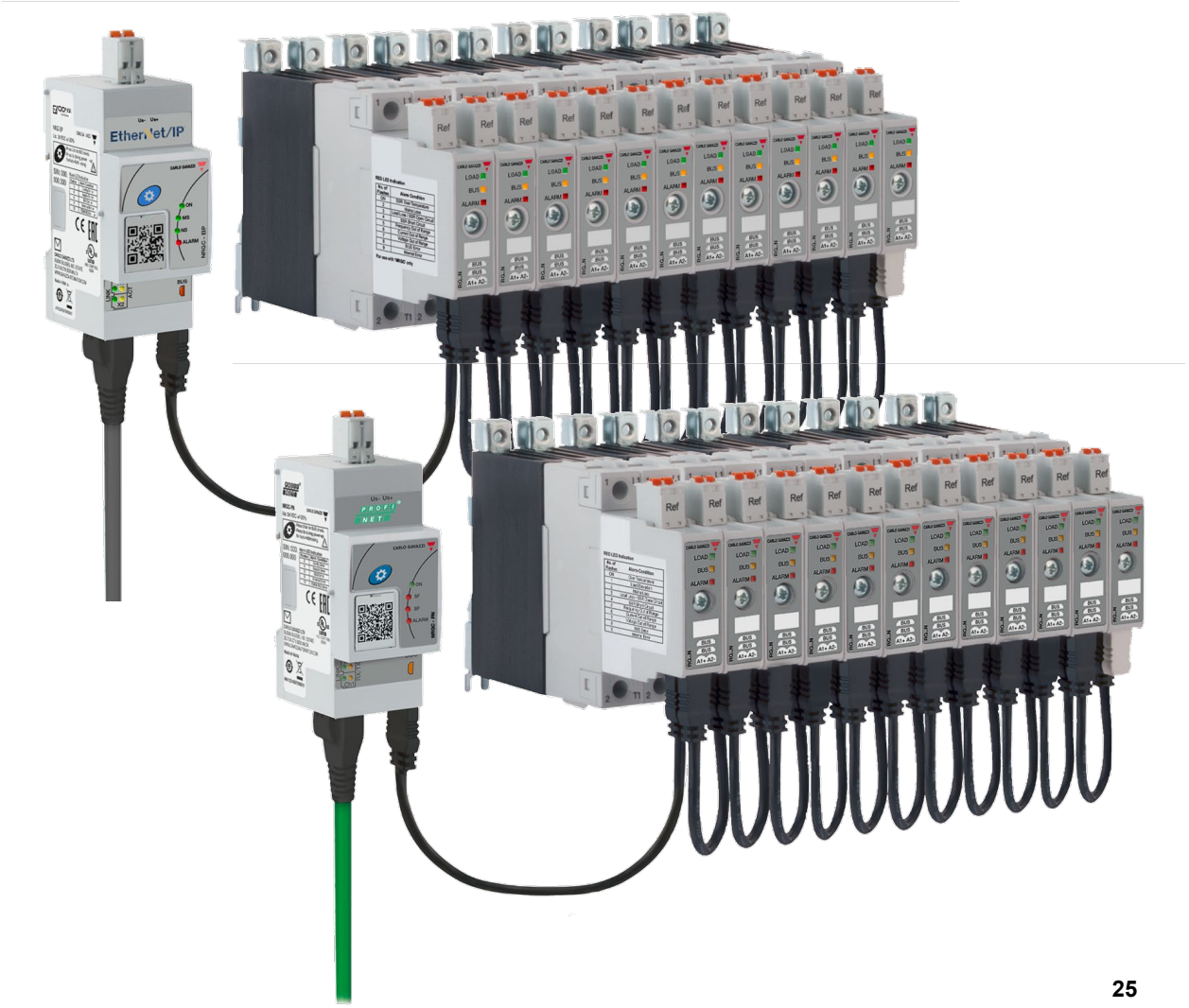
- Up to 90AAC, 600VAC
- ON/OFF, Burst, Distributed full cycle and Advanced full cycle switching

MEASUREMENTS

- Current, Voltage, Power, Energy consumption and running hours

DIAGNOSTICS

- Immediate system, SSR and communication fault detection



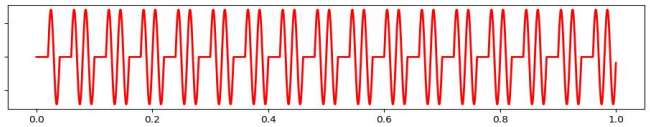
The products

Switching mode possibilities with the NRGC-EIP and NRGC-PN

- **ON/OFF Mode**
  - A direct replacement of A1+ A2-, therefore, minimal changes required to temperature control algorithm used with output modules in a typical system
  - All RG..Ns on the bus chain can be controller within 10ms

- **Power Control Modes**
  - Offloading computation from PLC with direct percentage control

Burst
Flexibility with the possibility to control also the timebase



Distributed full cycle
Reduction in thermal overshoots with more frequent switching

Advanced full cycle
Suitable for infrared heaters due to reduction in visual flickering

The products

Real time Monitoring – Parameters accessible with the NRG

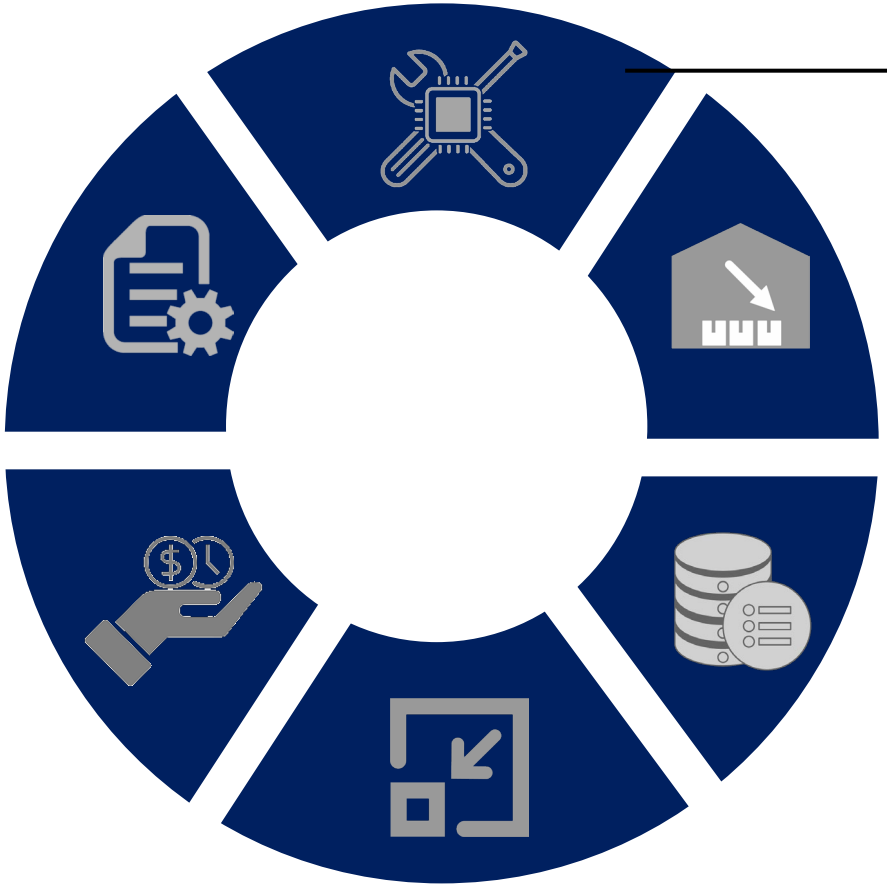
VOLTAGE	RMS voltage across L1-Ref (if Ref is connected)
CURRENT	RMS load current
HOLD CURRENT	highest RMS current recorded over a no. of past (configurable) cycles
FREQUENCY	measured line frequency
REAL POWER	calculated instantaneous voltage & current multiplication (if Ref is connected)
APPARENT POWER	calculated RMS voltage & RMS current multiplication (if Ref is connected)
ENERGY CONSUMPTION	energy reading in kWh (if Ref is connected)
SSR RUNNING HOURS	the time during which the SSR output is ON
LOAD RUNNING HOURS	the time during which the SSR output is ON. This reading is resettable in case of load or SSR replacement

Diagnostics – Failures that can be detected and identified with the NRG

LOAD DEVIATION	when the values of the Voltage Reference and Current Reference are > 0 either through an automatic '**TEACH**' command or updated manually. This alarm is issued if a change in current > than the set percentage value. This alarm is issued only if a change in current is irrespective of a change in voltage.
OVER-TEMPERATURE	when RG..N operates outside its specified operating range
MAINS LOSS	when voltage & current signals are absent
LOAD LOSS / SSR OPEN CIRCUIT	Load is not switching ON when control signal is present
SSR SHORT CIRCUIT	when current flows through the RG..N with control OFF
FREQUENCY OUT OF RANGE	when measured frequency is out of the default or set range
CURRENT OUT OF RANGE	when measured current is out of the default or set range
VOLTAGE OUT OF RANGE	when measured voltage is out of the default or set range
BUS ERROR	in case of an error on the internal BUS
INTERNAL ERROR	in case of abnormal behavior of the RG..N

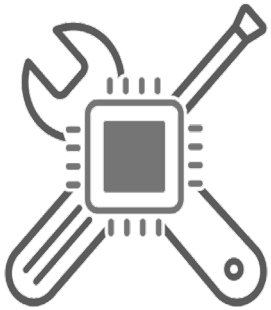
The products

NRG Features and Benefits

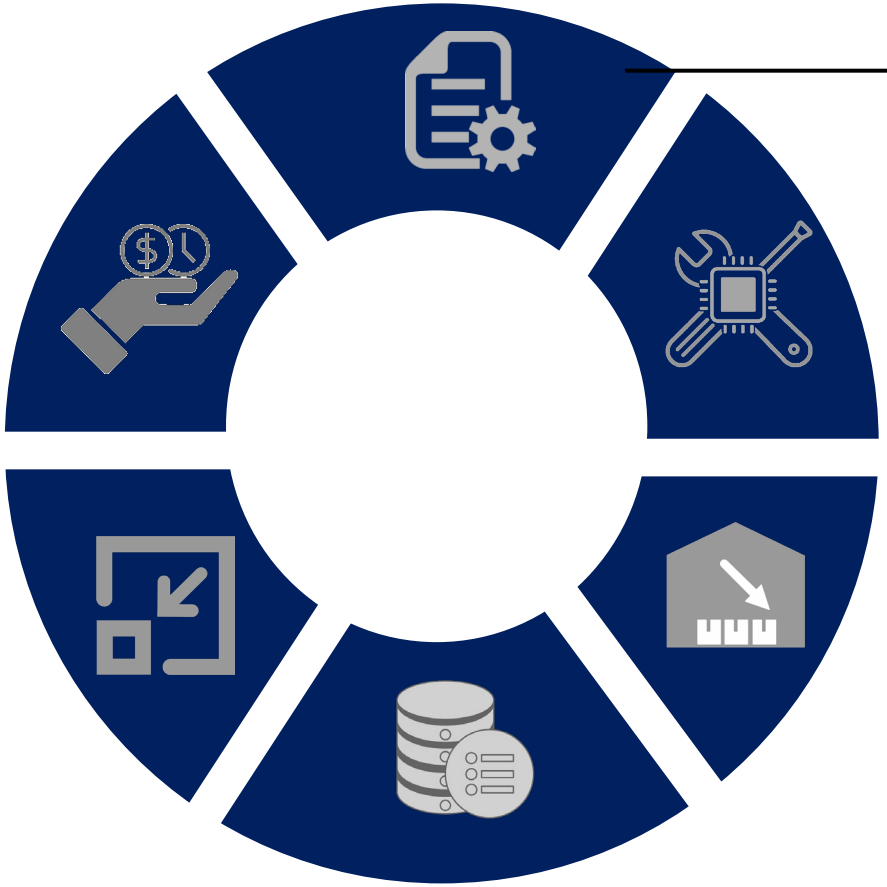


- **Predictive and better preventive maintenance plans**

With diagnostic features such as SSR and load running hours as well as load deviation alarms, OEMs can analyse the solid state relays as well as the degradation of the load to act on issues before they occur thus reducing scrap rates and machine downtimes.



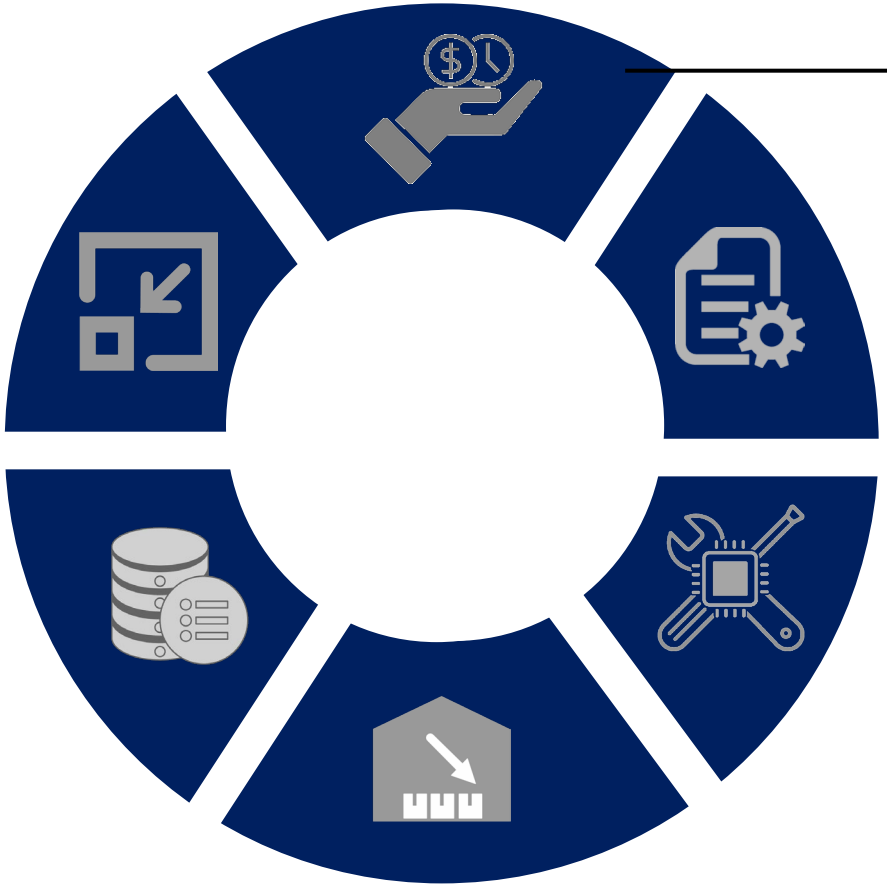
NRG Features and Benefits



- **Easy configuration and flexibility**

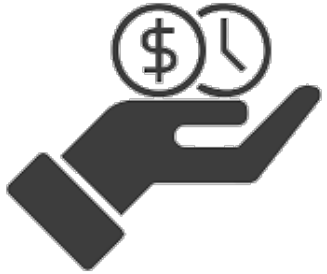
The integration of the NRG in the machine has never been easier. With the use of the EDS and GSD files, configuration is a simple matter of drag and drop.

NRG Features and Benefits

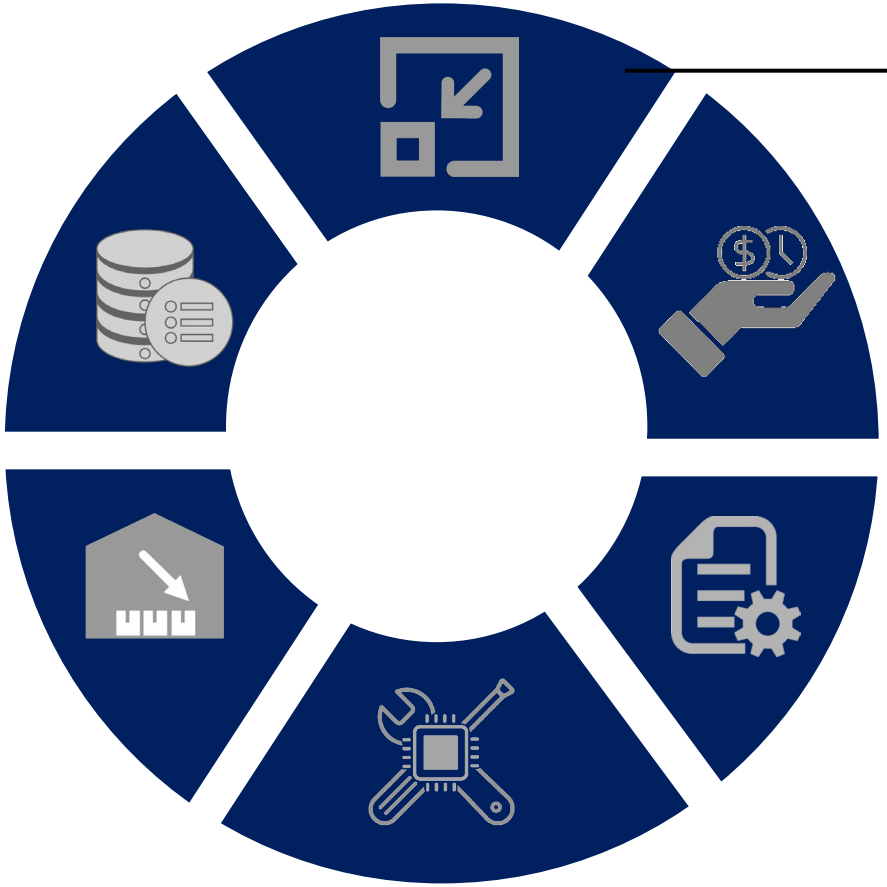


- **Time labor savings**

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 CTs and PLC cards



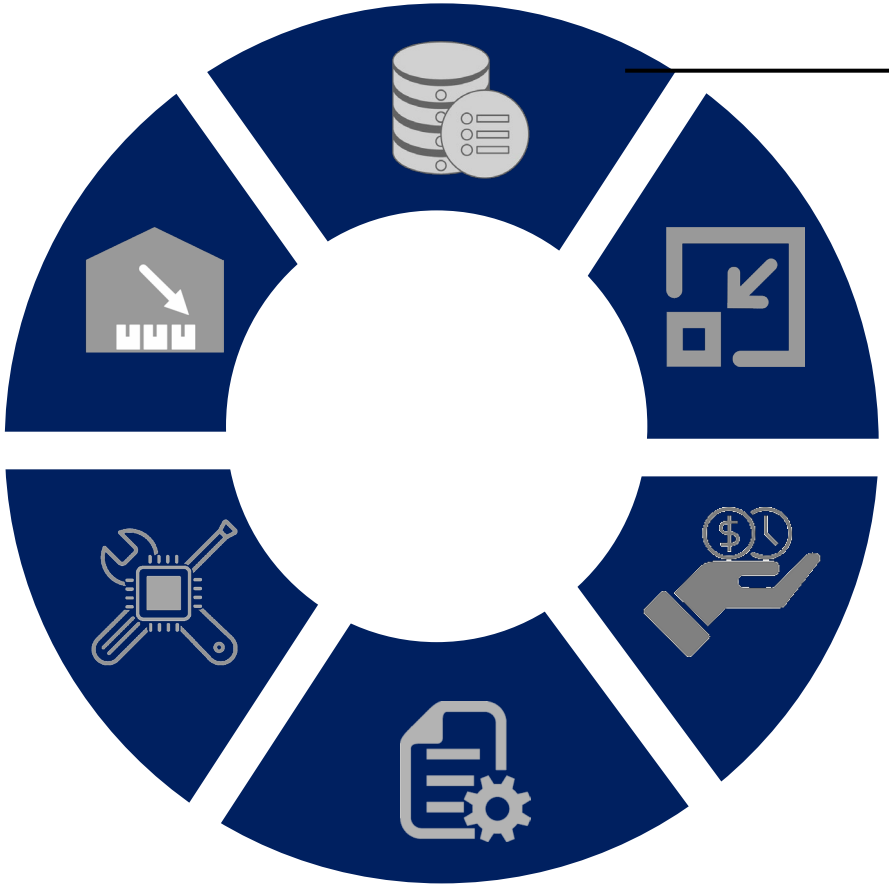
NRG Features and Benefits



- **Panel space occupancy**

With integrated switching, monitoring and diagnostics in the smallest solid state relay platform on the market, the NRG solution saves on valuable panel space since it eliminiates the need of external CTs, analog input cards and digital output card.

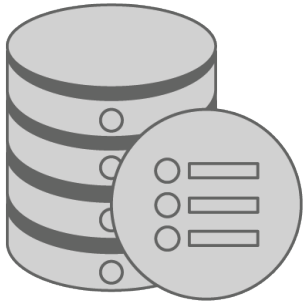
NRG Features and Benefits



- **Versatility of data & diagnostics**

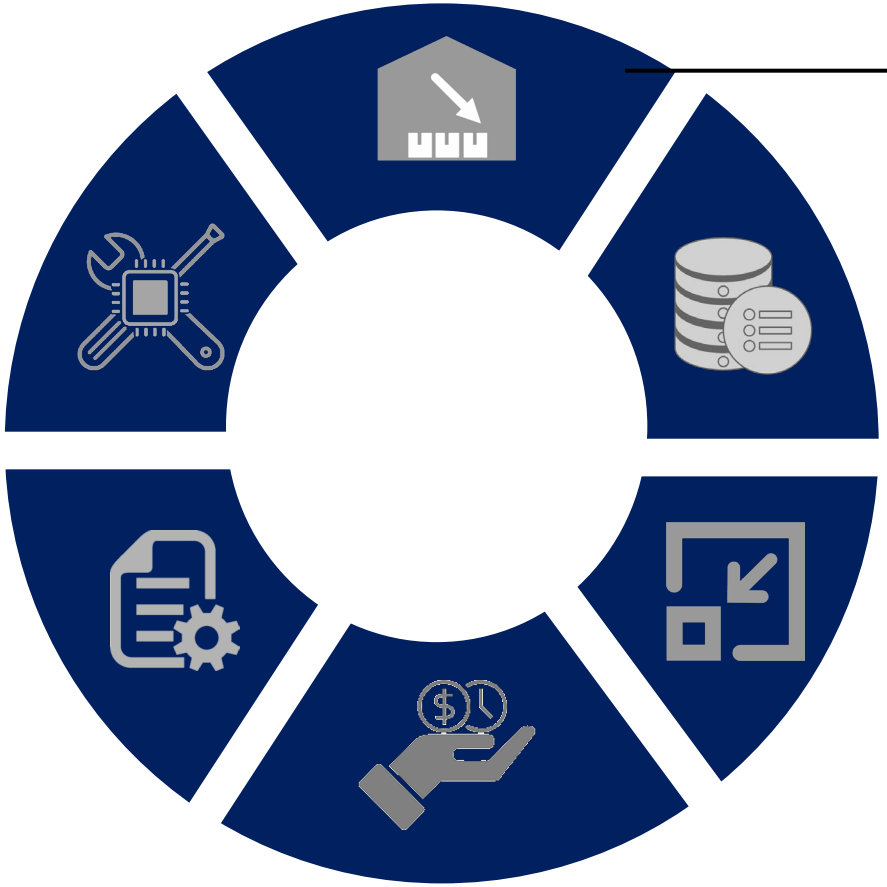
The NRG offers a wide variety of data from each solid state relay on the bus chain ensuring better data management and analysis in the machine.

With all the data and fault detections available via the communication system, remote access is possible for quick and efficient machine diagnostics.



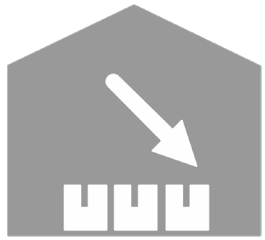
The products

NRG Features and Benefits



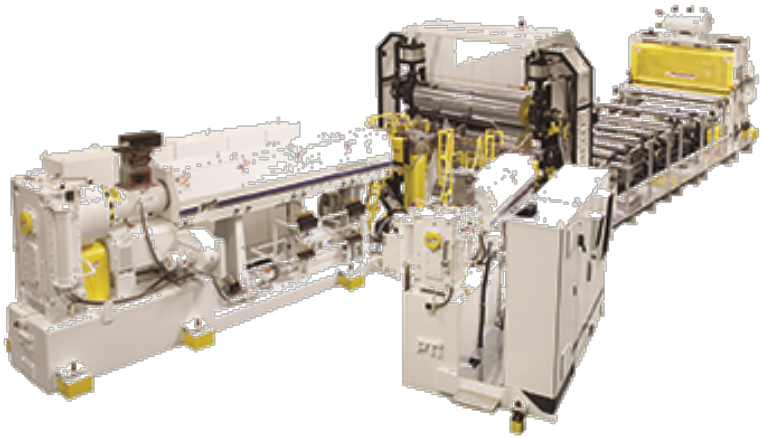
- **Inventory reductions**

With the NRG being an all-in-one solution incorporating variant switchings modes and extensive monitoring and diagnostic data; hardware otherwise needed in a machine is redudant. Thus, reducing inventory stock requirements.



The market

Relevant Applications



Market
Plastic and Rubber industry

Application
Control of heaters in extrusion machines

Specific needs
Ability to control the solid state relays as well as monitor the status of the SSR and the heater loads

Benefits when using NRG

- Reduced installation time by utilizing the bus for both monitoring and control
- Panel space savings due to the redundancy of other monitoring components and PLC O/P modules
- Off-loading of the PLC through the use of % power control algorithm to control the heaters

The market

Relevant Applications

Market
Plastic and Rubber industry

Application
Control of IR heaters in PET blow moldings

Specific needs
Ability to control the solid state relays as well as monitor the status of the SSR and the IR heater loads

Benefits when using NRG

- Reduction in installation time since the bus is used for both monitoring and control
- Cost savings due to the redundancy of other monitoring components and PLC O/P modules
- Off-loading of the PLC through the use of % power control algorithm to control the IR heaters
- Reduced visual flickering of the IR lamp with Advanced full cycle switching

The market

Marketing Tools

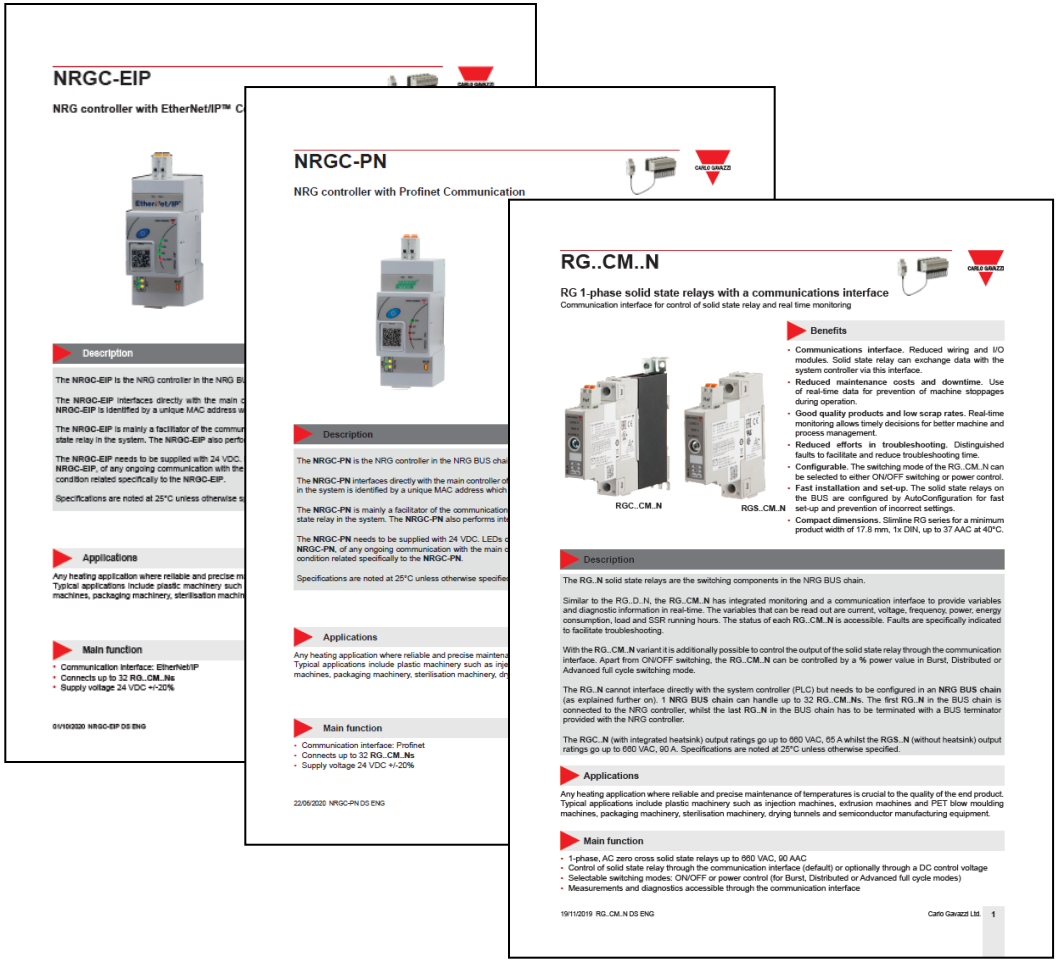
Datasheet
NRG series

New datasheets are available with the technical specifications of the **NRGC-EIP** and **NRGC-PN**.

The new **RG..CM..N** datasheet includes all material relevant to both protocols.

All available in:

- English
- Chinese
- Danish
- French
- German
- Italian
- Spanish

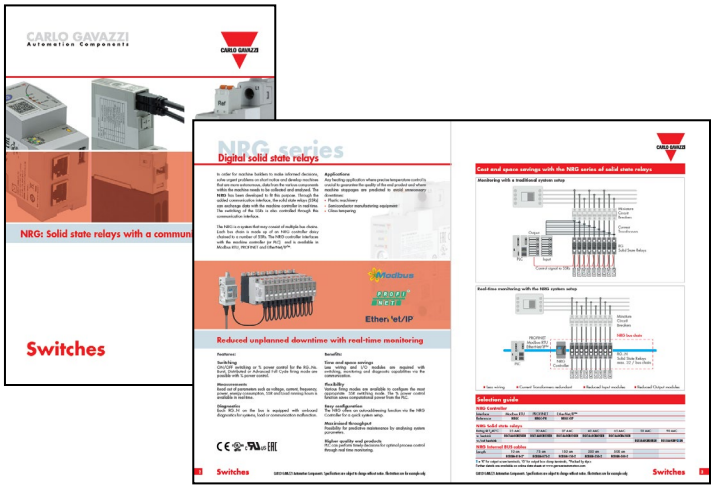


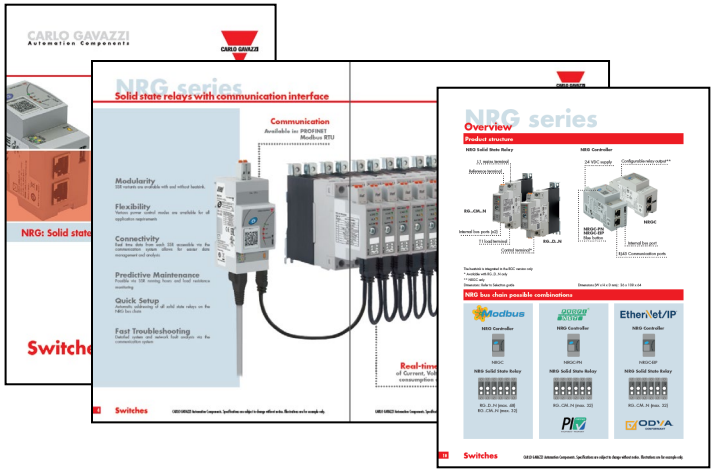
Marketing Tools

Product Brochures

- The NRG short brochure has been revised to incorporate the NRG controllers with EtherNet/Ip and PROFITNET
  Reference no.:
  3822069100- 03 –
  BRO NRG SERIES SHORT ENG 11/20

- The NRG long brochure has also been revised to incorporate the NRG controller with EtherNet/IP and PROFINET
  Reference no.:
  3822065100-03 –
  BRO NRG SERIES LONG ENG 11/20





The market

Certifications

EtherNet/IP certification

PROFINET certification

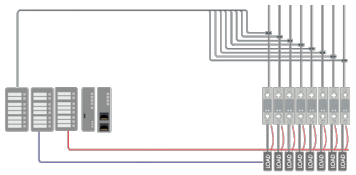
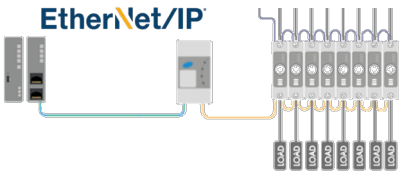
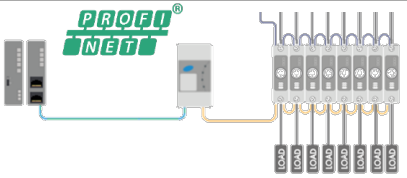
Europe: Conformité Européenne
- IEC / EN 60947-5-1

USA /Canada : Underwriters Laboratories Inc.
- UL listed (File No. E172877) according to UL508 – NMFT
- cUL listed (File No. E172877) according to C22.2 No.14-18 – NMFT7

Euroasian conformity mark

Quality and Environmental Management System (Factory)
- ISO 9001:2015, ISO 14001: 2015

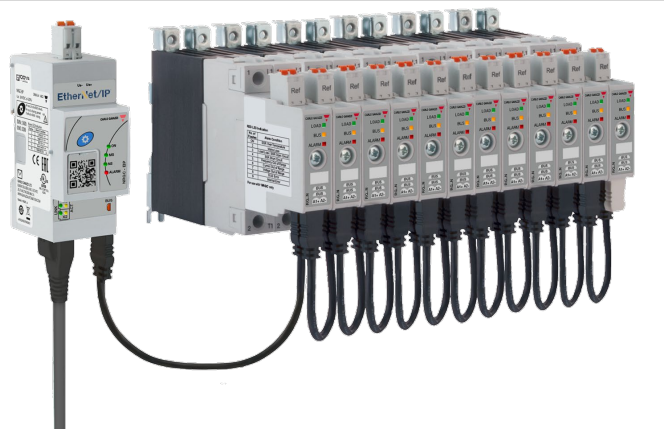
Conclusion

Real-time monitoring solutions	Traditional Setup	NRG EtherNet/IP	NRG PROFINET
FEATURES			
Versatility of data			
Diagnostic information			
Panel space occupancy			
Time labour savings on hardware			
Stock of external components			
Cost of NRG Controller	n/a		
Time savings on PLC configuration			
Total cost of ownership			

Conclusion

- The NRG system is the ideal solution for the requirements imposed by the digitalization of the automation industry.

- The New NRG with **EtherNet/IP** and **PROFINET** will carry forward all the features of the original NRG with Modbus RTU, and provide significant advantages over traditional networks that include:
  - Easier **integration** in the communication network
  - Easier **configuration** of devices
  - Faster **data transfer** speeds
  - More detailed **diagnostics** quickly identified via the communication system



Conclusion

- Offering **multiple switching modes**, **rich real-time data** and **extensive diagnostics** available via a communication interface, the NRG is an all-in-one solution for better data management and predictive maintenance plans to be adopted.

- When utilizing the NRG, the **overall system cost** is reduced by minimizing installation costs and saving on valuable panel space.

- With the introduction of ethernet based protocols, the NRG is more appealing to a wider market share and offers additional benefits including fast data transfer speed, easier system integration and quick configuration time by with the use of configuration files such as the EDS & GSDML file.

EtherNet/IP

PROFINET

Modbus


CARLO GAVAZZI
Thank you.