

## Principles of Measurement

### Conductivity measurement

The water level is detected between the electrode tips and the vessel wall (or reference electrode) and evaluated for control or limitation purposes. In this case it is essential that the medium is electrically conductive.

The high-integrity self-monitoring design of the level alarms ensures constant supervision of the insulating seal and electrode entry, immediately recognizing malfunctions in the system and failure of the electrode or supply cables. In addition, the equipment features periodic self-checking of the electronic control unit and the corresponding output contacts. Self-monitoring equipment with periodic self-checking is required for boilers with temperature/pressure ratings > 1 bar and > 120 °C and a volume > 50 l.

Before installation, the length of the conductivity electrode rods must be cut to the required switching levels.

### Capacitance measurement

Electrode rod and vessel wall (or reference electrode) form a capacitor; air and the fluid to be controlled act as dielectric. Due to the different dielectric constants of air and boiler water the capacitance value between the electrode and the vessel wall changes concurrently with level changes.

The switchpoints can be continuously adjusted during operation and multiplied by connecting in parallel several electronic control units.

## Types of Controls

### Water level limiters

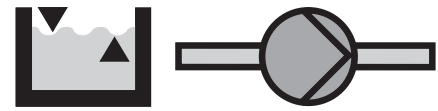
(High-level/low-level alarms)

As soon as the water level exceeds or falls below the adjusted switchpoints the burner protection circuit is interrupted (low level) or the feed pump is switched off (high level).



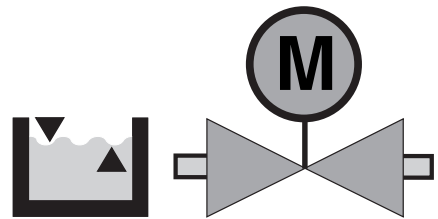
### On-off level control

The water level is controlled between two fixed or adjustable switchpoints. The signals are directly transmitted to the feed pump or valve.



### Modulating level control

The water level is continuously monitored and the actual value is compared with the adjusted set point by the associated controller. If a deviation between the two values is detected, a signal will be sent to the control valve to re-adjust the flowrate accordingly, thereby enabling a more economic and efficient steam plant operation.



## Field Bus System

### Digital Data Exchange

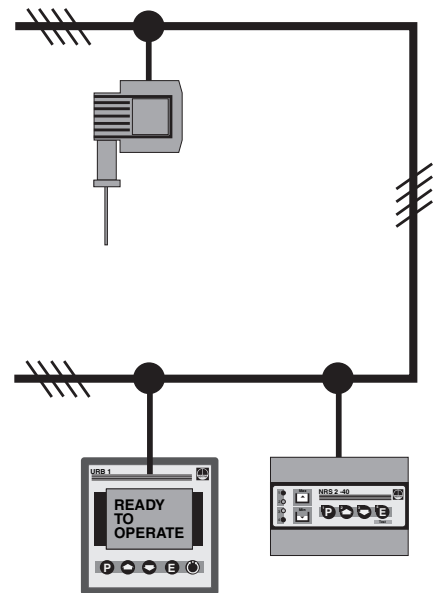


The Spector Bus system transfers the digitized measurement data acquired by the level probe to the electronic control unit located in the control cabinet. The centerpiece of this system is the stable and sophisticated CAN bus (Controller Area Network). Several sensors and switches can be interconnected via one bus line.

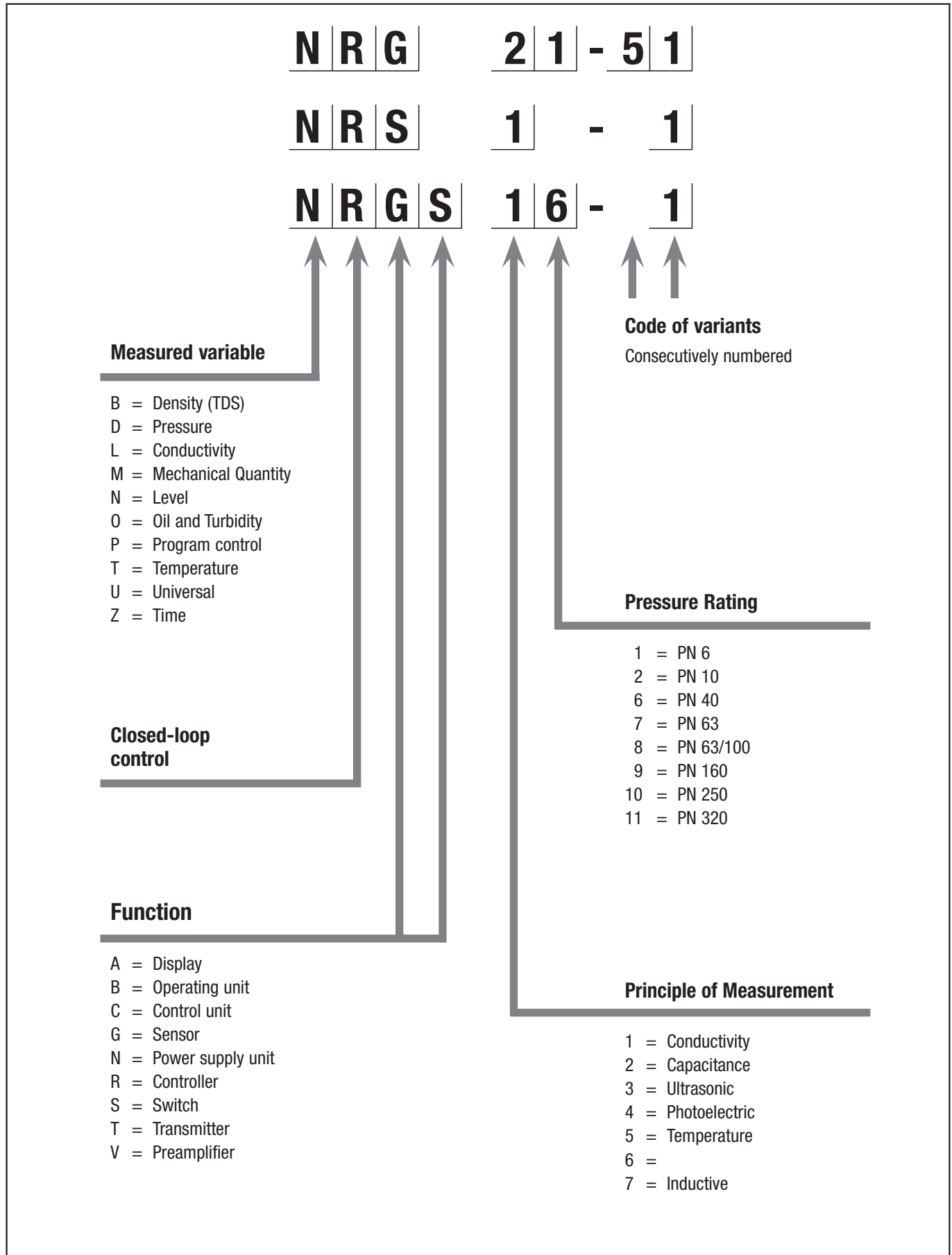
Apart from active cable monitoring a CAN bus system offers a host of benefits, such as increased design flexibility, reduced installation effort, optimized open and closed loop control, centralized operation and remote monitoring.

The standardised network opens up highly flexible possibilities for configuration. The CANopen protocol is used nowadays in medical equipment, electronic devices for marine applications, public means of transport and in burner and boiler controls of power plants.

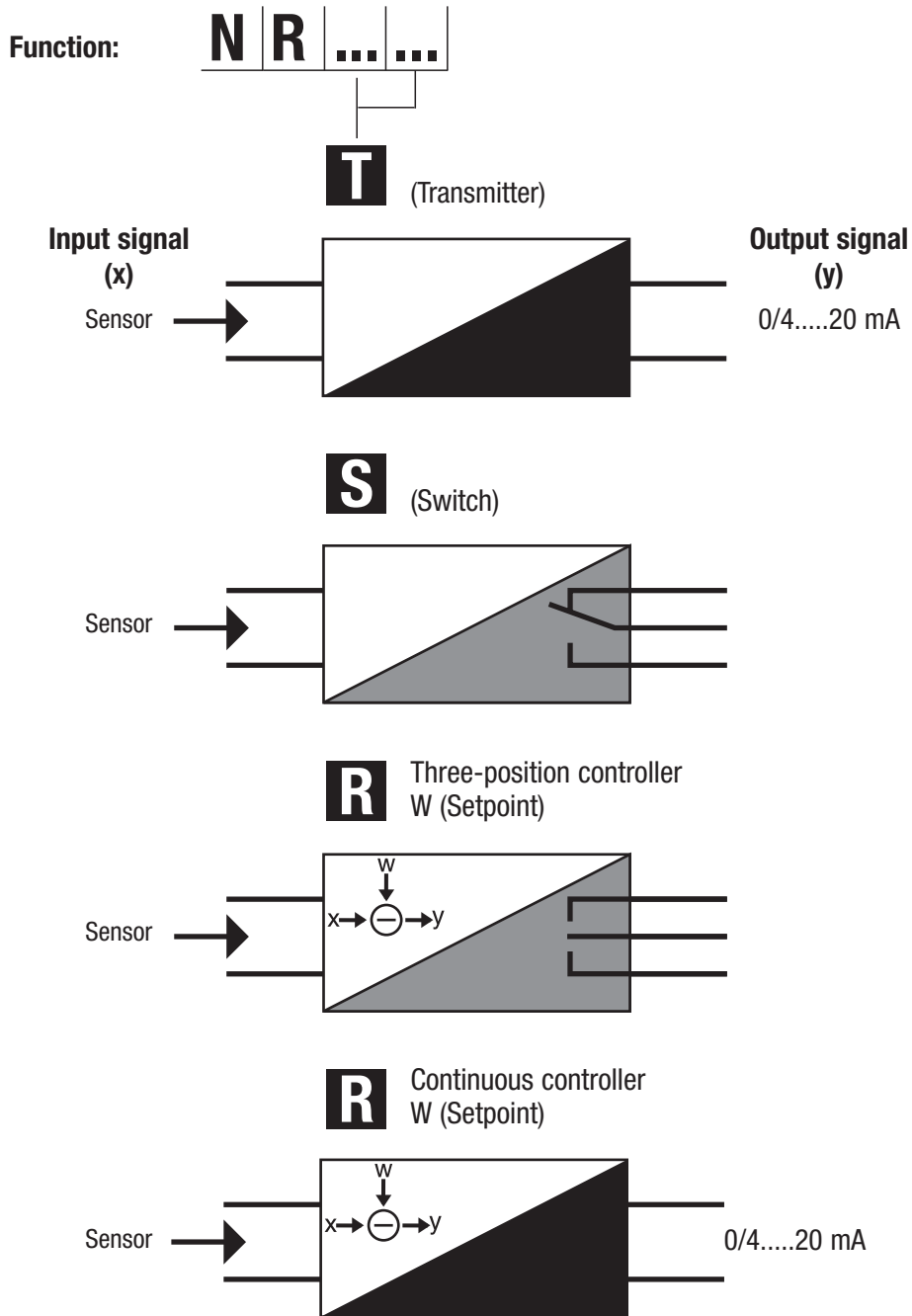
Thanks to the many CANbus applications a great number of equipment and interface components are widely available, providing an ideal addition to our product range.



**GESTRA Type Designations for Boiler Controls**



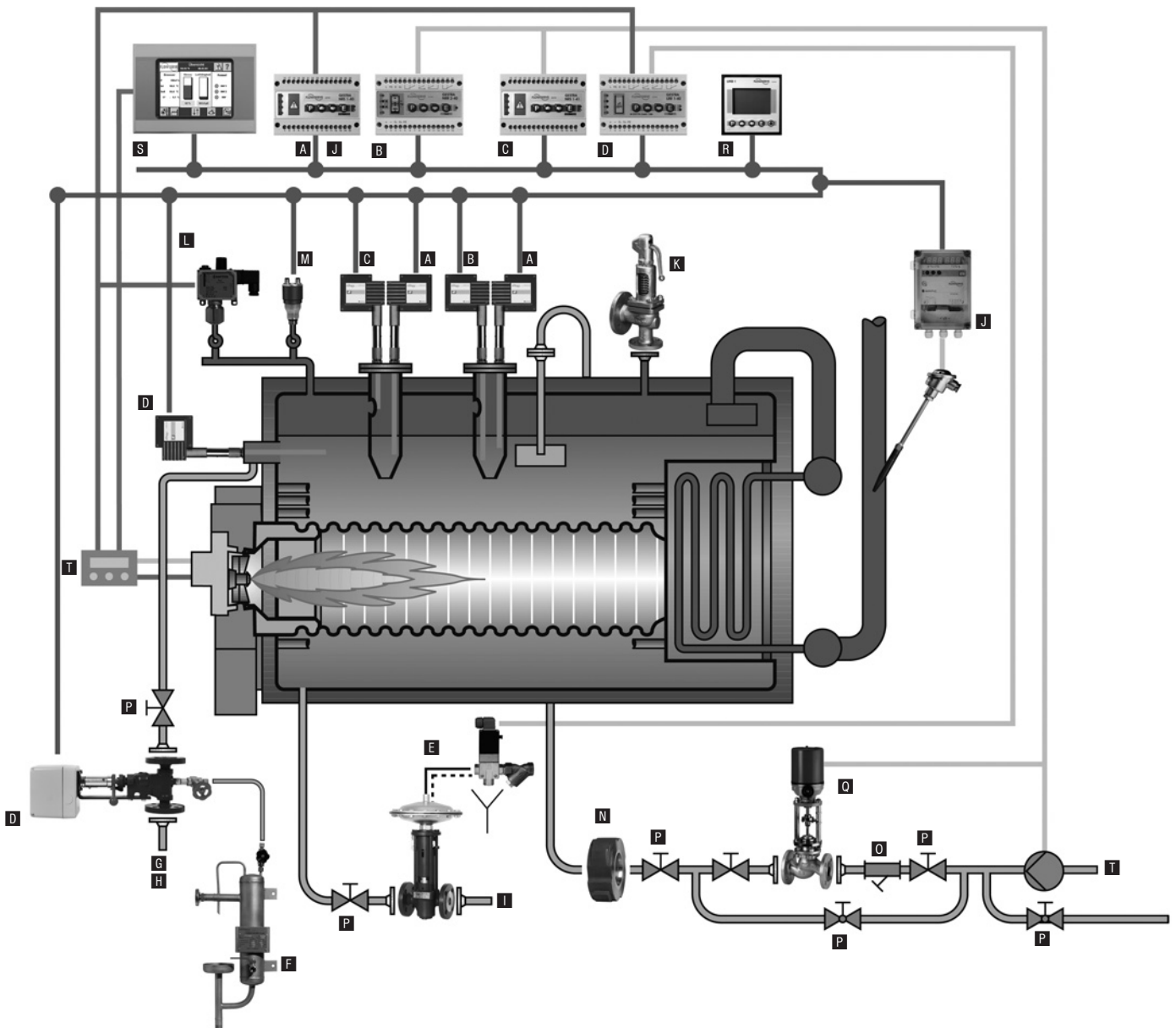
**GESTRA Type Designations for Boiler Controls**



**Level Switch Type NRS 1-1** ..

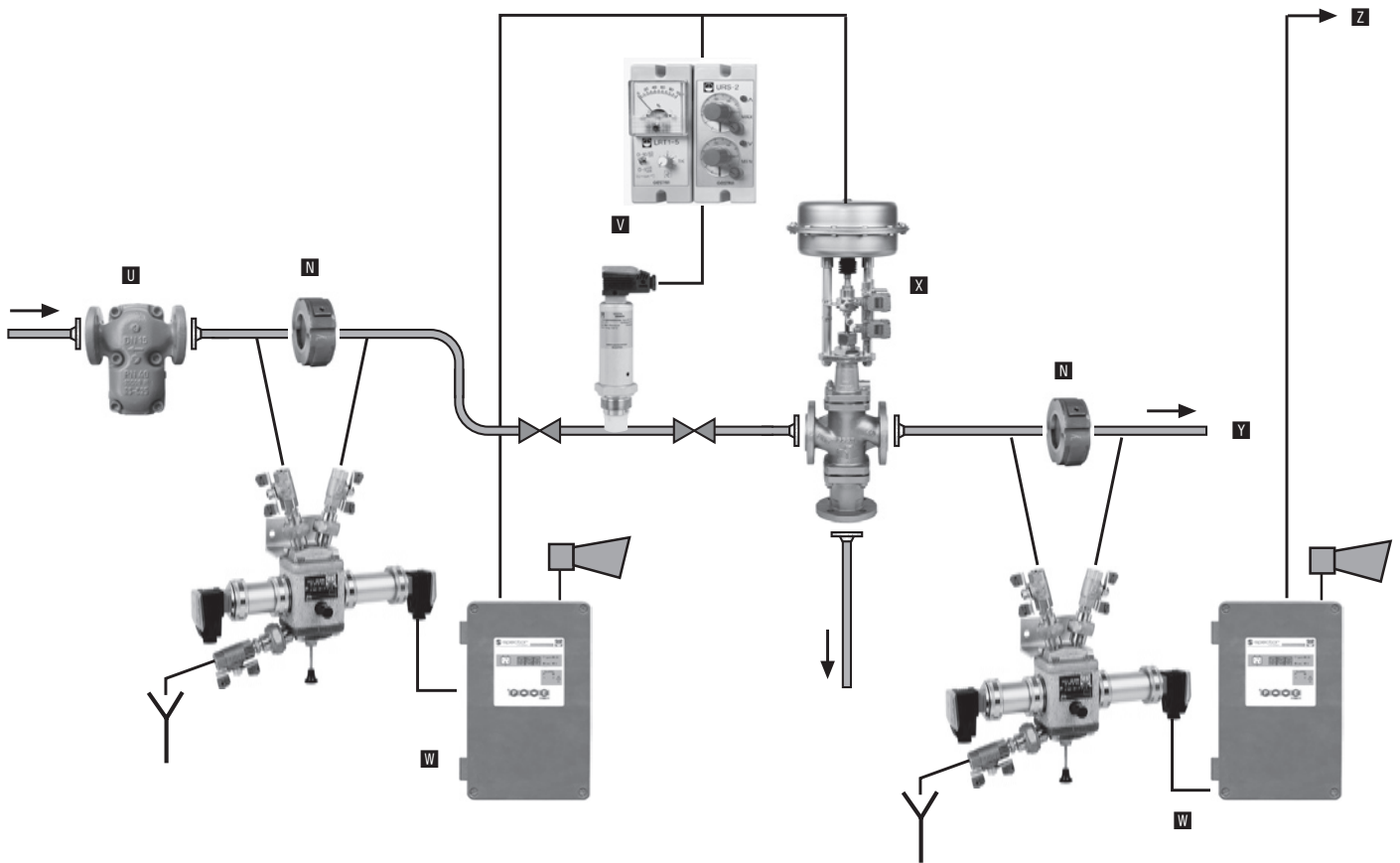
- a# Enclosure for wall mounting
- b Enclosure for installation in control cabinet
- c\* 19" slide-in unit
- d Spare plug-in card for 19" slide-in unit
- e Case for panel mounting
- f Integrated solenoid valve plug

# Often design b with additional enclosure for wall mounting  
 \* Installation in 19" mounting panel provided on site or separately supplied 19" mounting panel



**Boiler equipment acc. to TRD 604 (continuous operation without constant supervision for 24/72 hrs)  
or in accordance with other European guidelines, e. g. EN 12953 part 6**

- |  |   |
|--|---|
| <p><b>A</b> Self-monitoring low-level electrode NRG 16-40</p> <hr/> <p><b>A J</b> Low-level alarm NRS 1-40/NRS 1-40.1</p> <hr/> <p><b>B R</b> Modulating level control with fully integrated second level and conductivity (TDS) indicator: level electrode NRG 26-40, level controller NRR 2-40, control terminal and display unit URB 1/URB 2</p> <hr/> <p><b>C</b> Self-monitoring high-level alarm: level electrode NRG 16-41, level switch NRS 1-41</p> <hr/> <p><b>D E</b> TDS control / Continuous and intermittent boiler blowdown: Conductivity electrode LRG 16-40, continuous blowdown controller LRR 1-40, continuous blowdown valve BAE, intermittent blowdown valve MPA, 3/2 way pilot valve, strainer</p> <hr/> <p><b>F</b> Sample cooler</p> | <p><b>G</b> Flash vessel</p> <hr/> <p><b>H</b> Residual blowdown heat exchanger</p> <hr/> <p><b>I</b> Blowdown receiver (mixing cooler)</p> <hr/> <p><b>J</b> Self-monitoring temperature limiter: resistance thermometer TRG 5-65, temperature switch TRV 5-40, NRS 1-40.1 (only with existing superheater)</p> <hr/> <p><b>K</b> Safety valve GSV</p> <hr/> <p><b>L</b> Pressure limiter DSH</p> <hr/> <p><b>M</b> Pressure controller/transmitter</p> <hr/> <p><b>N</b> DISCO Non-return valve RK 86 A</p> |
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- O** Strainer GSF

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- P** Bypass/isolating valve GAV

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- Q** Electric/pneumatic control valve V 725

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- R** Control terminal and display unit URB 1/URB 2

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- S** Operating data acquisition

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- T** Feedwater monitoring:
  - ▶ On-line analysis of residual hardness of water
  - ▶ Demineralization plant: TDS control (conductivity monitoring)

**Steam and Condensate System**

- U** Steam trap

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- V** Contamination detectors (ingress of acids, alkalis, etc.):  
 Conductivity electrode LRG 12-1, conductivity transmitter LRT 1-6, max.-min. limit switch URS 2  
**Alternatively with EC / TÜV approval**  
 Compact electrode LRGT 16-1  
 Controller with MAX contact KS 90

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- W** Monitoring for the ingress of foreign substances such as oil, grease etc.: Oil and turbidity detector OR 52/5

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- X** Electric/pneumatic three-way control valve for the discharge of contaminated condensate

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- Y** Condensate receiver tank

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- Z** Safety circuit

### Technologically Advanced Liquid Level Control

With more than 40 years' experience in the design and manufacture of industrial electronics and almost a century in all fields of steam trapping and shut-off valves, GESTRA enjoys a unique position in the industry as a trusted single-source partner for boiler equipment.

Right from the outset GESTRA blazed a trail in advanced boiler safety. In our drive to set new safety standards, we were the first company to team up with the German Technical Supervisory Association TÜV in order to design self-monitoring low-level alarm systems.

Apart from low-level alarms GESTRA now offers an extensive range of electronic boiler equipment for power stations as well as industrial applications.

Our latest, trend-setting innovation is the new Spector equipment featuring advanced bus-based technology, which provides a future-proof framework for decentralized, flexible operations.

### Application

	Measurement	
	Capacitance	Conductivity
Steam boilers	●	●
Hot-water boilers	●	●
Steam regenerator	●	●
Condensate tanks	●	●
Feedwater tanks	●	●
Fresh water tanks	●	●
Pump sumps	●	●
Holding tanks	●	●
Product tanks	●	●
Tunnel drainage	●	●
Drainage systems in power stations	●	–
Autoclave drainage	●	●
Pump controls	●	●
Oil detection in cooling-water systems	–	●
Daily service tanks for oil	●	–
Diesel fuel tanks	●	–

### Examples of Industrial Applications

Purpose	Application	Principle of measurement	Level electrode	Level switch	Switch point
Level control	Fill or discharge control with protection against pump running dry <b>and</b> high-level alarm	Conductivity meas.	NRGS 1.-1	–	fixed
	Fill or discharge control with protection against pump running dry <b>and</b> high-level alarm	Conductivity meas.	NRG 16-42	NRS 1-42	fixed
	Fill or discharge control with protection against pump running dry <b>and</b> high-level alarm	Conductivity/capacitance meas.	NRG 26-40	NRS 2-40	adjustable
	Modulating fill or discharge control with protection against pump running dry <b>and</b> high-level alarm incl. level indicator	Conductivity/capacitance meas.	NRG 26-40	NRR 2-40/URB	adjustable
	Modulating level detection for remote indication	Conductivity/capacitance meas.	NRGT 26-1	URA 2	–
	Modulating fill or discharge control with protection against pump running dry <b>and</b> high-level alarm	Conductivity/capacitance meas.	NRGT 26-1	KS 92-1	adjustable
	Fill or discharge control with protection against pump running dry <b>and</b> high-level alarm	Conductivity/capacitance meas.	NRGT 26-1S	NRS 2-3	adjustable
	Fill control with high-level alarm	Conductivity/capacitance meas.	NRGT 26-1S	KS 92-1	adjustable

**Marine application**

**Marine application**

Boiler operating mode	Low level limiter WB	Feedwater controller WR	High level alarm HW	First low level alarm	Conduct. sensing electrode	Temperature limiter	PN	Level electrode	Level switch/controller	Switch-point	On-off control	Modulating control
<b>TRD 701</b> max. 1 bar*)	●	●	–	–			6	NRGS 11-2	–	fixed	●	–
<b>TRD 802</b> for fast steam generating units	●	●	–	–			40	NRGS 16-2	–	fixed	●	–
<b>TRD 604</b> without constant supervision – 24 hours 2 Low level limiter 1 Feedwater controller/high-level alarm	●	–	–	–			40	NRG 16-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			63	NRG 17-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			160	NRG 19-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			320	NRG 111-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			40	NRG 16-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			63	NRG 17-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			160	NRG 19-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			320	NRG 111-11 (2x)	NRS 1-7 (2x)	fixed	–	–
<b>EN 12953</b> section 6	–	●	●	●			40	NRG 16-42	NRS 1-42	fixed	●	–
	–	●	●	●			40	NRGS 16-1	–	fixed	●	–
	–	●	●	●			40	NRG 26-40	NRS 2-40	adjustable	●	–
	–	●	●	●			40	NRG 26-21	NRS 2-1	adjustable	●	–
<b>EN 12952</b> section 7	–	●	●	●			40	NRG 26-40	NRR 2-40/URB	adjustable	–	●
	–	●	●	●			40	NRGT 26-1	KS 92-1	adjustable	–	●
	–	●	●	●			40	NRG 26-21	NRR 2-2	adjustable	–	●
	–	●	–	–			40	NRG 26-21	NRR 2-1	adjustable	–	●
	–	●	●	●			63	144 LD / 705	KS 92-1	adjustable	–	●
	–	●	●	●			160	144 LD / 705	KS 92-1	adjustable	–	●
<b>TRD 604</b> without constant supervision – 72 hours 2 Low level limiters 1 Feedwater controller 1 High-level alarm	●	–	–	–			40	NRG 16-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			63	NRG 17-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			160	NRG 19-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			320	NRG 111-40 (2x)	NRS 1-40 (1x)	fixed	–	–
	●	–	–	–			40	NRG 16-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			63	NRG 17-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			160	NRG 19-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	●	–	–	–			320	NRG 111-11 (2x)	NRS 1-7 (2x)	fixed	–	–
	–	●	● <sup>1)</sup>	●			40	NRG 16-42	NRS 1-42	fixed	●	–
	–	●	● <sup>1)</sup>	●			40	NRGS 16-1	–	fixed	●	–
	–	●	● <sup>1)</sup>	●			40	NRG 26-40	NRS 2-40	adjustable	●	–
	–	●	● <sup>1)</sup>	●			40	NRG 26-21	NRS 2-1	adjustable	●	–
	–	●	● <sup>1)</sup>	●			40	NRG 26-40	NRR 2-40 / URB	adjustable	●	–
	–	●	● <sup>1)</sup>	●			40	NRG 26-21	NRR 2-2	adjustable	–	●
	–	●	● <sup>1)</sup>	●			40	NRGT 26-1	KS 92-1	adjustable	–	●
	–	●	● <sup>1)</sup>	●			63	144 LD / 705	KS 92-1	adjustable	–	●
	–	●	● <sup>1)</sup>	●			160	144 LD / 705	KS 92-1	adjustable	–	●
	–	–	●	–			40	NRG 16-4	NRS 1-2	fixed	–	–
	–	–	●	–			40	NRG 16-41	NRS 1-41	fixed	–	–
	–	–	●	–			63	NRG 17-41	NRS 1-41	fixed	–	–
	–	–	●	–			160	NRG 19-41	NRS 1-41	fixed	–	–
	–	–	●	–			40	NRG 16-12	NRS 1-8	fixed	–	–
	–	–	●	–			63	NRG 17-12	NRS 1-8	fixed	–	–
	–	–	●	–			160	NRG 19-12	NRS 1-8	fixed	–	–
1 Conductivity sensing electrode					●		40	LRGT 16-1	KS 90	adjustable	●	●
					●		40	LRGT 16-2	KS 90	adjustable	●	●
					●		63	LRGT 17-1	KS 90	adjustable	●	●
					●		40	LRG 16-40	LRR 1-40 / URB	adjustable	●	●
					●		40	LRG 16-41	LRR 1-40 / URB	adjustable	●	●
with superheater 1 Self-monitoring temp. limiter							63	LRG 17-40	LRR 1-40 / URB	adjustable	●	●
							63	LRG 17-1	LRR 1-5 / URS 2	adjustable	●	–
							160	LRG 19-1	LRR 1-5 / URS 2	adjustable	–	–
						●	40/160	TRG 5-6x/TRV 5-40	NRS 1-40.1 <sup>2*)</sup>	adjustable	–	–
					●	40/160	TRG 5-5x	TRS 5-6	adjustable	–	–	

\*) according to PED max. 0.5 bar

1) Only as first alarm. Low-level limiter and feedwater control electrodes or low-level limiter and high-level alarm electrodes can be installed together in one flange.

2\*) The level switch NRS 1-40.1 can be used for up to 4 limiting functions, e. g. 2 x NRG 16-40 (low level), 1 x NRG 16-41.1 (high level), 1 x TRV 5-40 (self-monitoring temperature limiter)