

## Description

The level switch NRS 1-51 is used in conjunction with level electrodes NRG 1...-51 as high level alarm in steam boilers and (pressurized) hot-water plants.

A high level alarm prevents the water level from exceeding the preset max. water level (HW) and for this purpose switches off e. g. the feedwater supply.

Depending on the directives listed below the level switch NRS 1-51 can be used in combination with the following level electrodes:

Directive	Level electrode type	
PED Pressure Equipment Directive 97/23/EC + Functional Safety IEC 61508 SIL 3	NRG 16-51 NRG 17-51 NRG 19-51	
VdTÜV Bulletin "Wasserstand 100" (= Water Level 100)	NRG 16-51 NRG 17-51 NRG 19-51	NRG 16-12 NRG 17-12 NRG 19-12

## Function

The level switch NRS 1-51 is designed for different electrical conductivities of the boiler water and for connecting one level electrode.

When the water level exceeds the MAX limit, the level electrode enters the liquid and an alarm is triggered in the level switch. This switchpoint is determined by the length of the electrode tip.

After the de-energizing delay has elapsed, both output contacts of the level switch will open the control circuit, e. g. for the feedwater supply. If the deactivation of the feedwater supply is interlocked in the external control circuit, the lockout can only be deactivated when the level electrode is exposed again.

An alarm will also be raised if a malfunction occurs in the level electrode and/or the electrical connection.

If the level electrode is installed in a level pot outside the boiler, make sure that the connecting lines are rinsed regularly. During the rinsing process the water level cannot be measured in the level pot for 5 minutes. The level switch therefore bypasses the level electrode and monitors the rinsing and bypass time (standby input, controlled by the logic unit SRL 6-50).

If the connecting lines for steam  $\geq 40$  mm and water  $\geq 100$  mm, the installation is considered to be internal. In this case the rinsing processes do not have to be monitored.

An automatic self-testing routine monitors the safety functions of the level switch. In the event of a malfunction the control circuit opens instantaneously and switches off e. g. the feedwater supply.

Alarm and malfunction messages are indicated by LEDs, and the signal output is instantaneously energized.

An alarm can be simulated by pressing the test button.

## Note

A high level alarm prevents the water level from exceeding the preset max. liquid level (HW). For this purpose it can, for instance, interrupt the feedwater supply. If the interruption of the feedwater supply endangers the heating surfaces in the feedwater preheater (economizer), the heating must be switched off, too.

## High-Level Alarm Level Switch NRS 1-51

### Directives and Standards

#### Pressure Equipment Directive (PED) 97/23/EC

The level switch NRS 1-51 in conjunction with level electrode NRG 1...-51 is EC type approved according to EN 12952/EN 12953. These Directives state, among other things, the requirements made on limiting systems and equipment for steam boiler plants and (pressurized) hot-water installations.

#### Functional Safety acc. to IEC 61508

The level switch NRS 1-51 is certified acc. to IEC 61508 only if used in combination with level electrode NRG 1...-51. This standard describes the functional safety of safety-related electrical/electronic/programmable electronic systems.

#### VdTÜV Bulletin "Wasserstand 100" (= Water Level 100)

The level switch NRS 1-51 in conjunction with the level electrodes NRG 1...-51, NRG 1...-12 is type approved according to the VdTÜV Bulletin "Water Level 100".

### Directives and Standards – continued –

#### LV (Low Voltage) Directive and EMC (electromagnetic compatibility)

The level switch NRS 1-51 meets the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC.

#### ATEX (Atmosphère Explosible)

According to the European Directive 94/9/EC the level switch NRS 1-51 must **not** be used in potentially explosive areas.

#### UL/cUL (CSA) Approval

The equipment meets the requirements of: UL 508 and CSA C22.2 No. 14-13, Standards for Industrial Control Equipment. File E243189.

### Functional Safety acc. to IEC 61508

#### Safety characteristics of the subsystem NRG 1...-51 / NRS 1-51

The equipment combination NRG 1...-51 / NRS 1-51 corresponds to a type B subsystem with Safety Integrity Level (SIL) 3. Type B means that the behaviour under fault conditions of non safety-related components cannot be completely determined. The functional safety of the equipment combination refers to the detection and evaluation of the water level and, as a consequence, the contact position of the output relays.

The design of the equipment combination NRG 1...-51 / NRS 1-51 corresponds to the architecture 1oo2. This architecture consists of two channels that run automatic self-testing routines to detect and diagnose faults in each other. If the self-testing routine detects a fault, the equipment combination NRG 1...-51 / NRS 1-51 will go to the safe state, which means that the output contacts will open the safety circuit.

Safety characteristics	SIL	Architecture	Lifetime (a)	Proof Test Interval (a)
General	3	1oo2	20	20
	SFF	PFD <sub>av</sub>	PFH <sub>av</sub>	$\lambda_{DU}$
Level switch NRS 1-51 alone	98.54 %	$1.18 \times 10^{-4}$	$3.73 \times 10^{-8}$	$7.33 \times 10^{-8}$ /h
Level switch NRS 1-51 in conjunction with one level electrode NRG 1...-51	98.17 %	$1.69 \times 10^{-4}$	$4.54 \times 10^{-8}$	$9.33 \times 10^{-8}$ /h

Terms / Abbreviations	Description
Safety Integrity Level SIL	Classification of the Safety Integrity Level acc. to IEC 61508
Lifetime (a)	Lifetime of equipment combination in years
Safe Failure Fraction SFF	Percentage of failures without the potential to put the safety-related system into a dangerous state
Probability Failure per Demand (Low Demand) PFD <sub>av</sub>	Average probability of failure on demand for low demand mode (once a year)
Probability Failure per Hour PFH <sub>av</sub>	Probability of failure per hour
$\lambda_{DU}$	Failure rate for all dangerous undetected failures (per hour) of a channel of a subsystem

### Determination of the Safety Integrity Level (SIL) for safety-related systems

Level electrode, level switch and actuators (auxiliary contactors in control circuit) are subsystems and together constitute a safety-related system that executes a safety function.

The specification of the safety-related characteristics refers to the level electrode and the level switch including the output contacts. The actuator (e. g. an auxiliary contactor in the control circuit) is installation specific and, according to IEC 61508, must be considered separately for the whole safety-related system.

# High-Level Alarm

## Level Switch

### NRS 1-51

#### Technical Data

##### Supply voltage

24 VDC +/- 20 %, 0,3 A;

100 – 240 VAC +10/-15 %, 47 – 63 Hz, 0,2 A (optional)

##### External fuse

0.5 A (semi-delay)

##### Power consumption

7 VA

##### Sensitivity of response

(Electrical conductivity of water at 25 °C):

> 0.5 ... < 1000 µS/cm or

> 10 ... < 10000 µS/cm

##### Inputs:

##### Electrical connection of level electrode

To connect the level electrode please use:

■ For level switch NRS 1-51 with response sensitivity 10 µS:  
Screened multi-core control cable, min. conductor size 0.5 mm<sup>2</sup>, e.g. LiYCY 4 x 0.5 mm<sup>2</sup>, max. length 100 m.

■ For level switch NRS 1-51 with response sensitivity 0.5 µS:  
Double-screened multi-core low-capacitance data cable, min. conductor size 0.5 mm<sup>2</sup>, **LiZCY PiMF 2 x 2 x 0.5 mm<sup>2</sup>, max. length 30 m.**

##### Stand-by input

1 volt-free input, 18 – 36 VDC, for monitoring the purging and bypass time.

Max. bypass time: 5 minutes.

Wiring: control cable 2 x 0.5 mm<sup>2</sup>.

##### Outputs:

##### Control circuit

2 volt-free make contacts,

6 A 250 V AC / 30 V DC cos φ = 1

Delay of response: 3 seconds

Provide inductive loads with RC combinations according to manufacturer's specification to ensure interference suppression.

##### Signal output

1 volt-free output for instantaneous external signalling, 24 V DC, max. 100 mA (semiconductor output).

Wiring: control cable 2 x 0.5 mm<sup>2</sup>.

##### Indicators and adjustors

1 button for test and diagnosis,

2 red/green LEDs for indicating the operating mode and alarm.

3 red LEDs for diagnosis.

##### Housing

Housing material: base: polycarbonate, black; front:

polycarbonate, grey. Terminal strips separately detachable

Fixing of housing: Mounting clip on supporting rail TH 35, EN 60715.

##### Electrical safety

Degree of contamination: 2, overvoltage category III to EN 61010-01.

##### Protection

Housing: IP 40 to EN 60529

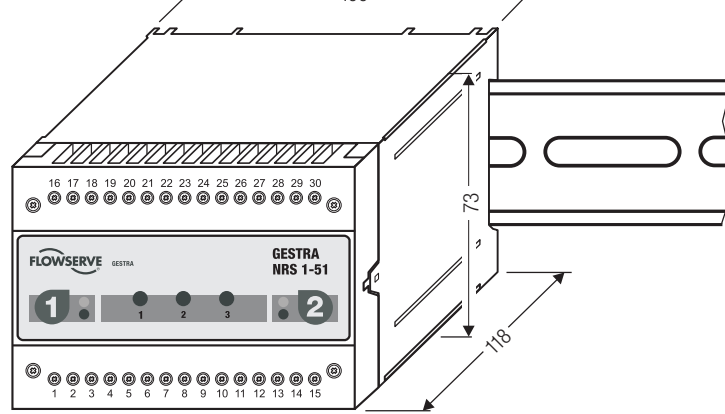
Terminal strip: IP 20 to EN 60529

##### Weight

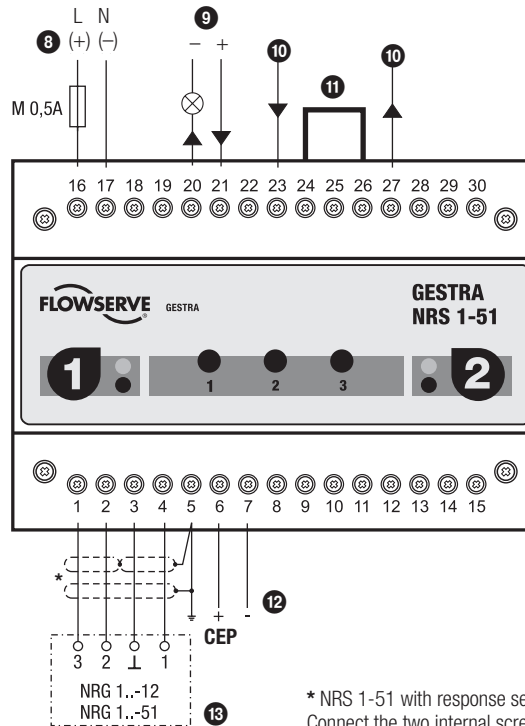
approx. 0.5 kg

Supply in accordance with our general terms of business.

#### Dimensions



#### Wiring Diagram



#### Key

- 8 Supply voltage
  - 9 Signal output 1 for external alarm 24 V DC, 100 mA (semiconductor output)
  - 10 Safety circuit, input and output, external fuse: 2 A (slow-blow) or 1 A (slow-blow) (TRD 604, 72 hours)
  - 11 Wire link, fitted on site, when used as high water level alarm acc. to TRD, EN 12952 / EN 12953
  - 12 Stand-by input 1, 24 V DC, for connecting the logic unit SRL 6-50
  - 13 Level electrode NRG 1...-51, NRG 1...-12
- CEP Central earthing point in control cabinet

\* NRS 1-51 with response sensitivity 0.5 µS/cm:  
Connect the two internal screens to terminal 5 and the CEP.

#### Further conditions:

##### Ambient temperature

when the equipment is switched on: 0 ... 55 °C,  
during operation: -10 ... 55 °C

##### Transport temperature

-20 ... +80 °C (< 100 hours), defrosting time of the de-energized equipment before it can be put into operation: 24 hours.

##### Storage temperature

-20 ... +70 °C, defrosting time of the de-energized equipment before it can be put into operation: 24 hours.

##### Relative humidity

max. 95 %, no moisture condensation

##### Site altitude

max. 2000 m

#### Interlock

In the event of an alarm the level switch NRS 1-51 does not interlock automatically. If a lockout function in the installation is required, the follow-up circuit (control circuit) must be equipped with an interlock. The circuitry must meet the requirements of the EN 50156.

#### Power supply and stand-by input

Use a safety power supply unit (SELV) to feed the level switch NRS 1-51 with 24 V DC. Only equipment with protection by electrical separation or with low voltage may be connected to the stand-by input.

#### Order & Enquiry Specification

GESTRA level switch NRS 1-51 as high water level limiter acc. to TRD, EN 12952/EN 12953

Supply voltage .....

Sensitivity ..... µS/cm

# GESTRA AG

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