



NRS 1-40

Installation Instructions 810635-00

Switching Controller Type NRS 1-40



An Invensys company



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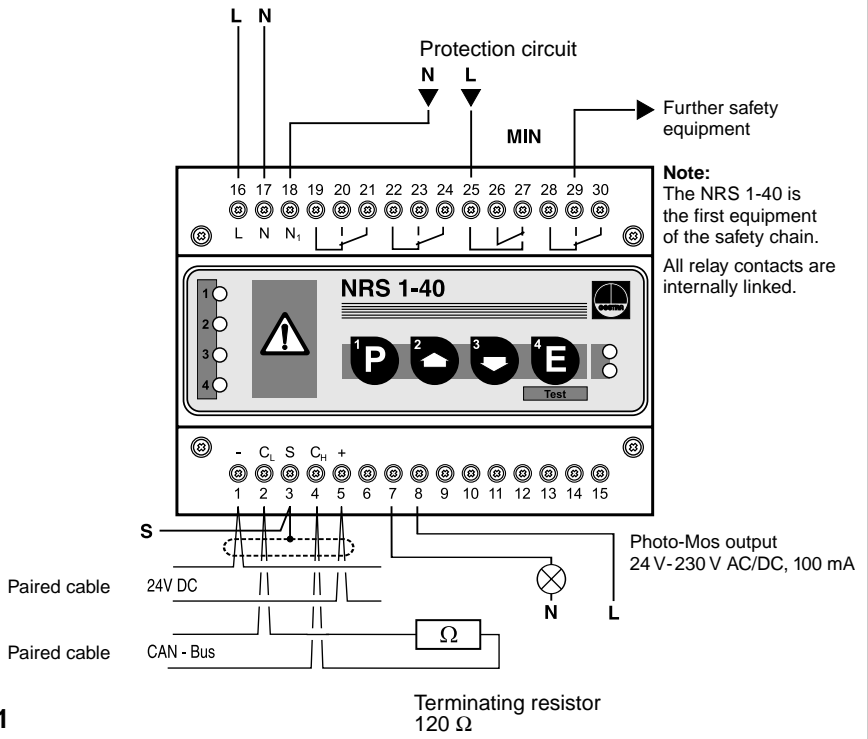


Fig. 1

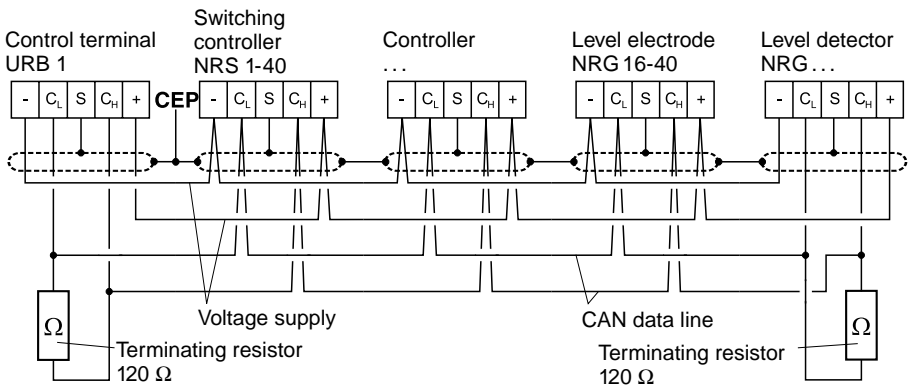


Fig. 2

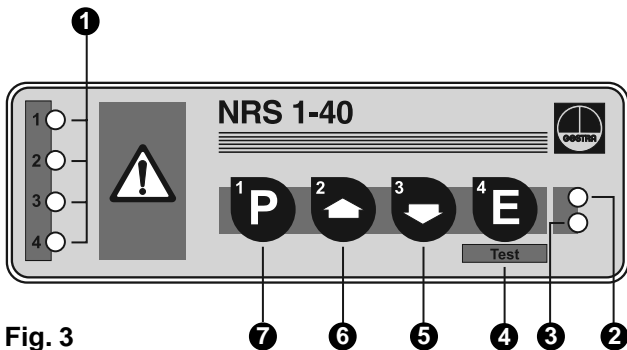


Fig. 3

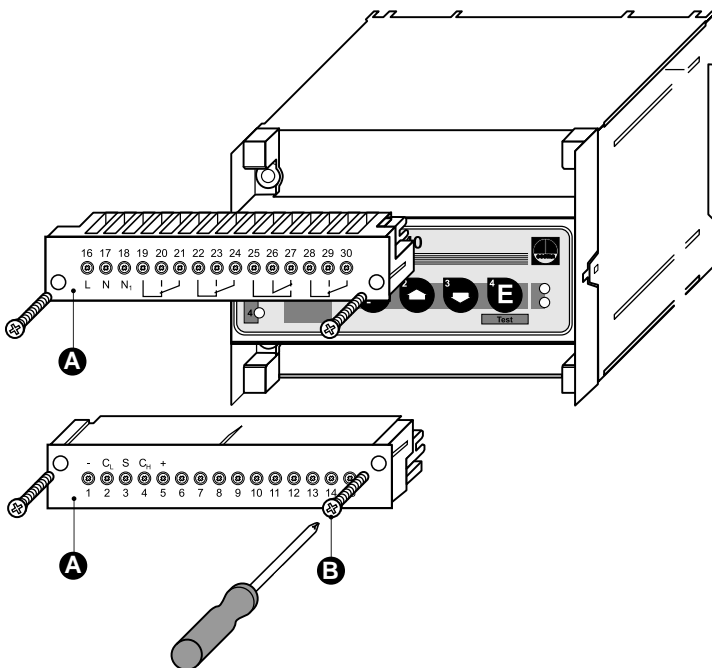


Fig. 4

Key

| 1 | Indicator LED | Alarm | Malfunction |
|----------|------------------------------|-----------------|--------------------|
| | LED 1: Electrode 1 | Low-level alarm | Multifunction |
| | LED 2: Electrode 2 | Low-level alarm | Multifunction |
| | LED 3: Ancillary equipment 1 | Alarm | Multifunction |
| | LED 4: Ancillary equipment 2 | Alarm | Multifunction |

2 LED “Bus status”

3 LED “Power”

4 Button “Test mode”

5 Cursor up

6 Cursor down

7 Program key

8 Two-pole code switch

9 Ten-pole code switch

A Terminal strip

B Screws for terminal strip

Important Notes

Usage to the intended purpose

Use switching controller type NRS 1-40 only for signalling low water level (min. alarm).

Safety Note

Installation must only be performed by qualified staff. Qualified staff are those persons who – through adequate training in electrical engineering, the use and application of safety equipment in accordance with regulations concerning electrical safety systems, and first aid & accident prevention – have achieved a recognised level of competence appropriate to the installation and commissioning of this critical safety device.



Danger

The terminal strip of the NRS 1-40 is live during operation.
This presents the danger of electric shock.
Cut off power supply before fixing or removing the housing cover.

Explanatory Notes

Scope of Supply

NRS 1-40

- 1 Switching controller NRS 1-40 (plug-in unit in plastic case with terminals)
- 1 Terminating resistor 120 Ω
- 1 Installation and service manual

Description

The controller type NRS 1-40 is a self-monitoring low-water level limiter with periodic self-checking and monitoring feature of the output relay contacts, to be used in conjunction with **one** level electrode type NRG 16-40, 17-40 or 19-40. The controller has the following function:

■ Low-water level alarm with **one** level electrode

The equipment detects the min. water level (low-level limiter) and complies with the German regulations for use in steam and hot-water plants operating without constant supervision according to TRD 401, TRD 602 and TRD 604.

When used with **two** level electrodes type NRG 16-40, 17-40 or 19-40, the controller NRS 1-40 constitutes a high-integrity low-water level limiter **system** with periodic self-checking. The controller features the following function:

■ Low-water level alarm with **two** level electrodes

This equipment combination detects the min. water level (low-level limiting system) and complies with the German regulations for use in steam and hot-water plants operating without constant supervision according to TRD 604, sheet 1 and 2 (24/72 hours operation without constant supervision).

This item of electrical equipment complies with the Technical Regulations on Protection Circuits to DIN VDE 0116 (prEN 50156).

The level data are transferred from the electrode NRG 1...-40 to the controller via CAN bus using the CANopen protocol. Only **one** low-level limiting system may be used per CAN-based network.

Function

At regular intervals the level electrode NRG 1...-40 sends a data signal to the controller NRS 1-40. The data transfer is effected by means of a CAN bus according to ISO 11898. The transferred measuring data are constantly evaluated by the controller. A periodic self-checking routine tests every 3 seconds the integrity of the system and its safety functions, with a malfunction in the controller resulting in immediate boiler shut-down. When the CAN bus line and, consequently, the data transmitting cycle are interrupted, the controller sends a visual signal to indicate a faulty condition and the relays are instantaneously de-energized (fail-safe position).

The controller also facilitates user-friendly performance tests and detection/evaluation of malfunctions. To guarantee the correct and safe functioning of the low-level limiter a min. electrical conductivity of 0.5 $\mu\text{S}/\text{cm}$ at 25 °C is required.

The relay de-energizing delay is normally set to 3 seconds at the factory but delays of 15 to 25 seconds are available on request.

Apart from the burner protection circuit there is also a separate Photo-MOS make contact output for remote indication.

Technical Data

Type approval no.

TÜV · WB · 99-403

Input

Interface for CAN bus to DIN ISO 11898 CANopen protocol

Output for protection circuit

Supply voltage 24 V DC, conditionally short-circuit protected

Two volt-free relay contacts, locally connected in series.

Max. contact rating for switching voltages 24 V AC/DC, 115 V AC and 230 V AC:

4 A ohmic/inductive.

Contact material: silver, hard-gold plated

Output for control circuit

Photo-MOS output, instantaneous, max. contact rating for switching voltages 24 V AC, 115 V AC and 230 V AC/DC: 100 mA ohmic

Relay de-energizing delay

Output “Low-level alarm”, set to 3 sec. (standard)

optional for e. g. marine applications 15 sec. or 25 sec.

Indicators and adjustors

4 pushbuttons Parameterisation/“TEST”

1 red LED “Low-level alarm electrode 1”

1 red LED “Low-level alarm electrode 2”

2 red LEDs “Multifunction”

1 red LED “Bus status”

1 green LED “Power”

1 ten-pole code switch: 7 poles for setting node ID, 3 poles for setting baud rate

1 two-pole code switch for limiter/limiting system

Internal self-checking routine

Every 3 seconds

Periodic testing of output relay contacts

Every 6 hours

Supply voltage

230 V +/- 10 %, 50/60 Hz

115 V +/- 10 %, 50/60 Hz (optional)

24 V +/- 10 %, 50/60 Hz (optional)

Power consumption

5 VA

Sensitivity

≥ 0.5 µS/cm at 25 °C

Protection

Enclosure: IP 40 to DIN EN 60529

Terminal strip: IP 20 to DIN EN 60529

Explanatory Notes – continued –

Technical Data – continued –

Admissible ambient temperature

0°C to 55°C

Enclosure material

Front panel: polycarbonate, grey
Enclosure: polycarbonate, black

Weight

Approx. 0.8 kg

Installation

NRS 1-40

Installation on mounting rail

1. Clip switching controller onto mounting rail 35 x 15 mm (DIN EN 50022):
2. Align switching controller, see **Fig. 11**

Tool

- Screwdriver (5.5/100)

Wiring

NRS 1-40

Note that multi-paired control cable is required, e. g. UNITRONIC® BUS DeviceNet™ drop cable (thin) 2 x 0.25², 2 x 0.34² or RE-2YCYV-fl 2x2x0.5².

Max. cable length: 250 m. Take baud rate into consideration!

Fig. 5, Fig. 10

Wiring should be in accordance with wiring diagram **Fig. 1, Fig. 2** on page 3.

When a max. cable length of 1000 m is desired, make sure to modify the baud rate accordingly. Refer to pages 20 and 21 for more details.

Wiring Diagram

Wiring diagram see page 3.



Attention

- Interlink screens of control cables such that electrical continuity is ensured and connect them to **one** central earthable point (CEP), **Fig. 2**.
- To protect the switching contacts fuse circuit with T 2.5 A or according to TRD regulations (1.0 A for 72 hrs operation).
- If more than one system component is connected to a CAN bus line provide the first and last equipment with a terminating resistor of 120 Ω. **Fig. 2**
- Use only **one** CAN-based water-level limiting system per CAN bus network.
- The CAN bus line must **not** be interrupted while operating with one or more system components.

An interruption will result in disconnection on faults.

If the switching controller has to be replaced be sure to first remove the terminal strips **A**, **Fig. 4**

Note: Make sure that all system components connected are *not operating* before removing the CAN bus line from the terminal strip.



Note

- Connect screen only to terminal 3.
- The loop resistance must be under 10 Ω.
- The rated voltage is stated on the name plate.
- When switching off inductive loads, voltage spikes are produced that may impair the operation of control and measuring systems. Inductive loads should therefore be provided with commercial arc suppressor RC combinations, e. g. 0.1 μF/100 W.

Tools

- Screwdriver for slotted screws, size 2.5, completely insulated according to VDE 0680

Basic Adjustments

CAN Bus

All level and conductivity controllers and associated electrodes are interconnected by means of a CAN bus using the CANopen protocol. Every item of equipment features an electronic address (Node ID). The four-core bus cable serves as power supply and data highway for high-speed data exchange.

The CAN address (Node ID) can be set between **1** and **123**.

The NRS 1-40 is configured at our works and ready for service with other GESTRA system components without having to set the node ID.

If several systems of the same kind are to communicate in one CAN bus network, be sure to assign one node ID for each individual system component (e. g. controller). Refer to pages 20 and 21 for more details.

Node ID

| Water-level limiter | | | | | | | |
|---------------------|------------------|------------------|----------------------|------------------|------------------|------------------|------------------|
| Display | Valve | Controller | NRS 1-40 | NRG 16-40 [1] | NRG 16-40 [2] | I/O equipm. 1 | I/O equipm. 2 |
| Node-ID X - 3 | Node-ID X - 2 | Node-ID X - 1 | Node-ID X (Basis) | Node-ID X + 1 | Node-ID X + 2 | Node-ID X + 3 | Node-ID X + 4 |
| Reserved area | | | | | | | |
| Control | | | | | | | |

Factory setting

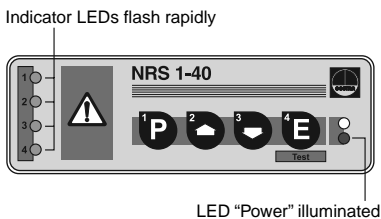
The switching controller features the following factory set default values:

- Baud rate: **250 kb/s**
- Sensitivity: **0.5 µS/cm**
- Node ID: **001**
- Relay with energizing delay switchpoint 1: **0s**
- Relay with energizing delay switchpoint 4: **0s**
- Relay with de-energizing delay switchpoint 1: **3s**
- Relay with de-energizing delay switchpoint 4: **3s**

Commissioning

NRS 1-40

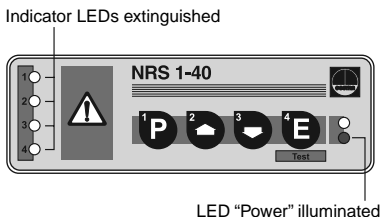
Apply power to the unit.
The four indicator LEDs flash rapidly.
The LED "Power" lights up.
The test cycle takes about 3 sec.



Operation

NRS 1-40

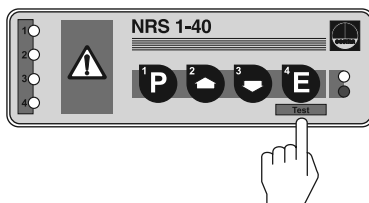
Normal operation, electrode(s) submerged.
The four indicator LEDs are not illuminated.
The LED "Power" lights up.



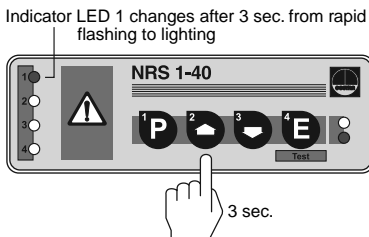
Test Cycle

NRS 1-40

Press button **E** briefly.
The test mode is activated for about 10 sec. Be sure to press button **P** or **E** within these 10 sec.
Note:
The safety circuit will be interrupted during the test cycle.



Press button **P** for 3 sec.
LED 1 flashes rapidly and remains permanently illuminated after 3 sec.
A low-level alarm is simulated for electrode 1.



Test Cycle – continued –

NRS 1-40

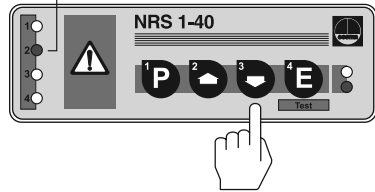
Press button  briefly.

LED 2 flashes rapidly and remains permanently illuminated after 3 s.

A low-level alarm is simulated for electrode 2.

This test cycle is performed for the water-level limiting system (two level electrodes).

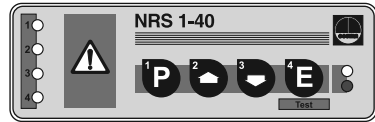
Indicator LED 2 changes after 3 sec. from rapid flashing to lighting



Alarm

There are four different alarm conditions:

- **Low-level alarm for water-level limiter** (one level electrode).
- **Low-level alarm for water-level limiting system** (two level electrodes).
- **Safety shutdown** for ancillary equipment 1
- **Safety shutdown** for ancillary equipment 2



Low-level alarm for water level limiter

LED 1 flashes rapidly.

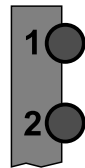
LED 1 remains permanently illuminated after the de-energizing delay.



Low-level alarm for water level limiting system

LED 1 and 2 flash rapidly.

LED 1 and 2 remain permanently illuminated after the de-energizing delay.



Alarm – continued –

Safety shutdown for ancillary equipment 1

LED 3 flashes rapidly.

LED 3 remains permanently illuminated after the de-energizing delay.



Safety shutdown for ancillary equipment 2

LED 4 flashes rapidly.

LED 4 remains permanently illuminated after the de-energizing delay.



Note

- The switching controller does not have its own lock-out circuit. Lock-out and manual reset facilities are to be provided externally.
- The signal output (terminal 7, 8) is instantaneously energized (no delay of response) in the event of an alarm.

System Faults

There are four system malfunctions that might occur in the level electrode and the switching controller.

- Max. admissible temperature in electrode terminal box exceeded
- No or faulty communication between controller and electrode
- Fault in CAN bus
- Failure of 24 V power supply unit built in switching controller NRS 1-40



Danger

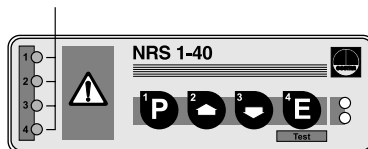
The terminal strip of the NRS 1-40 is live during operation. This presents the danger of electric shock. Cut off power supply before fixing or removing the housing cover.

System Fault 1

The four LEDs flash slowly.

MAX/MIN alarm

LEDs flash slowly



Fault: The max. admissible temperature in the electrode terminal box is exceeded.

Remedy: Insulate electrode flange to protect the equipment against heat radiation.

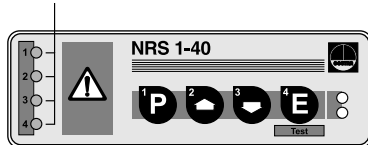
As soon as the temperature drops below the max. admissible limit the equipment automatically returns to normal operation.

System Fault 2

The four LEDs flash rapidly.

MAX/MIN alarm

LEDs flash rapidly



Fault: The CAN bus line between the nodes is interrupted.

Remedy: Check wiring and terminals. Press **E** to acknowledge the fault.

Fault: Incorrect node ID(s).

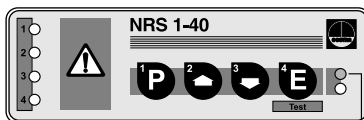
Remedy: Set correct node ID(s), referring to sections “Basic Adjustment” (page 11) and “Annex” (page 20).

Disconnect the system from its power supply. After 5 sec. connect the power and restart the system.

System Faults – continued –

System Fault 3

LED “Bus status” flashes slowly.



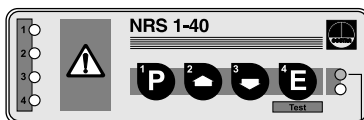
LED flashes slowly

Fault: Malfunction in CAN bus.

Remedy: Press button **E** to acknowledge the fault.

LED “Bus status” flashes slowly.

MAX/MIN alarm



LED flashes slowly

Fault: Data transfer in CAN bus interrupted.

Remedy: The bus cables have to be correctly connected according to the wiring diagram (observe polarity!).

Make sure that all **end-of-line nodes** are provided with 120 Ω terminating resistors, referring to the wiring diagram on page 3.

Disconnect the system from its power supply. After 5 sec. connect the power and restart the system.

Fault: The baud rate of one or more nodes is not set correctly.

Remedy: Check baud rate settings of all bus nodes. The baud rates **must be identical**. Refer to section “Annex” for more details.

Disconnect the system from its power supply. After 5 sec. connect the power and restart the system.

Fault: The overall length of the bus cable does not correspond to the selected baud rate.

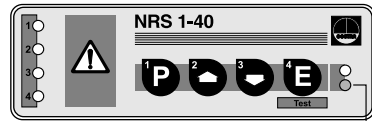
Remedy: Change baud rate settings of all nodes according to the ratings on page 21, **Fig. 10**

Disconnect the system from its power supply. After 5 sec. connect the power and restart the system.

System Faults – continued –

System Fault 4

LED “Power” flashes slowly.



LED flashes slowly

Fault: The power supply unit (PSU) is overloaded. The power supply unit may be misused for other components.

Remedy: Check load of power supply unit. Be sure to use the PSU only for the voltage supply of bus-based network components.

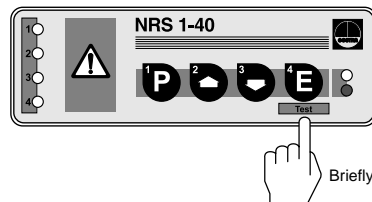
Disconnect the system from its power supply. After 5 sec. connect the power and restart the system.

Fault: Power supply unit fails to function.

Remedy: Replace power supply unit.

Acknowledge system fault

Once you have corrected system faults 2 and 3 press button **E** briefly to acknowledge the fault.



Malfunctions



Danger

The terminal strip of the NRS 1-40 is live during operation. This presents the danger of electric shock. Cut off power supply before fixing or removing the housing cover.

Fault finding list for trouble shooting

Water level below switchpoint LOW LEVEL – device fails to function

Fault: LED “Power” does not light up.

Remedy: Turn on the power. Connect the equipment properly, referring to wiring diagram on page 3.

Water level not yet below switchpoint LOW LEVEL – Low level alarm is raised

Fault: Low level alarm is given despite the electrode being submerged.

Remedy: The conductivity of the fluid to be monitored is $< 0.5 \mu\text{S}/\text{cm}$.

Fault: The electrode body does not have earth connection to the vessel.

Remedy: Clean seating surfaces and insert metal joint ring (of stainless steel 1.4301) D 27 x 32 to DIN 7603.

Do **not** insulate the level electrode with hemp or PTFE tape!

Fault: The vent hole in the protection tube does not exist, is obstructed or flooded.

Remedy: Check protection tube and, if necessary, provide vent hole.

Fault: The isolating valves of the external measuring pot (optional item) are closed.

Remedy: Open isolating valves.

If faults occur that are not listed above or cannot be corrected, please contact our service centre or authorized agency in your country.

Emergency Operation

Emergency operation of water-level limiting system

If one level electrode fails to operate the installation can continue to operate in emergency mode under constant supervision according to TRD 401 with **one** level electrode.

1. Undo screw **B** and remove the lower terminal strip **A**, **Fig. 4**.
2. Set code selector switches **S1** and **S2** to "OFF", **Fig. 6, Fig. 8**.
3. Set code selector switches **S1** to "ON" and **S2 - S7** to "OFF". The switching controller NRS 1-40 has now the node ID "1", **Fig. 7**.
4. Set node ID of the working electrode to "2" (cf. section "**Emergency operation**" in the **Installation Manual** for level electrodes **NRG 16-40, 17-40, 19-40**).
5. Affix lower terminal strip **A**.



Attention

- Enter beginning of emergency operation in the boiler log.
- An installation operating in emergency mode has to be constantly supervised.
- Install a visible sign or signal in the control room to indicate emergency operation.
- Immediately replace faulty level electrode.
- Enter end of emergency operation in the boiler log.

Annex

Assign/change node ID

If several systems of the same kind are to communicate in one CAN bus network, be sure to assign one node ID for each individual system component (e. g. controller).

Typical example of node IDs for several vessels

| Group 1 Steam boiler | Group 2 Vessel A | Group 3 Vessel B | Group 4 Vessel C | Group 5 Vessel D |
|--|---|---|---|---|
| Controller | Controller | Controller | Controller | Controller |
| (1) Default factory setting NRS 1-40 ID:001 NRS 1-41 ID:006 NRS 1-42 ID:020 NRS 2-40 ID:039 NRR 2-40 ID:040 LRR 1-40 ID:050 | (2) NRS 1-42 ID:070 NRS 2-40 ID:074 NRR 2-40 ID:075 | (3) NRS 1-42 ID:080 NRS 2-40 ID:084 NRR 2-40 ID:085 | (4) NRS 1-42 ID:090 NRS 2-40 ID:094 NRR 2-40 ID:095 | (5) NRS 1-42 ID:100 NRS 2-40 ID:104 NRR 2-40 ID:105 |
| Level electrode | Level electrode | Level electrode | Level electrode | Level electrode |
| NRG 16-40 ID:002 NRG 16-41 ID:007 NRG 16-42 ID:021 NRG 26-40 ID:041 LRG 16-40 ID:051 | NRG 16-42 ID:071 NRS 26-40 ID:076 | NRG 16-42 ID:081 NRS 26-40 ID:086 | NRG 16-42 ID:091 NRS 26-40 ID:096 | NRG 16-42 ID:101 NRS 26-40 ID:106 |

The node IDs of the individual units have to be manually adjusted. For more information refer to the corresponding installation manuals.



Attention

- Do **not** assign the same node ID twice within the CAN bus network.

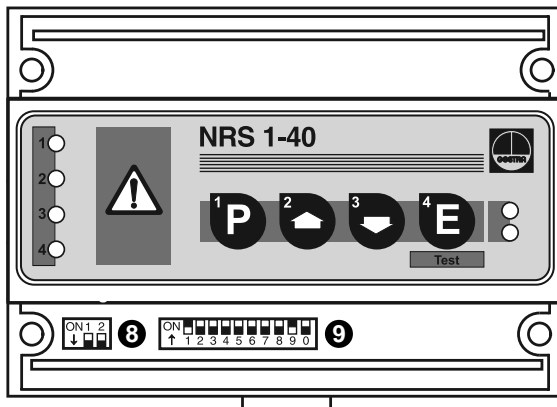


Fig. 5



| | | |
|----|----|-----------|
| | | Electrode |
| S1 | ON | 1+2 |
| S2 | ON | |

Fig. 6



| | | |
|----|-----|-----------|
| | | Electrode |
| S1 | OFF | 1 |
| S2 | OFF | |

Fig. 8



| | | | |
|----|-----|---------|---|
| | | Node ID | 1 |
| S1 | ON | 1 | |
| S2 | OFF | 2 | |
| S3 | OFF | 4 | |
| S4 | OFF | 8 | |
| S5 | OFF | 16 | |
| S6 | OFF | 32 | |
| S7 | OFF | 64 | |

Fig. 7 (Factory setting)



| | | | |
|----|-----|---------|----|
| | | Node ID | 12 |
| S1 | OFF | 1 | |
| S2 | OFF | 2 | |
| S3 | ON | 4 | |
| S4 | ON | 8 | |
| S5 | OFF | 16 | |
| S6 | OFF | 32 | |
| S7 | OFF | 64 | |

Fig. 9 (Example)

| S8 | S9 | S0 | Baud rate | Cable length |
|-----|-----|-----|-------------|--------------|
| OFF | OFF | OFF | 1000 kBit/s | 25 m |
| ON | OFF | OFF | 500 kBit/s | 100 m |
| OFF | ON | OFF | 250 kBit/s | 250 m |
| ON | ON | OFF | 125 kBit/s | 500 m |
| OFF | OFF | ON | 100 kBit/s | 670 m |
| ON | OFF | ON | 50 kBit/s | 1000 m |
| OFF | ON | ON | 20 kBit/s | 1000 m |
| ON | ON | ON | 10 kBit/s | 1000 m |

Fig. 10 (Factory setting: 250 kBits/s)

Declaration of conformity CE

We hereby declare that the equipment **NRS 1-40** conforms to the following European guidelines:

- LV guideline 73/23/EWG version 93/68/EWG
 - EMC guideline 89/336/EWG version 93/68/EWG
- which are based on the following harmonised standards:
- LV standard DIN EN 50178
 - EMC standard DIN EN 50 081-2, DIN EN 61 000-6-2

This declaration is no longer valid if modifications are made to the equipment without consultation with us.

Bremen, 27th October 2000
GESTRA GmbH



Head of the Design Dept.
Uwe Bledschun
(Academically qualified engineer)



Quality Assurance Manager
Walter Meyer

Legende

- Ⓐ Terminal strips
- Ⓒ Supporting rail 35 x 15 to DIN EN 50022

Example of Installation

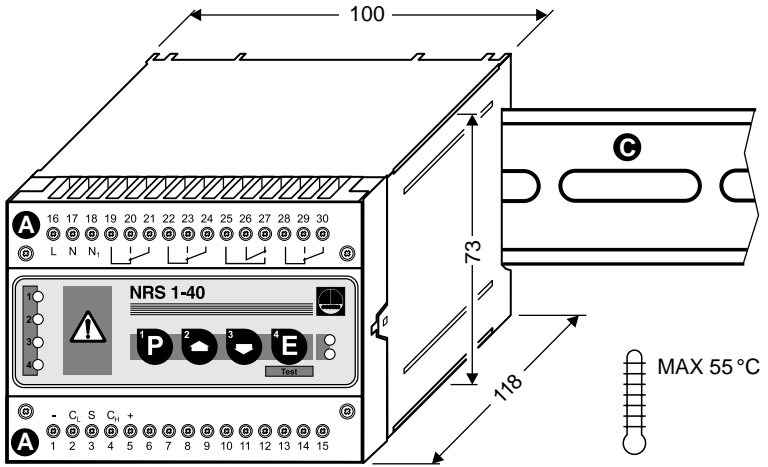


Fig. 11

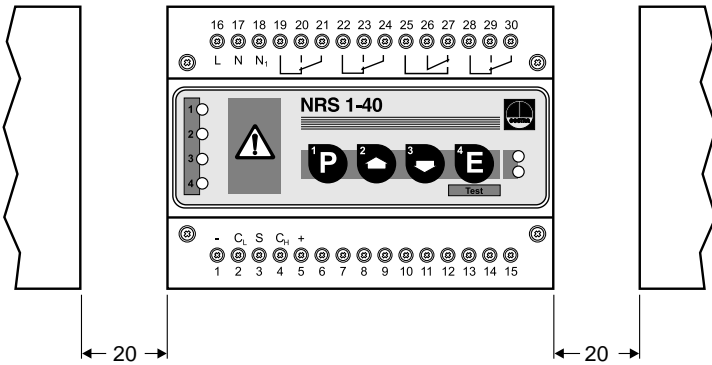


Fig. 12

España

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