

INSTRUCTION MANUAL Resistive level gauge ELG

1 General description

OFFICINE OROBICHE ELG is an electronic level measuring unit specifically designed for measuring water level inside vessels characterized by high pressures and temperatures.

It comprises a series of sensors (ELG-P) mounted on a column (ELG-C) connected to the vessel and an electronic unit (ELG-E); one or two remote displays can be connected as optional accessories (ELG-R 4-20 or ELG-R 4-20 DI).

Sensors are made of two metallic parts which are insulated by a ceramic part. The electronic unit measures the conductivity of the fluid around the metallic part and the discrimination of water or steam is based on their different conductivity values. Each sensor is connected to the control unit via a pair of conductors to guarantee operating continuity and to signal anomalies.

The electronic unit is located in a GRP IP66 enclosure (FIG. 1) which can be installed outdoors, typically on a wall.

Fig. 1



ELG system divides sensors into two groups:

Odd channels (group A)

Even channels (group B)

Each group has its own power supply source and feeding cable. It can continue to operate even if there is a failure in the other group.

Both groups (even and odd) are not perfectly aligned, due to the gap between sensors, but as the gap is suitable for required resolution commonly needed, each sensor could be considered as having redundancy equal to 1, with reduced resolution.

Inside ELG-E (electronic control unit) there are two completely independent sections:

- a. Probe detection section is carried out by analogue circuits only, one for each sensor. This guarantees operating continuity even if one or more channels fail.

Each channel has his own alarm relay with fail-safe contact typically used to send probe status to a remote display. Water or Steam status of each probe is displayed through bi-color LEDs located on the front panel:

GREEN with water, RED with steam.

The absence of software in this section conforms to the strictest requirements on safety equipment.

b. Processing section has 2 microprocessors that work independently. One microprocessor is associated with Group A sensors (odd) and the other with Group B (even). Nevertheless both microprocessors read signals from all sensors (odd and even), thus taking full advantage of the complete measuring resolution. Each microprocessor has its own independent alarm outputs and 4-20 mA current loop signal. By means of dip switches is possible to set level alarms for each A/B group.

Accurate design has isolated the microprocessors from the measuring circuits: no failure of one of the CPUs can invalidate the main measurement, which remains perfectly valid even if the digital section is out of service.

At same way microprocessor A can work even if B one is out of service and vice versa.

Each microprocessor:

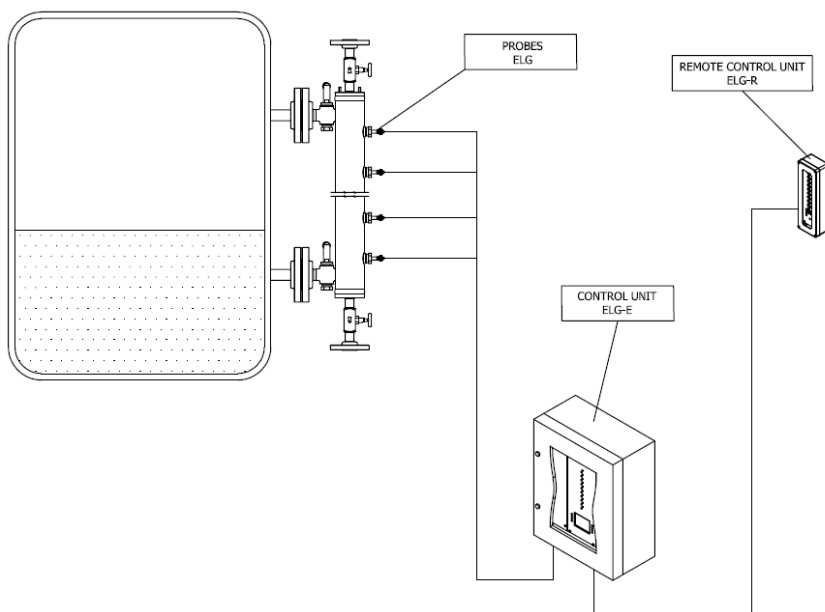
- 1) Verifies congruity of the measuring signals and detects anomalous situations showing the status on the display
- 2) Drives of a 4-20 mA analogue output (A/B current loop) proportional to water level for interfacing with remote indicators or DCS
- 3) Controls level alarms driving its own fail safe SPDT relays, one for High level (High) and one for Low level (Low) - High and Low Level position can be configured using Dip Switches on ELG-E board
- 4) Controls system alarm driving its own fail-safe SPDT relay (Alarm)

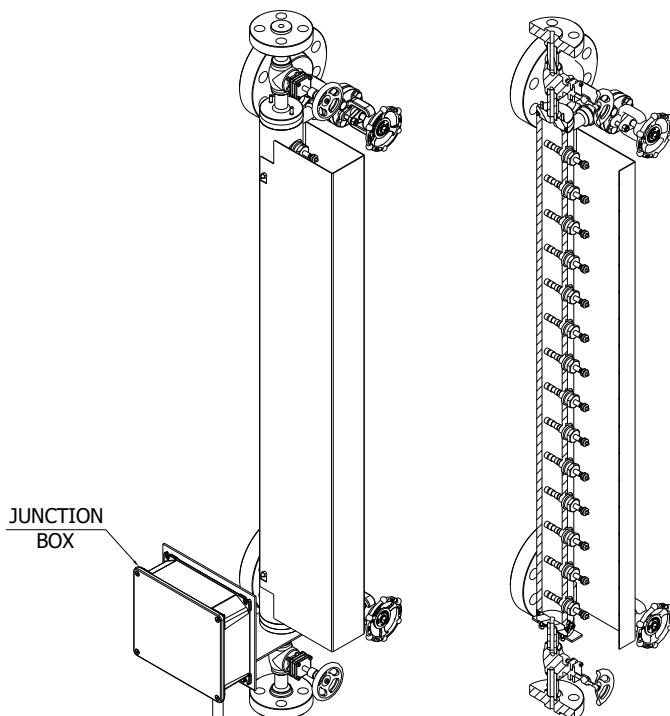
Alarm is set, after about 30 sec of delay to avoid false signaling, when Level limits has been overcome by at list 2 or more probes.

On the graphical display the operating status of the probes, the level and a clear description of the anomalies are shown.

1.1 System architecture

ELG system can adapt itself to different application requirements





1.1.1 Applications with very high reliability

This typically relates to installations controlled by redundant DCS, where the functioning occurs via 2/3 or even 3/4 logics; such as for example, thermoelectric stations.

In this case, it is usual to directly connect all the alarm outputs of the ELG to the digital inputs of the DCS, making sure to distribute them on separate I/O boards.

The relative higher complexity of wiring is repaid by the very high reliability that can be achieved. This comes from the use of independent analogue circuits which do not require the use of instrumental software

1.1.2 Simple applications

Many simple systems are not equipped with DCS control, but nevertheless, they require reliable and easy to manage measurements; specifically for simple boilers.

This allows to pre-set the correct configuration (water or steam in the right points) and to obtain a single signaling of the alarms when something unusual is detected; this would typically cause the boiler to shut-off.

The use of two independent processing sections also guarantees very high reliability. In particular, the total conformity to Criterion A for electromagnetic compatibility guarantees the absence of false or missing alarms even in the presence of strong electromagnetic disturbances or electrostatic discharges.

2 Mechanical installation and maintenance

2.1 Column and sensors

The mechanical part of the gauge consists of a column on which are installed the sensors. The column is pre-arranged for connecting to a boiler and can also be equipped with vent and drain connections. Sensors and connecting cables are protected by a stainless steel cover.

2.1.1 Installation

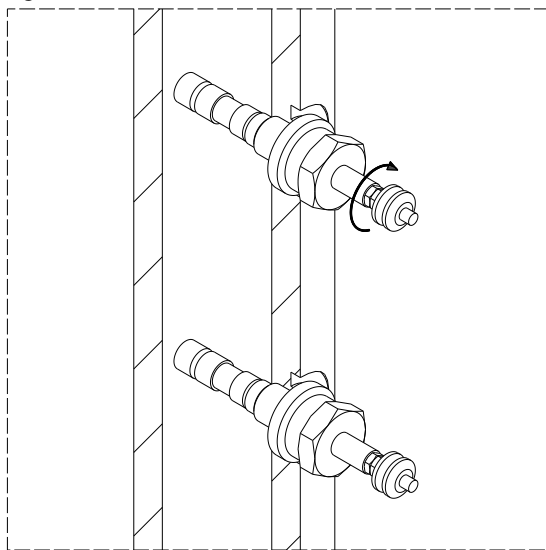
Installation must be carried out by qualified personnel. To prevent deformations of the structure of the gauge, before installation make sure to:

- install the gauge so that it does not have to sustain the weight of the pipes.
- support the level gauge when its weight is greater than 50 kg or it is longer than 1.5 m, particularly in the presence of vibrations.
- adequately support the level gauge if stress is expected due to seismic loads or wind.

Officine Orobiche can supply, on request, the necessary data for the calculations.

- prevent misalignment of the coupling connections between the gauge and tank or boiler.
- check that the center-to-center distance of the gauge connections (CC) coincides with that of the tank or boiler.
- prevent differential thermal expansions between the gauge and tank which may generate mechanical loads to the structure of the gauge. To reduce the effects of differential expansions install an expansion joint or pipe section between the tank or boiler and the length indicator for minimizing deformations.
- always install shut-off valves between the level gauge and the tank or boiler. These valves also provide a means of intercepting the gauge when maintenance is required.
- check the tightening torque of the sensors (90 Nm) with a torque wrench (see figure. 3.1). This check must be conducted because the initial load given to the gaskets could undergo variations after a certain period of time.

Fig. 3.1



2.1.2 Maintenance

Maintenance of the ELG gauges must be carried out by qualified personnel who have read and understood the contents of this manual.

Below maintenance schedule has to be followed:

- every 2 years verify and eventually change probes;
- every 2 years verify and eventually change connecting cable to each sensor

ATTENTION

Do not carry out any maintenance without first checking that:

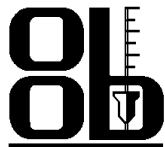
- The pressure inside the gauge has been reduced to the atmospheric value.

Do not only rely on the signaling of the pressure gauge to assume with certainty the actual de-pressurization of the tool.

- The temperature of the gauge is sufficiently low to prevent burns. Consider using gloves, safety glasses or other personal protection equipment if necessary.

Maintenance must be carried out by immediately putting the level gauge out of service, when:

- Leaks, even minimal, are noticed through the connections between the level gauge and the shut-off units.



- Signs of corrosion or seeping are noticed from the welding outside the body of the level gauge.
- Leaks, even minimal, are noticed from the gaskets of the sensors.

ATTENTION

The user must generate inspection reports based on their experience and knowledge of the plant. Realistic maintenance and inspection reports can be determined only with the complete knowledge of the service and atmosphere for which the product was designed.

2.1.3 Disassembly

1. Disconnect the level gauge from the machine, closing the root valves to intercept the process fluid between the tank or boiler and the level gauge, and then check the seal of the valves.
2. Release the pressure inside the gauge, using the dump valves and drain any residual fluid contained inside this gauge, taking care to prevent damage to property or injury to people.
3. Remove the protection cover
4. Disconnect the cables from the sensor which needs to be disassembled
5. Remove the sensor
6. Reassembly
7. After obtaining the sensor and relative spare gasket from OFFICINE OROBICHE, rest the new gasket on the new sensor and screw the sensor into its lodging.
Check that the sensor is tightened at 90Nm (see figure. 3.1)
8. Reconnect wires terminals of the sensor (each sensor is connected by 2 wires)
9. Replace the protection cover on the gauge for preventing the sensors and cables from damaging.

2.1.5 Expected life

Expected life of ELG level indicators is 5 years, if used in operating condition as stated in the label

2.2 Electronic unit

ELG-E standard electronic unit is contained in glass-filled polyester (GRP) (L=340 H=430 W=180 mm) enclosure with a protection degree of IP66 (EN60529), suitable for outdoor installation. It comes in a RAL 9002 grey color and supplied with wall-mounting brackets.

Enclosures have 2xM20 holes for power supply and I/O cables connections. Adaptors, cable glands or special holes on request. We recommend that min IP66 accessories are used for cable entrance.

Use suitable cable glands for diameter of cables to avoid losing the IP protection.

Treaded adaptors for cable glands or conduit entrance can be mounted on request.

2.2.1 Special cables for probes

Probe cables are made by 2 Single pole Cables each probe, and have been factory assembled on column side from the probe itself to the junction box fixed to the level gauge body and should not be modified by end user. Probe cables should be connected to ELG-E enclosure by multi pole cables through cable glands and terminals inside the enclosure.

Probe Cable characteristics:

From probes to on board junction box:

Single pole PFA high temperature cable

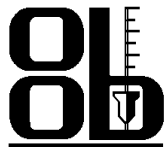
- Working temperature range -65 °C – 260 °C
- Working voltage 600 V
- Resistance to flame good

From on board junction box to ELG-E enclosure:

Multi pole 0,75 mm² tin plated copper conductors (black numbered + 1 Yellow Green GND)

Silicone rubber insulation Standard length 10 m

- Temperature range -60 °C +180 °C



- Temperature over short period +200 °C
- Working voltage 300/500 V
- Test voltage 2000 V
- Resistance to flame good

3 Electrical installation

The ELG level gauge has been designed to guarantee maximum versatility of use, allowing for the adoption of a large number of different electric wiring diagrams depending on the requirements.

Mains power supply must be connected to the power board inside the ELG-E control unit, accessible via 2xM20 cable glands placed on the bottom part of the enclosure. Terminals are also present (redundant in respect to the external connectors) for connecting the 24V power supply and the 4-20 mA analogue output.

The open box is no longer protected: be careful of electrocutions, entrance of water and dust. Carefully close the box after each intervention.

Different configuration of the electrical connections can be realized on request.

Refer to specific electrical schemes of the order.

3.1 Power supply

The power supply is redundant (i.e. it is completely independent for both sections of the equipment).

If two independent AC/DC power supplies are used, one section can continue to operate even if there is a power failure in the other section. Naturally, if there is only one source, the two sections can be connected in parallel, which however means they lose the redundancy.

Power supply can be supplied at 115/230Vac 50/60Hz connecting to Power Board input terminals or at 24Vdc directly on power board output terminals.

Pls note that it is not possible to power the same section simultaneously in both ways.

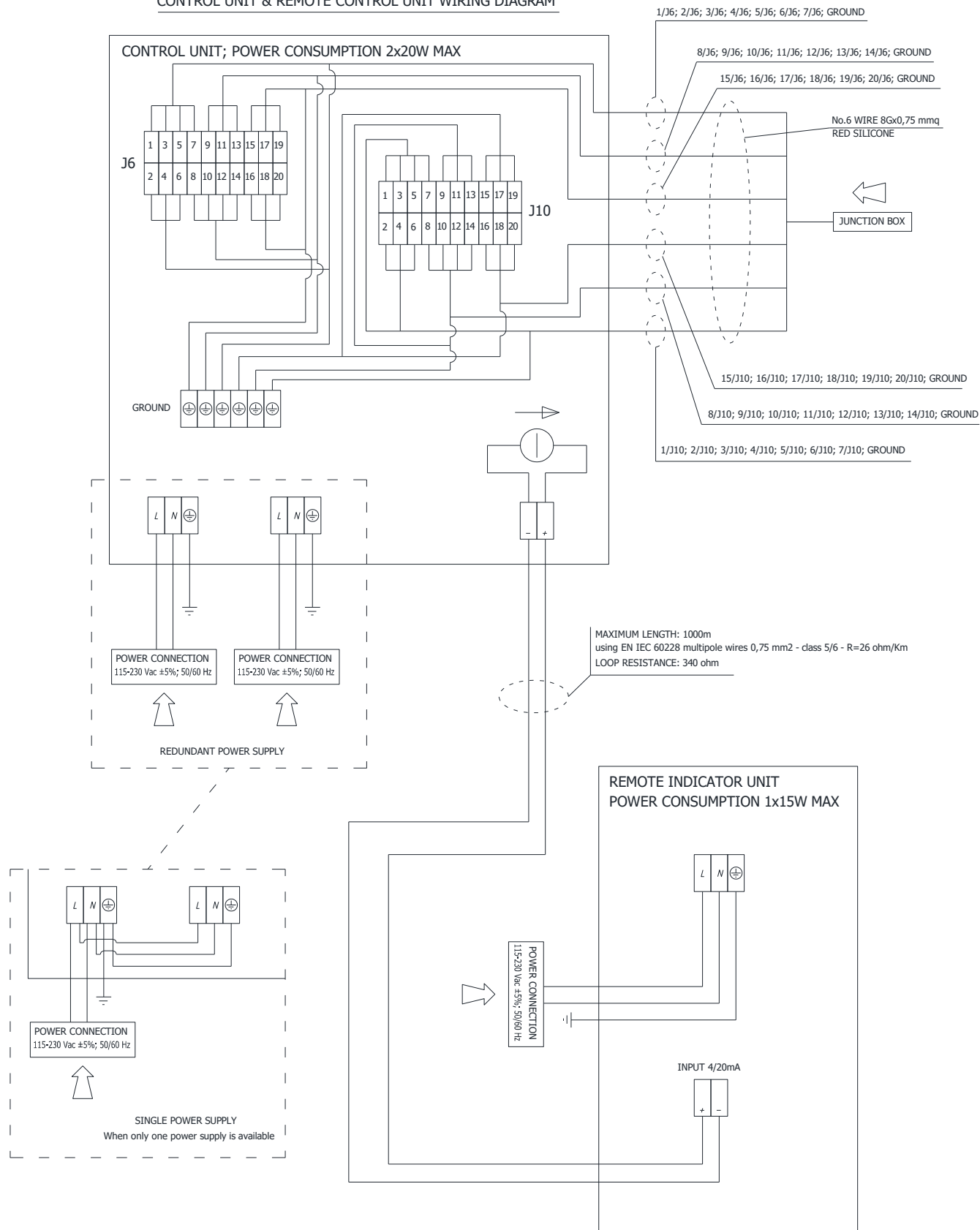
Pls take note that for power supply at 24Vdc, the negative pole (0Vdc) coincides with Ground connection (GND) of the equipment and of the measuring column.

A power supply of 24V can be connected to terminals on main board or to output terminals on power supply board. All these connections are in parallel; make sure to respect the polarity.

Pls refer to attached electrical schemes and to technical specifications for details.

Use suitable cable glands or conduit for cable entries.

CONTROL UNIT & REMOTE CONTROL UNIT WIRING DIAGRAM



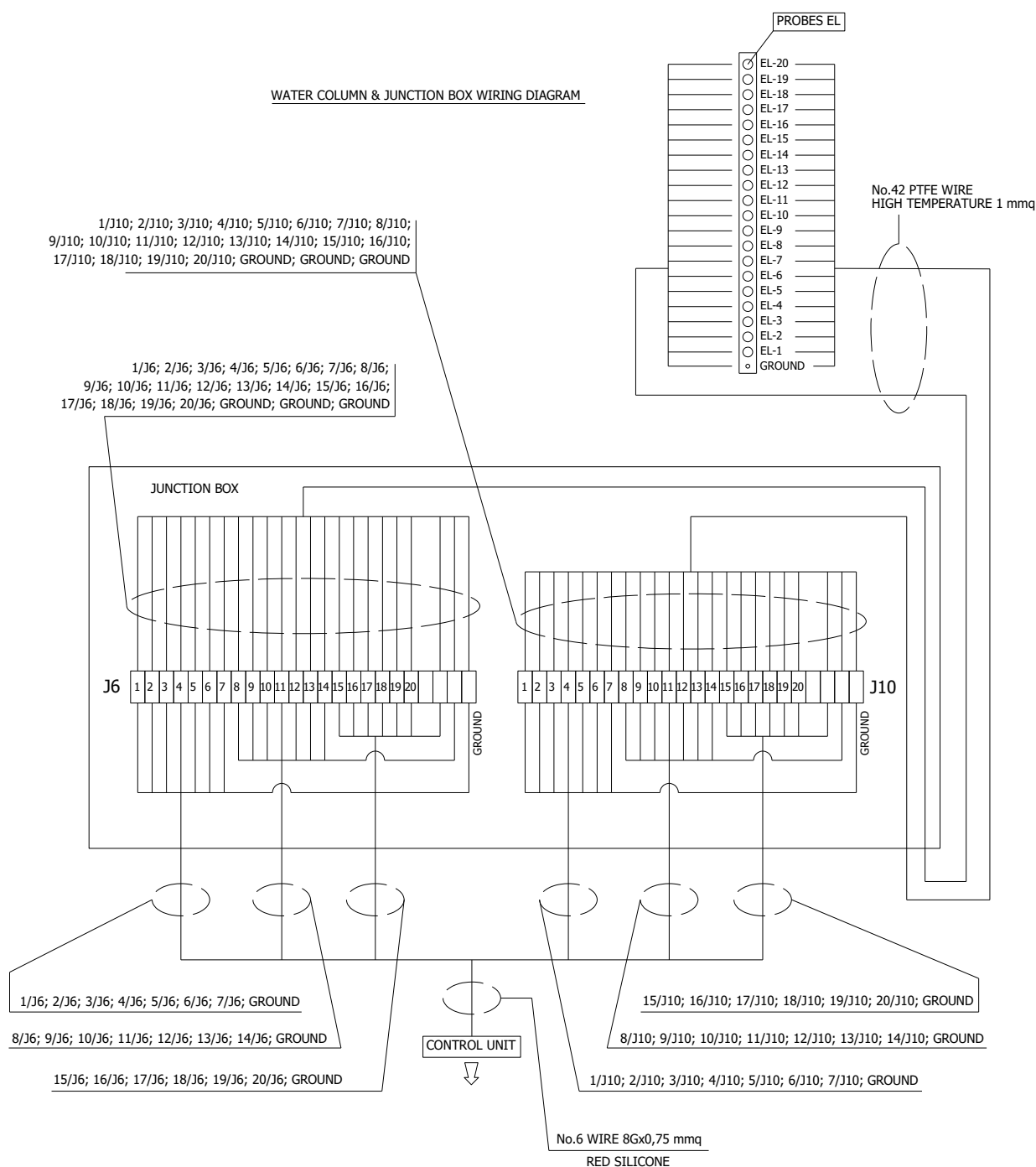
3.2 Sensors

Probes column is normally supplied with 2 cables for sensors already cabled into the junction box.

On control unit side cables, via cable glands, are already pre-connected.

All this makes wiring errors impossible and speeds up installation. The cables sensors are identified with the label J6 and J10 and numbered from 1 to 20 or less referred to probe quantity.

Warning: do not fix cables directly to the column or to other hot parts.





3.3 Signals - Alarms

Depending on the configuration of the control unit, connections of ALARMS, 4-20 mA LOOPS Signals and 24V dc Power for Remote Display or DCS can be made in different way.

For RLG-E standard version supplied for cabling and connecting all Signals and Alarms to Remote Display or control system cabinet.

3.3.1 Probe ALARMS Connector/Terminals - Probe Status Relay output

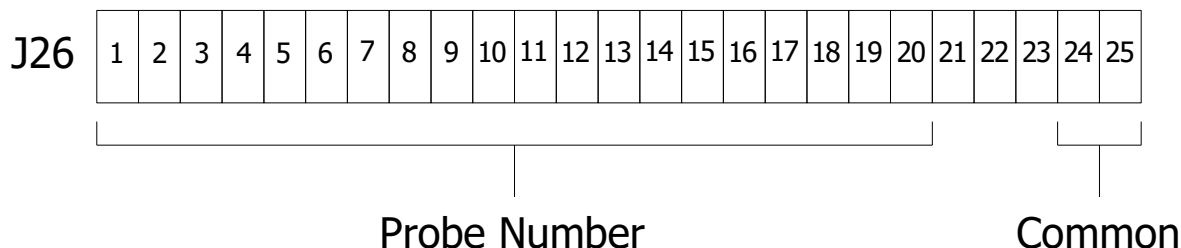
Each probe channel has its own "clean contact" SPST Normally Open (NO-COM) Relay output, available on the relative connector. These relays are directly driven by the analog circuit connected to each probe. No digital or software interfaces are interposed and their functioning is independent from microprocessor based processing section.

Relays outputs (ALR1 – ALRn) are available (when mounted) on ALARM J26 internal status terminal block, technical specifications and electrical schemes for details.

Channel Normal Condition Selectors are 2 positions (WATER OR STEAM) selectors available on back side of the RLG-E main board. There is a selector for each channel.

Correct configuration of this selector allows detection of any breaks on the cabling and sets the operating condition of the relay, increasing fail-safe characteristics of the system: e.g. if selector is in the WATER position, the relay is energized in presence of water, reverse condition occurs in the STEAM position, i.e. Channel relay is energized at presence of the desired condition (fail-safe).

As default lower channels up to the center level are configured for Normal Condition Water and upper channels for Steam.



3.3.2 LOOP OUTPUTS - Analogue output

RLG-E comes with two 4-20 mA independent analogue outputs and therefore redundant.

The signal is proportional to WATER level (GREEN led) indicated by probes, with this significance:

3.5 mA: situation of alarms/anomalies

4 mA: scale start: all the sensors in steam 20 mA: scale end: all the sensors in water

These 2 outputs have been designed to be connected to any type of 4-20 mA measuring device.

In particular analogue signal can be sent to Officine Orobiche ELG-R Remote Display digital gauge (see Per. 10 for details).

Signal terminals are on the MAIN board (refer to DRAWING 1: ELG-E MAIN BOARD) and on LOOP-ALARM-POWER external

Loop power connection is available inside the control unit, 4-20 mA cable will pass through its own cable gland and connected to terminal block.

The output is of the "current-source" type and is self-powered, which means can be directly connected to a normal passive load. For example, connect a 250 ohm resistor to obtain a signal of 1-5 volt.



3.3.3 ALARM OUTPUTS - Pre-configured alarms

HIGH - LOW level Alarms and GENERAL Alarms are also relay outputs, but in this case " clean contact" SPDT (NO-COM –NC) contacts are available.

HH_A and HH_B are HIGH LEVEL ALARM CONTACTS LL_A and LL_B are LOW LEVEL ALARM CONTACTS
ALL_A and ALL_B are SYSTEM ALARMS

These alarms are driven by the microprocessors.

Relays are energized when in normal conditions, de- energized when in alarm status.

Same alarms are available for both microprocessors units that read signals from all sensors (odd Group A + even Group B).

In case of power failure on one section the system continue to work but reading only the sensors connected to the section (odd or even) that continues to be powered.

Alarm outputs are available on JP1 (odd) and JP2 (even) alarm output terminal block numbered from 4 to 12.

Refer to following paragraph for Alarms configuration.

JP1	1	2	3	4	5	6	7	8	9	10	11	12
Odd Section												

JP2	1	2	3	4	5	6	7	8	9	10	11	12
Even Section												

HH Alarm

7 - Com

9 - NC

5 - NA

LL Alarm

4 - Com

12 - NC

11 - NO

Generic Alarm

8 - Com

10 - NC

6 - NO

4 Alarms configuration

ELG-E comes with two internal microprocessors that read the status of the analog measuring circuits.

Each microprocessor section read independently the status of all the channels to check the correctness of the operating conditions. Each microprocessor pilots its own alarm relays.

Relays are energized when in normal conditions, de- energized when in alarm status.

There are 4 Leds on each section for signaling the status of the system:

OK - Green Led - Section Status HIGH –

Yellow Led - High Level Alarm LOW –

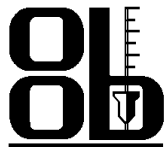
Yellow Led - Low Level Alarm ALARM –

Red Led - General Alarm

OK Green led is ON when the section is working properly

Each microprocessor controls level alarms driving its own fail safe SPDT relays and turning ON corresponding Leds.

If Water level goes lower than minimum, LOW level alarm is activated.



If Water overcomes an expected Steam position, HIGH level alarm is activated.

General Alarm is set when Level limits has been overcome by at list 2 or more probes.

When power is lost on one group (odd A or even B) the ALARM red LED of both groups is activated and control of the level passes to other group that continues reading its sensors (odd or even).

High and Low Level alarm position can be configured using Dip Switches on ELG-E board with three positions for each channel (see below):



Water ← Don't care → Steam

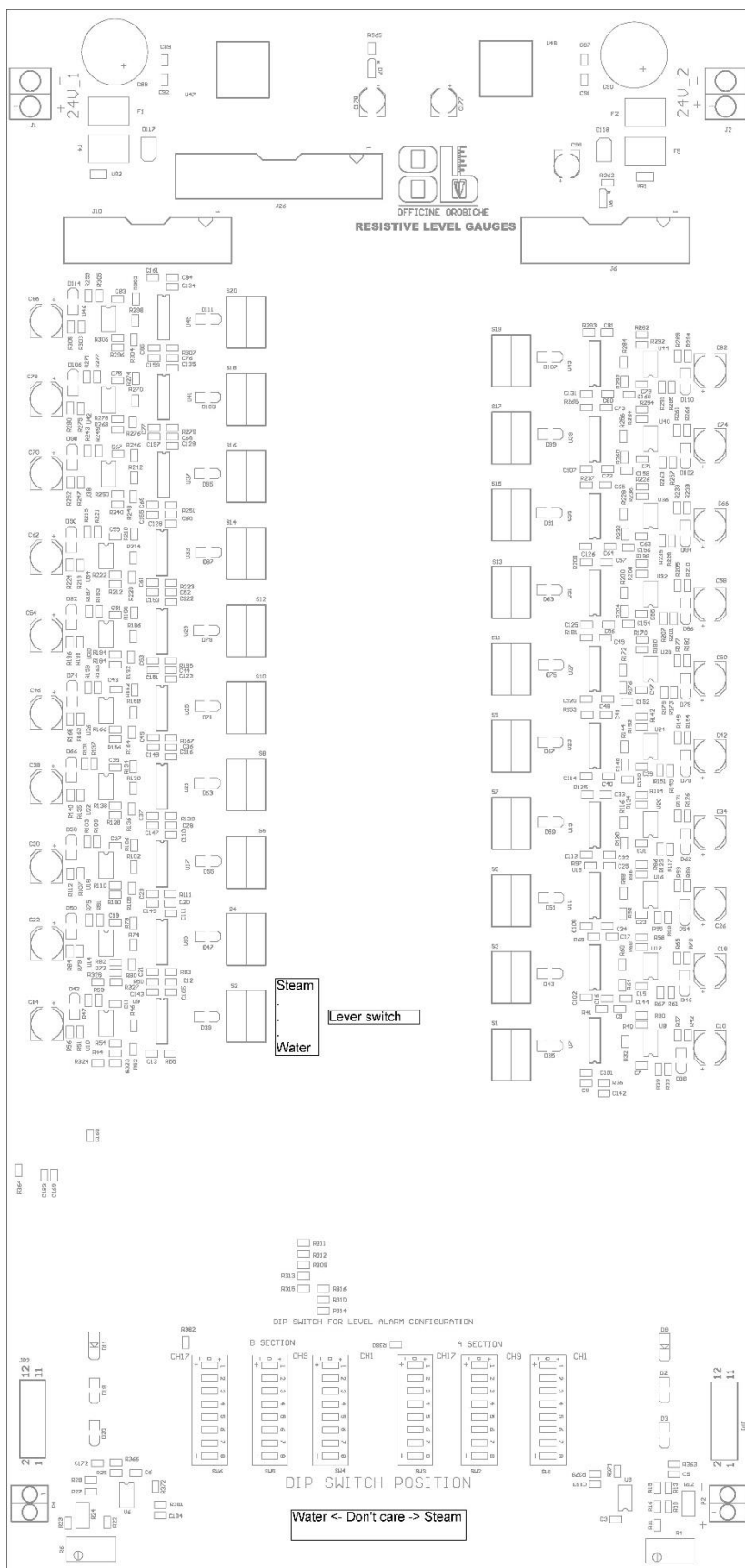
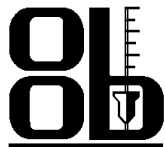
WATER: Normally Water -> Alarm condition if Steam

DON'T CARE: No alarm for this channel

STEAM: Normally Steam -> Alarm condition if Water

For each channel, simply move the selector on the condition considered ordinary. If measured situation is different from the configured situation, control unit will activate an alarm. In most cases, the four lowest sensors of the column will be configured as "WATER" and the four highest as "STEAM"; those in between, where the level can vary during operation without danger, will remain in the "DON'T CARE" position.

Pls refer to "ELG-E Main Board drawing" in attachments





5 Control unit and remote display

ELG-E control unit can function in "STAND ALONE" mode (without remote display). Alternatively, it can be connected to a 4-20mA remote digital gauge ELG-R.

6 Final warnings

Save this manual and make it available for maintenance personnel. Be sure that maintenance staff read this manual before any use or maintenance operation.

If you have lost the manual or if you need further information, please contact Officine Orobiche.

9 Technical specs

Sensors & column

Sensors

Design temperature: 374°C Design pressure: 220 bar

Test pressure at ambient T: 420 bar

Column

Design temperature: 374°C Design pressure: 220 bar

Test pressure at ambient T: 420 bar Min Pitch 50 mm

Control unit ELG-E

Glass-filled polyester, RAL 9002 with front window Dimensions: 340 x 430 x 180 mm - Weight < 4 Kg Wall-mounted with brackets supplied

IP66

Remote display ELG-R

Painted aluminium

Power supply (ac Input)

100-240Vac nominal – 50/60Hz (auto-switch) Double power supply unit (redundant)

Output 24Vdc Nominal - Negative connected to GND Absorbed power < 2 x 20W

Power supply (dc Input)

1x 40W min - 24Vdc nominal +/- 10 % - Negative connected to GND

Or redundant)

2x 20W - 24Vdc nominal +/- 10 % - Negative connected to GND

Outputs and alarm contacts Channel Relays

Standard Relays SPST contacts (NO–C) Maximum capacity of contacts: 48Vdc – 1A

Alarm Relays

Standard Relays SPDT contacts (NC–C–NO) Maximum capacity of contacts: 48Vdc – 1A Optional Relay Board SPDT contacts (NC–C–NO) Maximum capacity of contacts: 250V AC – 1.5A

Analogue output

Double analogue output 4-20 mA (current loop) Open circuit Voltage: 21.5 V

Drive capability: 800 ohm

Setting to 3.5 mA in case of alarm

Level Indication

One bi-color LED for each channel, green for water and red for steam

One LCD display – white/blue backlighted – resolution of 128x64 Alarms Signaling

Green LED for normal functioning Yellow LED for level alarm signaling Red LED for system alarm signaling

Environment

Compatible with standard industrial environments. Temperature range of control unit: $-20 \div +60$ °C

10 Remote Display Digital Gauge

OFFICINE OROBICHE ELG comes with a Remote Display Digital Gauge (ELG-R). It can receive a 4-20 mA current loop signal (ELG-R 4-20) or both a 4-20 mA current loop signal and a digital signal (ELG-R 4-20 DI). The analogue signal works even in case of fail of the two microprocessors, providing great reliability to the system. It can indicate LOW and HIGH warnings and in case of alarm it has two red LEDs and the display will indicate 000.

All terminals are connected in 1:1 connection.

Refer to ELECTRICAL SCHEME 1: ELG-E to ELG-R WIRING DIAGRAM

ELG-E control unit has following outputs:

- N. 2 independent 4-20 mA Loop Outputs (Loop A – Loop B)
- Probes status (20 or less related to specific configuration)
- System Alarms status clean contacts

Use preferably 2 multi-pole twisted shielded cables (not supplied) with minimum 0.75 mm² wires section: max suggested length is 1000 m.

Technical specs

Remote Display ELG-R Electrical Data:

Power supply: 24 Vdc ± 10 % nominal - 115/230 VAC - 47/63 Hz

Maximum power supply consumption: 5W

Loop resistance: 340 ohm

Distance: (Using EN IEC 60228 multipole wires 0.75 mm² - class 5/6 – R= 26 ohm/Km) max suggested 1000 m (Contact Officine Orobiche Tech Dpt for detailed distance calculation)

4-20 mA Passive or Active Loop

Environment

Compatible with standard industrial environments. Temperature range of control unit: $-20 \div +60$ °C

Probe Status

The ALARM terminal board receives the status of each Probe.

Expected status (Water/Steam) of each probe can be configured in ELG-E control unit using Water/Steam selectors on ELG-E board. Please note that Probe Relay Contacts are closed when the status of the probe is correct, that is:

- Water if water was expected,
- Steam if steam was expected.

Probe status is displayed with small green LEDs on the right side of ELG-R Unit front panel: probe Green LED is ON when corresponding probe status is correct.

NOTE: it is possible to force to ON each one of these green LEDs via dip-switches visible on the rear side of ELG-R unit PCB.



High/ Low Level and System ALARMS Status

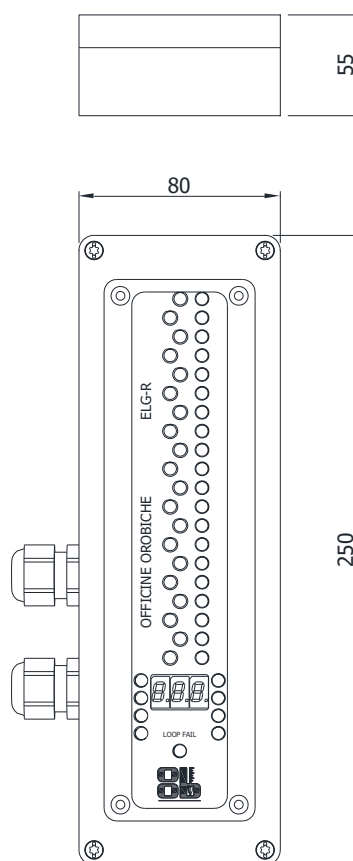
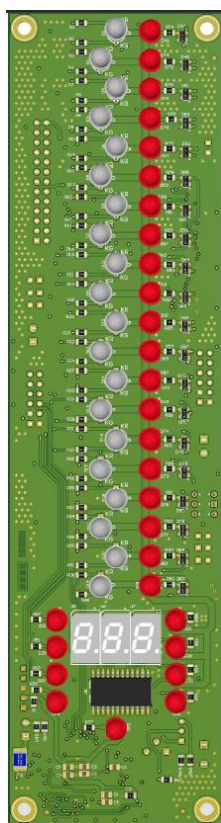
LOOP/ALARM/POWER connector receives the Alarm status as well as power supply 24VDC and 4-20 mA signal.

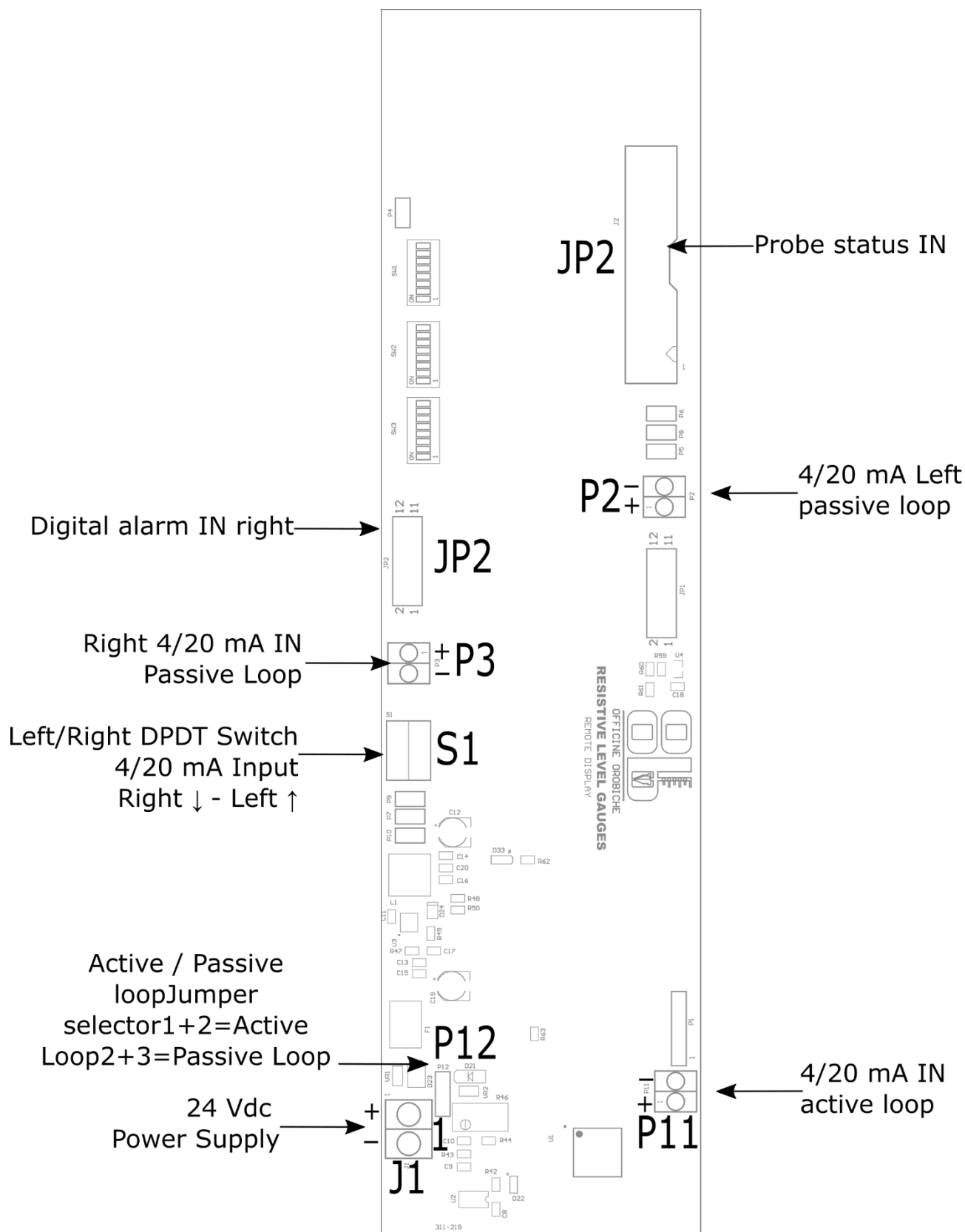
Alarms Status is displayed on RLG-D front panel LEDs:

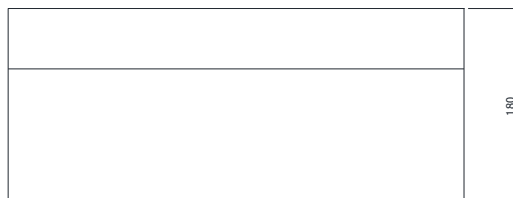
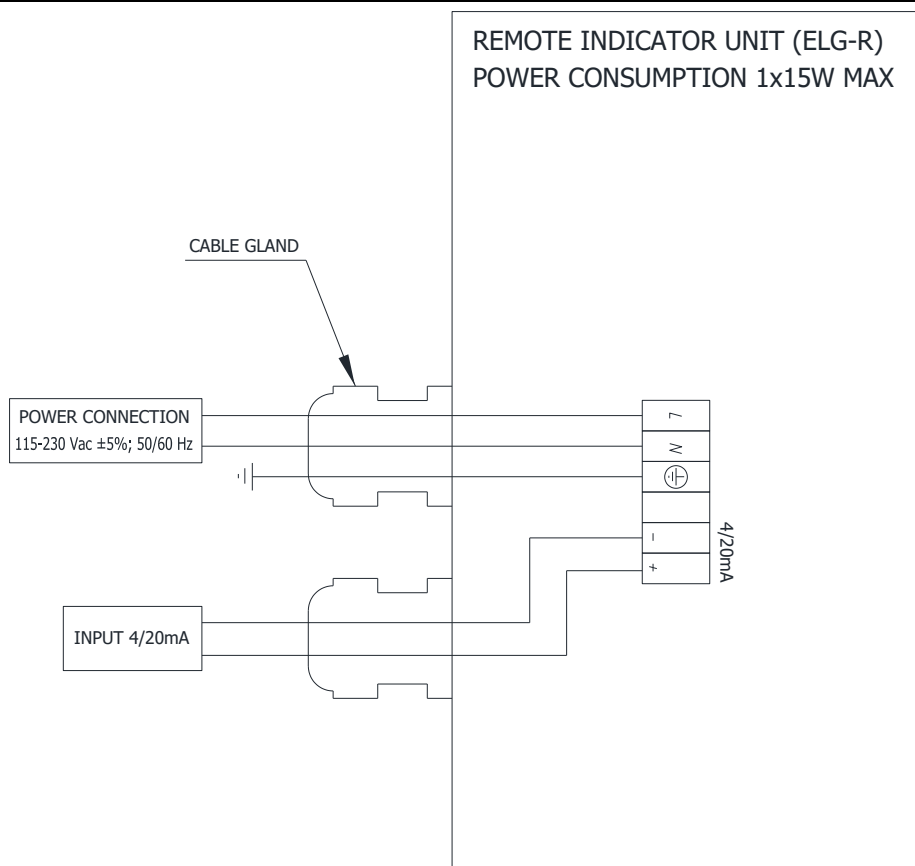
- Green - No Alarms
- Red - System Alarm
- Yellow - High and Low level Alarms

4-20 mA output is read by ELG-R Unit and water level is shown on front panel Red/Green column of LEDs. ELG-R turns on the bottom yellow LED (LOOP FAIL) when the 4-20 mA signal is missing, out of range or there is an major alarm on the ELG-E control unit.

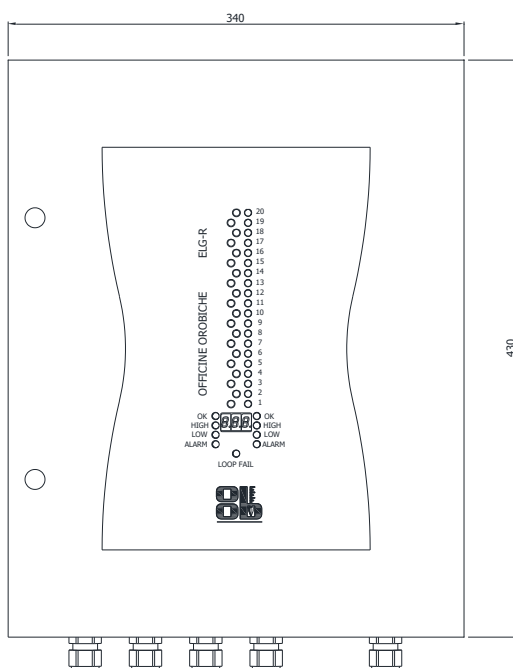
A selector, located on the back of ELG-R, is for selecting 4-20 mA signal and power from Section “A” (Loop A and 24 VA) or “B” (Loop B and 24 VB) of ELG-E.







ELG-R 4-20 DI



Wiring Diagram ELG-E / ELG-R 4-20 DI

