Levelstate Systems Ltd.

INSTALLATION, OPERATION & MAINTENANCE MANUAL FOR ELS NANO

ISSUE I : DECEMBER 2009

Little Kitfield, Gradwell Lane, Four Marks, Hampshire, GU34 5AS,U.K.
Tel: +44 (0) 1962 773829 Fax: +44 (0) 1962 773849
E-mail: info@levelstate.com
Web: www.levelstate.com

© 2009 Levelstate Systems Ltd.
All rights reserved
With technical progress the company reserves the right to change specifications without notice

Solution at all levels

C O N T E N T S

1.0 OPERATING PRINCIPLE

The Levelstate Electronic Type Level Switch – NANO is an alternative to the Float Level Switch for steam / water applications, providing a significant improvement in reliability and safety, reduced installation and maintenance costs.

Applications include single point level detection for Steam / Water / Vacuum / no water which is used in high security low-water cut-off for Boilers, the detection of water in turbine steam extraction lines, Deaerator, HP Heater, LP Heater, Steam extraction lines, Condenser hotwell etc.

The discrimination between water and steam is based on the significant difference in resistivity between the two states over the saturation range. The sensing element is a probe with an insulated tip, inserted in housing assembly (Fig. 1.1) or standpipe, which protrudes into the required sensing location. If a voltage is applied to the tip and it senses water, conduction occurs between probe tip and inside wall of the insert assembly. The level of conduction is electronically detected to initiate relay action.

The ELS NANO system is designed as a single probe channel system.

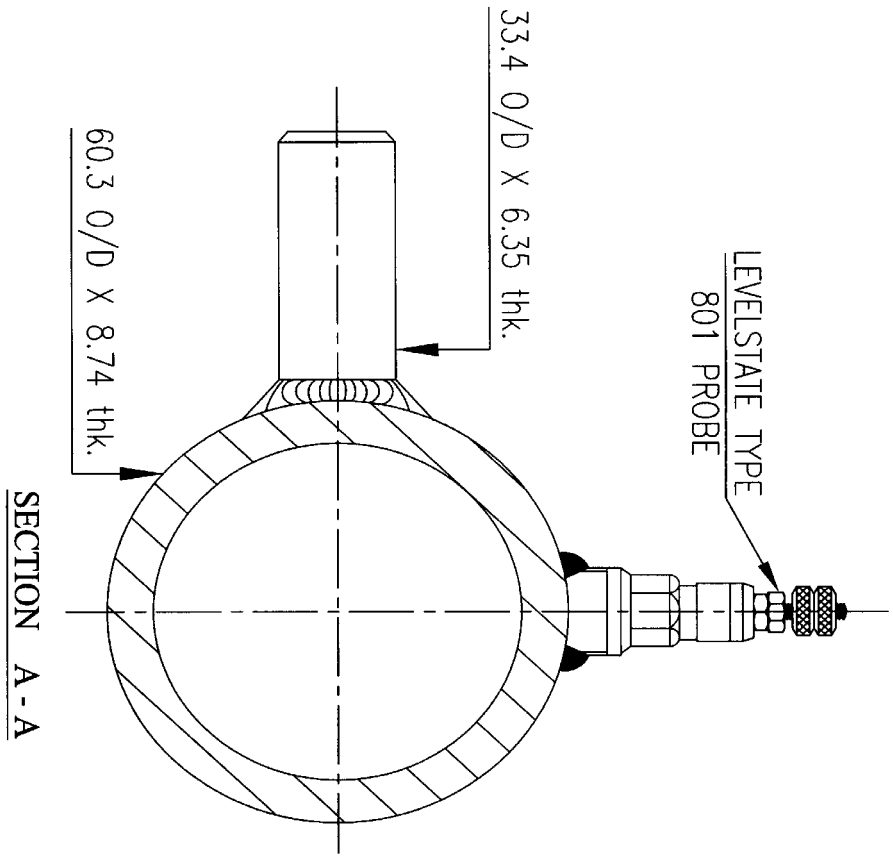

Fig. 1.1

Typical water conductivity's are shown in Fig 1.2. The definition of the various categories is indicated at the top.

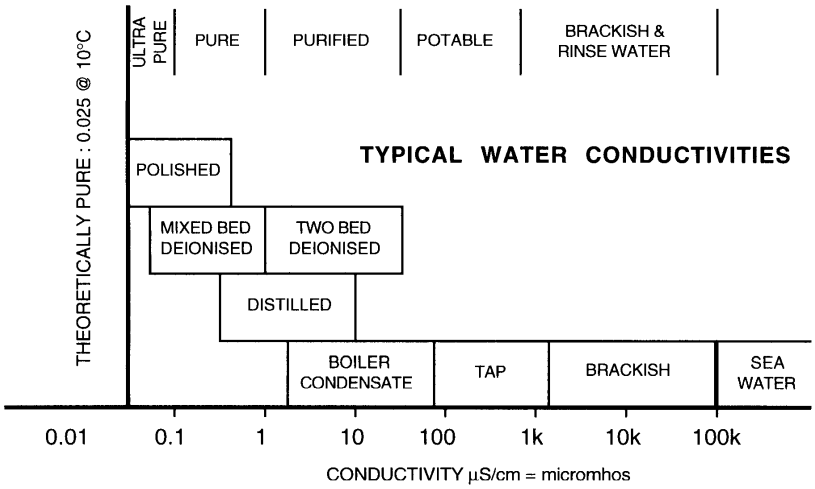

Fig 1.2

Fig 1.3 below shows the relationship between boiler water resistivity (the inverse of conductivity) and boiler drum pressure. The side-arm column purposely stimulates condensate flow and this flushing effect results in the column water being purer than the water in the drum. As the pressure increases the water resistivity increases and it is essential that the water/steam switching threshold lies above the side-arm water resistivity for the maximum boiler pressure encountered. On the other hand it is advisable to use as low a resistivity switching threshold as possible to render the system less susceptible to switching over due to moisture and water droplets.

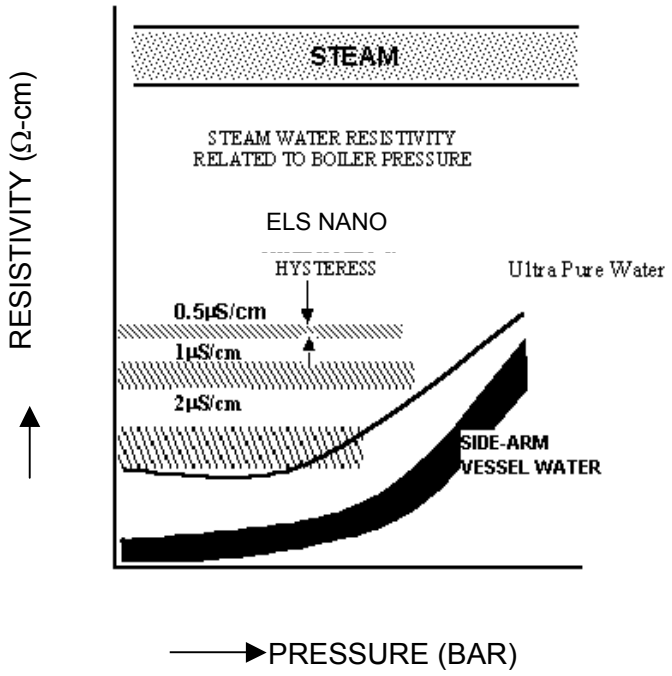

Fig. 1.3

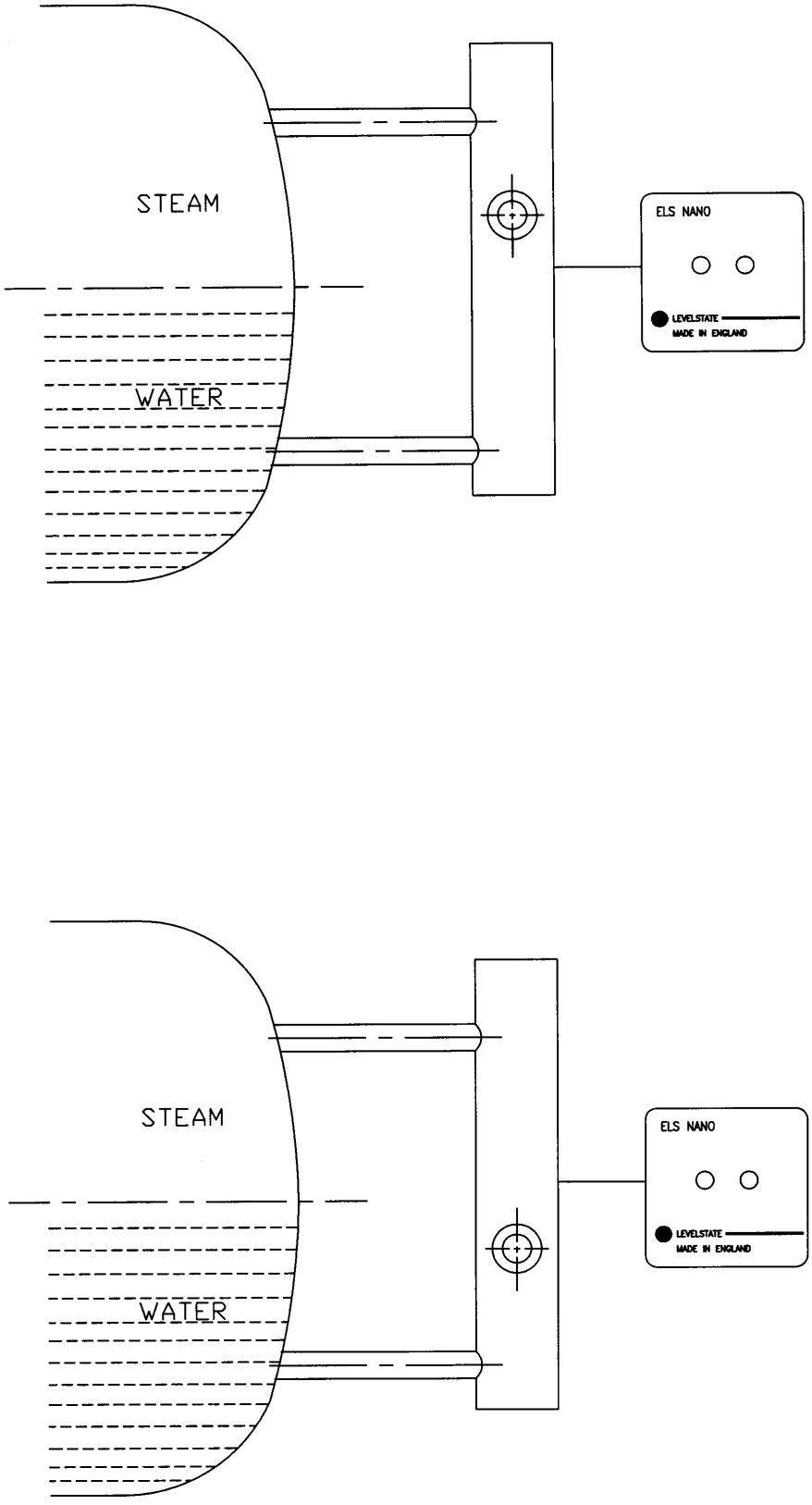

Fig. 1.4 Typical application of ELS NANO

2.0 EQUIPMENT DESCRIPTION

2.1 ELS NANO Electronic Unit

Electronics – Single probe system design with microprocessor technology offers replacement / substitution to traditional float level switches. The process fault circuit indicates a change in the normal operating state of probe (e.g. from steam to water or vice-versa).

The ELS NANO provides single probe channel out put with one mains supply input. The Mains Supply should be provided from secure source appropriate to the reliability and integrity of the protective system to be installed.

The channel may be used for High or Low alarm/trip configuration. One DPDT relay is used for this purpose. The relay can be configured either energized or de-energizing in the 'normal' state.

2.2 Electronic Unit Enclosure

The polyester / glass-fibre (FRP) reinforced enclosure with overall dimensions of 200H x 154W x 76D mm (Refer Fig. 5.1) is intended for wall mounting using four M6 or 0.25" fixing screws through the corner apertures. The cover has quick release four screws at the top. Three cable glands (PG-9, PG-13.5 & PG-16) are provided on the bottom face of the base unit. PG-9 cable gland is used for entry of probe cable. PG-13.5 is used for entry of Power cable & PG-16 for relay out-put cable. Protection rating for this enclosure is IP65 / NEMA 4X for locations in harsh environments.

The PCB & SMPS are secured in the enclosure cover. The channel process display LED's are visible through suitably designed transparent front label.

A metal chassis plate is secured to the base unit by four M6 screws. The SMPS unit is mounted on the chassis plate and retained by screws. Terminals are provided for the mains supply input on the SMPS, rating : 88 – 264 V. AC, 47 – 63 Hz. Or 125 – 373 V. DC.

The PCB has been designed for long term reliability using the minimum number of components and inter connections.

Replacement of PCB components is a delicate operation requiring special equipment to avoid damage to other components or the copper track. To maintain operational reliability and security it is recommended to use spare boards and the faulty board should be returned to the manufacturer for repair and test.

2.3 Discriminator & Display PCB (NANO-2501)

The ELS NANO has single probe channel and the system works on microprocessor based digital CMOS electronics. Discriminator & Display board (Refer Fig. 2.1) contains single sensing circuit to sense steam/water and display process status through Red / Green LED display. In addition to these, circuits are included for process fault relay 'on' delay & 'off' delay.

The channel display comprises of 5 mm round Red and Green high visibility LEDs. Red LED represents steam state and Green LED represents water state. All the above LED displays are available in enclosure front cover (Refer Fig. 5.1).

The channel displays and alarm/trip circuit works on the digital electronic and channel output is derived from the discriminator Circuit output.

An on & off delay circuit are included in the channel to prevent initiation of the process fault output from transient conditions. A delay of 0, 2, 4 & 6 Sec. for on-delay & 0-63 Sec. for off delay can be set by shorting the solder-pads on PCB.

Upon occurrence of the Process Fault corresponding channel LED changes state with flashing and in PCB the output Relay (RL1) will be activated. The output relay can be either normally energized or de-energized state by shorting the solder split pad. The relay contacts are terminated in terminal of TB3 for alarm/trip outputs (see Fig.2.1).

The channel can be configured either Steam or Water as normal condition by solder split pad shorting. Thus the configuration facilitates to select the channel as Hi or Lo.

Input Probe Cable for the Channel from Water Column is terminated in TB2.

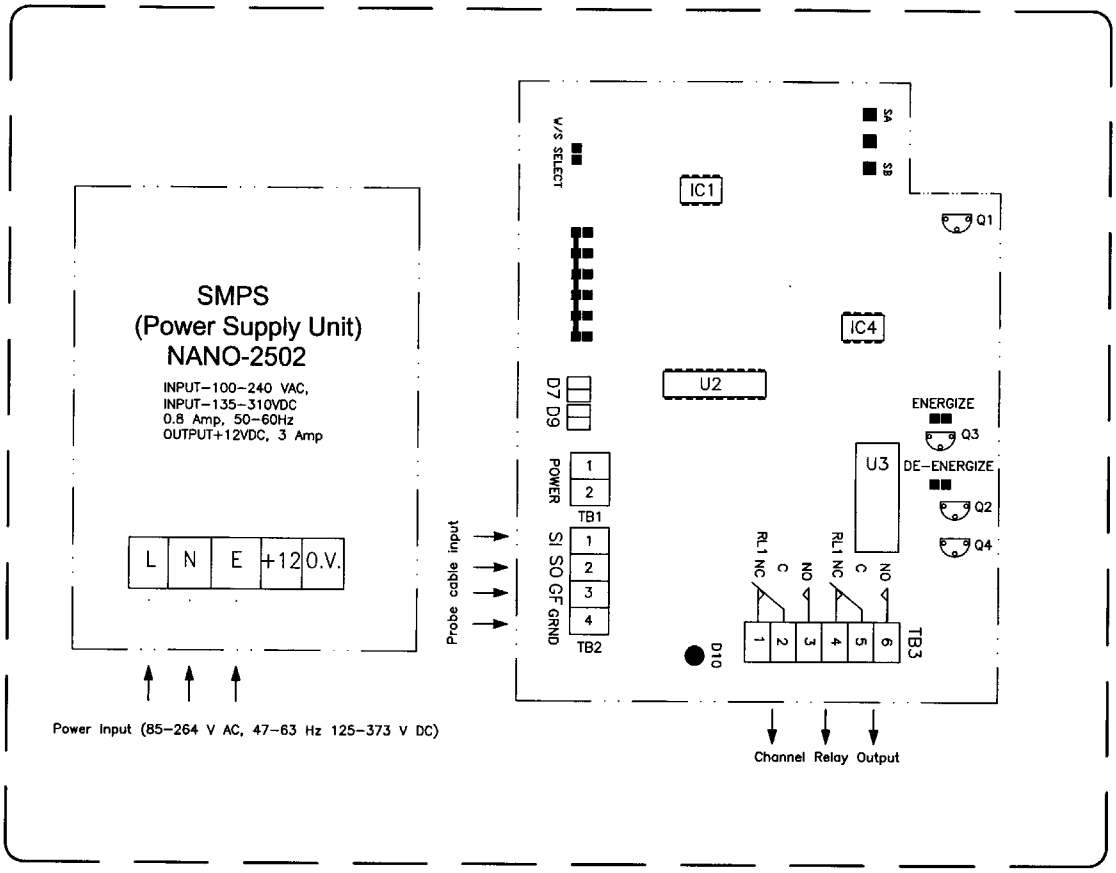

Fig. 2.1 ELS NANO PCB

2.4 Power Supply Module (NANO-2502)

One mains supply is connected to SMPS. Rating : 85 – 264 V. AC, 47 – 63 Hz. or 125 – 373 V. DC. Healthiness of SMPS can be identified by green LED (3mm) at ON condition.

Normally Power Supply module receives power from Mains AC input. For the SMPS there is only one output of +12V for supply the Discriminator & Relay PCB (see Fig.2.1).

3.0 PROBES

The robust design probes are made of stainless steel with high resistive insulators exhibiting a high degree of chemical inertness at elevated temperatures. Pressure sealing is achieved through ceramic to metal vacuum brazing. The standard probes (Refer Fig. 3.1) for ELS NANO are as follows:

a) Type 801 / 811 – rated at 150 bar / 23 bar and screwed type design,

b) Type 802 / 812 – rated at 207 bar / 23 bar and Swagelok type design

Hydrostatic test at twice the rated pressure is performed on the probes. Probes 801/811 is provided with a Metaflex gasket seal. Probe 802/812 is of Compression fitting with metal to metal contact.

Where moisture on the standard ceramic insulator could cause problems, Type 811/812 probes are supplied. These probes are rated at 23 bar @ 220 °C and are fitted with a non-wetting PTFE insulator.

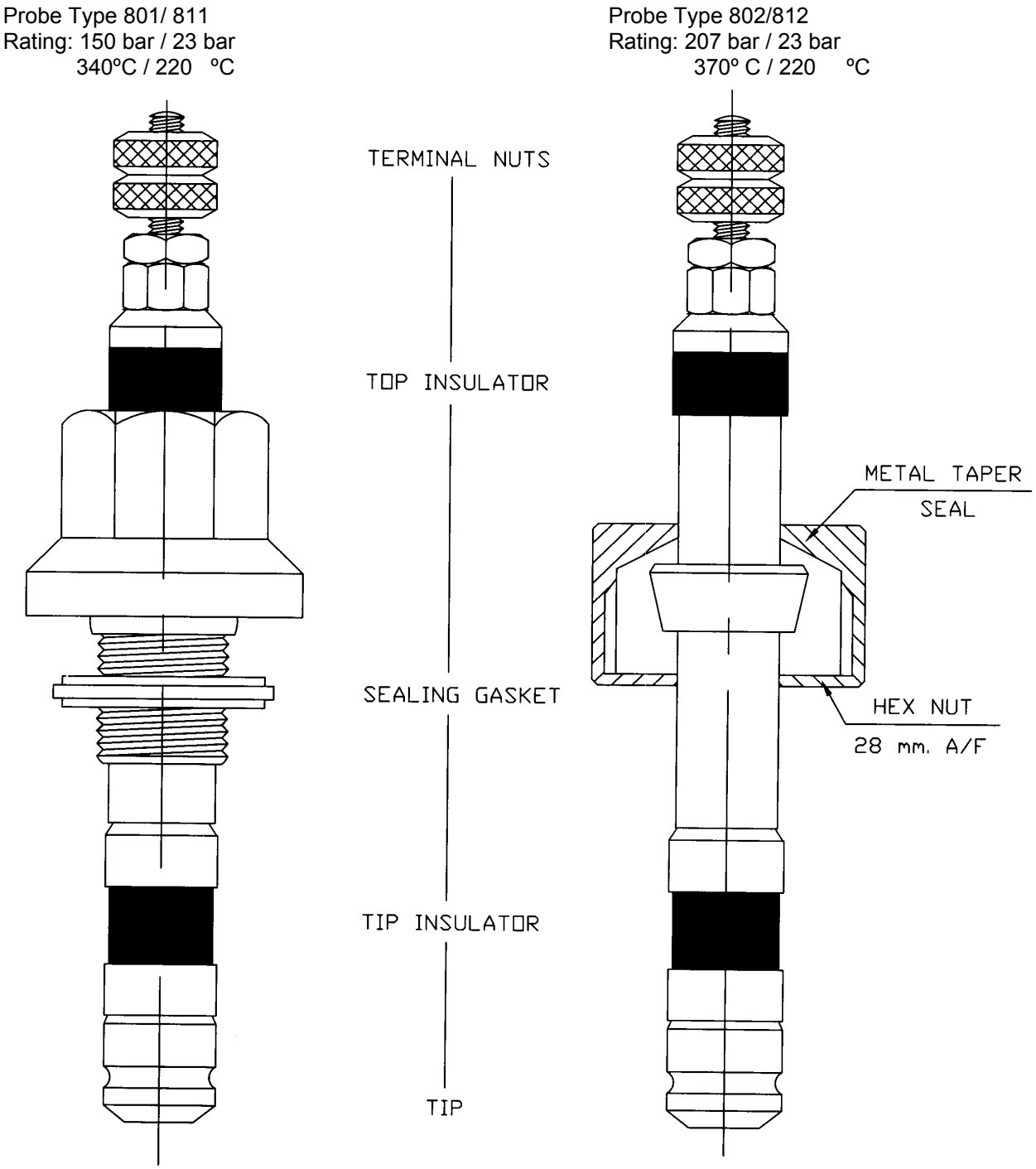

Fig. 3.1 Standard Probes For ELS NANO

3.1 Mounting Assemblies

Probe Insert Assembly

Probe Type 801 & 802 may be mounted in Type 701 & 702 Probe Insert Assembly depending on the pressure rating. This Insert Assembly shrouds the probe to define a particular water resistance-switching threshold for specified water conductivity. This assembly has an integral cover and removable end cap. The insert is welded into the required location observing recognizing standards.

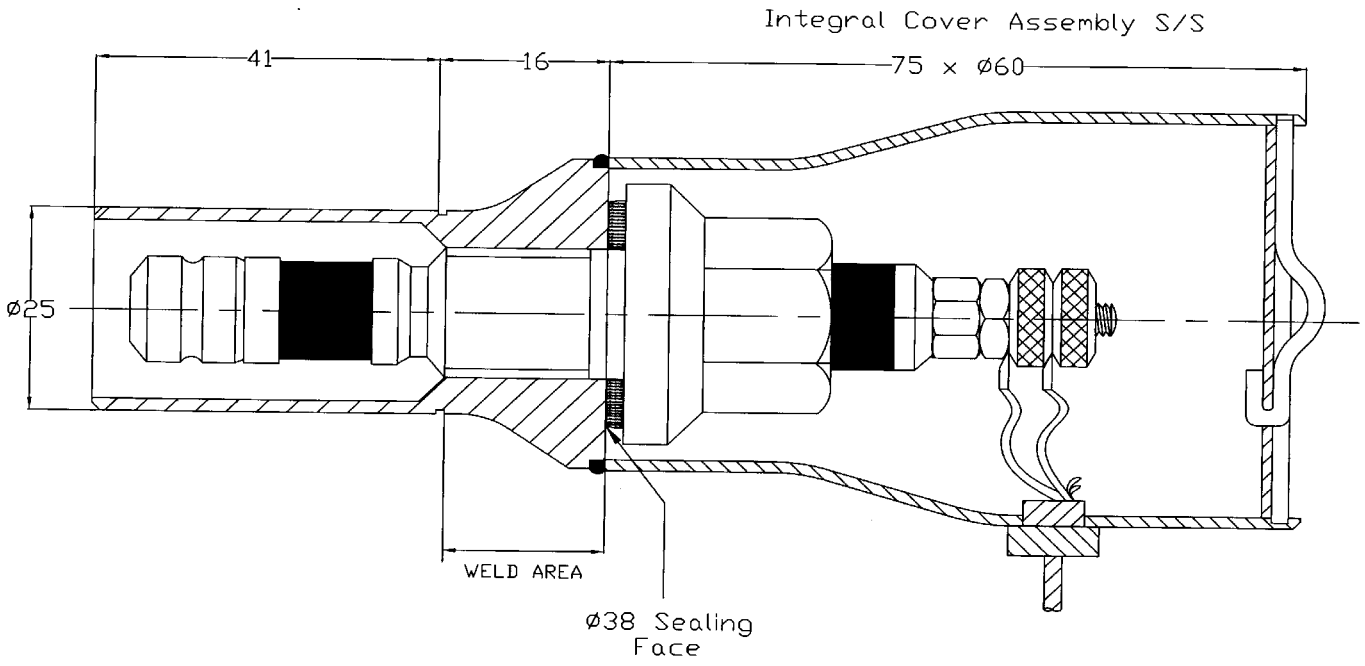

Fig. 3.2 Probe Insert

Stand Pipe Assembly

As stated below 2” nominal bore pipe work is supplied with unshrouded insert (optionally supplied if ordered), fitted at defined position and an overall probe guard assembly applied (Refer Fig 3.3).

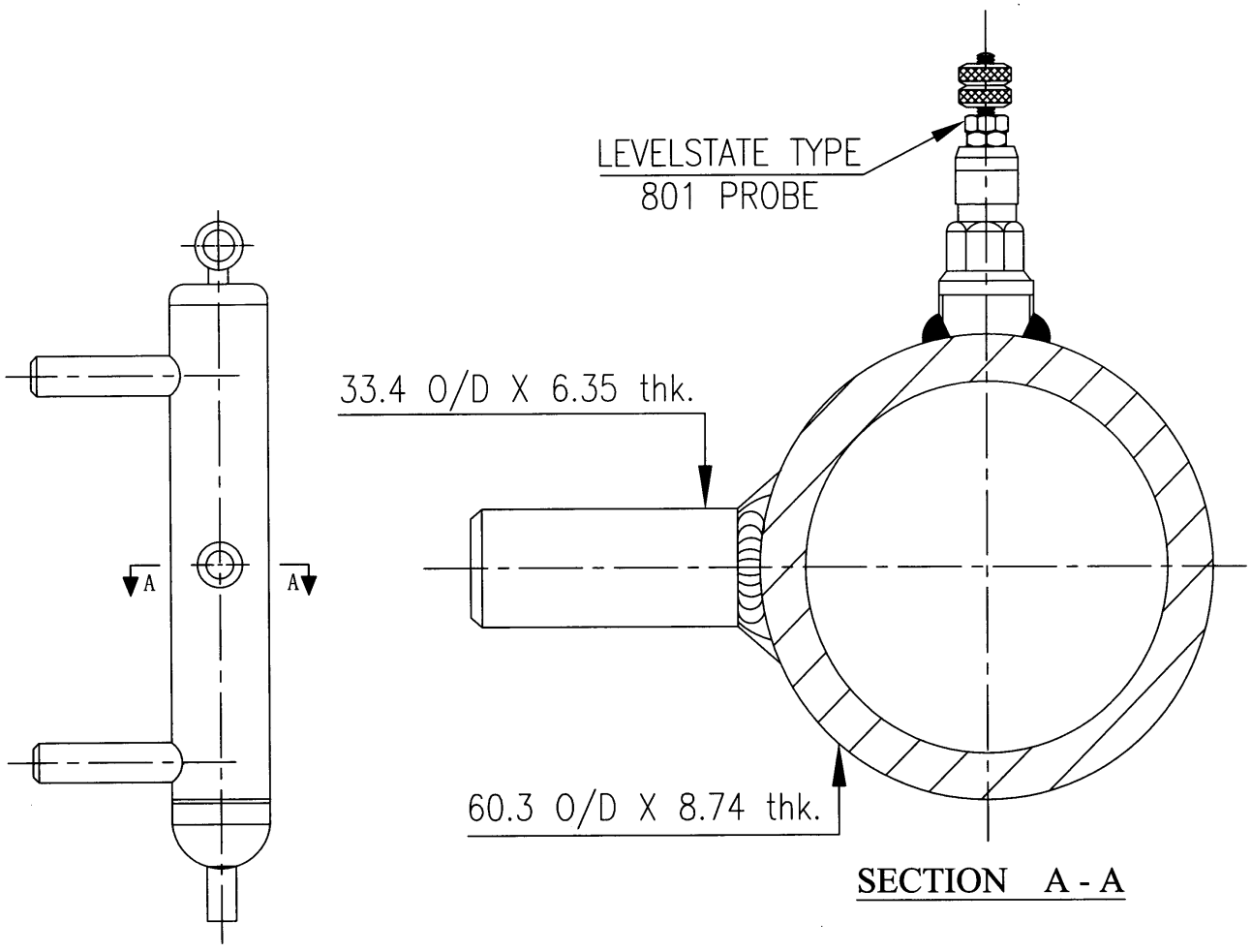

Fig. 3.3 Stand Pipe Assembly

4.0 GENERAL CONFIGURATION

4.1 Sensing Circuit Functions

To avoid galvanic action at the Probe and variations in sensing voltage due to electrolytic potentials, an alternating source voltage is applied to the probe and the sensing circuit responds only to an alternating waveform. The peak voltage applied to the probe is less than 6V; current limited to 50 microamps and presents no risk to personnel.

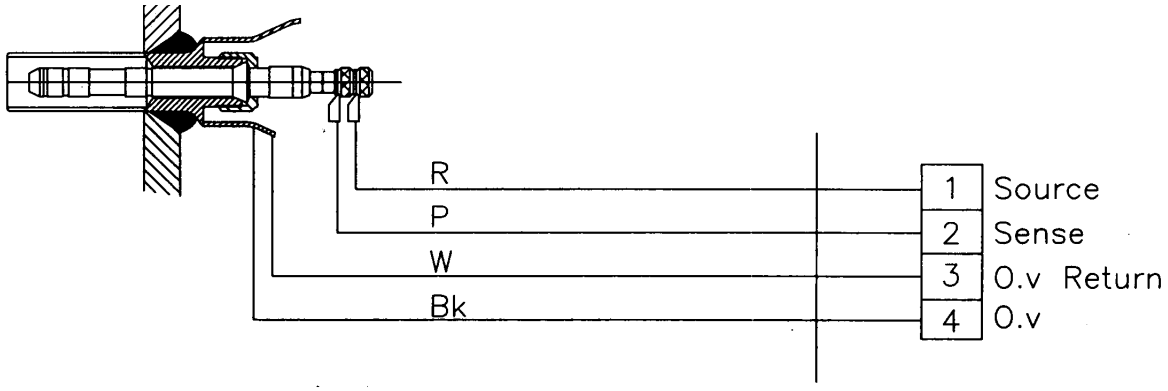

Fig. 4.1a Probe Normally in Steam.
Water = Alarm condition

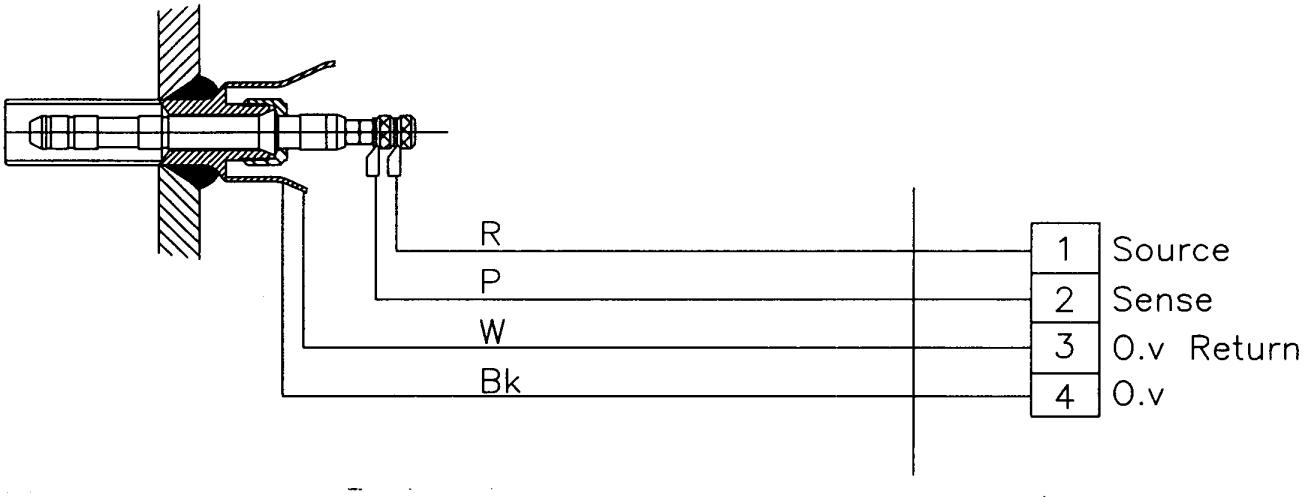

Fig. 4.1b Probe Normally in Water.
Steam = Alarm condition

4.2 Channel Output Relays

RL1 is channel output relay & it has 2 set of potential free contacts (DPDT). The Contact rating of Relay (max.) is 8 Amps., 250V AC / 10 Amps. 30V DC. The digital contact outputs are used in the protective circuits as per plant requirement.

The channel relays can be configured either normally energised or de-energised. For normally de-energised system, protection system works while Relay is energised. On the other hand, for normally energised system, protection works when the Relay is de-energised. Although later is fail safe, this will cause spurious condition resulting loss of production. Therefore both systems has advantages and disadvantages.

LED		
Channel Status	**GREEN**	**RED**
WATER	ON	OFF
STEAM	OFF	ON
PROCESS FAULT (NS)	FLASH	OFF
PROCESS FAULT (NW)	OFF	FLASH

Fig. 4.2 Sequence of Indication

Note: NS- channel is in normally steam, NW- Channel is in normally water.

4.3 Different Jumper setting:

4.3.1 W/S SELECT:

Open : Normal Condition is set to water.
Short : Normal Condition is set to steam.

4.3.2 ENERGIZE/ DEENERGIZE:

'E' Pad short and 'D' pad open : Initial Relay condition is energized.
'D' Pad short and 'E' pad open : Initial Relay condition is de energized.

4.3.3 ON DELAY (0-6sec):

D1 Open	D0 Open	0 sec
D1 Open	D0 Short	2 sec
D1 Short	D0 Open	4 sec
D1 short	D0 Short	6 sec

4.3.4 OFF DELAY (0-63sec):

All open mean 0sec.
All short mean 63 sec
e.g: To get 13 sec delay: Need to short 8, 4 and 1
e.g:To get 57 sec delay: Need to short 32, 16, 8 and 1

4.3.5 SA-SB PAD:

Shorting of this pad is to be utilized to select range of water and steam condition. If SA shorted then sensitivity is 0.5μS/cm, if SB shorted then sensitivity is 1μS/cm & in case of all pad open then 2μS/cm.

5.0 ELS NANO ELECTRONIC UNIT INSTALLATION

1. Mount the base of the enclosure with cable glands downward at the site chosen using 4 corner fixing screws, M6 or 0.25 inch.
2. Strip cable sheaths so that they do not project beyond the inside of cable gland; PTFE probe cable is pre-formed for correct length. Insert cable through glands, trim ends to template and fit crimped ferrules where required.
3. Test cable continuity.

5.1 NANO Electronic Unit Dimension, Cable Gland Location & Installation

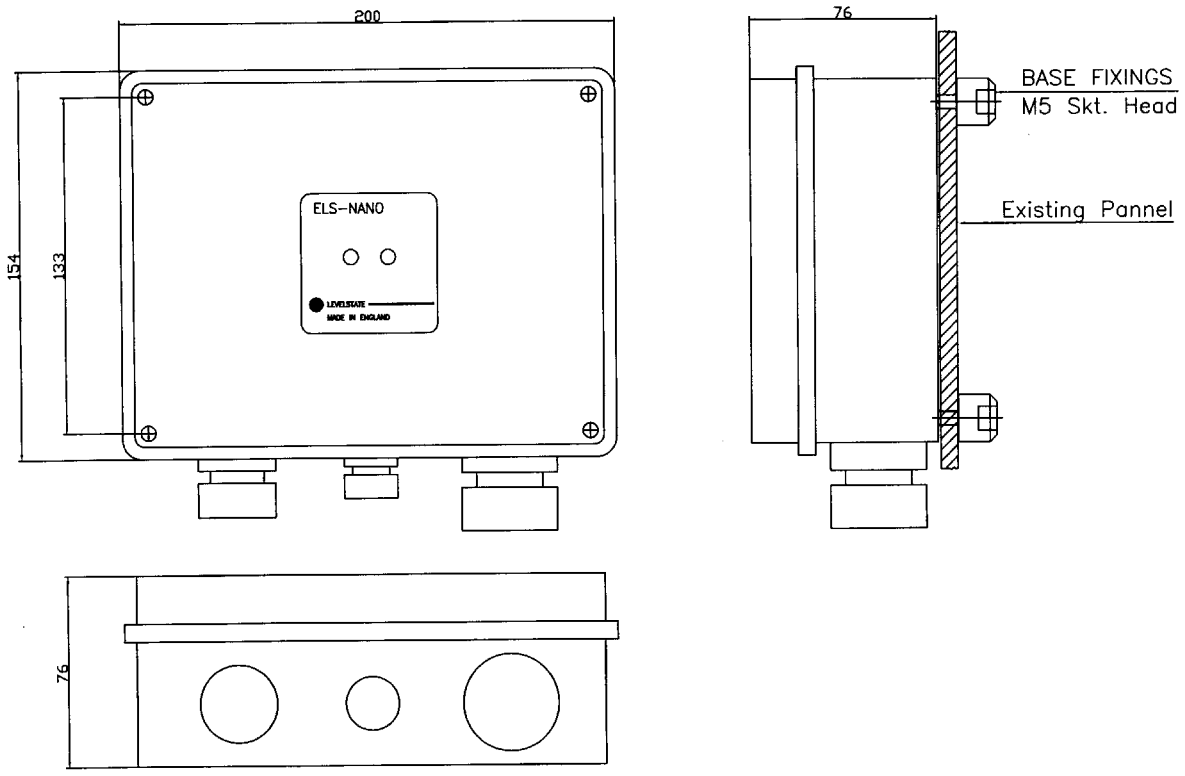

Fig. 5.1 Electronic Unit Dimensions And Cable Gland Location

5.2 System Cabling

Fig. 5.2 shows the probe cable fitting in the probe and ELS NANO Electronic Unit. A 10 meter length of special 4 core high temperature PTFE cable which may be extended up to 30 meter establishes connection between the probe & ELS NANO unit. Crimped nickel ring terminations and cable bush are pre-formed for probe assembly fitting.

One 3 core Power supply cable is required. PVC insulated armored copper conductor cable shall be used and copper size either 0.5 mm^2 or 1 mm^2 is recommended.

For alarm normally requires 2/4/6 core copper conductor cable (0.5 or 1 mm^2). It is preferred that no. of cores for alarm/trip cable should be decided after finalization of the plant requirement for alarm / interlock protection logic.

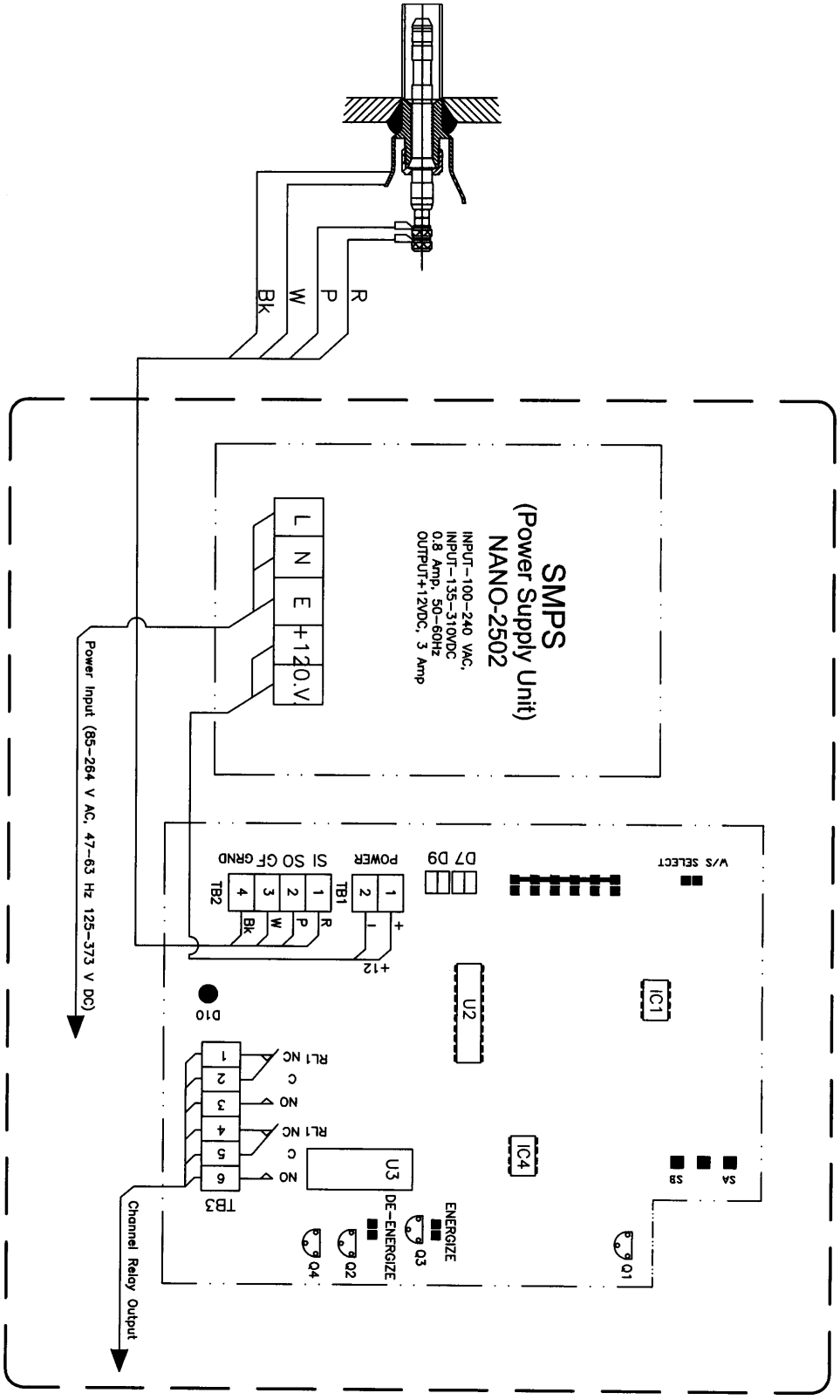

Fig. 5.2 System Cabling

6.0 COMMISSIONING PROCEDURE

It is essential that the probe is not installed until acid cleaning or steam purging of the plant has been completed. The location may be valved off during this procedure or special probe position blanking plug can be inserted.

6.1 Probe Installation

Handle probe with care. Do not remove from packing until required for insertion. The probe insulators are high quality ceramic material and are liable to crack if subjected to crack – do not use if dropped.

Type 801 :

(i) Inspect vessel seating recess ensuring it is clean dry and free of radial score marks.

(ii) Use copper or molybdenum based anti-seize compound on threads avoiding contact with seating face and probe insulators.

(iii) Screw in each probe with gasket and tighten. **DO NOT EXCEED 70 Nm (52lb.ft).**

(iv) Connect wires to probe terminals (Refer System Cabling Fig. 10.1 as required), tighten knurled nuts using finger pressure only. Refit guards for probe protection.

Type 802 :

(i) Inspect the column sealing taper ensuring it is clean, dry & free of radial score marks.

(ii) Use a Molly Disulphide anti-scuffing paste on threads.

(iii) Fit probe and tighten retaining nut until probe body is just nipped, i.e. where it just can not be rotated.

(iv) Apply 27mm A/F long socket and initially tighten just beyond one hex flat (75° to 80°).

(v) Subsequent insertion of Probes should only require 10° to 20° rotation using torque wrench.

(vi) Connect wires to probe terminals tighten knurled nuts using finger pressure only.

(vii) Refit insert end cap for probe connection.

Connect wires to probe terminals (Refer System Cabling Fig. 5.1 as required), tighten knurled nuts using finger pressure only.

6.2 Electronic Unit

(i) Ensure mains cables are not live and connect to SMPS Line(L), Neutral(N) and Earth(E).

(ii) Connect probe wires to PCB by inserting TB2.

(iii) Connect Alarm / Trip relay contact cable to terminal TB3

(iv) Switch on the mains supply.

(v) Check the various operation states of external alarm/trip circuits etc., by open circuiting or shorting the probe wires. Applying a shorting link between the probe top terminal and the body represents water; disconnecting the top terminal wire but isolated from the standpipe represents steam.

If any error noticed during the above procedures, check the connections and Refer to Maintenance and Fault Identification section (Sec. 7.0).

(vi) It is advisable to keep the ELS NANO enclosure cover closed at all times except for test and maintenance. Generally plant locations have corrosive atmospheres which in the presence of moisture can cause serious problems with electronic equipment particularly terminals and contact connections.

6.3 Probe Standpipe – Bringing on line

(i) Notify personnel of the intention to commission the ELS NANO Level Switch.

(ii) When operational, check probe for steam leaks. If steam leaks from the probe top insulator replace probe.

7.0 MAINTENANCE AND FAULT IDENTIFICATIONS

The following sections outline fault identification and rectification procedures. No routine maintenance is required apart from periodic dusting of probe external insulators using a small paintbrush to remove the possible accumulation of fly ash.

It is recommended in the interests of preventative maintenance that the probe is replaced every 4 years as some dissolution of the ceramic insulator does occur, particularly at high temperatures and pressures.

A check on the condition of the probe, normally immersed in water is recommended every six months to ensure that it correctly switches to the steam condition by draining the stand pipe empty through isolation & drain valves. When fully drained check that the probe channel indicates steam condition (Red). If it indicates water (Green) check the probe connection at the electronic unit and probe ends. If it is connected properly, remove the probe connection and verify that the indication changes from Green to Red, in which case the probe is faulty and must be replaced. If a fault has occurred on the electronic unit rectify this first then replace the probe connection before determining whether probe is faulty.

7.1 Pressure Parts

If a serious probe leak occurs the standpipe should be isolated immediately otherwise gasket seat erosion may entail re-machining of the insert seating faces.

For damaged seating faces on Type 702 inserts, re-cut taper seat at 40° included angle ensuring a surface finish which must be better that N5C, ensuring it is concentric with bore. For the Type 701 insert re-cut seating face to an N8C, finish which must be accurately machined at 90° to the center line of the thread opening.

7.1.1 Probe leaks

It is difficult to distinguish between probe internal seal failure or seating face failure unless the leak is small. Steam emanating from the probe top ceramic insulator indicates internal seal failure and requires probe replacement. Steam emanating from the insert / probe seating area may be rectified by further tightening of the probe. **DO NOT EXCEED** probe tightening torque – as recommended otherwise replace probe or gasket using the following procedures.

7.1.2 Standpipe Isolation Procedure

(i) If shutdown or trip circuits are connected to the system ensure they are disarmed.
(ii) Close the steam and water isolation valves.
(iii) Slowly open the drain valve(s) and leave open.
(iv) Check at drain outlet turn dish that the isolation valves are sealing properly.
(v) Isolate and drain standpipe.

7.1.3 Probe Replacement Procedure

(i) Isolate water column as per 7.1.2 above, ensuring drain valve is open, with steam and water isolation valves closed and sealing properly.

(ii) Remove probe guard and disconnect probe wire(s).
(iii) Replace probe as per procedure Clause 6.1 for Type 801, Type 802.

7.1.4 Column Re-commissioning Procedure

(i) Close drain valve(s).

(ii) Crack open the steam isolation valve(s) and check with the display that the water column fills slowly due to condensate.

(iii) Crack open the water isolation valve(s) and check that the water level falls to the expected NWL.

(iv) Check probe for steam leaks using Clause 7.1.1.

(v) After approximately 10 minutes fully open first water and then the steam isolation valves.

(vi) Ensure all valves are correctly set (and locked).

(vii) Inform operators that the indication system is now in service.

(viii) Check that approximately normal water level is displayed before ordering any shutdown or trip circuits are connected to the System.

The above procedure allows the water column and probe to be heated at a controlled rate to prevent the probe being subjected to excessive thermal shock which could damage the ceramic insulators.

7.1.5 Column or Standpipe Blockage

If the water column and standpipe installation complies with recommendations of Chapter 2 and with the stimulation of condensate flow through the water column, standpipe blockage should not occur. However, the boiler water treatment should conform to recommended practices such as ASME "Consensus on Operating Practices for the Control of Feed water and Boiler Water Quality in Modern Industrial Boilers" or BS 2486 "Recommendations for treatment of water for land boilers".

If a partial blockage is suspected by the slow response time of the level, isolate the water column as per procedure 7.1.2. With the drain valve open, slowly open the steam isolating valve until there is free flow of steam at the drain outlet. Then close the steam valve. Slowly open the water isolating valve until there is free flow at the drain outlet. Then close the water valve. Close the drain valve(s) and open steam and water valves. Ensure all valves are correctly set (and locked) and re-arm trip circuits if fitted. If the response time is still sluggish suspect problems with Isolation valves not opening fully.

7.2 Electronic Unit Faults

Check probe connections – Check black & white connections to housing assembly. Check probe top connections, Red and Pink.

Channel indicating Steam – Apply a short circuit between the probe top terminal and insert cover assembly – probe channel should change to short circuit & indication will be as per (Fig. 4.2 Sequence of Indication).

Channel indicating Water – Disconnect red and pink wires from probe but isolated from metalwork – probe channel should change to steam. If this check is all right but when wire reconnected to the probe the channel indicates water when it is judged to be in steam, suspect a faulty probe. Then fit new probe.

If the operation does not comply with the above procedure, an electronic fault is to be suspected.

Checking the Electronic Unit – Open the enclosure by releasing the four cap screws. Check probes connections to PCB, TB2.

If a circuit board is found to be defective it is preferable to replace it with a spare.

For local board repairs ensure precautions are taken to avoid STATIC, as some components are MOS devices.

8.0 TECHNICAL SPECIFICATION OF ELS NANO

(A) GENERAL

1.	Make	Levelstate Systems Ltd., U.K
2.	Principle of Measurement	Conductivity based

(B) STAND PIPE

1.	Type	501/502, with 25 NB side arm Steam & Water nozzles and 15 NB Drain nozzles
2.	No. of probe connections	Single
3.	Stand Pipe Length / Probe pitch	As required.
4.	Material	Carbon Steel seamless pipe to ASTM A 106 / A 105
5.	Design code	ANSI B 31.1 Power Piping code
6.	Design Pressure / Temp	Up to 207 bar g @ 370 °C
7.	Steam / Water connection	25 NB – SW Sch. 160
8.	Drain Connection	15 NB – SW Sch. 80
9.	Testing & Certification	IBR form III C

(C) PROBES (ELECTRODES)

1.	Type	801 / 802 and 811/812 (for Low Pressure application)
2.	No. of probes	1 per Stand Pipe
3.	Probe connection	Threaded, M16 x 1.5 / 28 mm AF
4.	Material of construction	Stainless Steel with high purity Zirconia insulator / PTFE insulator (for Low Pressure application).
5.	Max. working Press./Temp.	150 bar g @ 340 °C (For Probe 801) 207 bar g @ 370 °C (For Probe 802) 23 bar g @ 220 °C (For Probe 811 / 812)

(D) PROBE (ELECTRODE) CABLE

1.	Quantity per probe	01
2.	Length	10 meters (extended up to 30 meter)
3.	Insulation	PTFE
4.	No. of cores	04

(E) ELECTRONIC UNIT

1.	Type	ELS NANO
2.	No. of Channels	01
3.	Enclosure Rating	IP 65 / NEMA 4X protection
4.	Enclosure Dimensions	200H x 154W x 76D mm
5.	Display	Single Channel Red and Green LED display. Red for steam and Green for water
6.	Supply Requirements	Single Power Supply 88-264 V. AC @ 47-63 Hz, 125 – 373 V. DC.
9.	Alarm Relays	One output relay for alarm. Relay can be selected either energized or de-energized state for normal condition.
10.	Relay Contact Ratings	Two pole change-over (DPCO) contact for channel. Rating: 8A @ 250V AC, 10A @ 30V DC Response time: 0.5 m Sec (approx).

(G) ISOLATION VALVES AND DRAIN VALVES

1.	Type	Globe with socket weld ends
2.	Material	Carbon Steel ASTM A 105 with SS trim
3.	Size	Isolation valves: 25 NB Drain valves: 15 NB
4.	Pressure class	Up to ANSI Class 2500
5.	Operation	Manual
6.	Certification	IBR form IIIC

(H) SPARE PART LIST

	Description	**Part no.**
1.	Discriminator & Display Card	NANO-2501
2.	Power Supply Module	NANO-2502