**Operating Manual**
24685034, Rev. AE
June 2011

**Hydrastep 2468**

# Hydrastep 2468CB and 2468CD

## Electronic Gauging System
(Dual Power Supply Version)

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# HYDRASTEP TROUBLESHOOTING CHART

| CATEGORY | SYMPTOM | POSSIBLE CAUSES (See Note 1) | SOLUTION (See Note 2) |
|---|---|---|---|
| PSU (AC) | • Hydrastep system does not power-up. | • Wrong voltage setting.<br>• Incorrect supply.<br>• Blown fuse.<br>• Incorrect cable termination. | • Refer to Part 1, Section 2.4.2.4. |
| PSU (DC) | • Hydrastep system does not power-up. | • Incorrect supply.<br>• Blown fuse.<br>• Incorrect cable termination. | • Refer to Part 1, Section 2.4.2.4. |
| MAIN DISPLAY | • Chequered / intermittent display.<br>• No display.<br>• Yellow LED illuminated. | • Incorrect configuration. | • Refer to Part 1, Section 2.5.2.<br>• Refer to Part 1, Section 2.5.2.1.<br>• Refer to Part 1, Section 2.5.2.2. |
| REMOTE DISPLAY | • Chequered / intermittent display.<br>• No display.<br>• Yellow LED illuminated. | • Incorrect configuration.<br>• Incorrect interface cable connection. | • Check Main Display, as above.<br>• See Part 1, Section 4.2 (Relevant display).<br>• Check cable connections. See Part 1, Section4.4. |
| ELECTRODE ALARM ERROR | • Flashing Red (steam) and Green (water) LED's with Yellow alarm LED illuminated. | • Electrode contamination<br>• Incorrect column installation reducing condensate flow.<br>• Water conductivity is too high. | • Refer to Part 2, Section 3.<br>• Refer to Part 2, Section 2.3.<br>• Refer to Part 1, Section 2.5.1.3.<br>• Refer to Part 1, Section 2.5.1.4. |
| WATER/STEAM SWITCHING THRESHOLD | • Water above steam (green above red) with yellow LED illuminated | • Threshold not matched to application.<br>• Electrode contamination. | • Refer to Part 1, Section 2.5.2.3.<br>• Refer to Part 2, Section 3. |

**Note 1:** Further detailed information can be found in Fault finding Part 1, Sections 2.6 and 4.5.
**Note 2:** References are to Operating Manuals 24685033 (for 2468CA and 2468CC models) and 24685034 (for 2468CB and 2468CD models).

# HYDRASTEP START-UP

It is possible that some of these conditions will be seen on a new Hydrastep installation.

**** This does not mean that the equipment you have purchased is faulty ****

Due to the nature of the areas that Hydrastep is normally installed, various conditions can occur that make the instrument operate in an unusual manner.
It would be easy to think you have installed defective equipment, but it is very unlikely that this is the case.

Great care must be taken when installing a Hydrastep system so that these problems are less likely to be seen; firstly, please take the time to ensure that the various people involved in the fitting of the components have been shown and have read the handbook, which is supplied with all new Hydrastep systems.
This, along with the wiring diagrams (also supplied), should make for a trouble free installation.

1. Please read and understand Part 2 of the handbook, which explains the pressure side of the equipment.
2. Ensure wiring is of the correct type and that the wiring diagram supplied has been followed.
3. Hydrastep relies on a 'path back to earth'. Please make sure that all earth points are made and are of a good standard.
4. Great care must be taken with the mounting of the water column; the columns must be vertical; angles stated in the manual should be as close as possible, as this ensures condensate flow back into the column.
5. Lagging of the pipe work must be as stated; ** The last 0.5 m of the (top) steam leg MUST NOT be insulated as this will inhibit condensate flow into the column; this will cause a flickering display.**
6. Please be aware of your water quality as some adjustments to the Hydrastep may be required if it has a high conductivity. Please let us know when placing your order if your water conductivity is high. We can modify the units up to 1600Us/cm.
7. Units will not leave the factory configured for customer orders unless requested. If you wish it to be configured, please request it on your order and it will then be done. Options include mains voltage to be used, trip points (if relay cards are to be fitted), number of electrodes to be used and remote display option (if ordered). These points are not pre-set as standard as the factory do not know your requirement unless stated on your order.
8. Care should be taken to make sure that a new set of electrodes have been fitted after the first acid wash of the system. The electrodes may well have been damaged during this process and a new set should go in before you run the system up for the first time.
9. The most common problem seen with Hydrastep systems is a flickering pattern on the display while the boiler is being brought up to operating pressure and temperature. This is not a fault and is caused by a few conditions specific to power stations:

   (**a**) If a boiler is new or has seen a large amount re-work, it may well get a coating of magnetite inside of it, when it is first started up. This creates a small DC voltage that is picked up on the electrodes and shows its self as a flickering in the bottom few electrodes. When the system is brought up to its normal working condition's this will settle but can take a couple of days to do so.

   (**b**) It is possible that the top electrodes may have a wet coating on them until these working conditions are met; again, if left to settle, this will work at normal working conditions.

   (**c**) Should the plant generate a higher than normal amount of DC noise, we can supply a blocking cap that is built into a PCB that will stop this problem.

If you are in any doubt about what you are doing, contact Customer Support of Mobrey Limited on +44 (0) 1753 756600 for guidance

**Mobrey Customer Support**
(April 2005)

# About this manual

This manual describes the Hydrastep **2468CB** and **2468CD** Electronic Gauging Systems along with the recommended options. Except where stated otherwise, the information contained in this manual can be assumed to apply to either system.

This manual is divided into three parts; the first covers the electrical/electronic system; the second describes the pressure parts; the third is for coverage of all other aspects.

## Part 1 – Electrical/Electronic System

Chapter 1 introduces the Hydrastep 2468 Electronic Gauging System and its operating principles.

Chapter 2 covers the installation, configuration and fault analysis procedures.

Chapter 3 covers the installation, configuration and fault analysis procedures for the Relay Output Board (Chapter 3a), the Delay Relay Output Board (Chapter 3b) and the Opto-isolated Output Board (Chapter 3c).

Chapter 4 covers the installation, configuration and fault analysis procedures for all versions of the Remote Display Unit.

## Part 2 – Pressure Parts

Chapter 1 is a general introduction to the Hydrastep system of water level determination.

Chapter 2 describes the water column and its components – the preparation, installation of the water column on to the boiler, acid and steam purging of the boiler system and the fitting of the electrode sensors.

Chapter 3 details the fault repair procedures carried out on the system pressure parts and their commissioning.

Chapter 4 provides a general description of the pressure parts used in the Hydrastep systems.

Chapter 5 details the Pressure Parts specifications.

**Caution:**
For installation under the Pressure Equipment Directive (PED) 97/23/EC, refer to safety instruction manual 24688006/SI.

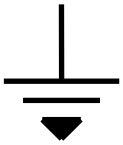
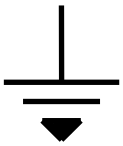
**Caution:**
For installation under ATEX directive 94/09/EC, refer to safety instruction manual 24685033/SI.

## Part 3 – Appendix

Appendix A contains a CSA certified connection drawing and associated notes.

**Caution:**
For installation in potentially explosive atmospheres in Canada and USA, refer to control drawing 24685037 in Part 3.

# SYMBOLS USED IN THIS MANUAL AND ON THE UNIT

| Symbol | Meaning |
|---|---|
|  | Direct Current |
|  | Alternating Current |
|  | Earth (ground) terminal |
|  | Protective conductor terminal |
|  | Caution (refer to accompanying documents) |

# Part 1

Hydrastep 2468CB & 2468CD
Electronic Gauging System

DANGEROUS VOLTAGES ARE PRESENT IN THIS EQUIPMENT. ANY WARNING NOTICES OR PROCEDURES CONTAINED IN THIS MANUAL OR ON THE EQUIPMENT SHOULD BE STRICTLY OBSERVED TO MAINTAIN SAFETY. THE USE OF THIS EQUIPMENT IN A MANNER NOT SPECIFIED IN THIS MANUAL MAY IMPAIR THE PROTECTION PROVIDED BY THIS EQUIPMENT. GREAT CARE SHOULD BE EXERCISED WHEN SERVICING THIS EQUIPMENT.

TO ENSURE COMPLIANCE WITH THE EMC DIRECTIVE (WHERE APPLICABLE) THE INSTRUCTIONS ON CABLE SCREENING, ROUTING AND TERMINATION GIVEN IN THIS MANUAL MUST BE FOLLOWED.

# Part 1

# Contents

# 1 Introduction to the Hydrastep 2468 Electronic Gauging System

## Contents



### Illustrations



### Tables

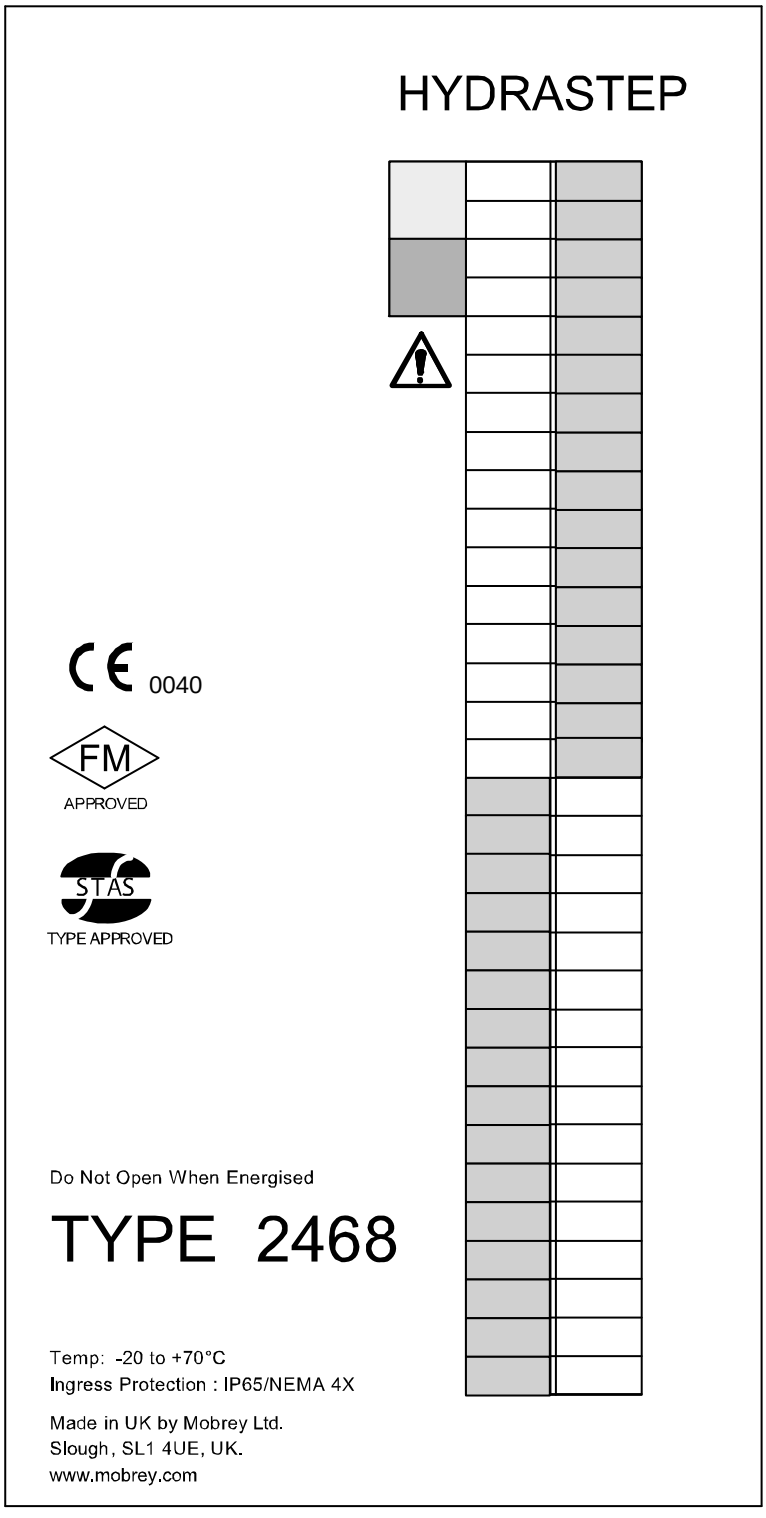



***Figure 1.1** - Front panel of the Hydrastep 2468 gauging system*

## 1.1 WATER LEVEL MEASUREMENT

The Hydrastep 2468 Electronic Gauging System is designed as an electronic alternative to water level gauges on boilers, giving a more reliable and safer water level indication than conventional visual gauges. It uses the significant difference in resistivities of water and steam in temperatures up to 370°C (698°F) to determine the water level.

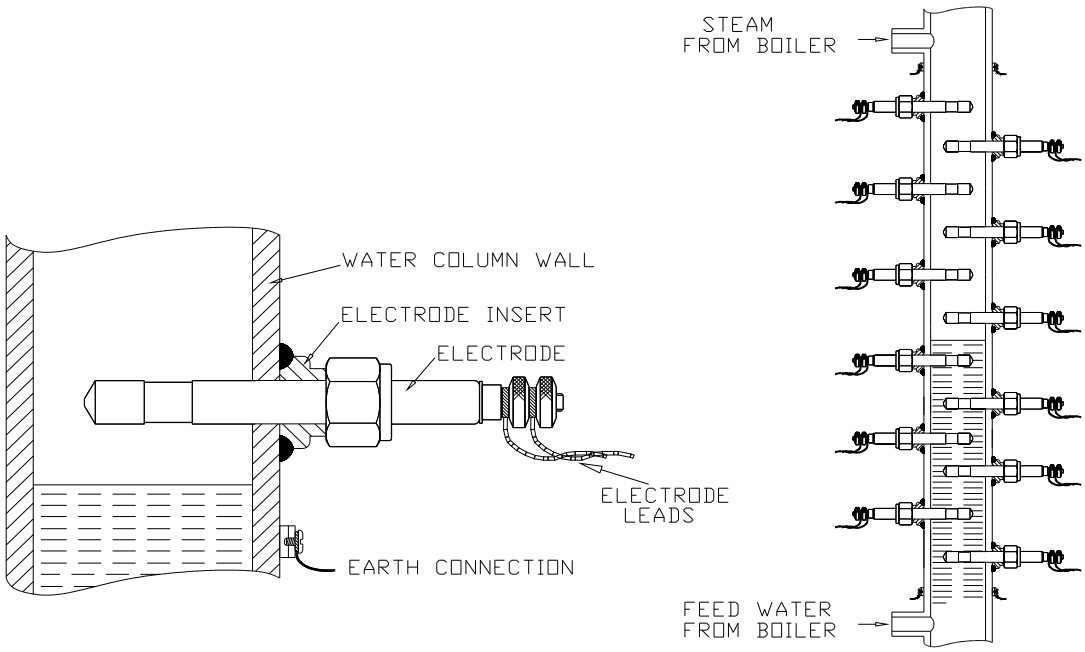



***Figure 1.2 - Schematic of resistance measuring cell and electrodes***

A vertical row of electrodes is installed in the water level column attached to boiler and typically aligned so that half the electrodes are above and half below the normal water level (see Figure 1.2). The resistance measurement is made between the insulated tip of each electrode and the wall of the column.

The “cell constant” defining the actual resistance measured is determined by the length and diameter of the electrode tip and the column bore. In practice, the cell constant is chosen so that the resistance in water is less than 100k ohms and the steam resistance is greater than 10M ohms. Since the resistivities of water and steam are substantially different, the system is simple and requires no setting up adjustments. It is not susceptible to power supply variations, ambient temperature changes, etc., resulting in a highly reliable system.

A general overview showing how a typical Hydrastep 2468 System is installed is illustrated in Figure 1.3.

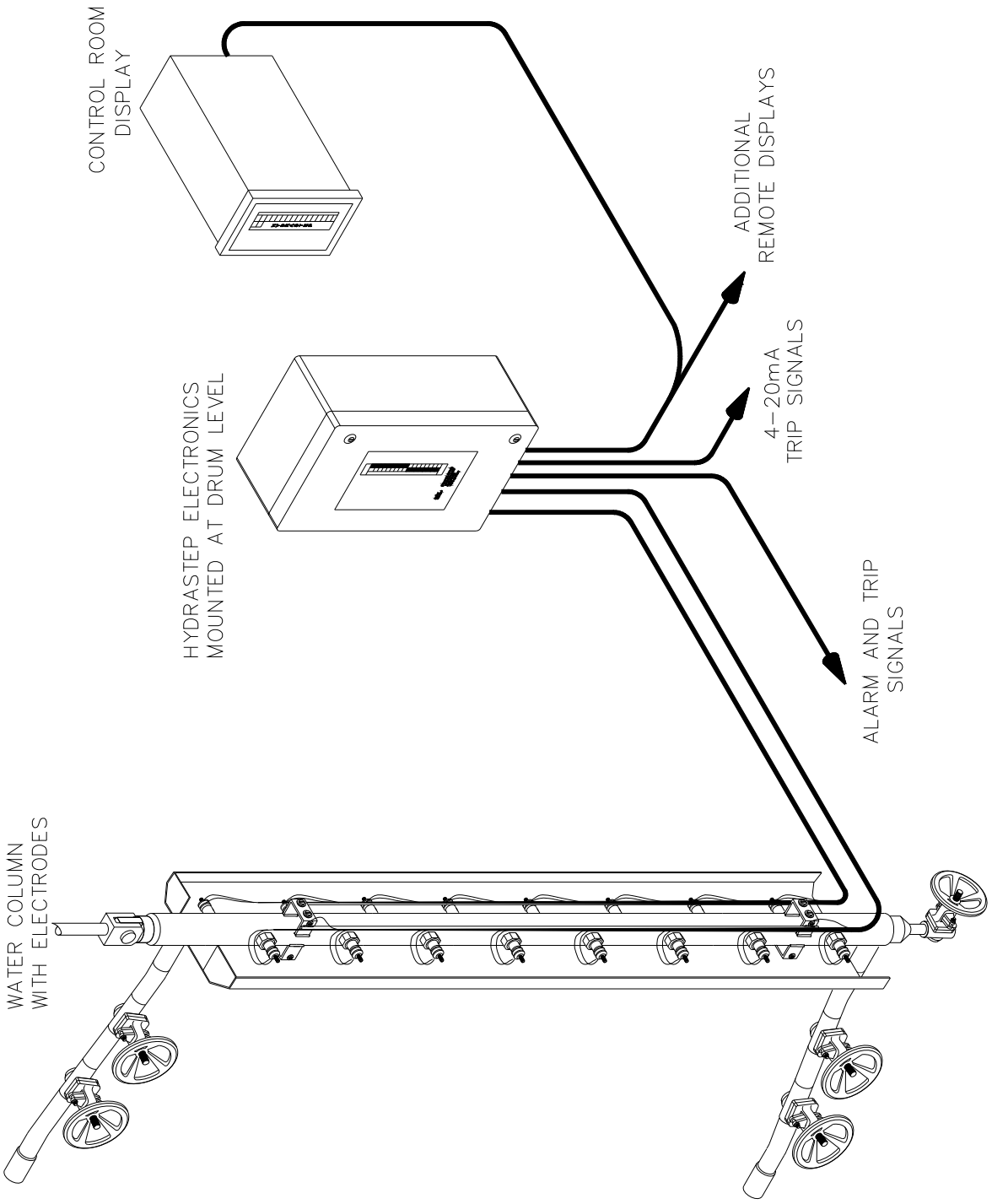



***Figure 1.3 - Typical Hydrastep 2468 System Installation***

## 1.2 HYDRASTEP 2468 ELECTRONIC GAUGING SYSTEM

The Hydrastep 2468 is a sophisticated and flexible electronic gauging system. It is supplied in two main versions:

- **A Single Power Supply System with Local Level Display**
- **A Dual Power Supply System with Local Level Display**

For both systems, the printed circuit boards are housed in the same enclosure, allowing customers full capability to expand their system as and when conditions dictate.

Table 1.1 on page 1.7 is a summary of all upgrade paths and options for the Hydrastep 2468 system.

### 1.2.1 INPUT BOARDS

All versions of the Hydrastep 2468 unit contain one or two input boards. The input boards mount on to the base plate in the enclosure. Each input board provides power supplies, electrode drive, signal processing, fault analysis and an analogue output.

The input board can accept inputs from 8, 10, 12, 14 or 16 electrodes. When two input boards are used (in a 'dual power supply' system) the electrodes are 'interlaced'; that is, the odd numbered electrodes are connected to one input board and the even numbered electrodes are connected to the other. Full details of the wiring are covered in Chapter 2 under Installation.

Each input board also includes a current output circuit that provides an analogue representation of the water level in the column. The analogue output can be configured to give a current output in one of the following ranges:

- 0 to 20mA
- 4 to 20mA
- 20 to 0mA
- 20 to 4mA

### 1.2.2 DISPLAY BOARD

The display board is mounted on to the hinged lid of the unit and provides indication through the viewing window on the enclosure. It also supplies configuration information to the input board(s); that is, the number of electrodes connected to the unit and the required water/steam switching threshold.

Figure 1.1 shows the local display with **water level** and **system fault** indication. **Water level** is indicated by two columns of LEDs, one red to indicate steam and one green to indicate water. The number of LEDs illuminated is dependent on the number of electrodes present and a blanking panel is available to mask the LEDs not used. In addition to the **system fault** indication is an opto-isolated **system fault output**. Switches are provided to allow the number of electrodes to be selected (8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 or 32). Two solder link pads are provided to select the water/steam switching threshold (0.6μS/cm or 1.6μS/cm).

### 1.2.3 SYSTEM FAULTS (2468CB OR 2468CD)

**System fault** indication, a yellow LED and an opto-isolated output, is provided for a 'water above steam' condition, an electrode fault or wiring failure and the detection of an internal fault. A further fault is indicated when the electrode number switch is incorrectly set. This fault is indicated by a chequered display of red and green LEDs on the level display.

Faults and their remedies are covered in Chapter 2 under 'Fault Analysis & Corrective Action'.

## 1.3 SYSTEM OPTIONS

### 1.3.1 OUTPUT BOARDS

Each input board can accept one or two output boards that can be used for water level signalling, alarm or trip functions. Each output board provides four relay outputs or four opto-isolated outputs. The first output board is fitted directly on top of the input board using three nylon pillars. A second output board (when required) can be fitted on top of the first output board using the same type of fixture. The various output boards are described in Chapter 3.

### 1.3.2 REMOTE DISPLAY UNITS

Provision is made to drive Remote Display Units. The display board is capable of driving up to 6 remote display units. Only one of these can be powered by the Hydrastep unit, any additional remote displays must be locally powered.

A remote display unit 'mimics' the display on the Hydrastep 2468 and is as described in Chapter 4.

### 1.3.3 OPTION DETAILS

| | | |
|---|---|---|
| **1.** | Relay Board 24680504 has 4 fully configurable relay outputs | **Chapter 3a** |
| **2.** | Relay with Time Delay board 24680509 has 4 fully configurable relay outputs | **Chapter 3b** |
| **3.** | Opto-isolator board 24680505 has 4 fully configurable opto-isolated outputs | **Chapter 3c** |
| **4.** | Remote Display 24683B. Panel mounted DIN size 8 to 32 electrode display | **Chapter 4** |
| **5.** | Remote Display 24683C Panel mounted large LED 8 to 32 electrode display | **Chapter 4** |
| **6.** | Remote Display 24683D Wall mounted splash proof version of 24683C | **Chapter 4** |

## 1.4 HYDRASTEP 2468 UPGRADE PATHS AND AVAILABLE OPTIONS

Table 1.1 describes the available versions of the Hydrastep 2468 Electronic Gauging System and their possible options.

| Existing System | Available Options | | Comments |
|---|---|---|---|
| | Description | Part No. | |
| 2468 CA or 2468 CC<br><br>16 point EGS with local display<br><br>Single power supply. | Relay output board | 24680504C | } |
| | Time delay relay output board | 24680509B | } Up to two boards (of any one } type) can be fitted. |
| | Opto-isolated output board | 24680505A | } |
| | Remote display unit | 24683B, C, or D | Up to 6 can be used |
| | Input board upgrade (ac) | 24680501C | Provides an additional power supply (ac mains source) and 16 point input circuit. Upgrades 2468CA to 2468CB. |
| | Input board upgrade (dc) | 24680516B | Provides an additional power supply (24V dc source) and 16 point input circuit. Upgrades 2468CC to 2468CD. |
| 2468 CB or 2468 CD<br><br>32 point EGS with local display<br><br>Dual power supply. | Relay output board | 24680504C | } |
| | Time delay relay output board | 24680509B | } Up to four boards (of any one } type) can be fitted. |
| | Opto-isolated output board | 24680505A | } |
| | Remote display unit | 24683B, C, or D | Up to 6 can be used |

**Note:** If required, a 24680501C board can be fitted to a 2468CC (or a 24680516B board can be fitted to a 2468CA) to upgrade to a **2468CE**. The 2468CE is a 32 point Electronic Gauging System (EGS) with one ac mains source power supply and one 24Vdc source power supply.

***Table 1.1 - Upgrade paths and available options***

# 2

# 2468CB & 2468CD Dual Power Supply Version

## Contents

**Page No.**

## Illustrations



## Tables

## 2.1 INTRODUCTION

This chapter introduces the dual power supply version of the Hydrastep 2468 Electronic Gauging System, its mechanical installation, system configuration, simple fault analysis/corrective action capability and its specification.

## 2.2 ELECTRODE CABLING SYSTEM

This system can have 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 or 32 electrodes and uses 18-core electrode cables. The cables consist of nine pairs of coloured cores with the black cores in each cable used for the EARTH terminations. Each electrode requires one pair of cores, one core for the signal drive and one for the signal return.

| Number of Electrodes | Number of Cables Required |
|---|---|
| 8 | 1 |
| 10-16 | 2 |
| 18-24 | 3 or 4 |
| 26-32 | 4 |

The electrode cable is pre-formed for simple installation. The connections to the electrodes are terminated on the connection stud of the electrode. Either core can be connected to the electronic enclosure as the signal drive or return.

## 2.3 ELECTRONIC ENCLOSURE

The basic arrangement of boards in the electronic enclosure is as follows:

- Two input boards supply power to the system and to the input signal processing circuits. These boards are: PCB 24680501, ac (mains) input, or PCB 24680516, dc input. One board is mounted on the right hand side of the base plate and receives the **odd numbered** electrode inputs. The other board is mounted on the left hand side of the base plate and receives the **even numbered** electrode inputs.

- A display board (PCB 24680515) contains the LED drive circuits for the two columns (32 red LEDs and 32 green LEDs) and the system fault LEDs. This board is mounted on the rear of the front panel, with the LEDs protruding through the front panel.

- Up to four output boards, Relay Board (PCB 24680504), Relay with time delay Board (24680509) or Opto-isolator Board (PCB 24680505) may be fitted, two per input board. Output board mounting pillars are fitted to each input board during manufacture to support the first output board mounted.

Refer to Figure 2.1 on page 2-4 for an annotated view of the internal layout of the unit.

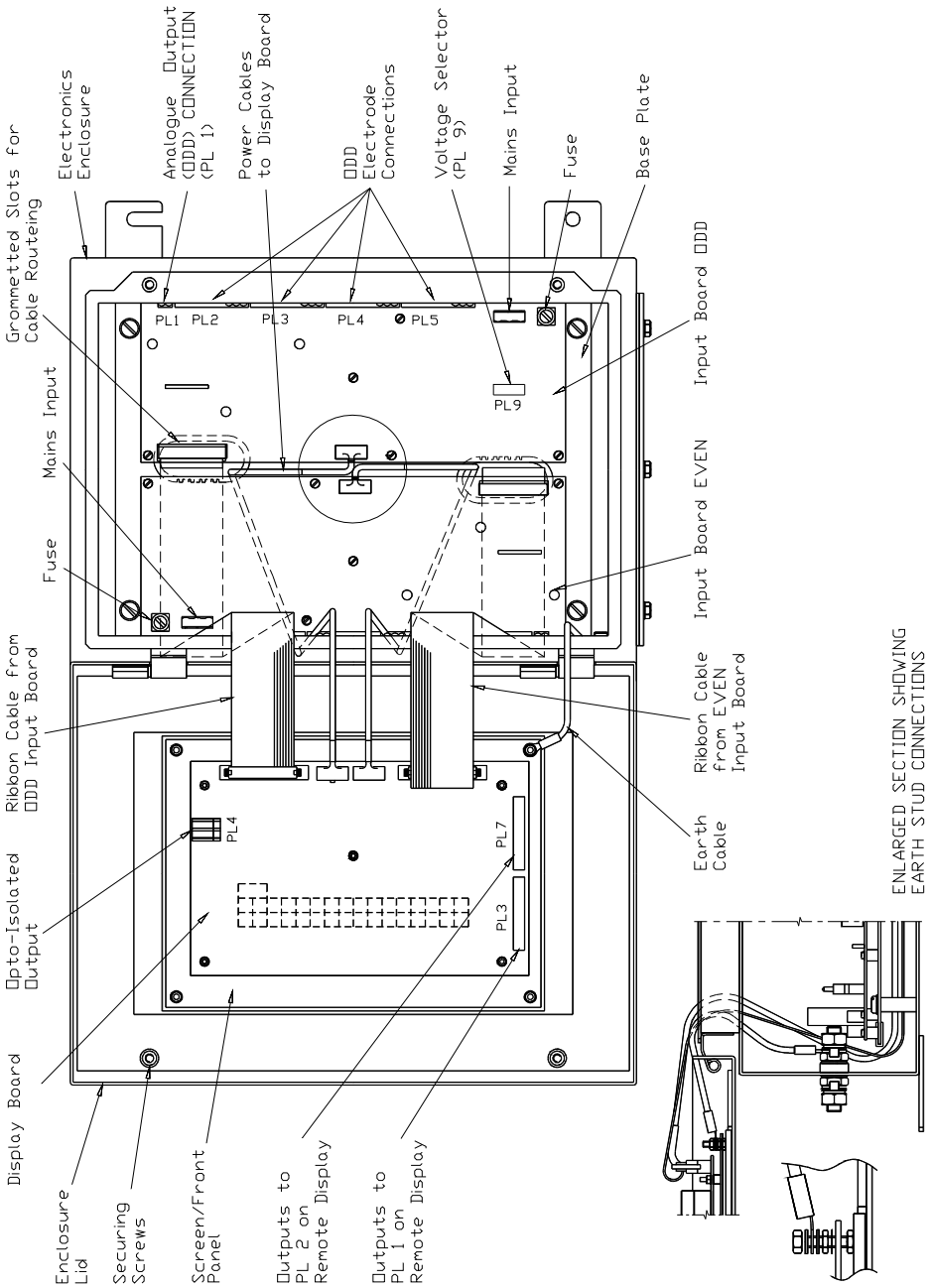



***Figure 2.1: Outline drawing showing PCB layout and interconnections***

### 2.3.1 INPUT BOARD (PCB 24680501 AND PCB 24680516)

The input board processes the electrode inputs to provide water level data for display purposes and a current output representing the water level. Fault detection is also carried out where the condition of the electrode inputs are examined and a FAULT is indicated when:

1. An open circuit in either of the electrode conductor cores is present.
2. A short circuit to EARTH on either the electrode or conductor cores.
3. A **water above steam** condition exists.
4. An internal circuit fault condition exists.

A current output circuit is also provided on each input board. This gives an analogue representation of the water level. The sense (**forward** or **reverse**) and type (**0-20mA** or **4-20mA**) is selectable and described in Section 2.5 of this chapter. Fault indication on the analogue output is an oscillating waveform (of approximately 0.5 Hz) superimposed on the main analogue signal.

The electrode inputs to each input board are passed to the other input board so that each analogue circuit can output the full range content of electrode input signals. However, should either of the input boards fail, the remaining board recognises that data is missing and doubles its own electrode input signal to remedy the data loss giving a maximum error of ± 1 electrode.

Provision is made on each input board to accept one or two output boards, either relay outputs or opto-isolated outputs. Both types of output board are offered as options.

Each input board produces the power supplies for the whole instrument which are derived either from the local mains voltage supply of 110V ac or 240V ac nominal for the 24680501 input board or 20V dc to 40V dc for the 24680516 input board.

Apart from the input voltage there are two other differences between the AC (24680501) and DC (24680516) input boards. These are the analogue output drive capability and the remote display drive capability.

#### 2.3.1.1 Analogue Output Drive Capability

With the minimum DC supply voltage of 20V for the DC input board (24680516) the maximum load that can be driven by the analogue output is 500Ω.

At the minimum mains input voltage the AC input board (24680501) the maximum load that can be driven by the analogue output is 600Ω.

### 2.3.2 REMOTE DISPLAY DRIVE CAPABILITY

The remote display drive capability is only a consideration when the 2468C is providing power for a remote display. With either input board the unit is capable of driving six remote displays at up to 1000m (3280ft) from the unit but only powering one remote display (any others must be locally powered). With the AC input board the maximum cable loop resistance to the remote display is 27Ω whilst with the DC input the maximum cable loop resistance to the remote display is 7Ω. (See remote display section for more details).

### 2.3.3 DISPLAY BOARD (PCB 24680515)

The display board receives its power supplies and electrode data from the input boards. This data is decoded and used to illuminate the required LEDs mounted on the display board. The data is also converted to serial format for transmission to remote display units.

The water level in the column is indicated on the front panel by two columns of 32 LEDs, one **green** column to indicate the electrodes which are **in water** and one **red** column to indicate the electrodes which are **in steam**. The number of LEDs illuminated is dependent on the number of electrodes being used in the system. When 8 to 16 electrodes are being used, the unit illuminates two LEDs per electrode. When between 18 and 32 electrodes are being used, the unit illuminates one LED per electrode. In both cases, the display is **top biased** (unused LEDs are at the bottom of the display). A blanking label is provided to mask any LEDs that are not used.

The **system fault** is indicated by the **yellow** LED. Provision is also made for external indication of a **system fault**. This takes the form of an opto-isolated output which is normally in its short-circuit state. When an alarm condition exists, the opto-isolated output is open-circuited.

Full illumination of the Fault LED indicates **a water above steam** condition has been detected. Illumination of half the Fault LED indicates an electrode, wiring or input board related fault. The top half of the Fault LED illuminates when faults are detected by the left hand input board (the **even** electrodes) and the bottom half of the Fault LED illuminates when faults are detected by the right hand input board (the **odd** electrodes). Faults are covered under “Fault Analysis & Corrective Action” in section 2.4 of this chapter.

The switch that **sets** the number of electrodes to be scanned is also mounted on this board. A ‘chequered pattern’ is displayed by the RED and GREEN columns if an invalid switch setting is made on the **number of electrodes** switch.

The **water/steam** switching threshold (0.6μS/cm or 1.6μS/cm*)* may be changed by solder split pads.

#### 2.3.3.1 Link LK1

The display board caters for both single input board and dual input boards versions of the Hydrastep 2468 system. With dual input boards, the odd electrode inputs are connected to one half of the display board circuit with the even electrode inputs connected to the other half of the circuit.

With the single input board, only one half of the board is connected to the odd and even electrode inputs. In this case the link **LK1** must be fitted to connect the **odd** and **even** halves of the display board circuit.

**Note:** This link **MUST** be removed for the dual input board system.

#### 2.3.3.2 Links LK2, LK3, LK4 and LK5

These links are used to select either the 8 - 16 display mode (two LEDs per electrode) or the 18 - 32 display mode (one LED per electrode).

Two link headers are provided with the unit and must be fitted in either **LK2 and LK4**, to enable the 8 - 16 electrode mode, or **LK3 and LK5**, to enable the 18 - 32 electrode mode.

| No. of Electrodes used | Link Headers fitted |
|---|---|
| 8 - 16 electrodes | LK 2 & LK 4 |
| 18 - 32 electrodes | LK 3 & LK 5 |

See also Figure 2.5 on page 2-21.

### 2.3.4 PCB INTERCONNECTIONS

Signal interconnection between the input boards and the display board is via ribbon cables. The power supplies to the display board come from each input board via a 6-core cable.

Slots are provided in the base plate to guide the cables towards the hinge-side of the enclosure case, thus minimising any cable strain when the enclosure lid is opened. See Figure 2.1 for layout details.

# 2.4 INSTALLATION

This section deals with the mechanical installation of the electronic enclosure and the electrical connections required for the basic system. Any installation dealing with the options available for use on this version of the system are covered in Chapters 3 & 4.

**Notes:**

**1.** The Electronic Enclosure cover should not be removed or opened until the equipment is ready for physical installation to its fixing point. Under no circumstances should the Electronic Enclosure be left open unless internal work is actually in progress.

**2.** When working on a bench with the enclosure open, the lid should be supported in its open position.

**3.** To clean the instrument, use a damp cloth with a mild, water-based cleaner. Clean the exterior of the instrument only. Do not allow liquids to enter or spill into the instrument.

## 2.4.1 MECHANICAL INSTALLATION

The electronic enclosure must be sited within electrode cable length of the water column fixture. The preferred site for the electronic enclosure is a wall or vertical bracket structure where easy access is available for viewing and servicing, and of suitable composition/load bearing ability to be capable of supporting 4 times the equipment weight (see page 2-32 for weight specification.) It is assumed that the water column is fully installed.

The electronic enclosure is equipped with four welded feet, allowing it to be secured in a vertical position. Using a template derived from the enclosure details, given in Figure 2.2, drill the necessary holes in the prepared surface. Secure the electronic enclosure with M10 bolts or equivalent fixings.

The wiring enters the unit through a gland plate in the bottom of the enclosure. A blank gland plate is provided to give users a choice in the type of glands and gland configuration for the required system. Alternatively, cable entry can be made directly via trunking. Note that the gland plate should be removed for fitting of the glands. EMC compatibility for European installations is proven for an enclosure using a gland plate and RF glands making a good annular (ring shape) connection to screened cables for all connections. An installation using unscreened cables or trunked routing without a gland plate and RF gland would not be covered by the manufacturer's EMC declaration of conformity.

The cabling involved is:

- Mains Supplies (2 cables)
- Electrode Inputs (up to 4 cables)
- Relay or Opto-isolated Outputs (Up to 16 relay or opto-isolated outputs)
- Remote Display (up to 6 cables)
- Analogue Outputs (1 or 2 cables)
- Opto-isolated Fault Output (1 cable)

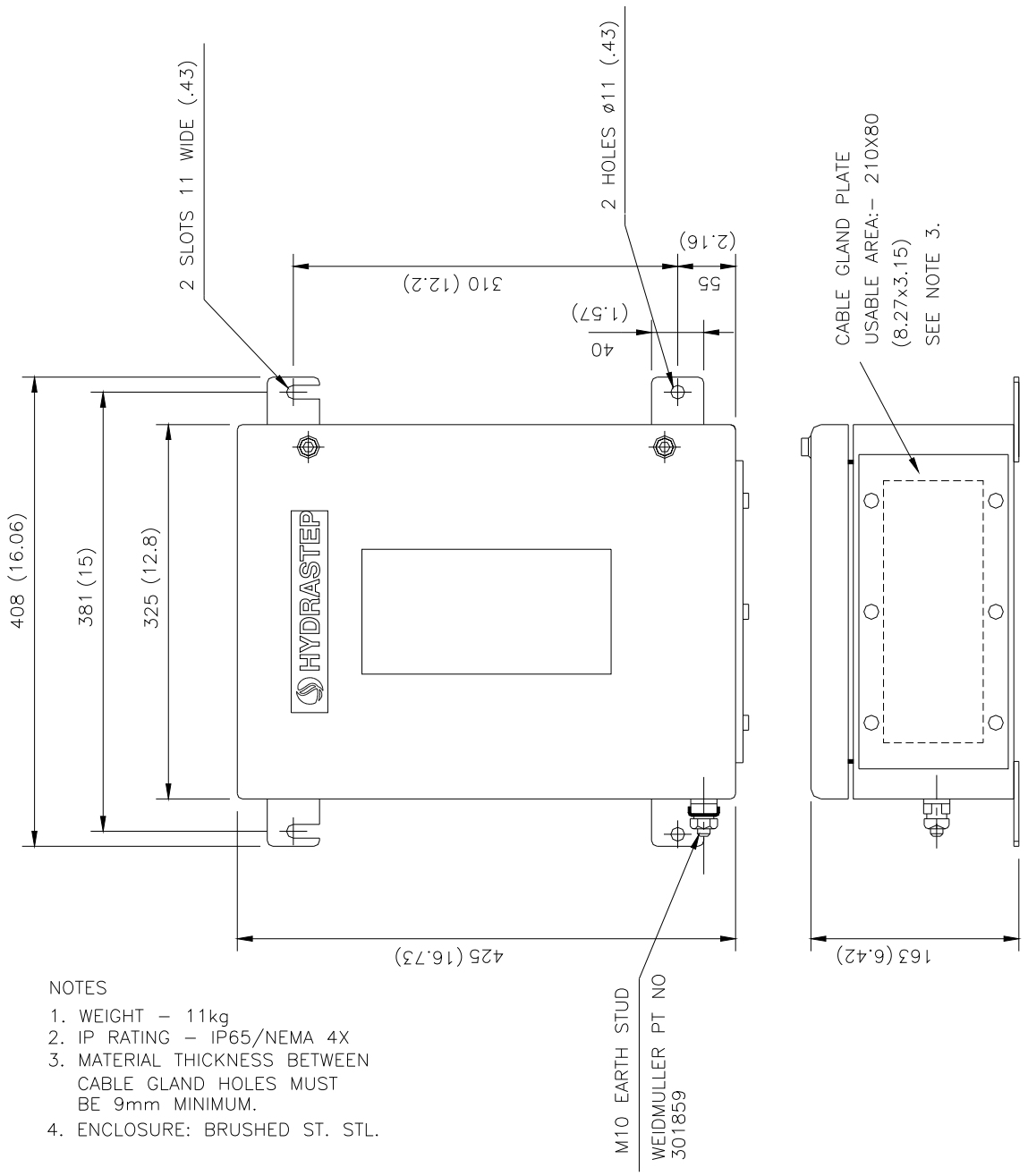



***Figure 2.2: Installation diagram for Hydrastep 2468 Electronic Gauging System unit***

### 2.4.2 ELECTRICAL INSTALLATION

This section deals with the interconnection between the electrodes and the electronic enclosure, the connection of the ac mains power supply to the electronic enclosure and the analogue output connections from the electronic enclosure.

#### 2.4.2.1 Electrode Connections

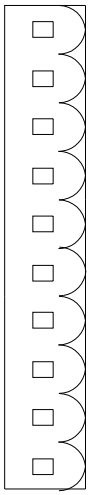
**Hydrastep Electrode Cables**

Special electrode cable assemblies of length 3, 10, 18 or 30 metres are provided with the system for connecting the Hydrastep 2468 Electronic Enclosure to the Water Column Electrodes. The cable looms are 18-core multi-strand conductors.

The conductors are colour coded for ease of installation and have pure nickel ring clamps fitted at one end for connection to the electrodes. A set of wire crimps is provided for use on the Enclosure connections.

The **black** conductors in each cable are used for the EARTH terminations, leaving eight pairs of coloured conductors for connection to the electrodes. At least one cable assembly is required and certain conductor pairs in the cables will be redundant. The exceptions are the 8, 16 and 32 electrode systems where all the conductors in the cables are fully used.

**Electrode connections**



| Pin Number | Function PL2, PL3, PL4, PL5 |
|---|---|
| **1** | Electrode Drive |
| **2** | Electrode Pickup |
| **3** | Functional Earth |
| **4** | Electrode Drive |
| **5** | Electrode Pickup |
| **6** | Electrode Drive |
| **7** | Electrode Pickup |
| **8** | Functional Earth |
| **9** | Electrode Drive |
| **10** | Electrode Pickup |

The connection requirements for the 16 electrode system is used as the example case. A full set of electrode connection diagrams is included at the end of Chapter 2 covering the pin-by-pin pairings for all electrode systems mentioned.

### 2.4.2.2 Connecting Cables to Water Column Electrodes

**(16 Electrode System - See Page 2-WD.7)**

The following assumes that the electrodes have been fitted to the water column.

1. Gain access to the electrodes mounted on the water column.
2. Undo both knurled nuts on the stud of the bottom electrode (referenced **EL.1** on the drawings) and remove both the nuts and washers.
3. Take one of the brown (**BN**) conductors in **Cable 1** and fit the ring clamp of the conductor over the stud, followed by a washer and a knurled nut. Tighten the nut to form a good secure contact, ensuring the conductor run to the cableform clamping bar is free from snags and sharp bends.
4. Repeat the operation for the remaining brown (**BN**) conductor of **Cable 1**.
5. Take the next electrode up, referenced **EL.2** on the drawings, and repeat the operations detailed in paragraph **2** above.
6. Take the brown (**BN**) conductors of **Cable 2** and repeat the fitting instructions detailed in paragraph **3** above.
7. Repeat the operations of paragraphs **2** and **3** for the remaining tabulated conductor/electrode pairings on the next page and connect as detailed on page 2-WD.7.
8. Check that all conductor runs affecting **Cables 1** and **2** on the water column are satisfactory then clamp the cable securely to its clamping bar.
9. Refit any Electrode Protection Covers to the water column.

## Water column connections for 16 electrodes

| Electrode Number | Conductor Number | Cable Number | Enclosure Connection |
|---|---|---|---|
| 1 | Brown | 1 | PL2 pin 1 |
| | Brown | | PL2 pin 2 |
| 2 | Brown | 2 | PL2 pin 1 |
| | Brown | | PL2 pin 2 |
| 3 | Red | 1 | PL2 pin 4 |
| | Red | | PL2 pin 5 |
| 4 | Red | 2 | PL2 pin 4 |
| | Red | | PL2 pin 5 |
| 5 | Orange | 1 | PL2 pin 6 |
| | Orange | | PL2 pin 7 |
| 6 | Orange | 2 | PL2 pin 6 |
| | Orange | | PL2 pin 7 |
| 7 | Yellow | 1 | PL2 pin 9 |
| | Yellow | | PL2 pin 10 |
| 8 | Yellow | 2 | PL2 pin 9 |
| | Yellow | | PL2 pin 10 |
| 9 | Green | 1 | PL2 pin 9 |
| | Green | | PL2 pin 10 |

| Electrode Number | Conductor Number | Cable Number | Enclosure Connection |
|---|---|---|---|
| 10 | Green | 2 | PL3 pin 1 |
| | Green | | PL3 pin 2 |
| 11 | Blue | 1 | PL3 pin 4 |
| | Blue | | PL3 pin 5 |
| 12 | Blue | 2 | PL3 pin 4 |
| | Blue | | PL3 pin 5 |
| 13 | Purple | 1 | PL3 pin 6 |
| | Purple | | PL3 pin 7 |
| 14 | Purple | 2 | PL3 pin 6 |
| | Purple | | PL3 pin 7 |
| 15 | Grey | 1 | PL3 pin 9 |
| | Grey | | PL3 pin 10 |
| 16 | Grey | 2 | PL3 pin 9 |
| | Grey | | PL3 pin 10 |
| Earth | Black | 1 | PL2 pin 3 |
| | Black | | PL2 pin 3 |
| Earth | Black | 2 | PL2 pin 3 |
| | Black | | PL2 pin 3 |

**Note:** There are two conductors of each colour per cable.

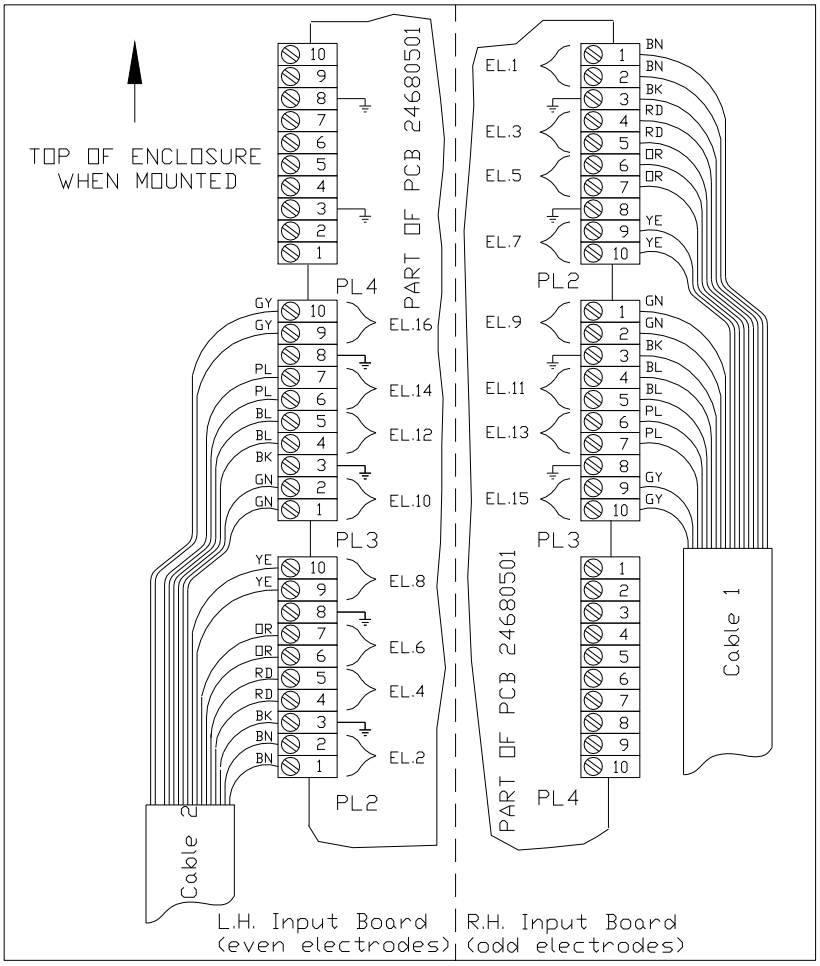



***Figure 2.3: Enclosure cable layout for 16 electrode system***

### 2.4.2.3 Connecting the Electrode Cable Assemblies to 2468 Enclosure

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

Four 10-way plugs are provided on each PCB1 to terminate all the necessary connections from the electrode cables.

1. Ensure power is removed from electronic enclosure and open the front cover.
2. Feed **Cables 1** and **2** into the enclosure through its gland (if applicable). Prepare the cable screens and terminate the screens at the gland plate.

   Screened cables must be used, and each one grounded at the cable gland entering the enclosure. Use a good quality RF cable gland and ensure a good annual (ring shape) connection with the screen. The screens should not be grounded at the electrode end.
3. Prepare the individual conductor lengths to suit their orientation in the terminal blocks PL2 and PL3 on their respective PCB 24680501 as shown in Figure 2.3.

   It is considered good practice to twist wire-pairs together for each electrode circuit, and twist the pairs that are in the same cable together into one bundle.

Wiring to the 'hinge-side' 24680501 board (even-numbered electrodes) should not be pressed hard against the ribbon cables, but instead run forward of the connectors and away from the side of the casing. Do not route them over the board.

Wiring to the 'catch-side' 24680501 board (single channel set-up / odd-numbered electrodes) should be tucked into the back of the enclosure, next to the connectors, as close to the casing as possible and below the base plate level.

4. Fit the free sockets into the terminal blocks PL2 and PL3.
5. Prepare the conductor core ends, fit the crimp terminals and connect the conductors to their respective free sockets.
6. Ensure that both cables have a stress-free run inside the enclosure.

#### 2.4.2.4 Hydrastep Power Supply Cables

**WARNING Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

### AC Powered Units (input board 24680501)

The Hydrastep 2468C must be installed with a fuse or circuit breaker with a maximum rating of 5A mounted as close as practicable, in an easily reached location. The fuse or circuit breaker must be uniquely identified as the disconnecting device.

The cable gland used must have an inlet or bushing with a smoothly rounded bell-mouthed opening with a radius of curvature of at least one and a half times the overall diameter of the mains cable fitted. Alternatively, a fixed guard made of insulating material protruding beyond the inlet opening by at least five times the cable diameter may be used.

A shielded power cable, and shielded signal cables with the connection to the unit through RF glands mounted on the gland plate should be used for all units that need to comply with the requirements of the European EMC Directive.

Gain access to each input board and proceed as follows:

1. Ensure that the mains cable is safely isolated before starting work, and ensure that enough length is prepared to install it according to the route described in Step 2 and Step 3 below. The power inlet must be dedicated to that function only. No signal wiring must share the power inlet cable. Two separate protected AC mains circuits (of the same electrical phase) may be provided in a suitably rated multi-way cable.
2. Use a good quality RF cable gland, and ensure there is a good annular (ring shape) connection with the screen. A ferrite (supplied) must be attached inside the unit to each supply input, as close to the inlet gland as possible. Make a double-turn through each ferrite – ensure that the cable is prepared with enough length to accommodate this – and have the entire run stress-free.
3. Route the cables to both boards along the right-hand (catch) side of the enclosure.

   The supply wiring to the even-numbered electrode boards should run up the right-hand side and across the top of the enclosure. Do not run it close to the display board ribbon cables. The run must be stress-free, and it is good practice to twist power pairs together. The use of a self-adhesive cable tie (not supplied) is recommended to hold the power cables close to the metalwork and away from the PCB.
4. Connect the live and neutral conductor to their respective terminals.
5. Check the voltage setting by checking which voltage selection plug is fitted (set to 240V at the factory) and, if required, adjust as guided in Figure 2.4.

6. With power disconnected release voltage selection plug PL9 by squeezing lugs. Insert appropriate selector plug.
7. Remove fuse and fit 200mA ceramic anti-surge fuse for 240Vac nominal and 400mA ceramic anti-surge fuse for 110Vac nominal.

**The Hydrastep 2468C unit must be earthed via the protective earth terminal (stud) on the enclosure. The cable or braid used to attach the unit to the protective earth must be capable of carrying a current of at least 10A. No disconnecting device should be fitted to the protective earth conductor.**

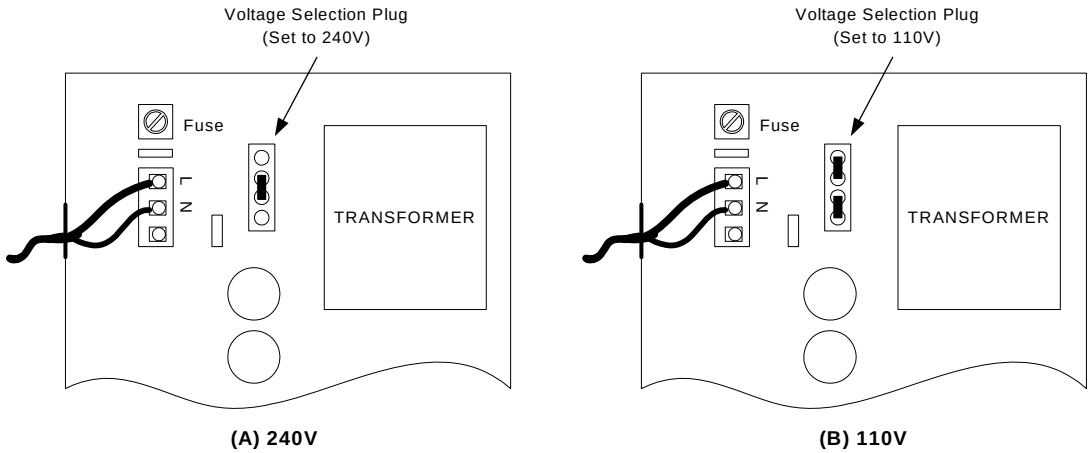



***Figure 2.4: Voltage Selection (240V or 110V)***

## DC Powered Units (input board 24680516)

A shielded power cable, and shielded signal cables with the connection to the unit through RF glands mounted on the gland plate should be used for all units that need to comply with the requirements of the European EMC Directive. The supply is connected to the unit in the same way as for the AC version. A ferrite (supplied) must be attached inside the enclosure for each DC inlet (with a double-turn). The DC inlet must not be shared by signal wiring for any other purpose. Route the supply wires in twisted pairs as described in the AC section. The DC supply must be either negative earth of fully isolated from plant ground

1. Positive (+Vs) is connected to the terminal marked **L**.
2. Negative (-Vs) is connected to the terminal marked **N**.
3. A separate ground wire is required which must be connected to the earth stud on the enclosure.
4. For a non-isolated supply, the maximum difference between the plant earth at the water column and the -Vs supply is 7V.
5. Use a good quality RF cable gland, and ensure there is a good annular (ring shape) connection with the screen.

**The Hydrastep 2468C unit must be earthed via the protective earth terminal (stud) on the enclosure. The cable or braid used to attach the unit to the protective earth must be capable of carrying a current of at least 10A. No disconnecting device should be fitted to the protective earth conductor.**

### 2.4.2.5 Analogue Output Connection

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

Plug PL1 on each input board is used for the analogue output. A 2-core screened cable is required and is connected into a 2-way socket such that:

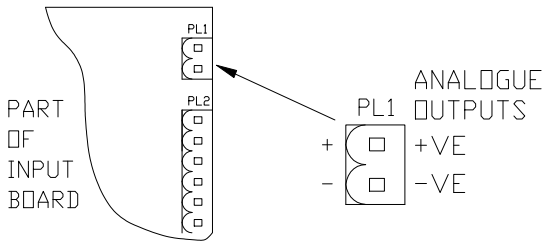
- The positive output conductor terminates in socket SK1 pin 1.
- The negative output conductor terminates in socket SK1 pin 2.

Gain access to each PCB 24680501 and connect the analogue output cable as follows:

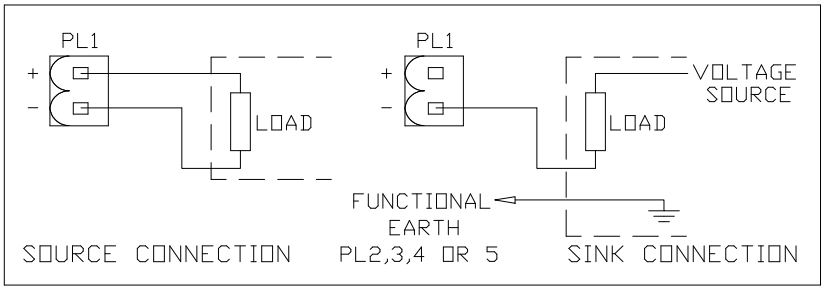
1. Pass the analogue cable through its gland (if applicable) and into the enclosure.
2. Prepare the analogue cable to give a stress-free run to PL1 on each PCB 24680501, allowing for a double-turn to pass through a ferrite.

   Analogue wiring must not share cables with power input, electrode input, or relay output.

   It is considered good practice to twist the analogue pairs together.




3. Use a good quality RF cable gland, and ensure there is a good annular (ring shape) connection with the screen. A ferrite (supplied) must be attached to each analogue pair inside the enclosure, as close to the cable gland as possible. Make a double-turn through each ferrite.
4. Prepare the conductor ends, fit the crimp connectors and connect the cores into their respective socket SK1 terminals.
5. Fit the socket into plug PL1 and check the cable run.



### 2.4.2.6 Opto-Isolated Fault Output Connection

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

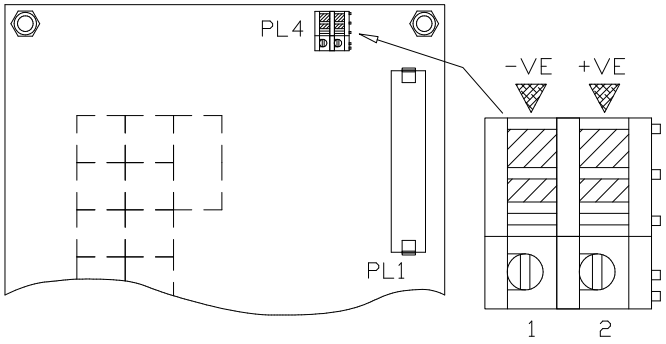
Plug PL4 is used for the FAULT output. A 2-core screened cable, capable of taking 1A and 30V is required and is connected into its 2-way terminal block such that:

**Note:** No fault present = Short circuit, < 1.1V at 1 Amp
Fault present = Open circuit, < 1 mA at 30V

- The positive output conductor terminates in socket PL4 pin 2.
- The negative output conductor terminates in socket PL4 pin 1.

Gain access to PCB 24680515 and connect the FAULT output cable as follows:

1. Prepare the FAULT output cable to give a stress-free run to PL4 on PCB 24680515. Fault output wiring must not share cables with power inputs or electrode inputs, and is considered good practice to twist the FAULT cable pairs together.
2. Use a good quality RF cable gland, and ensure there is a good annular (ring shape) connection with the screen.
3. Prepare the conductor ends and connect the conductors into their respective terminal. Check the cable run and tie it to the present loom. Tighten the gland nut (if applicable) and close the instrument front cover.




**Part of Display Board showing PL4**

If the installation is adversely affected by the operation of nearby equipment, then re-routing the cables to these instructions should improve the performance:

- Avoid bundling the cables from both channels together
- Ensure that cables run against earthed metalwork where possible
- Use screened cables for all connections, making sure that a good annular (ring shape) connection is made with a good quality RF cable gland

Electrode, Relay, and Analogue Output wiring on the left-hand (enclosure hinge) side should not be pressed hard against the ribbon cables, but instead run forward of the connectors and away from the side of the casing. Do not run the wiring over the PCB.

Wiring on the right-hand (enclosure catch) side should be tucked into the back of the enclosure, next to the connectors, and as close to the casing as possible and below the vase plate level.

Supply wiring should be run close to the metalwork, forward of the signal wiring, but never along the left-hand (hinged) side of the enclosure near the ribbon cables.

The ribbon cables must be run under the back plate and up the left-hand (hinged) side of the enclosure, and secured by using clips (supplied).

This concludes the electrical installation requirements for the basic instrument configuration. Connections within the enclosure for the options available will be covered in the Installation sections of the appropriate Chapter 3a (Relay Outputs), 3b (Relay with time delay Outputs), 3c (Opto-isolated Outputs) or Chapter 4 (Remote Display).

# 2.5 SYSTEM CONFIGURATION

This section describes mains voltage selection, analogue output setting and electrode error configuration on each input board. Also the 'number of electrodes' setting and configuration of the water/steam switching threshold value display board is described.

The three main PCBs require configuration. These are:

- Two Input Boards - PCB 24680501 or 24680516
- Display Board - PCB 24680515

## 2.5.1 INPUT BOARD (PCB 24680501 OR 24680516)

Two settings may be configured on this board, the analogue output range and sense, and the electrode error configuration.

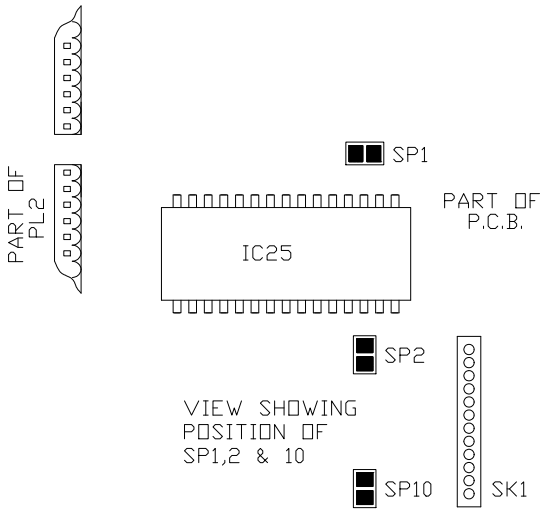
### 2.5.1.1 Analogue Output Configuration

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

Two sets of split pads are provided to select the required range (0-20mA or 4-20mA) and the sense of the mA current output (normal sense as shown or in reverse, i.e. 4-20mA or 20-4mA).

To configure the analogue output, refer to Table 2.1 then:

1. Ensure the power supply is disconnected.
2. Locate the position of split pads SP1 and SP2 on the input board (PCB).
3. Refer to Table 2.1, select which configuration is required and where 'bridged' is ticked, bridge the gap on the pad with solder. Where 'open circuit' is ticked, ensure that any solder bridge on the split pad is removed and the gap is clean.
4. Carry out a resistance test across any altered split pad for short circuit or open circuit conditions as appropriate.




| OUTPUT | SPLIT PAD | BRIDGED | OPEN CIRCUIT |
|---|---|---|---|
| 0-20mA | 1 | ✓ | |
| | 2 | | ✓ |
| 4-20mA | 1 | | ✓ |
| | 2 | | ✓ |
| 20-0mA | 1 | ✓ | |
| | 2 | ✓ | |
| 20-4mA | 1 | | ✓ |
| | 2 | ✓ | |

***Table 2.1 - Analogue output configurations***

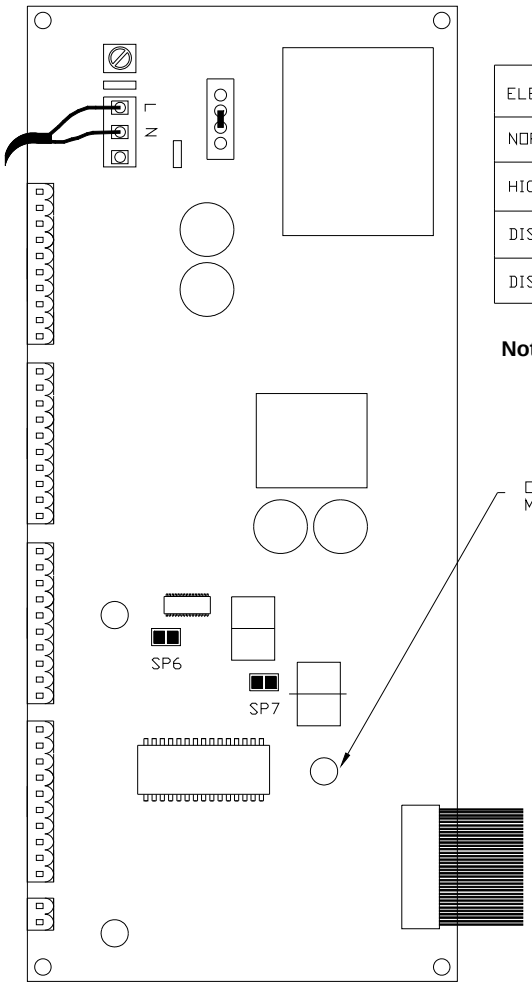
### 2.5.1.2 Pulsed Output Setting

As configured at the factory, the analogue output pulses if a fault condition occurs.

1. To disable this feature the split pad SP10 must be broken by cutting the track that passes between the pads.
2. To re-enable the pulse for fault conditions the split pad can be bridged with solder.

### 2.5.1.3 Electrode Error Configuration

An electrode error is triggered if the electrode resistance measured falls below the set electrode error threshold. Possible causes are a short to ground (short in cabling or dirty electrode) or a break in the electrode wire (may also be very conductive water). This unit can either be configured to take electrode error into account when measuring electrode resistance or the facility can be disabled. When enabled, if an electrode error occurs the alarm (yellow) LED relating to the board on which the error occurred is illuminated and the LED pair (red and green) corresponding to the electrode, alternate between red and green.




| ELECTRODE ERROR THRESHOLD | SP6 | SP7 |
|---|---|---|
| NORMAL | ☐ ☐ | ☐ ☐ |
| HIGH CONDUCTIVITY | ▬ | ☐ ☐ |
| DISABLED | ☐ ☐ | ▬ |
| DISABLED | ▬ | ▬ |

**Note:** If SP6 has been bridged, this may be left in position even if SP7 is subsequently bridged.

***Input Board (Option Board Removed)***

### 2.5.1.4 Configuring the Unit to Detect Electrode Error

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Disconnect the power supply. Gain access to the input PCB by opening the cover and removing the option board.
2. Check split pads SP6 & SP7 on the input PCB are open circuit and clean (this is the default setting).
3. To change the electrode error threshold value or to disable the feature, bridge the split pads SP6 or SP7 with solder as shown in the table above.

Repeat the procedure used in configuring the first input board to set up the remaining input board as required. This concludes the configuration on the input boards.

**WARNING** **Bridging SP7 will disable the electrode fault alarm. In this condition, a fouled electrode in water will not be detected. This is of particular importance when electrodes are used for low level alarm or cut off.**

By bridging split pad 6 on the input board, the **conductivity fault detection level** will be increased from 104μS (normal) to 300μS (high). This may be sufficient in some cases, but not all.

Factory modifications are available to further increase this level to 800μS, 1600μS or 2000μS. At each of these stages, the measuring sensitivity of the Hydrastep system is reduced, so the most appropriate level should be chosen, not the highest. Contact your local representative for further details.

Note that input boards that have been modified are marked with the number 24680229A and the conductivity level that is acceptable.

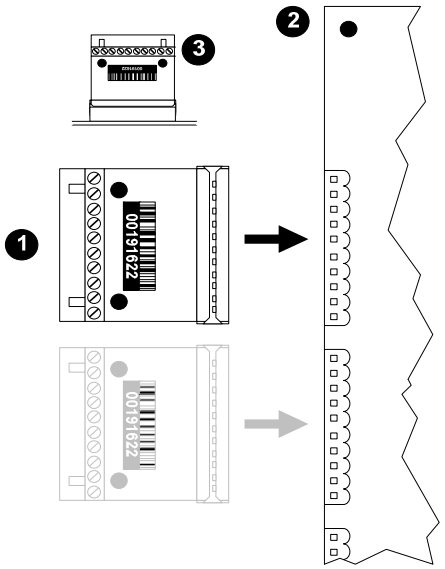
**Offset voltages:**

When an offset voltage is present on the return signal and is relatively high compared to the ac voltage, it may have the effect of lifting the square wave to the water/steam switching point.

This will cause one, or more, electrodes to flash rapidly on the display as the detection circuits alternate between steam and water. When combined with the problem described above, the display becomes very confusing.

Input adapter boards (24680523A) are available which fit into the electrode cable connectors on the input board (see inset picture, right). These have series capacitors in the return side of the cables, blocking any dc offset voltages.

The electrode cable then plugs into the Input Adapter Board instead of the electrode cable connector.




**1.** Input Adapter Board.
**2.** Input Board (Partial Top View).
**3.** Adapter plugged into electrode cable connector (Horizontal View).

### 2.5.2 DISPLAY BOARD 24680515

The Display Board needs to know how many electrodes are being used and if one or two input boards are being used. A centrally mounted dual-in-line switch assembly, SW1 (titled “Number of Electrodes”) uses four individual switch channels to select between an 8 and 32 electrode operation as shown in Table 2.2 below. A socket LK1 (situated near switch SW1) is provided to link the two halves of the display board together with a link header when only one input board is used. In this case when two input boards are being used, the link header is not fitted.

Sockets are also provided at LK2, LK3, LK4 and LK5 locations (see Figure 2.5), to select an 8 - 16 (two LEDs per electrode) display mode or an 18 - 32 (one LED per electrode) display mode. For hazardous area applications, links 2, 3, 4 and 5, when fitted, must be secured into the sockets using a cable tie passed underneath the socket base.

| SWITCH SW1 | | | | NO. OF ELECTRODES | | LINKS 2-5 | |
|---|---|---|---|---|---|---|---|
| CHANNEL NO. | | | | IN WATER | PER INPUT | LINKS | LINKS |
| 1 | 2 | 3 | 4 | COLUMN | BOARD | 2 & 4 | 3 & 5 |
| Off | Off | On | On | 8 | 4 | | |
| On | On | Off | On | 10 | 5 | Fitted | Not |
| Off | On | Off | On | 12 | 6 | | Fitted |
| On | Off | Off | On | 14 | 7 | | |
| Off | Off | Off | On | 16 | 8 | | |
| On | On | On | Off | 18 | 9 | | |
| Off | On | On | Off | 20 | 10 | | |
| On | Off | On | Off | 22 | 11 | | |
| Off | Off | On | Off | 24 | 12 | Not | Fitted |
| On | On | Off | Off | 26 | 13 | Fitted | |
| Off | On | Off | Off | 28 | 14 | | |
| On | Off | Off | Off | 30 | 15 | | |
| Off | Off | Off | Off | 32 | 16 | | |

***Table 2.2 - Number of electrodes being displayed***

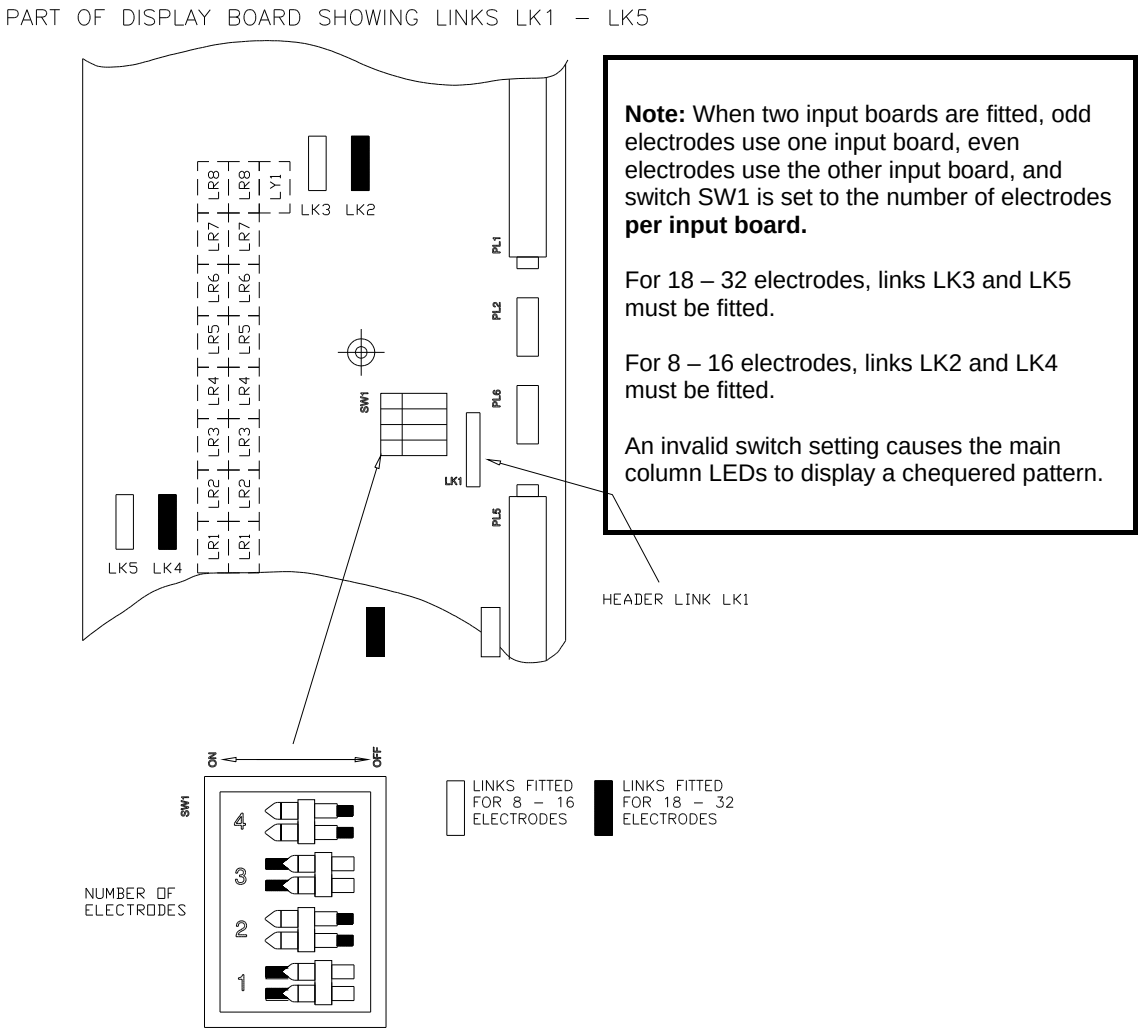
#### 2.5.2.1 Link LK1 Setting

Ensure that link header LK1 is not fitted (see Figure 2.5).

#### 2.5.2.2 Configuring the ‘Number of Electrodes’ Switch

**WARNING Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Disconnect the power supply. Gain access to PCB 24680515 by opening the cover.
2. Locate position of ‘Number of Electrodes’ switch SW1 see Figure 2.5.
3. Depending upon the number of electrodes being used, set the switches as defined in Table 2.2. The switch positions in the example shown are for a twelve electrode system.




**Note:** When two input boards are fitted, odd electrodes use one input board, even electrodes use the other input board, and switch SW1 is set to the number of electrodes **per input board.**

For 18 – 32 electrodes, links LK3 and LK5 must be fitted.

For 8 – 16 electrodes, links LK2 and LK4 must be fitted.

An invalid switch setting causes the main column LEDs to display a chequered pattern.

***Figure 2.5- Location of display board links LK1 to LK5 & switch SW1 with configuration details***

### 2.5.2.3 'Switching Threshold' Setting

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Disconnect the power supply. Gain access to PCB 24680515 by opening the cover.
2. Check split pads SF1 & SP2 on the PCB are open circuit and clean (this is the normal setting 0.6μS/cm). See Figure 2.6 for details.
3. If the preferred setting is 1.6μS/cm (i.e. low temperature), bridge the split pads SP1 & SP2 with solder.

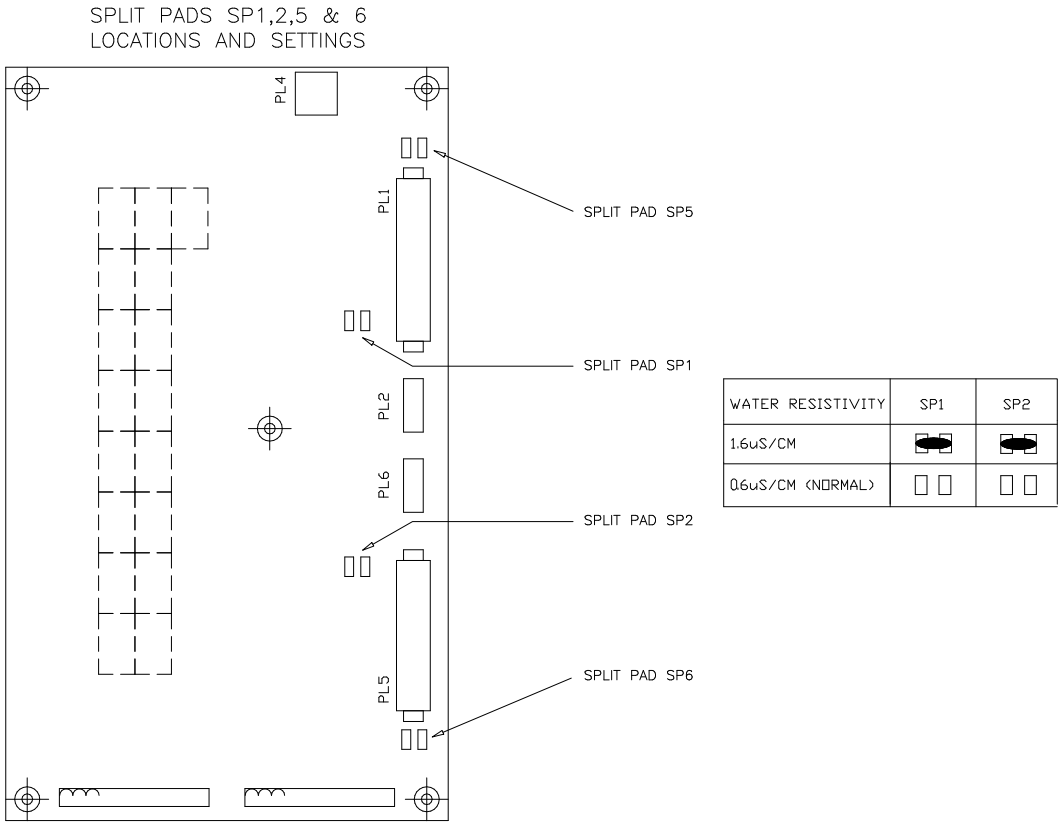



***Figure 2.6- Split pads SP1, SP2, SP5 & SP6 locations and settings***

### 2.5.2.4 'Compatibility' Setting

The split pads SP5 and SP6 should be open when used with a 24680501C or 24680516B input board. When used with a 24680501A, 24680501B or 24680516A input boards these split pads should be made. With these older input cards the LEDs corresponding to an 'electrode error' will not alternate but remain steady.

## 2.6 FAULT ANALYSIS & CORRECTIVE ACTION

Faults in the system will generally be indicated by the YELLOW LED on the front panel and by the **fault output** on the display board. The main faults, which are catered for, are:

- **Water above steam condition**
- **Electrode or Wiring fault**
- **Detection of an internal circuit fault**

When any of the above mentioned conditions exist within the Hydrastep 2468CB system, the **yellow** LED is illuminated to indicate the FAULT state. Since the electrode inputs are split between the two input boards, the ALARM indicator is configured to differentiate between ODD and EVEN electrode faults. An opto-coupler output, normally short-circuited, becomes open-circuited on a FAULT state, providing an ALARM indication output for external use. The current output indicates an alarm condition by a 0.5Hz waveform superimposed on the main analogue signal.

A further FAULT is indicated when the **number of electrodes** switch on the display board is set to an invalid number. This error brings up an alternate LED illumination display, that is a chequered display of GREEN and RED LEDs on the two front panel columns.

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

**Some parts of the water column and electrodes may be very hot. Please ensure parts are adequately cooled or that suitable precautions are taken before handling.**

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 1**<br>**Top** and **bottom** halves of fault LED illuminated<br>One or more LED pairs alternating between water and steam | Water **conductivity.**<br>**All** LED pairs in water **alternating** between water and steam. | Check ac voltage on all electrodes immersed in water with a true r.m.s. voltmeter. If several of the immersed electrodes show a voltage of less than approximately 0.1V ac then very high water conductivity is probable.<br>Check water column installation is correct; sloping pipework and insulation details. Make sure that there is sufficient condensate flow through the column.<br>If the normal water conductivity is high, the electrode error circuit can be de-sensitised or disabled.<br>If the normal water conductivity is still too high (40mV ac at electrode), the electrode error circuit must be disabled – refer to the electrode error configuration section. |
| | **Water above steam**, caused by electrode wiring or internal fault<br>Electrode connection open-circuit or short-circuit to earth | The electrode channel(s) causing the problem will be evident from the unit display by an **alternating** indication in the **steam** area.<br>Check the suspect electrode(s) has the correct pair of conductors connected, check the connections to the input board. Rectify if incorrect. |

***Table 2.3 - Fault analysis/corrective action chart***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 1** *(contd.)* | Incorrect wiring, broken connection or damaged cable assembly<br>Affected electrode(s) **alternate** between water and steam. | Check ac voltage on electrodes with a true r.m.s. voltmeter. A voltage of less than 0.1V ac indicates a fault condition.<br>If wiring to the electrode is correct and the electrode gives a voltage reading of greater than 0.1V ac and a fault is still indicated, carry out the following procedure:<br>**1.** Remove both conductors from the suspect electrode. With the conductors isolated from each other, the level display should show the electrode as **alternating between water and steam** (green and red).<br>**2.** With the conductors touching each other, the level display should show electrode as being **in steam**.<br>The above procedure checks the electrode wiring. If the display does not show the correct results, then check for a break in either of the suspect electrode conductors.<br>Carry out repair to any faulty connection or substitute a new conductor or cable assembly in place of the defective item. |
| | Dirt on electrode<br>Affected electrode(s) **alternate** between water and steam. | If the wiring checks carried out as described above have not located a fault, then dirt on an electrode insulator may be the cause of the problem giving an effective short-circuit to ground.<br>Check the electrodes for dirt over the external insulator and clean with a cloth as required.<br>Checking for dirt on the internal insulator of the electrode requires the draining of the water column (refer to Part 2 of this manual for the correct procedure).<br>Once the water column is drained, check the ac voltage on each electrode using a true r.m.s. voltmeter. Any electrode showing a voltage of less than 3V ac needs cleaning or replacement. Electrodes must be removed from the column for inspection and cleaning.<br>**Note:** The electrode insulator can be cleaned using a clean cloth |
| | Internal fault | If the wiring checks carried out as described above have not located a fault, then it is possible an internal fault exists.<br>**1.** Disconnect the electrode cable sockets from the input board.<br>**2.** Make up four 10-way sockets (six or eight sockets required for systems with more than 16 points) with wire links connecting the following pins on each socket; 1-2, 4-5, 6-7, 9-10. |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 1** *(contd.)* | | **3.** Insert these sockets in place of the electrode cable sockets in the input boards, the level display should now show an **all steam** state and no fault indication. If this does not occur an internal fault exists.<br>The circuit fault may be on either input board or the display board. If spares are available, change the input board first and if the fault is not rectified change the display board. If spares are not available, call the service engineer. |
| **State 2**<br>**Top** and **bottom** halves of fault LED illuminated<br>No LED pairs alternating between water and steam | Internal fault | This state is indicating a fault which is not related to an electrode error because **no LED pairs are alternating between water and steam.** It is therefore likely that an internal fault exists.<br>Follow same procedure as above. |
| **State 3**<br>**Top** half of fault LED illuminated<br>One or more LED pairs alternating between water and steam | Electrode wiring or internal fault<br>Even numbered electrode connection open-circuit or short-circuit to earth<br>Affected electrode **alternates** between water and steam.<br>Incorrect wiring, broken connection or damaged cable assembly | Check that all **even** numbered electrodes indicating **water** have the correct pair of conductors connected. Check the connections to the left hand input board. Rectify wiring if incorrect.<br>Check ac voltage on all **even** electrodes immersed in water with a true r.m.s. voltmeter. A voltage of less than 0.1V ac indicates a fault condition.<br>If wiring to all **even** electrodes is correct and the electrodes still give a voltage reading of greater than 0.1V ac and a fault is still indicated, carry out the following procedure:<br>**1.** Remove both conductors from electrode 2. With the conductors isolated from each other, the level display should show electrode 2 **as alternating between water and steam** (green and red).<br>**2.** With the conductors touching each other, the level display should show electrode 2 as being **in steam**.<br>**3.** Repeat operations **1** and **2** for all affected **even** numbered electrodes until a faulty indication is found.<br>The above procedure checks the electrode wiring. If the display does not show the correct results, then check for a break in either of the suspect electrode conductors.<br>Carry out repair to any faulty connection or substitute a new conductor or cable assembly in place of the defective item. |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 3** *(contd.)* | Dirt on electrode<br><br>Affected electrode **alternates** between water and steam. | If the wiring checks carried out as described above have not located a fault, then dirt on an electrode insulator may be the cause of the problem giving an effective short-circuit to ground.<br><br>Check all **even** numbered electrodes alternating between water and steam for dirt over the external insulator and clean with a cloth as required.<br><br>Checking for dirt on the internal insulator of the electrode requires draining of the water column (refer to the appropriate manual for the correct procedure).<br><br>Once the water column is drained, check the ac voltage on each **even** numbered electrode using a true r.m.s. voltmeter. Any electrode showing a voltage of less than 3V ac needs cleaning or replacement. Electrodes must be removed from the column for inspection and cleaning<br><br>**Note:** The electrode insulator can be cleaned using a clean cloth |
| | Internal circuit fault on left hand circuit board or the display board | If the wiring checks carried out as described above have not located a fault, then it is possible that an internal fault exists.<br><br>**1.** Disconnect the electrode cable sockets from the input boards.<br><br>**2.** Make up four 10-way sockets (six or eight sockets required for systems with more than 16 points) with wire links connecting the following pins on each socket: 1-2, 4-5, 6-7, 9-10.<br><br>**3.** Insert these sockets in place of the electrode cable sockets in the input boards. The level display should now show an **all steam** state and no fault indication. If this does not occur an internal fault exists.<br><br>The circuit fault may be on either input board or the display board. If spares are available, change the left hand input board first, and if the fault is not rectified change the display board followed by the right hand input board. If spares are not available, call the service engineer. |
| **State 4**<br><br>**Top** *half of fault LED illuminated*<br><br>No LED pairs alternating between water and steam | Internal circuit fault on left hand circuit board or the display board | This state is indicating a fault which is not related to an electrode error **because no LED pairs are alternating between water and steam**. It is therefore likely that an internal fault exists.<br><br>Follow same procedure as above. |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 5**<br>**Bottom** half of fault LED illuminated<br>One or more LED pairs alternating between water and steam | Electrode wiring or internal fault<br>Odd numbered electrode connection open-circuit or short-circuit to earth<br>Affected electrode **alternates** between water and steam.<br>Incorrect wiring, broken connection or damaged cable assembly | Check that all **odd** numbered electrodes indicating **water** have the correct pair of conductors connected. Check the connections to the right hand input board. Rectify wiring if incorrect.<br>Check ac voltage on all **odd** electrodes immersed in water with a true r.m.s. voltmeter. A voltage of less than 0.1V ac indicates a fault condition.<br>If wiring to all **odd** electrodes is correct and the electrodes still give a voltage reading of greater than 0.1V ac and a fault is still indicated, carry out the following procedure:<br>**1.** Remove both conductors from electrode 1. With the conductors isolated from each other, the level display should show electrode 1 as **being alternating between water and steam** (green and red).<br>**2.** With the conductors touching each other, the level display should show electrode 1 as being **in steam**.<br>**3.** Repeat operations **1** and **2** for all affected **odd** numbered electrodes until a faulty indication is found.<br>The above procedure checks the electrode wiring. If the display does not show the correct results, then check for a break in either of the suspect electrode conductors.<br>Carry out repair to any faulty connection or substitute a new conductor or cable assembly in place of the defective item. |
| | Dirt on electrode<br>Affected electrode **alternates** between water and steam. | If the wiring checks carried out as described above have not located a fault, then dirt on an electrode insulator may be the cause of the problem giving an effective short-circuit to ground.<br>Check all **odd** numbered electrodes alternating between water and steam for dirt over the external insulator and clean with a cloth as required.<br>Checking for dirt on the internal insulator of the electrode requires the draining of the water column (refer to the appropriate manual for the correct procedure).<br>Once the water column is drained, check the ac voltage on each **odd** numbered electrode using a true r.m.s. voltmeter. Any electrode showing a voltage of less than 3V ac needs cleaning or replacement. Electrodes must be removed from the column for inspection and cleaning.<br>**Note:** The electrode insulator can be cleaned using a clean cloth |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 5** *(contd.)* | Integral circuit fault on right hand circuit board or the display board | If the wiring checks carried out as described above have not located the fault, then it is possible and internal fault exists.<br>**1.** Disconnect the electrode cable sockets from the input boards.<br>**2.** Make up four 10-way sockets (six or eight sockets required for systems with more than 16 points) with wire links connecting the following pins on each socket: 1-2, 4-5, 6-7, 9-10.<br>**3.** Insert these sockets in place of the electrode cable sockets in the input boards. The level display should now show an **all steam** state and no fault indication. If this does not occur an internal fault exists.<br>The circuit fault may be on either input board or the display board. If spares are available, change the right hand input board first and if the fault is not rectified change the display board, followed by the left hand input board. If spares are not available, call the service engineer. |
| **State 6**<br>**Bottom** half of fault LED illuminated<br>No LED pairs alternating between water and steam | Internal circuit fault on right hand circuit board or the display board | This state is indicating a fault which is not related to an electrode error because no LED pairs are alternating between water and steam. It is therefore likely that an internal fault exists.<br>Follow same procedure as above. |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

| Indication | Fault(s) | Analysis and Corrective Action |
|---|---|---|
| **State 7**<br>Only **odd** or **even** LEDs illuminated | No power to one input board or a power supply fault | Only **odd** LEDs illuminating indicates a problem with the left hand input board. Only **even** LEDs illuminating indicates a problem with the right hand input board.<br>Check the wiring to the unit from the mains supply then check the following:<br>Fuse and fuse rating<br>Voltage and voltage setting<br>(See Section 2.2 & 2.3 of this chapter)<br>If none of these checks locate the problem and the correct mains supply voltage is present at the input board terminals then a circuit fault exists and replacement of the faulty input board is required. |
| **State 8**<br>Chequered pattern on RED & GREEN LED display | Wrong setting of **Number of Electrodes** switch on display board | Refer to Section 2.3 of this chapter and ensure that the switch is set correctly. If the display still shows a chequered pattern then a circuit fault exists on the display board and the board will need replacing. |
| **State 9**<br>ON/OFF pattern on RED & GREEN LED display | Wrong setting of **Number of Electrodes** switch or linking on LK2, LK3, LK4, LK5 incorrect on display board | As above |
| **State 10**<br>Lower electrodes not displayed | As above | As above |

***Table 2.3 - Fault analysis/corrective action chart (continued)***

### 2.6.1 COMPONENT REPLACEMENT

The Hydrastep 2468 contains no user-replaceable components. Board failure requires the replacement of the entire printed circuit board.

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

#### 2.6.1.1 Removing the Input Board (24680501 or 24680516)

The input board is secured on to the base plate of the electronic enclosure by seven set screws and washers, distributed one at each corner of the board and three in the board centre. See Figure 2.1. To remove the input board, carry out the following procedure:

1. Isolate the electronic enclosure from the ac (mains) or dc supply and open the lid.
2. Unplug the supply connector TB1.
3. Unplug the electrode input connectors PL2, 3, 4 and 5 as necessary and the analogue output connector PL1 (if used) from the input board.
4. Disconnect the ribbon cable connector on the display board and the display board power cable socket on the input board - see Figure 2.1 on page 2-4.
5. Undo the seven securing screws and remove them and their washers. Lift off the input board from the base plate.

#### 2.6.1.2 Refitting the Input Board

To refit the input board, carry out the removal procedure in the reverse order.

#### 2.6.1.3 Removing the Display Board 24680515

The display board is attached to pillars mounted on the rear of the front panel by five securing nuts and washers. See Figure 2.1 on page 2-4.

To remove the display board, carry out the following procedure:

1. Isolate the electronic enclosure from the mains supply and open the lid.
2. Disconnect the ribbon cable socket and the display board power cable socket from the display board, see Figure 2.1. Remove remote display and system fault connections if applicable.
3. Undo the five securing nuts and remove them and their washers. Lift off the display board from the attachment pillars.

#### 2.6.1.4 Refitting the Display Board

To refit the display board, carry out the removal procedure in the reverse order.

**Note:** Special attention must be taken to ensure the lid screening is satisfactory after any display board refitting. The screening cable is taken to the bottom left hand securing screw on the display plate and this connection must have good conductivity.

### 2.6.2 PARTS LIST - HYDRASTEP 2468 CB & CD VERSIONS

| Item Description | Mobrey Part No. | Item Description | Mobrey Part No. |
|---|---|---|---|
| **Electronic Enclosure** | | | |
| Input PCB assembly **(2468CB)** | 24680501C | Display PCB assembly | 24680515B |
| Fuse link 200mA (T) ceramic | K9634 | Header programmable (10-way) | 399100380 |
| Fuse link 400mA (T) ceramic | K9635 | Header programmable (8-way) | 399100390 |
| Input PCB assembly **(2468CD)** | 24680516B | Socket SK3 free (10-way) | 351510140 |
| Fuse link 1.25A (T) ceramic | 360190320 | Socket SK7 free (10-way) | 351510140 |
| Cable assembly (10-way) | 24680210A | Earth lead | 24680216A |
| Socket SK1 free (2-way) | 351502180 | **Electrode Cables** | |
| Socket SK2 free (10-way) | 351510140 | Electrode cable (3 metre) | 24680204A |
| Socket SK3 free (10-way) | 351510140 | Electrode cable (10 metre) | 24680205A |
| Socket SK4 free (10-way) | 351510140 | Electrode cable (18 metre) | 24680206A |
| Socket SK5 free (10-way) | 351510140 | Electrode cable (30 metre) | 24680207A |
| Input Adapter Board | 24680523A | | |

## 2.7 SPECIFICATION

| | |
|---|---|
| **Enclosure:** | 425mm x 325mm x 163mm (16.7in x 12.8in x 6.4in)<br>Brushed stainless steel<br>Wall-mounting<br>lP65 / NEMA4X<br>Gland plate - stainless steel 250mm x 120mm (9.8in x 4.7in) |
| **Weight of unit:** | 12kg (26.4lb) |
| **Operating temperature:** | -20°C to +70°C (-4°F to +158°F) |
| **Relative humidity:** | up to 100% |
| **Location:** | Indoor or outdoor |
| **Power supply requirements:**<br>(ac input) | 115V ac nominal<br>93.5V - 130V ac / 48Hz - 65Hz<br>240V ac nominal<br>187V - 256V ac / 48Hz - 65Hz |
| **Power supply loading (ac):** | 60VA maximum |
| **Power supply requirements:**<br>(dc input) | 24V dc nominal<br>20-25V dc negative earth or isolated<br><br>**Note:** Under fault conditions, an overvoltage of 30V can be withstood for short periods. |
| **Power supply loading (dc):** | 60W maximum |
| **Supply -Vs to plant ground:** | 7V maximum for non-isolated supply |
| **Installation category:** | III |
| **Outputs:** | Drive to remote display (6 or 8 wire)<br>Opto-isolated fault output<br>Analogue output |
| **Analogue output:** | |
| Range: | 0 - 20mA or 4 - 20mA, forward or reverse |
| Accuracy: | ± 0.2mA |
| Drive capability: | 600Ω at nominal supply voltage<br>500Ω at minimum supply voltage |
| **Opto-isolated fault output:** | |
| Maximum open-circuit voltage: | 30V dc |
| Maximum short-circuit current: | 1A dc |
| Short-circuit voltage drop: | 1.1V dc maximum at 1A dc |
| Open-circuit leakage current: | 1mA maximum at 30V dc |
| **Remote display drive:** | |
| Loop Resistance (ac powered unit): | 27Ω maximum |
| Loop Resistance (dc powered unit): | 7Ω maximum |
| Distance: | 1000m (3280ft) maximum |
| **Electrical connections:** | Plug-in screw terminals |

# Wiring Diagrams for Dual Power Supply Version

## Contents

**Page No.**

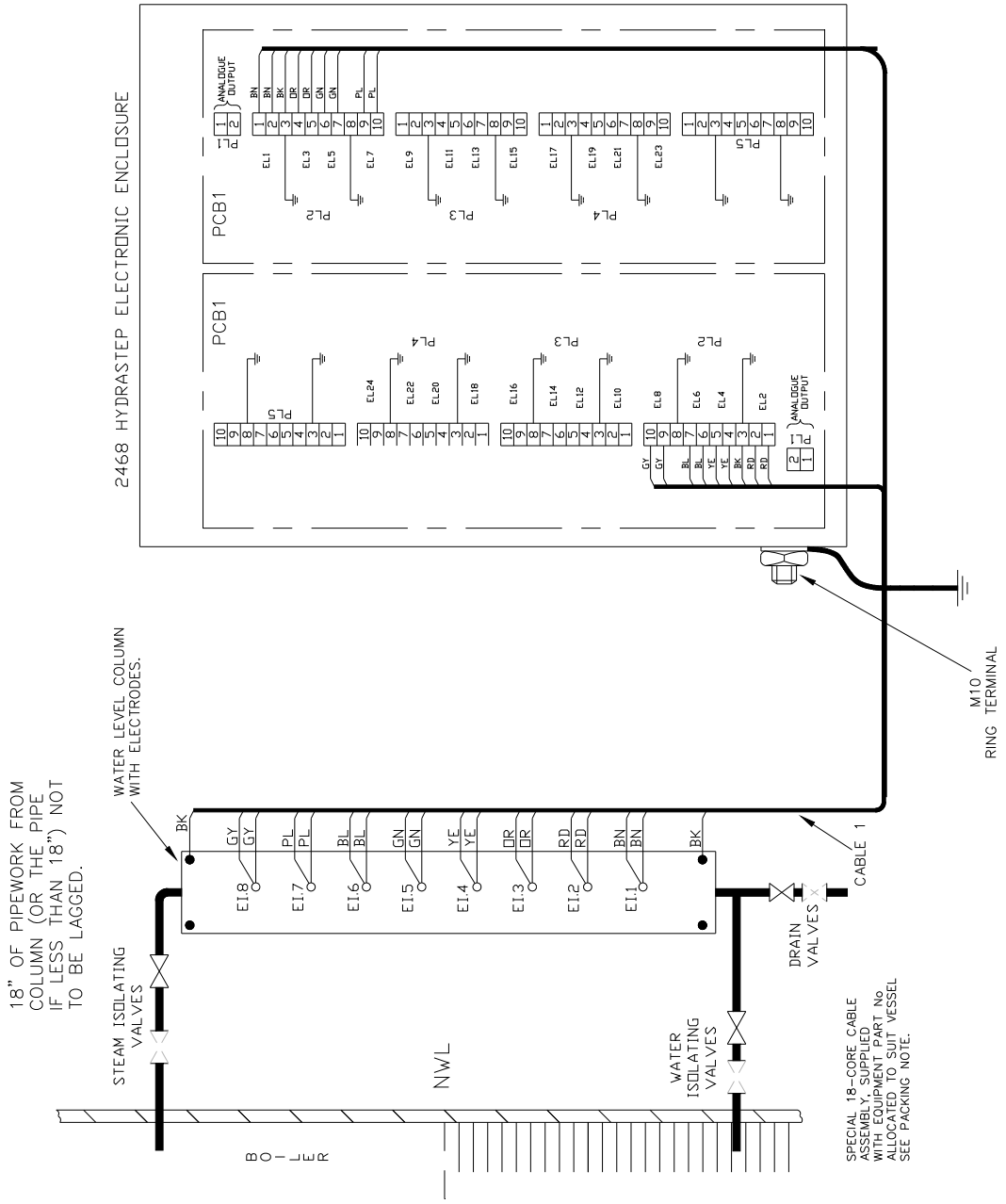



***Figure 2.1 - Electrode cable connections to 8 port column***

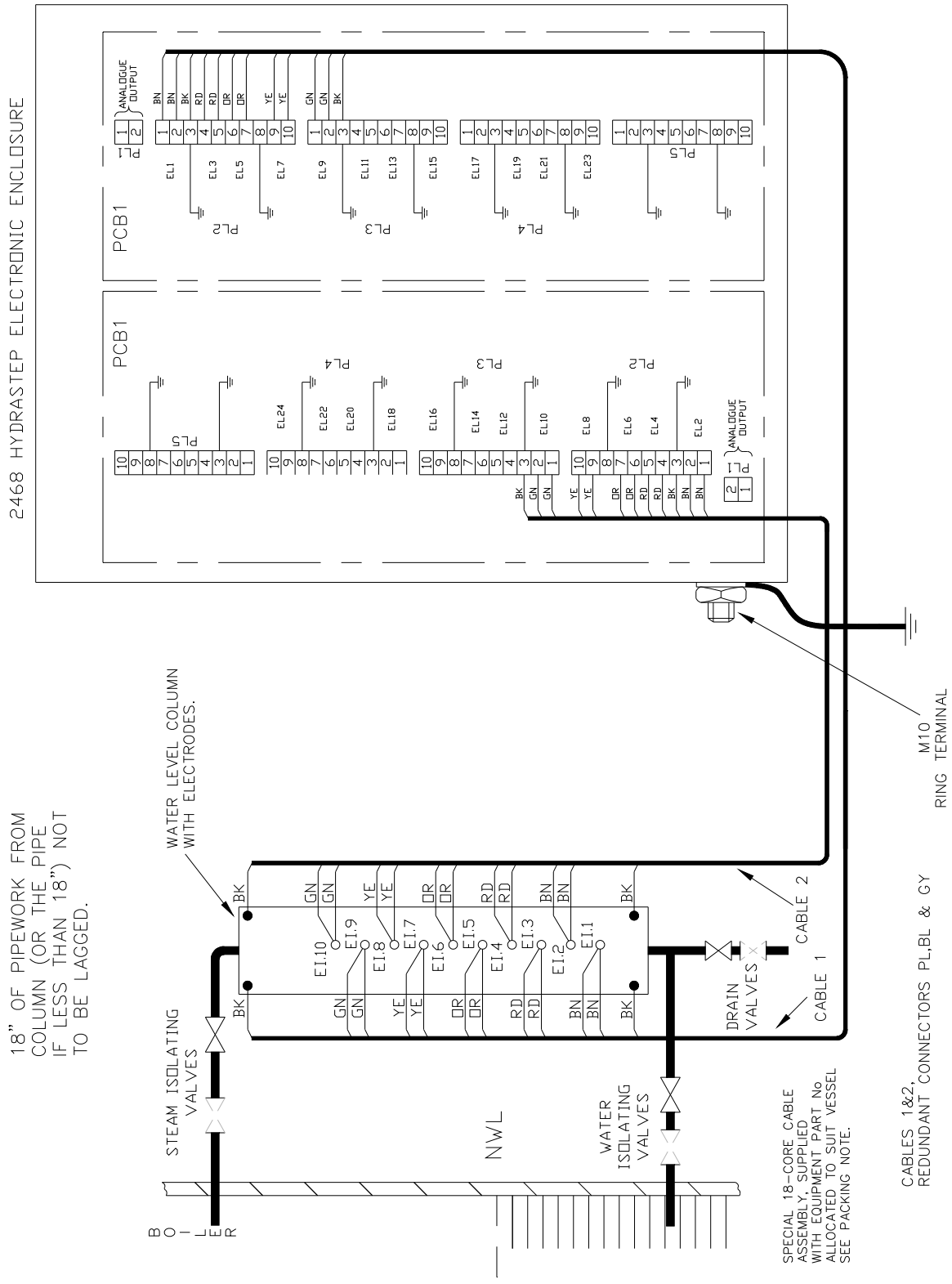



***Figure 2.2 - Electrode cable connections to 10 port column***

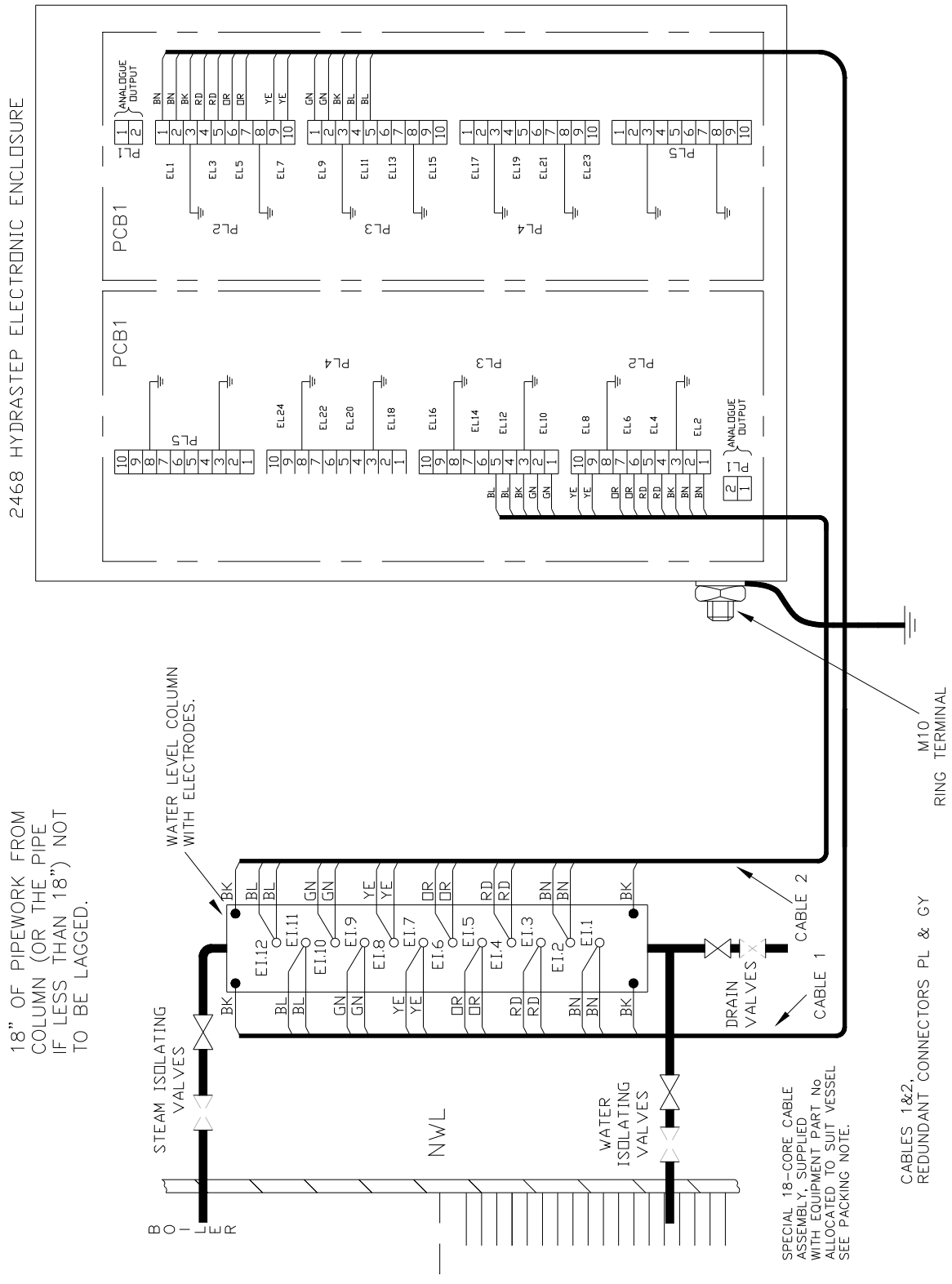



***Figure 2.3 - Electrode cable connections to 12 port column***

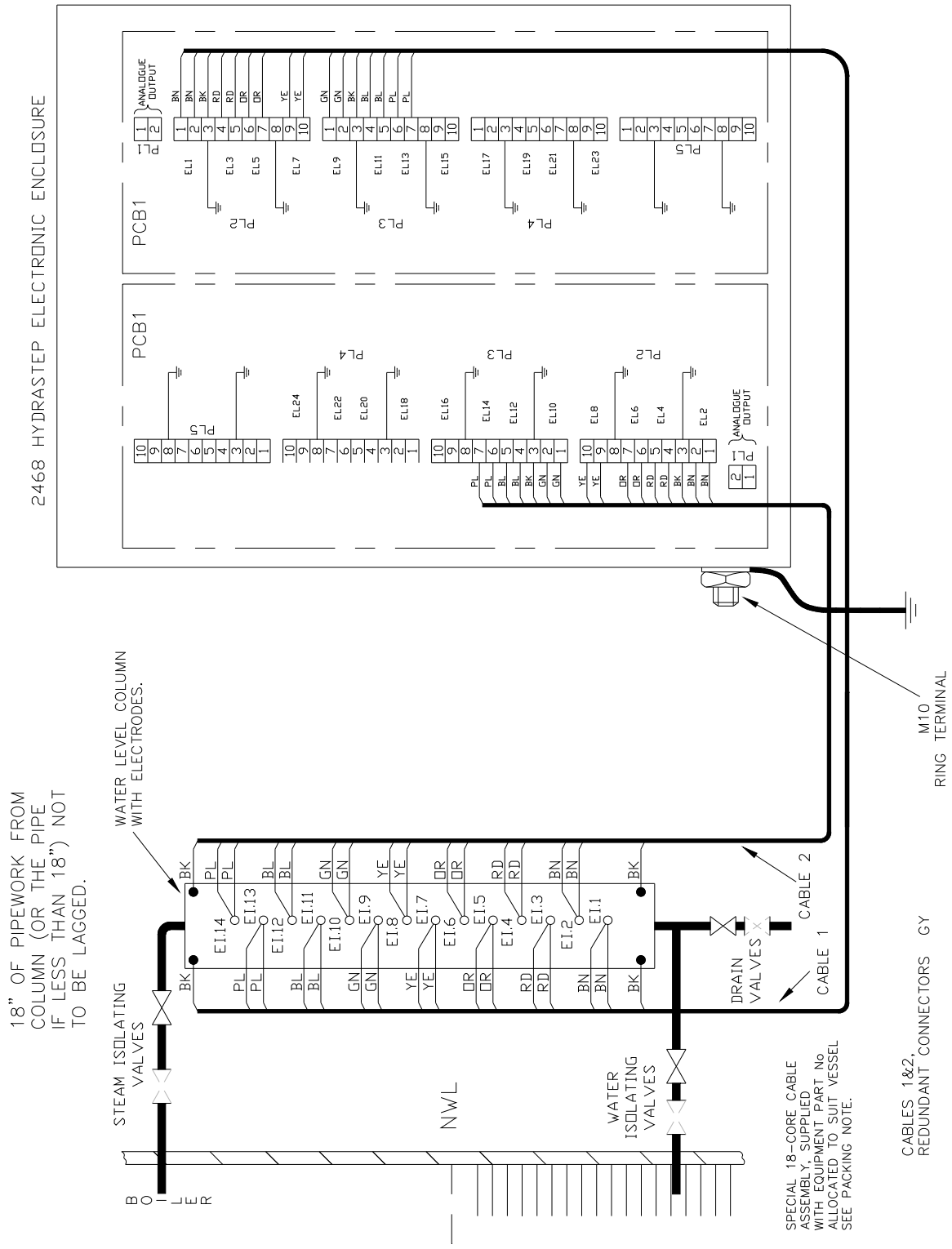



***Figure 2.4 - Electrode cable connections to 14 port column***

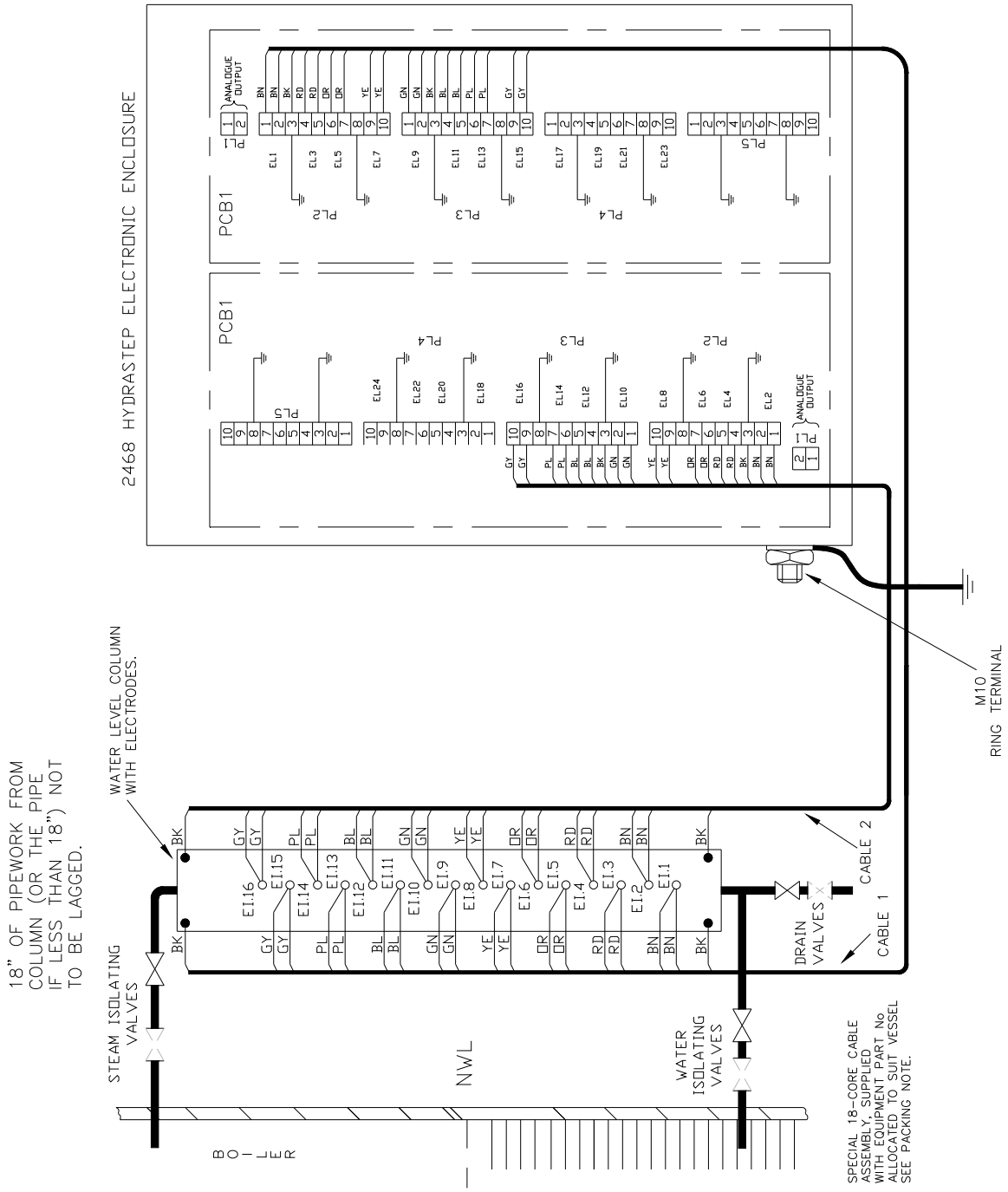



***Figure 2.5 - Electrode cable connections to 16 port column***

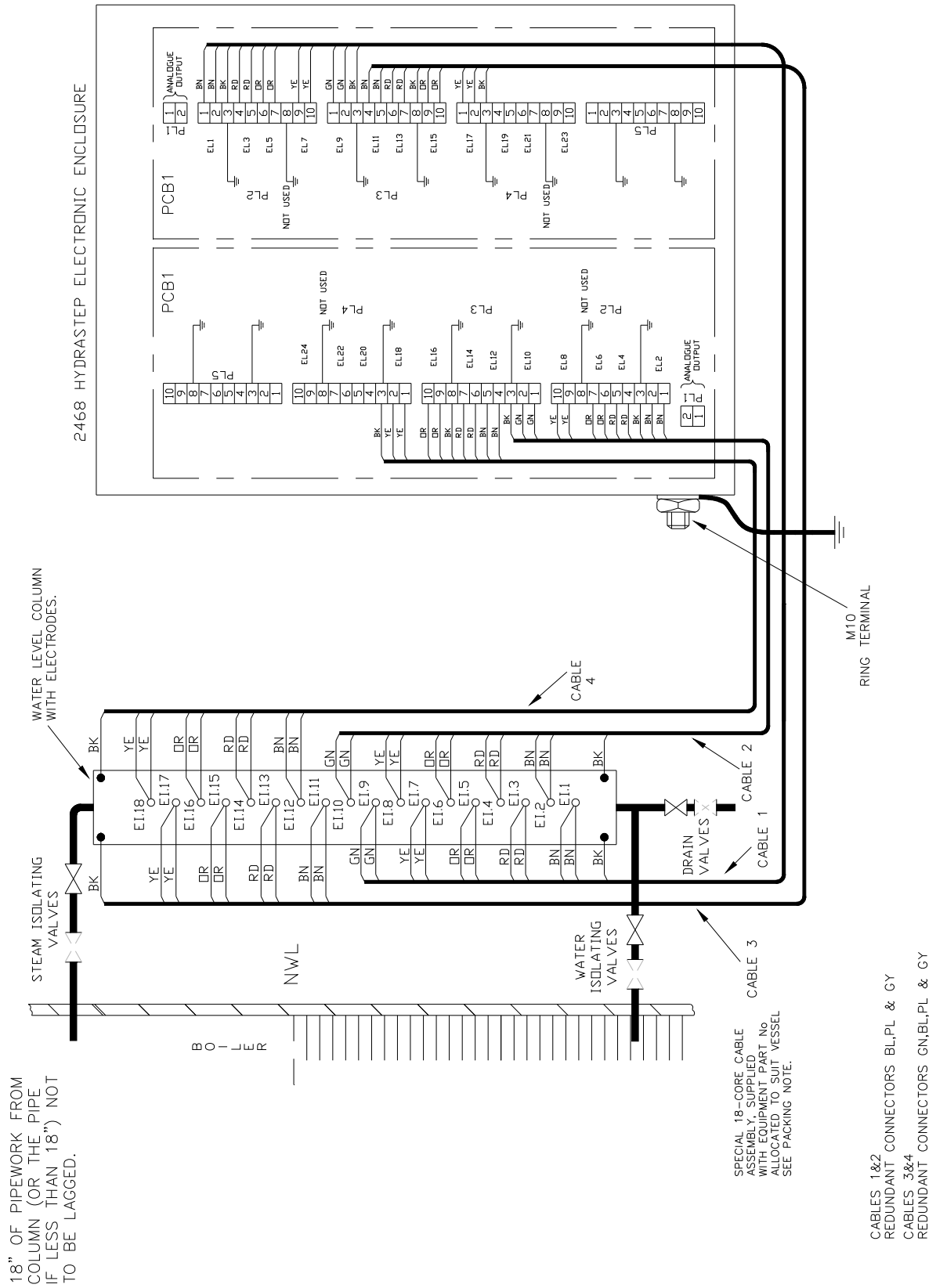



***Figure 2.6 - Electrode cable connections to 18 port column***

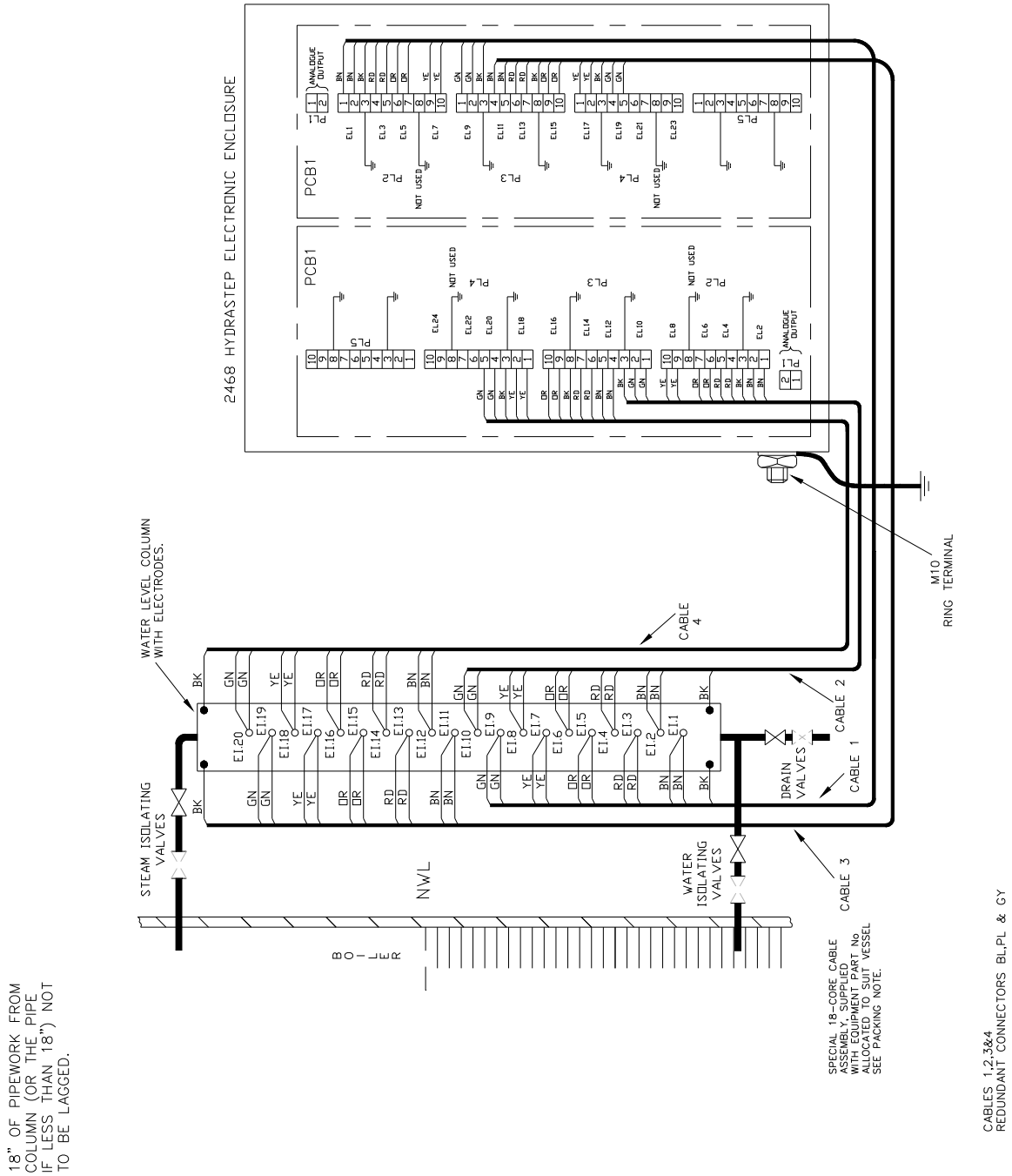



***Figure 2.7 - Electrode cable connections to 20 port column***

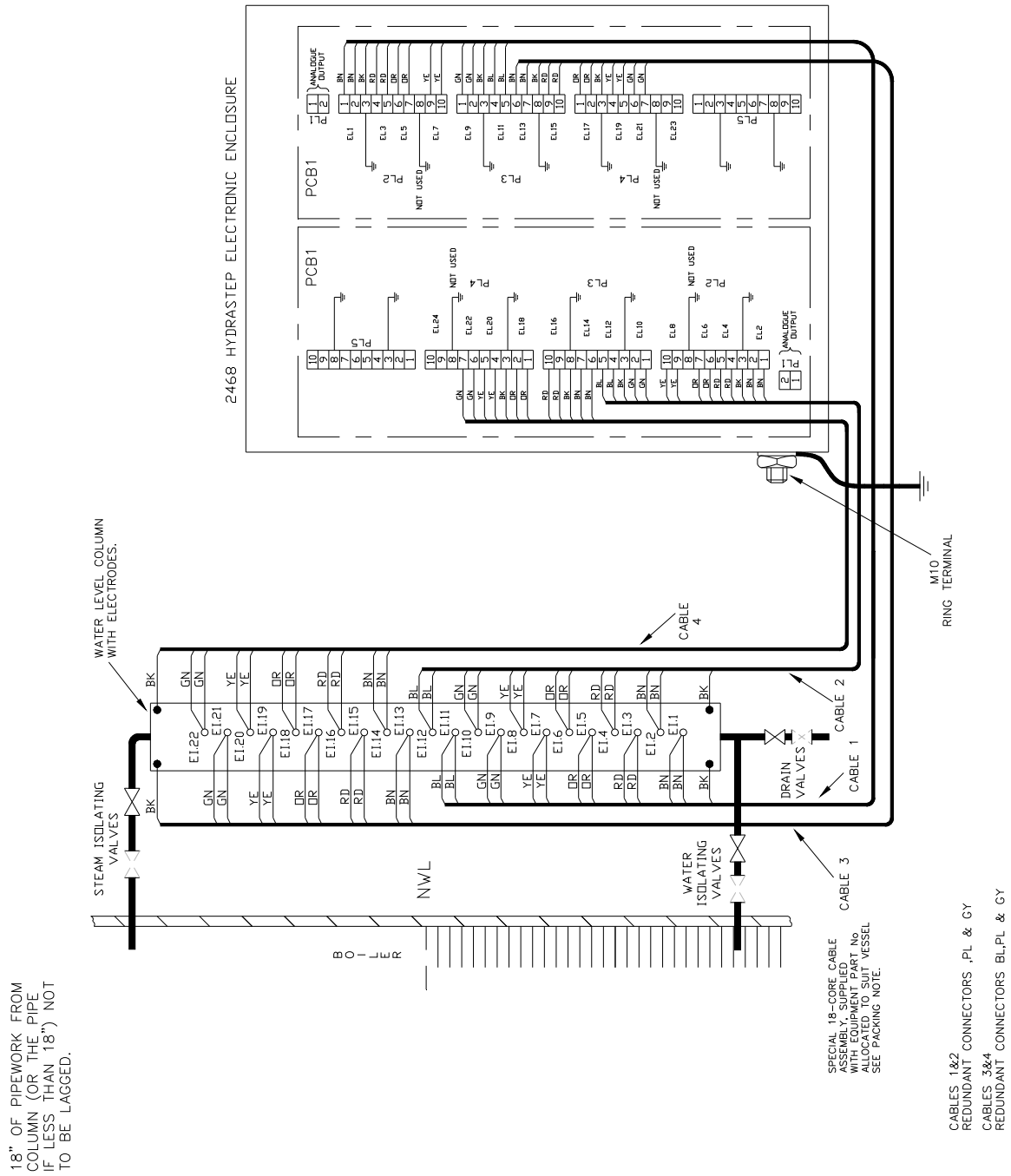



***Figure 2.8 - Electrode cable connections to 22 port column***

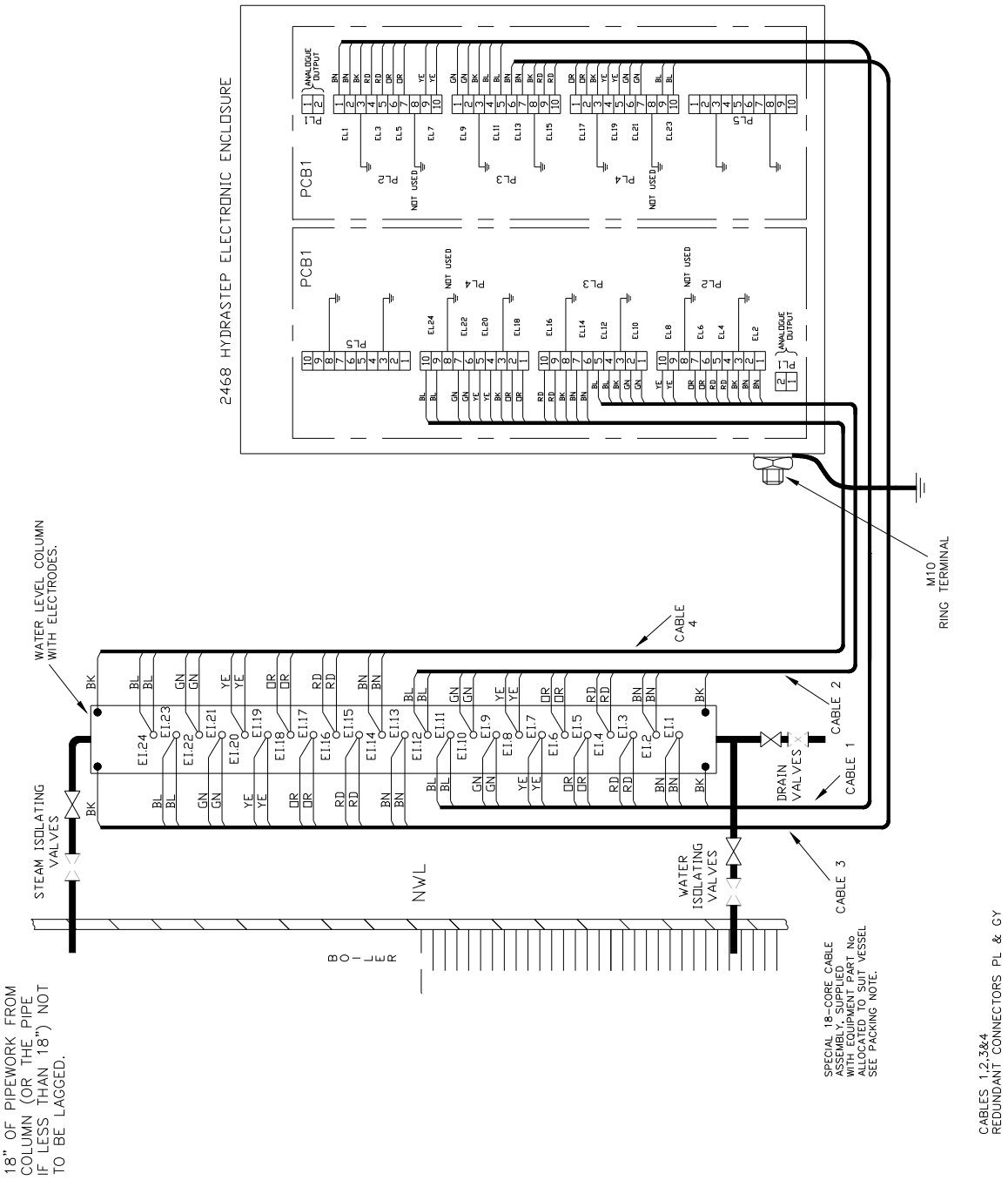



***Figure 2.9 - Electrode cable connections to 24 port column***

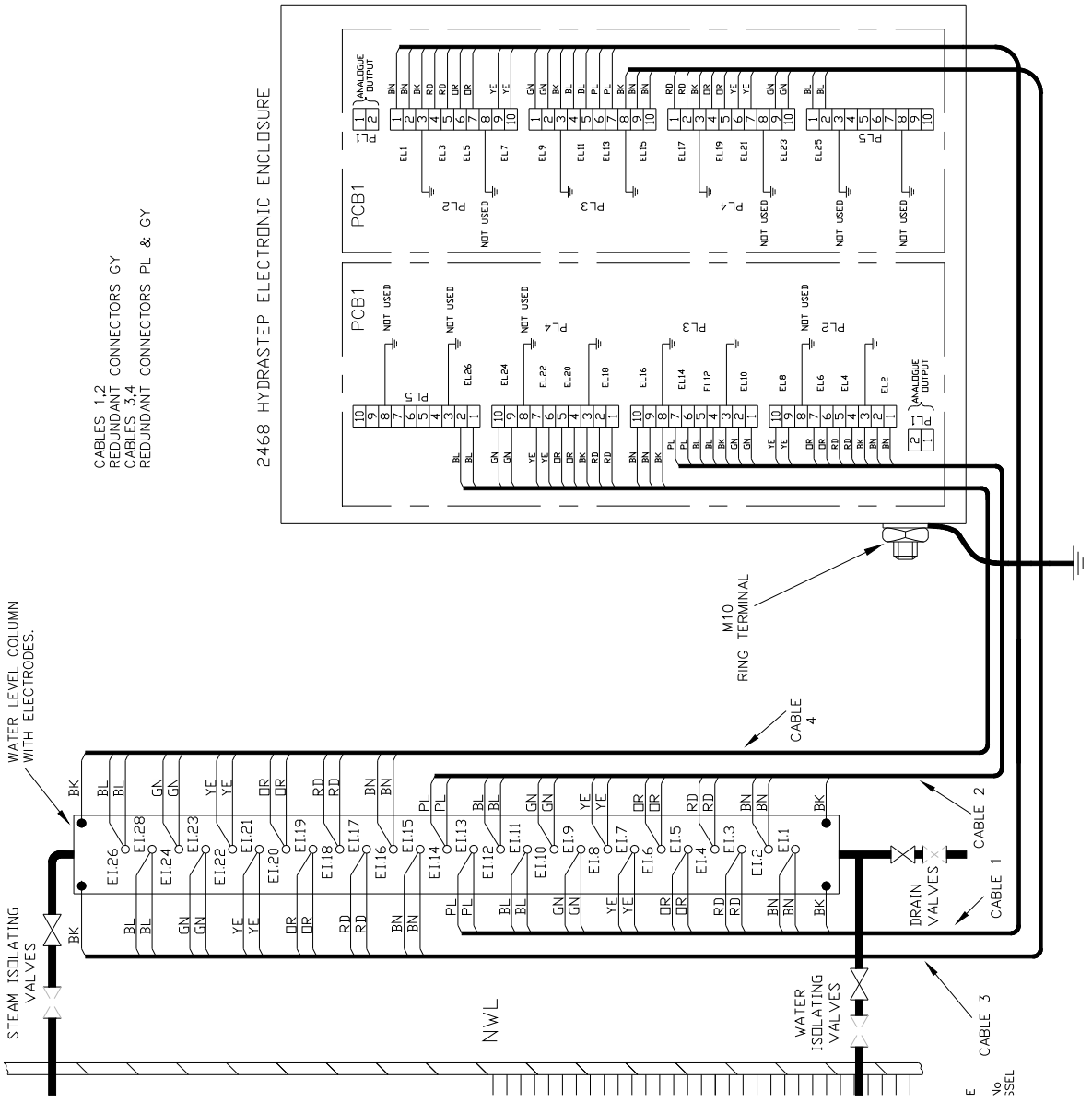



***Figure 2.10 - Electrode cable connections to 26 port column***

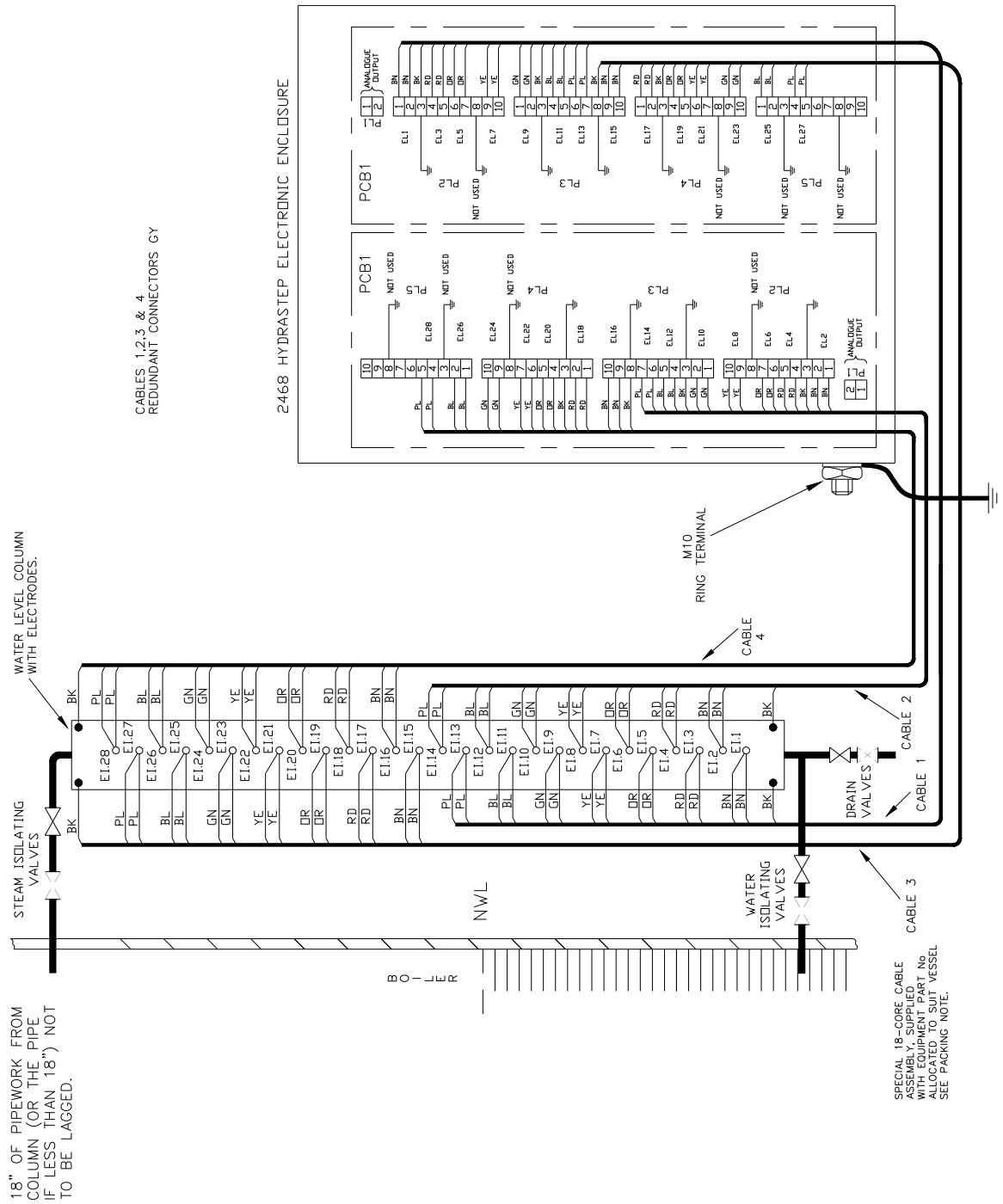



***Figure 2.11 - Electrode cable connections to 28 port column***

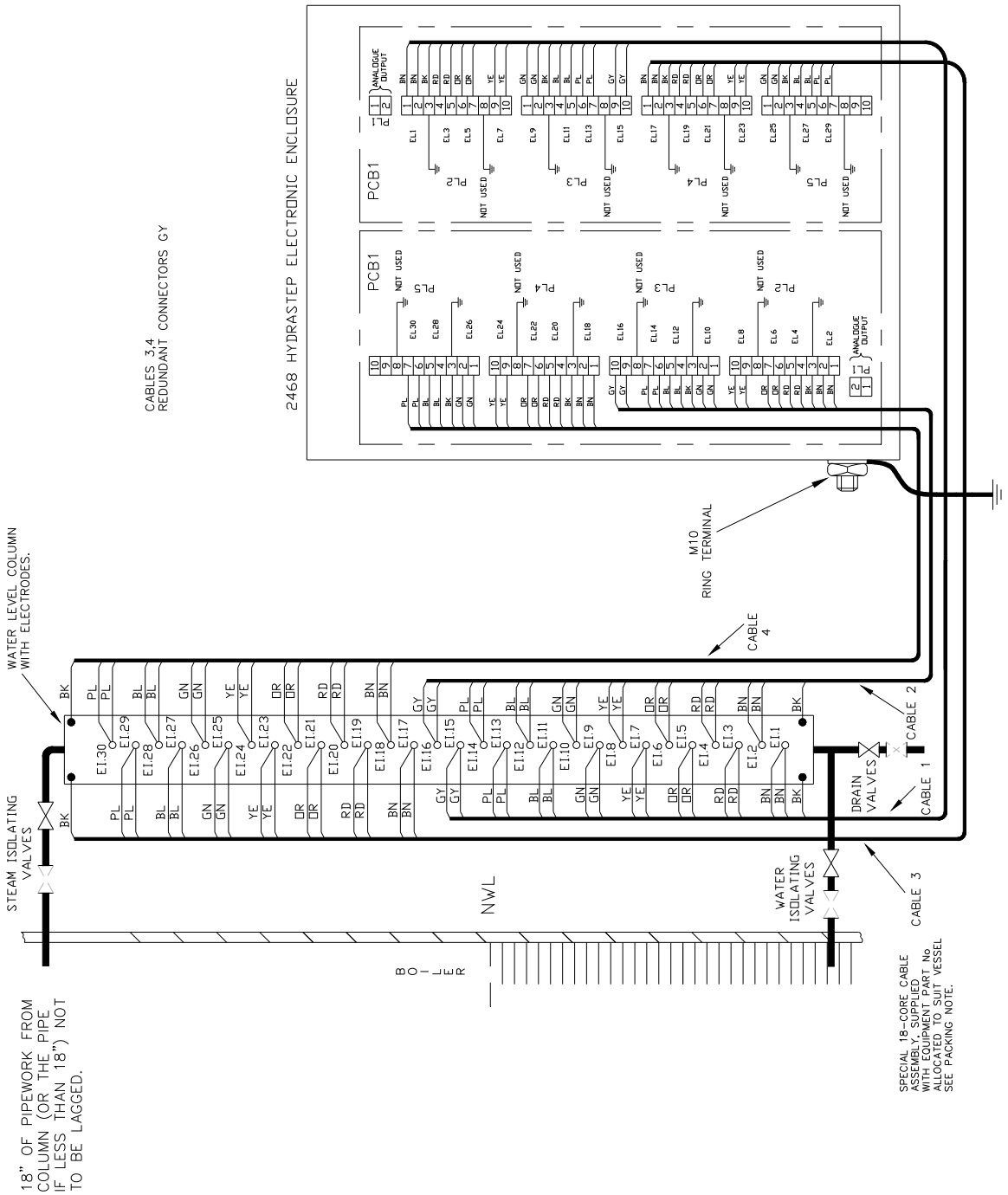



***Figure 2.12 - Electrode cable connections to 30 port column***

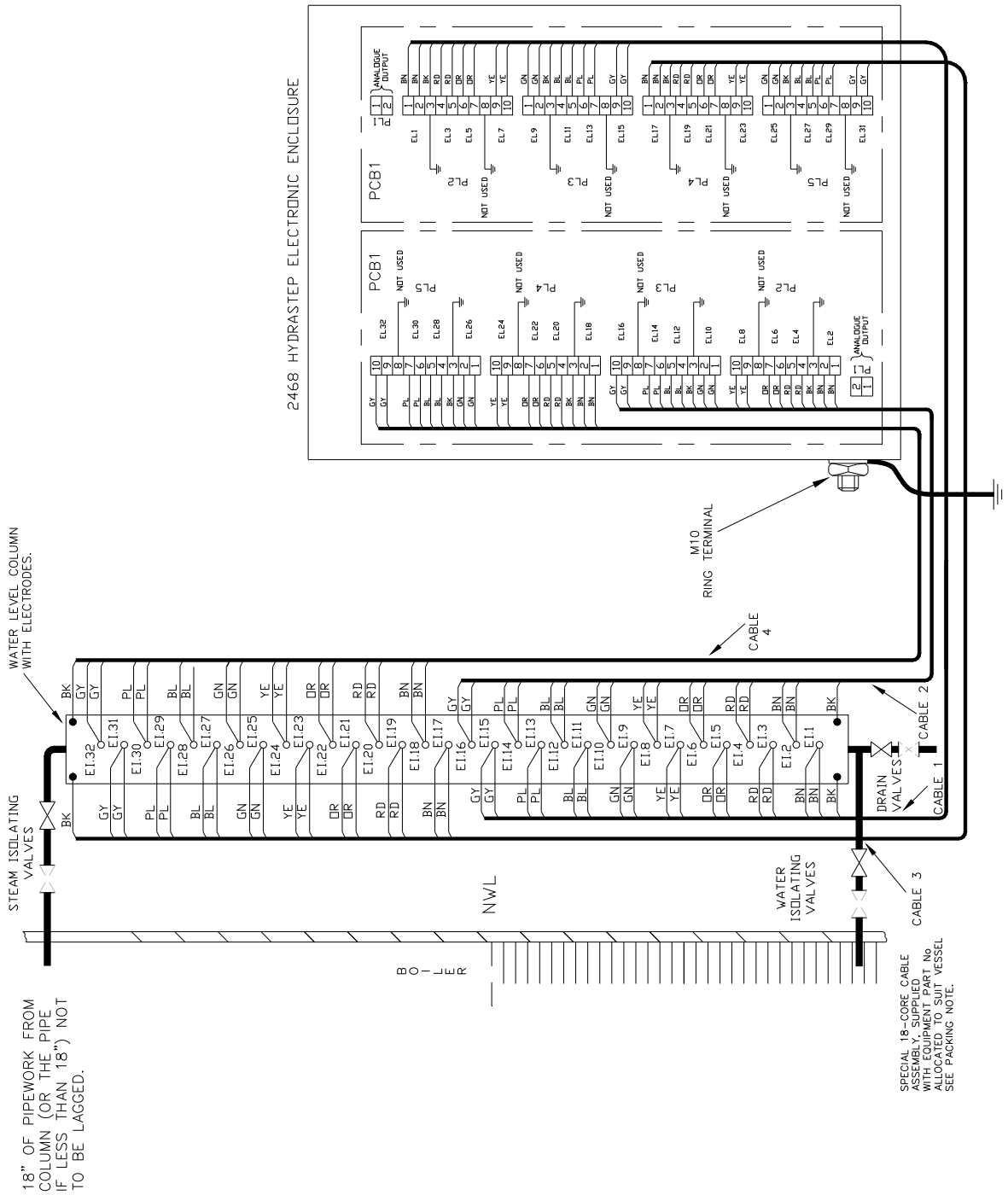



***Figure 2.13 - Electrode cable connections to 32 port column***

# 3a
# 2468 - Relay Output Board Option

## Contents

## Illustrations



## Tables

# 3A.1 GENERAL DESCRIPTION

The Relay Output Board (PCB 24680504) has four relays and is mounted on top of the input board using 3 nylon spacers. Electrical connection between the two boards is via plug and socket (SK1 on the input board and PL1 on the relay output board).

A second relay output board may be mounted on top of the first on nylon spacers. Holes have been drilled on all relay output boards to receive the 3 nylon spacers. The top board is offset towards the centre of the unit improving the cable layout from the relay output boards. The nylon spacer fixing holes and mounting holes are illustrated in Figure 3a.1 on page 3a-6.

Each of the 4 relays can be energised by any one of up to 16 electrodes, with an individual choice of being energised when its selected electrode is **in steam** or is **in water**. Furthermore, relay RL1 can be used to monitor an electrode state or to register an ALARM condition. When set to register the ALARM state, the relay is energised in the 'system normal' state and de-energises when an ALARM condition exists.

This option comes complete with the nylon spacers and two 8-way output sockets.

# 3A.2 INSTALLATION

This sub-section deals with the mechanical and electrical installation of the Relay Output Board (PCB 24680504) option. In the rest of this chapter the 'relay output board' title is shortened to 'relay board'.

## 3A.2.1 STORAGE & PRE-INSTALLATION INSPECTION

### 3a.2.1.1 Storage Area

The storage area must be dry, dust-free and kept at a reasonable temperature. The storage area should allow for access and inspection of all items of equipment.

### 3a.2.1.2 Pre-Installation Inspection

Open the option package and inspect the contents for signs of damage. Check contents for completeness.

## 3A.2.2 MECHANICAL INSTALLATION

The output board is mounted directly on top of the input board. The input board is supplied with three nylon spacers fitted. The output board is then aligned on its Berg socket/plug interconnection (PL1/SK1) and input board-mounted spacers and pressed home on to the spacers.

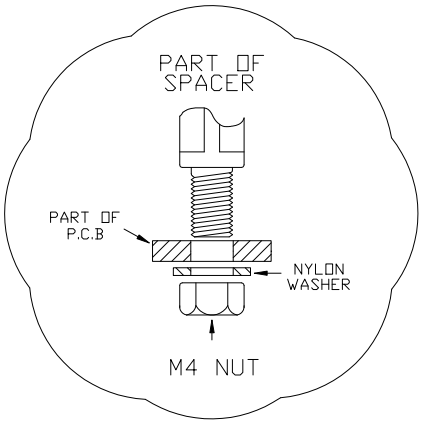
When two output boards are required to be mounted on an input board, the second output board is mounted on three nylon spacers fitted on the first mounted output board.

### 3a.2.2.1 Fitting the Nylon Spacers to the Relay Output Board

The spacers fit into the holes within the white-bordered areas on the output board (see Figure 3a.1 on page 3a-6).

1. Fit the nylon spacers into their prepared holes on the output board and lock in position using the nylon washer and M4 nut, see inset diagram.

2. Fit the output board on to the spacers and check for correct alignment and adjust if necessary.




### 3a.2.2.2 Mounting the Relay Output Board on to the Input Board

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

This task can be performed on a mounted 2468 electronic enclosure or the enclosure can be removed to a bench for the installation. Here it is assumed that the enclosure is in its normal working location. The procedure for mounting the relay output board is as follows:

1. Isolate the power supply from the 2468 electronic enclosure and open the instrument front cover.

2. If two output boards are to be fitted, make sure that the first output board to be fitted has had its nylon spacers fitted before installation. Also ensure the first output board is fully configured before fitting the second output board.

3. Ease the pins of the Berg plug PL1 of the output board into the Berg socket SK1 on the input board, checking that the mounting holes on the output board (the holes which are not contained in white bordered areas) are aligned over the fitted spacers and gently press the output board 'home' until the spring-loaded spigot on each spacer is locked firmly on to the output board.

**Note:** When fitting a second output board, use the same procedure described in operation 3 but refer to the components, etc., on the mounted output board.

This concludes the mechanical installation of the output board(s) and should be followed by the electrical installation. If the latter is not to be carried out in the immediate future then the power supply can be reconnected.

### 3A.2.3 ELECTRICAL INSTALLATION

This sub-section deals with the output of the states of the four relays. Two 8-way sockets are provided with each output board through which the relay outputs are delivered to their external destinations.

#### 3a.2.3.1 PCB Interconnections

Signal interconnection between the input board (PCB1) and the output board (PCB4) is direct via the SK1/PL1 12-way Berg connectors. When two output boards are fitted, the top board's plug PL1 engages in the lower board's SK1.

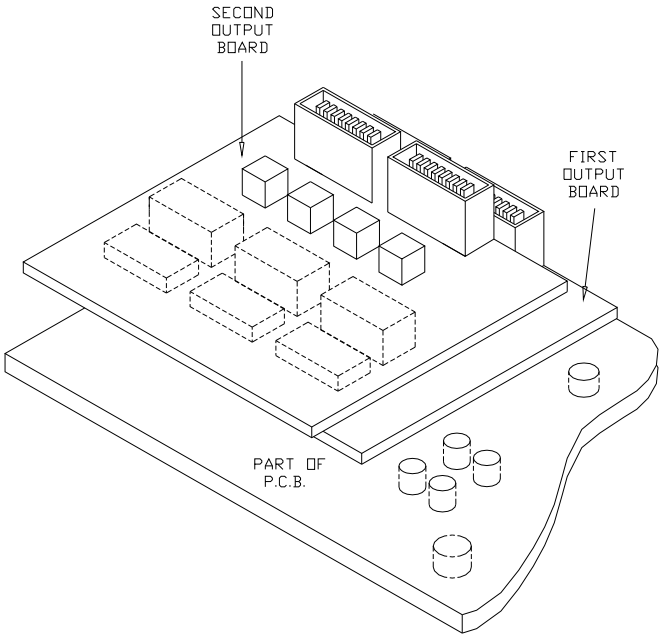
#### 3a.2.3.2 Relay Output Connections

The relay outputs can be taken out of the enclosure via the gland plate or along with the other cables in suitable trunking.

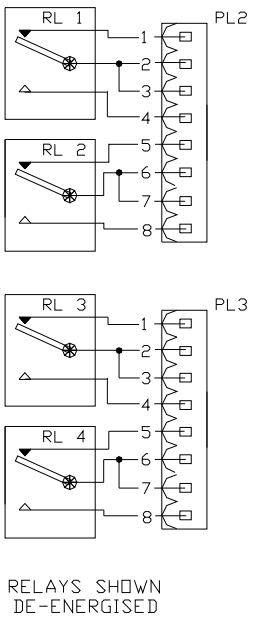
Use screened cables for all connections, making sure a good annular (ring shape) connection is made with a good quality RF cable gland. The run must be stress-free, and it is considered good practice to twist relay pairs together.

Since the output board is mounted on top of the input board, the routing of the relay cabling should take the same kind of formation as the electrode cabling, but separated from it as far as practical. The cable should be arranged such that the cables do not lie across any of the PCBs. The layout and plug pin details of the two plugs on the relay board is given in the diagram on the right, with the relay contacts shown in their de-energised state.

When two output boards are fitted, the output terminals of the uppermost output board are offset towards the centre of the input board.




***View illustrating mounted positions of dual relay output boards***




***Relay output PCB connectors***

## 3A.3 RELAY BOARD CONFIGURATION

The 24680504 Relay Output Board has three configuration switches:

- SW6: Selects Electrode or Alarm state for RL1.
- SW1 - SW4: Selects individual electrode for relays RL1 to RL4.
- SW5: Selects RL1 - RL4 to be energised in steam or in water.

Figure 3a.1 provides a view of the output board layout to highlight the positions of the various configuration switches.

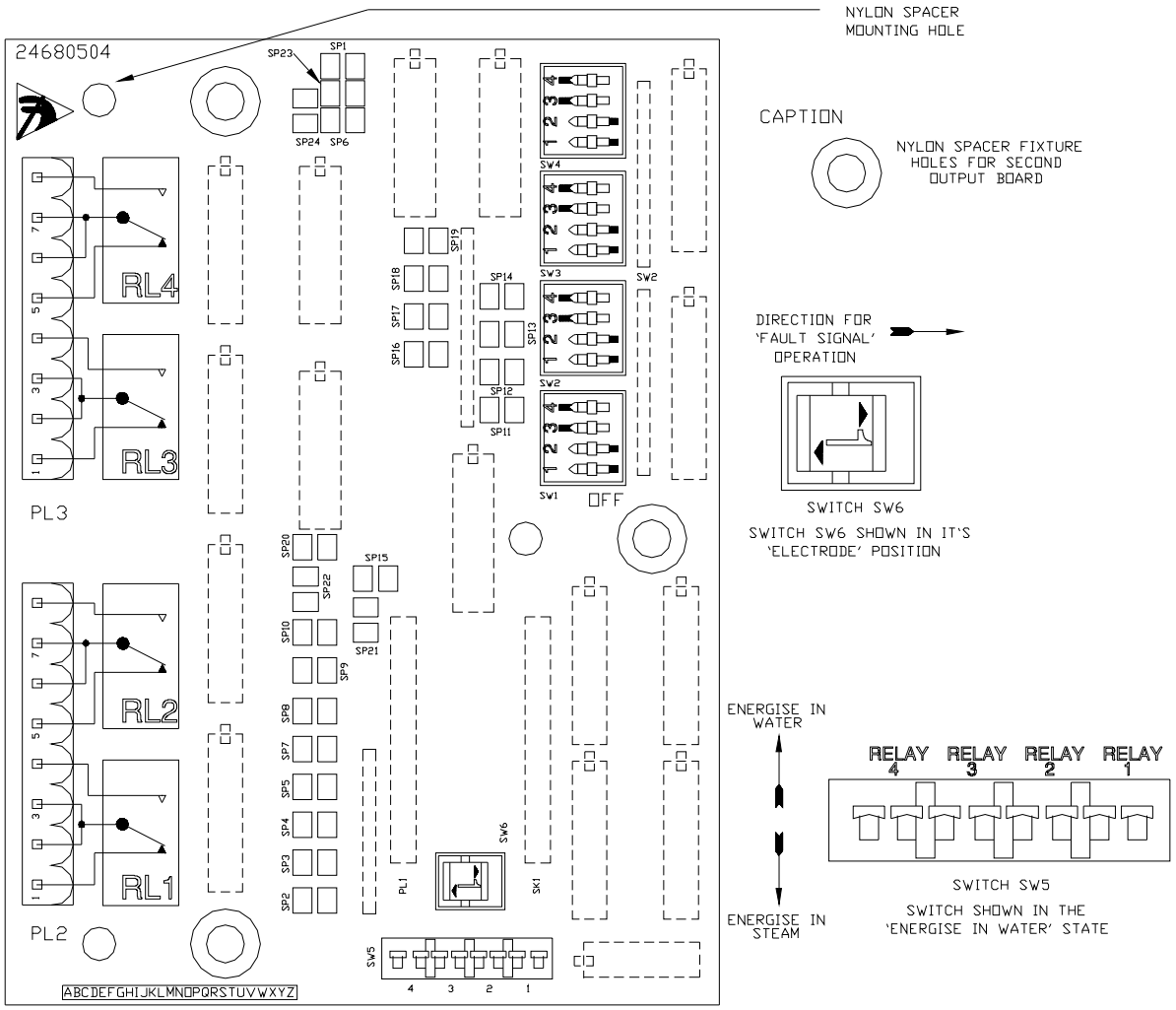



***Figure 3a.1 - View of relay output board showing switch positions and output pin details***

## 3A.3.1 RELAY OUTPUT BOARD

### 3a.3.1.1 Configuring the Relay Output Board

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

**1.** Isolate the 2468 electronics enclosure from its power supplies.

**2.** Gain access to the relay output PCB and set the relevant switches for the required function.

### 3a.3.1.2 Electrode/Relay Selection (Relays RL1, RL2, RL3 & RL4) - SW1 To SW4

Four identical switches are provided on the relay board for electrode selection. Any of the electrodes, connected to the input board on which the relay board is mounted, can be selected as the input for any of the relays.

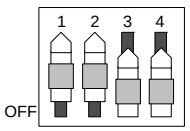
With one input board installed, any electrode connected to the system can be used as the source for any of the four relays. With two input boards installed, the relay board mounted on the input board connected to the odd numbered electrodes, accepts inputs from the odd numbered electrodes. Similarly, the relay board mounted on the input board connected to the even numbered electrodes, accepts inputs from even numbered electrodes. Table 3a.1 details switch selection.

| Switch SW1, SW2, SW3 or SW4 Settings for RL1 to RL4 respectively | | | | Electrode Selection | | |
|---|---|---|---|---|---|---|
| Switch Contacts | | | | One Input | Two Input Cards | |
| 1 | 2 | 3 | 4 | Card | Odd I/P Card | Even I/P Card |
| On | On | On | On | 1 | 1 | 2 |
| Off | On | On | On | 2 | 3 | 4 |
| On | Off | On | On | 3 | 5 | 6 |
| Off | Off | On | On | 4 | 7 | 8 |
| On | On | Off | On | 5 | 9 | 10 |
| Off | On | Off | On | 6 | 11 | 12 |
| On | Off | Off | On | 7 | 13 | 14 |
| Off | Off | Off | On | 8 | 15 | 16 |
| On | On | On | Off | 9 | 17 | 18 |
| Off | On | On | Off | 10 | 19 | 20 |
| On | Off | On | Off | 11 | 21 | 22 |
| Off | Off | On | Off | 12 | 23 | 24 |
| On | On | Off | Off | 13 | 25 | 26 |
| Off | On | Off | Off | 14 | 27 | 28 |
| On | Off | Off | Off | 15 | 29 | 30 |
| Off | Off | Off | Off | 16 | 31 | 32 |

***Table 3a.1 - Electrode selections for relays RL1 to RL4***

**Example:** Single Input Board: Electrode 13 selected.

Dual Input Boards: Odd input board - Electrode 25 selected
Even input board - Electrode 26 selected.



### 3a.3.1.3 Relay Energisation ('In Steam' or 'In Water') - SW5

This is a four-channel switch, one channel allocated per relay. The switch selects whether the relay is energised when the selected electrode is **in water** or is **in steam**. This switch is highlighted in Figure 3a.1 (on page 3a-6) to provide additional information on channel identity and the switch 'electrode state'.

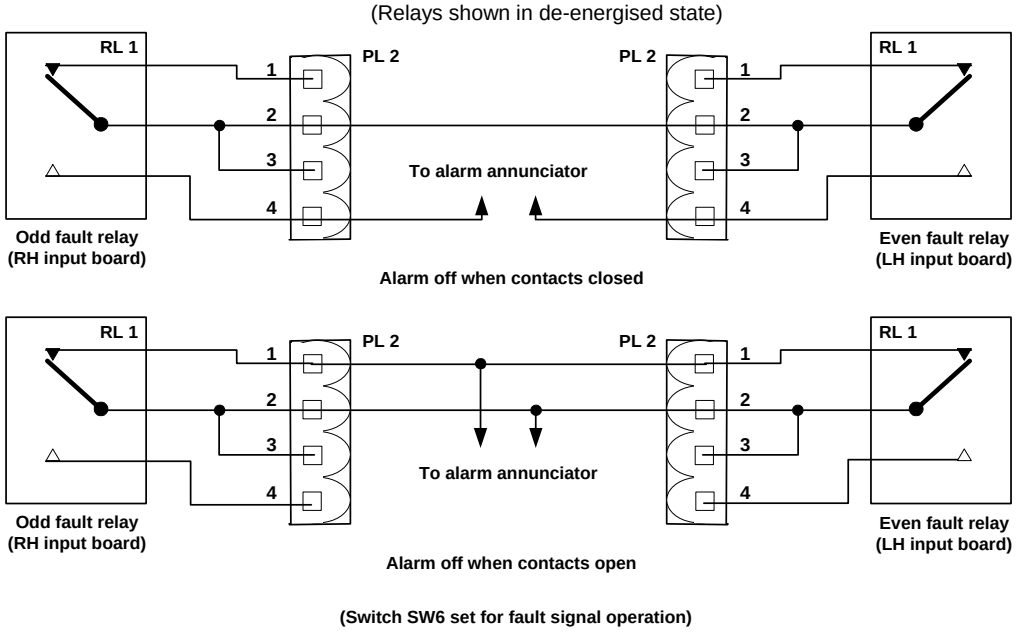
### 3a.3.1.4 Electrode/Alarm Operation (RL1 Function Only) - SW6

Relay 1 can be configured to receive either an electrode input or it can be used as the 'system fault' relay (see Figure 3a.1 on page 3a-6). When configured as the system fault relay, the **normal** state of the relay is **energised**, a **fault** state will de-energise the relay. See the next section for contact output details.

### 3a.3.1.5 System Fault Output

Relay 1 on each relay board can be configured to be used as a **system fault** relay by setting SW6. When used as a system fault relay the **normal state** of the relay is **energised** and a fault state will **de-energise** the relay.

The relay will only output faults detected by the input board onto which it is installed. With a dual power supply Hydrastep unit, this means it is necessary to used two relay boards (one on each input board) to create a **system** fault output.




**Note:** Systems with a local display have an opto-isolated system fault available from the display board.

### 3A.3.2 ALARM AND TRIPPING FACILITIES

The relay boards provide high and low water level alarm and trip facilities for the 2468 Hydrastep system. Four to eight relays can be made available for each input board fitted.

#### 3a.3.2.1 Philosophy

A requirement in regulations concerning steam raising plant is the provision of an automatic low water level shut-down or trip device. In the 2468 Hydrastep the relay output board provides the required output signals for such devices.

In practical applications of shut-down systems two factors must be considered, the consequences of spurious trips and the non-availability of a trip when required, due to protection system faults.

The following relay output circuits are specific to the 2468 Hydrastep Electronic Gauging Systems.

#### 3a.3.2.2 Relay Interconnections for Alarm/Tripping Systems

It is necessary to open the Hydrastep 2468 Electronic Enclosure to carry out any wiring, therefore care must be taken when working inside the unit.

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

**Note:** Before any relay interconnections are made it is necessary to fulfil any safety regulations governing the plant shutdown procedures.

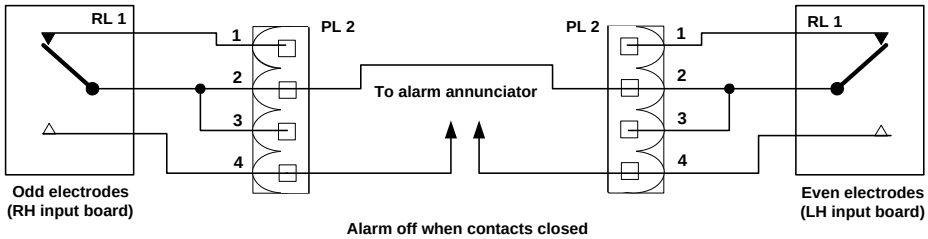
Since one input board receive inputs from the **odd** numbered electrodes and the other input board receives inputs from the **even** numbered electrodes, interconnections between **odd** and **even** relay boards will be required.

The following are examples of relay configurations used.

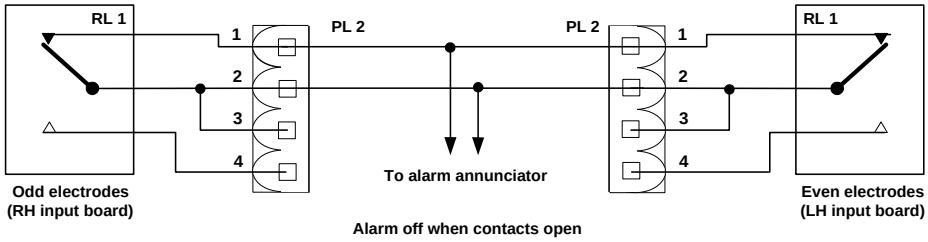
### 3a.3.2.3 'One out of Two' Relay Alarm System

Either of the relays involved can cause an alarm when their assigned electrode registers an alarm condition. The alarm condition is selected by switch SW5 to provide relay energisation in water **EW** or energisation in steam **ES**.

**Case A - Relays normally energised, de-energise either one to trip**
(Relays shown in de-energised state)



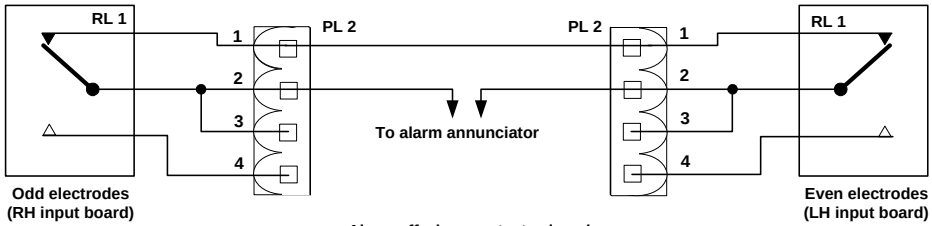

Alarm off when contacts closed



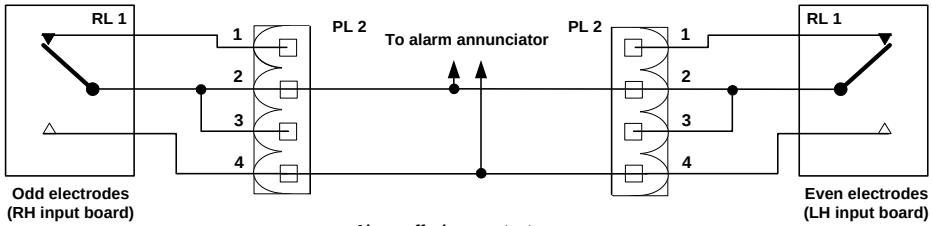

Alarm off when contacts open

(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)

**Case B - Relays normally de-energised, energise either one to trip**
(Relays shown in de-energised state)




Alarm off when contacts closed



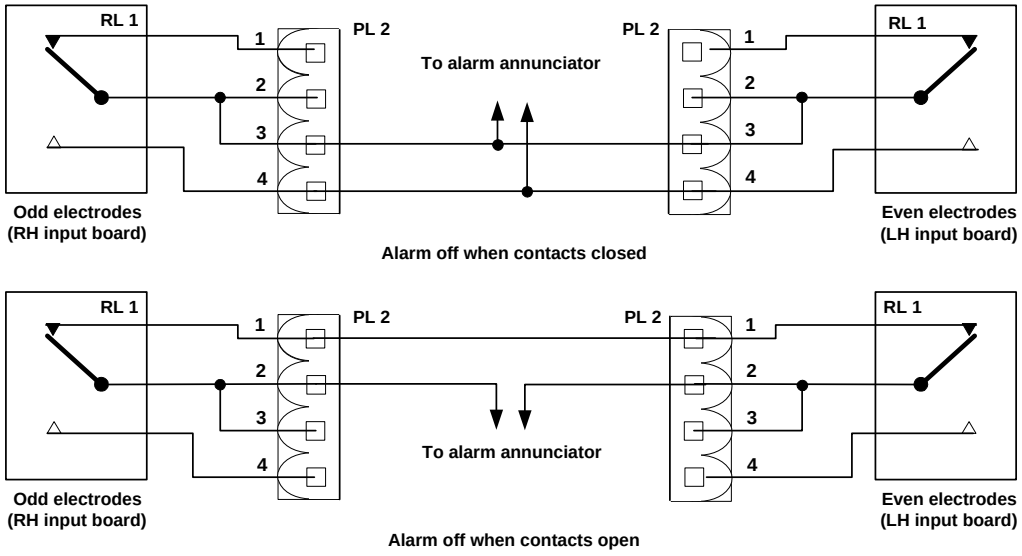

Alarm off when contacts open

(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)

### 3a.3.2.4 'Two out of Two' Relay Alarm System

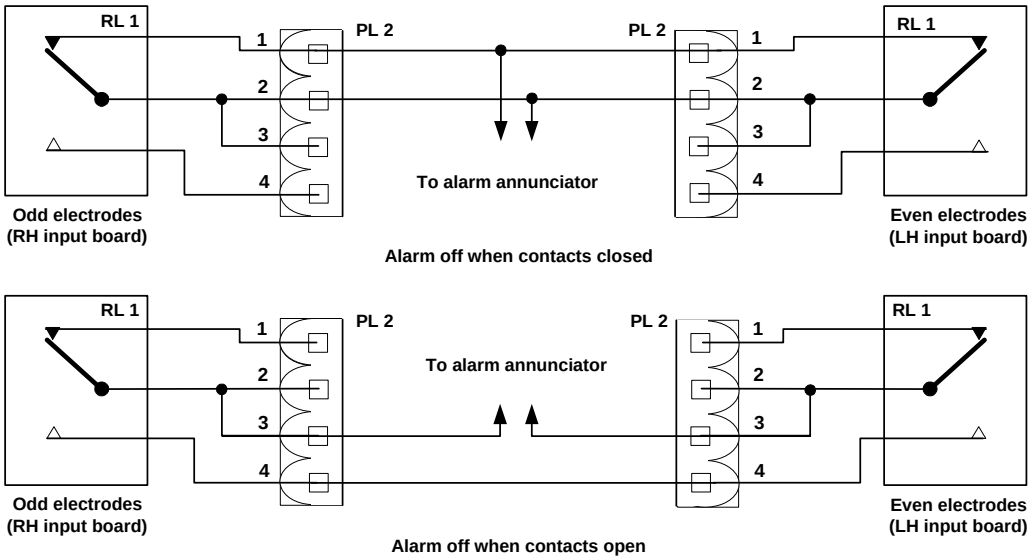
This system requires both relays to operate to cause an alarm when their assigned electrodes register an **alarm** condition.

**Case A - Relays normally energised, de-energise both to trip**
(Relays shown in de-energised state)




**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

**Case B - Relays normally de-energised, energise both to trip**
(Relays shown in de-energised state)

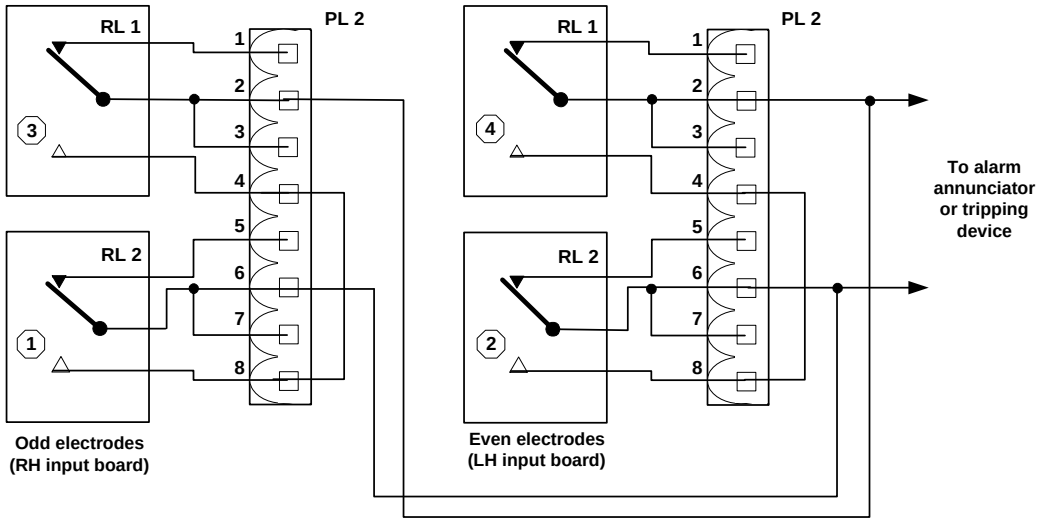



**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

### 3a.3.2.5 'Two out of Four' Relay Alarm System

In the following diagrams (5A & 5B) ①②③④ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will perform a **low level** trip at electrode level **3**. For a **high level** trip, using electrode channels **11, 12, 9** and **10** respectively and switch **SW5** set for **ES**, a healthy system would trip at level **10**.

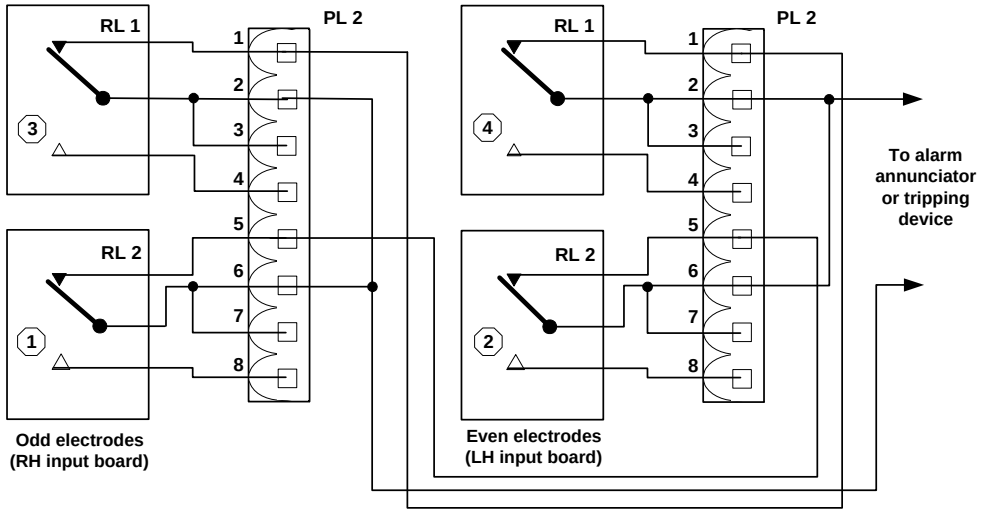
**Case A - Relays normally energised, de-energise one in each pair to trip**
(Relays shown in de-energised state)




**Alarm off when contacts open**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally energised, de-energise one pair to trip**
(Relays shown in de-energised state)

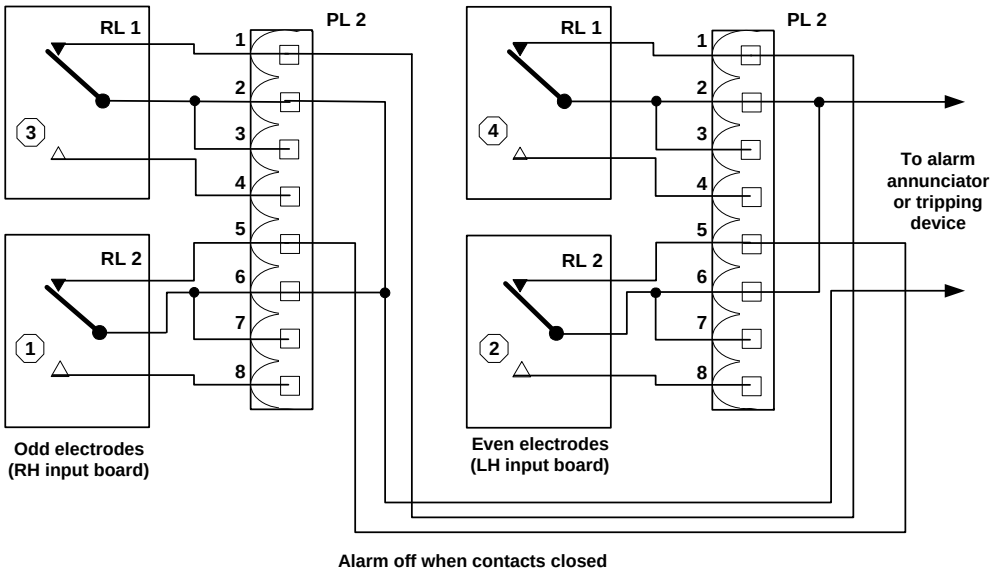



**Alarm off when contacts open**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

In the following diagrams (6A & 6B) ①②③④ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will perform a **low level** trip at electrode level **2**. For a **high level** trip, using electrode channels **9,10, 11** and **12** respectively and switch **SW5** set for **ES**, a healthy system would trip at level **11**.

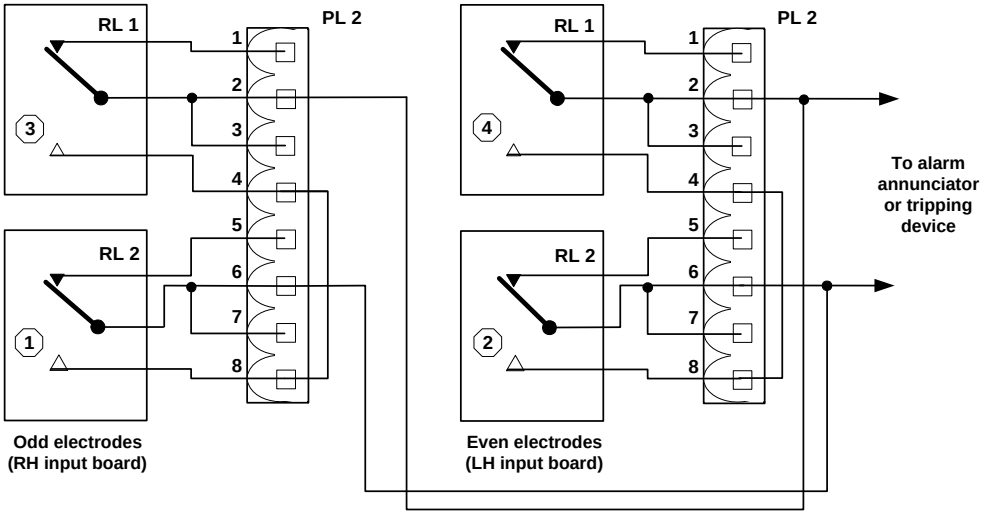
**Case A - Relays normally energised, de-energise one in each pair to trip**
(Relays shown in de-energised state)




**Alarm off when contacts closed**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally de-energised, energise one in each pair to trip**
(Relays shown in de-energised state)



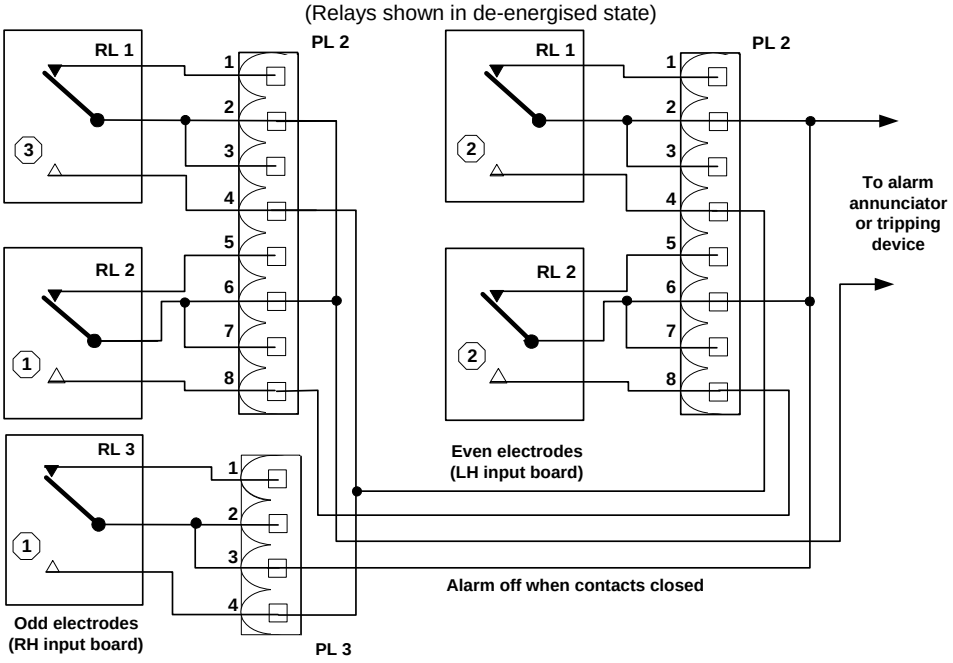

**Alarm off when contacts open**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

### 3a.3.2.6 'Two out of Three' Relay Alarm System

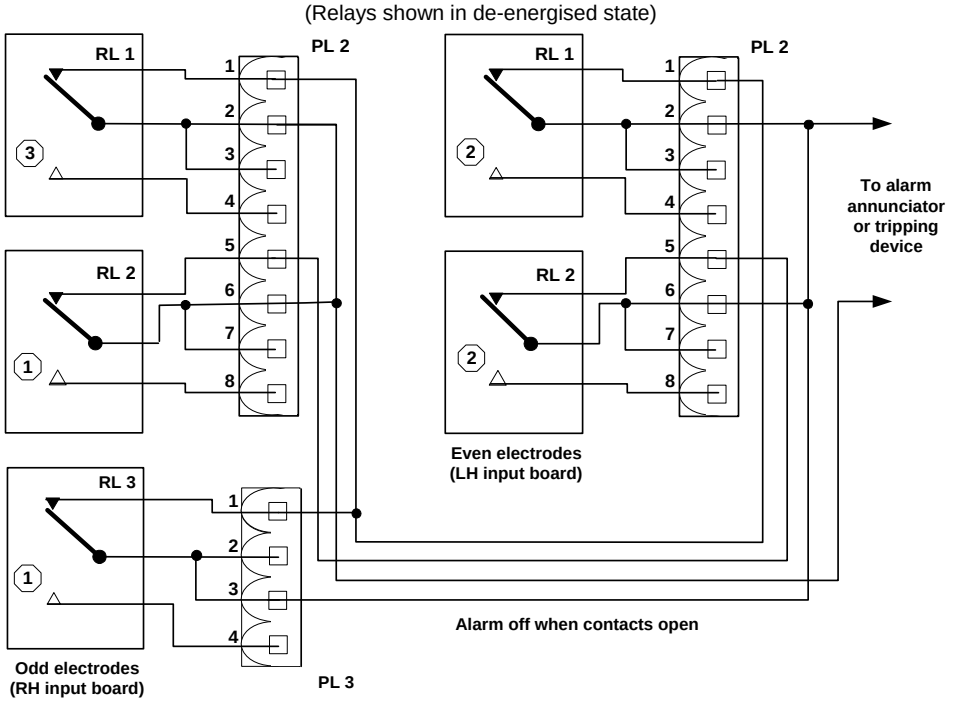
In the following diagrams (7A & 7B) ①②③ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will cause a **low level** trip at electrode level **2**. Using high-level electrode channels and **SW5** set to **ES**, the circuit can perform a **high level** trip.
**Note:** Inputs from electrodes 1 & 2 are applied to two separate relays on their respective boards.

**Case A - Relays normally energised, de-energise two to trip**




**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally de-energised, energise two to trip**




**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

# 3A.4 COMPONENT REPLACEMENT

The relay board contains no replaceable circuit components, failure of the board requires replacement of the entire board. The only component that can be replaced is the nylon spacer.

### 3A.4.1 REPLACEMENT OF NYLON SPACERS

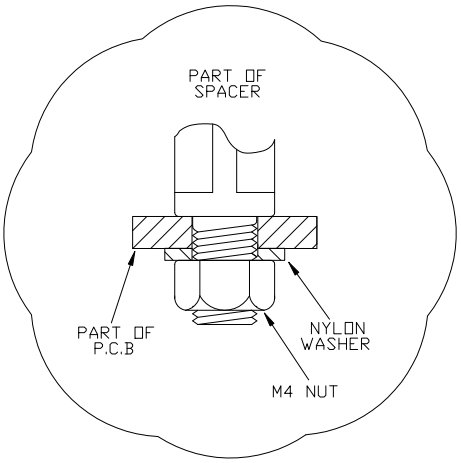
The replacement of nylon spacers fitted to the output board requires access to the non-component side of the PCB.

**Note:** Spacers will only be fitted on the output board if a second output board is to be fitted or has been fitted.

The spacers are secured in their holes by nut and nylon washer. To carry out a spacer replacement, the output board has to be removed from the input board. The procedure adopted is:

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Isolate the 2468 electronic enclosure from the power supply.
2. Gain access to the PCBs and undo sufficient connections for the removal of the output board containing the defective spacer.
3. Remove the output board(s) by applying pressure to the upper spring-loaded spigots and easing the output board off its spacers and out of its Berg plug/socket connection.
4. Undo the nut and washer securing the faulty spacer and extract it from its hole, see inset diagram.
5. Fit the new spacer in position, align correctly on the board and secure firmly using the M4 nut and nylon washer.
6. Refit the PCB(s) into the enclosure, re-connect the PCB(s) as required and close the enclosure cover. Re-apply the power.




### 3A.4.2 PARTS LIST - RELAY OUTPUT BOARD 24680504

The following list items are available as spare parts:

| Item Description | Mobrey Part Number | Item Description | Mobrey Part Number |
|---|---|---|---|
| **Electrical:** | | **Mechanical:** | |
| Relay PCB assembly: | 24680504C | Spacer, nylon 15.9 LG | 412012080 |
| Socket 5K2 free (8-way) | 351508100 | Washer, nylon | 411999910 |
| Socket 5k3 free (8-way) | 351503100 | Nut, M4 | 410031020 |

## 3A.5 SPECIFICATION

| | | |
|---|---|---|
| **Outputs:** | 4 x Alarm/Trip Relays | |
| **Relay Contact Rating:** | **ac** | **dc** |
| Maximum voltage: | 250V | 125V |
| Maximum current: | 8A | 8A |
| Maximum switching power: | 1500VA | 240W (≤ 30V)<br>65W (≤ 60V)<br>25W (≤ 125V) |
| For type nA safety: | | 100mA at 30Vdc |
| Maximum initial contact resistance: | 30mΩ | |

# 3b

# Delay Relay Output Board Option

## Contents

## Illustrations



## Tables

# 3B.1 GENERAL DESCRIPTION

The Delay Relay Output Board (PCB 24680509) is mounted on top of the input board using 3 nylon spacers. Electrical connection between the two boards is via plug and socket (SK1 on the input board and PL1 on the delay relay output board).

A second delay relay output board may be mounted on top of the first on nylon spacers. Holes have been drilled on all delay relay output boards to receive the 3 nylon spacers. The top output board is offset towards the centre of the unit improving the cable layout from the delay relay output boards. The nylon spacer fixing holes and mounting holes are illustrated in Figure 3b.1 (on page 3b-6).

Each of the four delay relays can be energised by any one of up to 16 electrodes, with an individual choice of being energised when its selected electrode is **in steam** or is **in water**. Furthermore, relay RL1 can be used to monitor an electrode state or to register an ALARM condition. When set to register the ALARM state, the relay is energised in the 'system normal' state and de-energises when an ALARM condition exists.

Each relay channel also contains a delay circuit where set delays of between 0 and 23 seconds can be provided using one of four split pad links. Provision is also made by split pad links, to bypass each delay circuit. The split pad linkage is fully covered in section 3b.3 of this chapter.

This option comes complete with the nylon spacers and two 8-way output sockets.

# 3B.2 INSTALLATION

This sub-section deals with the mechanical and electrical installation of the Delay Relay Output Board (PCB 24680504) option. In the rest of this chapter the 'delay relay output board' title is shortened to 'output board'.

## 3B.2.1 STORAGE & PRE-INSTALLATION INSPECTION

### 3b.2.1.1 Storage Area

The storage area must be dry, dust-free and kept at a reasonable temperature. The storage area should allow for access and inspection of all items of equipment.

### 3b.2.1.2 Pre-Installation Inspection

Open the option package and inspect the contents for signs of damage. Check contents for completeness.

### 3B.2.2 MECHANICAL INSTALLATION

The output board is mounted directly on top of the input board. The input board is supplied with three nylon spacers fitted. The output board is then aligned on its Berg socket/plug interconnection (PL1/SK1) and input board-mounted spacers and pressed home on to the spacers.

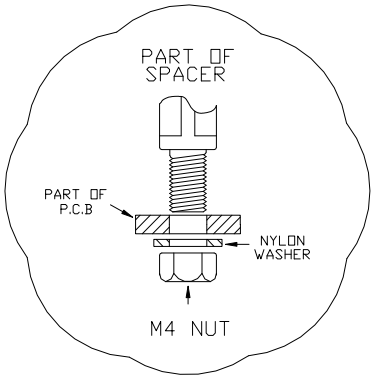
When two output boards are required to be mounted on an input board, the second output board is mounted on three nylon spacers fitted on the first mounted output board.

#### 3b.2.2.1 Fitting the Nylon Spacers to the Delay Relay Output Board

The spacers fit into the holes within the white-bordered areas on the output board (see Figure 3b.1 on page 3b-6).

1. Fit the nylon spacers into their prepared holes on the output board and lock in position using the nylon washer and M4 nut, see inset diagram.

2. Fit the output board on to the spacers and check for correct alignment and adjust if necessary.




#### 3b.2.2.2 Mounting the Delay Relay Output Board on to the Input Board

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

This task can be performed on a mounted 2468 electronic enclosure or the enclosure can be removed to a bench for the installation. Here it is assumed that the enclosure is in its normal working location. The procedure for mounting the delay relay output board is as follows:

1. Isolate the power supply from the 2468 electronic enclosure and open the instrument front cover.

2. If two output boards are to be fitted, make sure that the first output board to be fitted has had its nylon spacers fitted before installation. Also ensure the first output board is fully configured before fitting the second output board.

3. Ease the pins of the Berg plug PL1 of the output board into the Berg socket SK1 on the input board, checking that the mounting holes on the output board (the holes which are not contained in white bordered areas) are aligned over the fitted spacers and gently press the output board 'home' until the spring-loaded spigot on each spacer is locked firmly on to the output board.

**Note:** When fitting a second output board, use the same procedure described in operation 3 but refer to the components, etc., on the mounted output board.

This concludes the mechanical installation of the output board(s) and should be followed by the electrical installation. If the latter is not to be carried out in the immediate future then the power supply can be reconnected.

### 3B.2.3 ELECTRICAL INSTALLATION

This sub-section deals with the output of the states of the four relays. Two 8-way sockets are provided with each output board through which the relay outputs are delivered to their external destinations.

#### 3b.2.3.1 PCB Interconnections

Signal interconnection between the input board (PCB1) and the output board (PCB 9) is direct via the SK1/PL1 12-way Berg connectors. When two output boards are fitted, the top board's plug PL1 engages in the lower board's SK1.

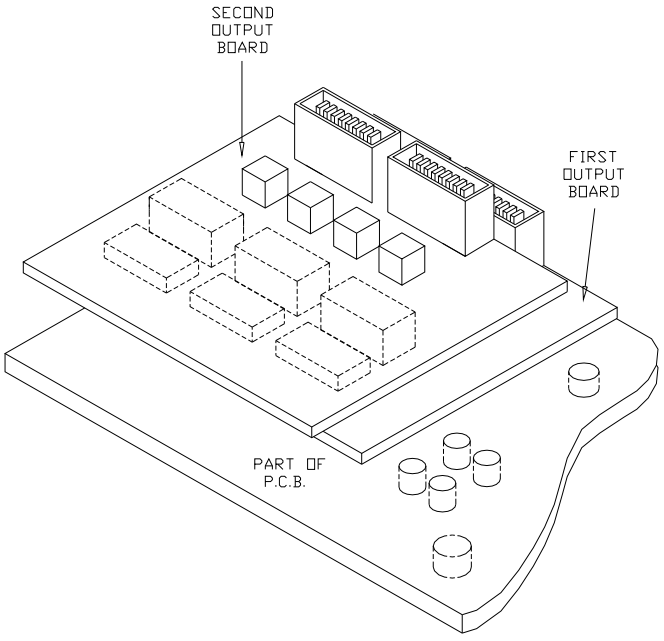
#### 3b.2.3.2 Relay Output Connections

The relay outputs can be taken out of the enclosure via the gland plate (if used) or along with the other cables in suitable trunking.

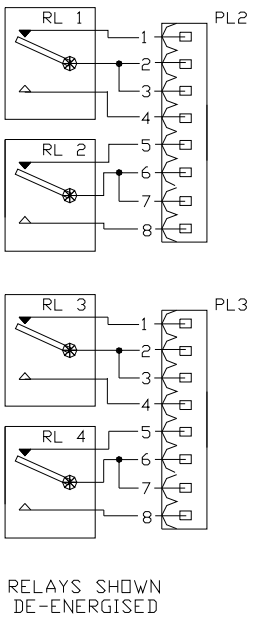
Use screened cables for all connections, making sure a good annular (ring shape) connection is made with a good quality RF cable gland. The run must be stress-free, and it is considered good practice to twist relay pairs together.

Since the output board is mounted on top of the input board, the routing of the relay cabling should take the same kind of formation as the electrode cabling, but separated from it as far as practical. The cable should be arranged such that the cables do not lie across any of the PCBs. The layout and plug pin details of the two plugs on the relay board is given in the diagram on the right, with the relay contacts shown in their de-energised state.

When two output boards are fitted, the output terminals of the uppermost output board are offset towards the centre of the input board.




***View illustrating mounted positions of dual delay relay output boards***




***Relay output PCB connectors***

# 3B.3 DELAY RELAY BOARD CONFIGURATION

The 24680509 Delay Relay Output Board has three configuration switches and twenty split pad links for delay time selection. The switches are:

- SW6: Selects Electrode or Alarm state for RL1.
- SW1 - SW4: Selects individual electrode for relays RL1 to RL4.
- SW5: Selects RL1 - RL4 to be energised **in steam** or **in water**.

Figure 3b.1 provides a view of the output board layout to highlight the positions of the various configuration switches.

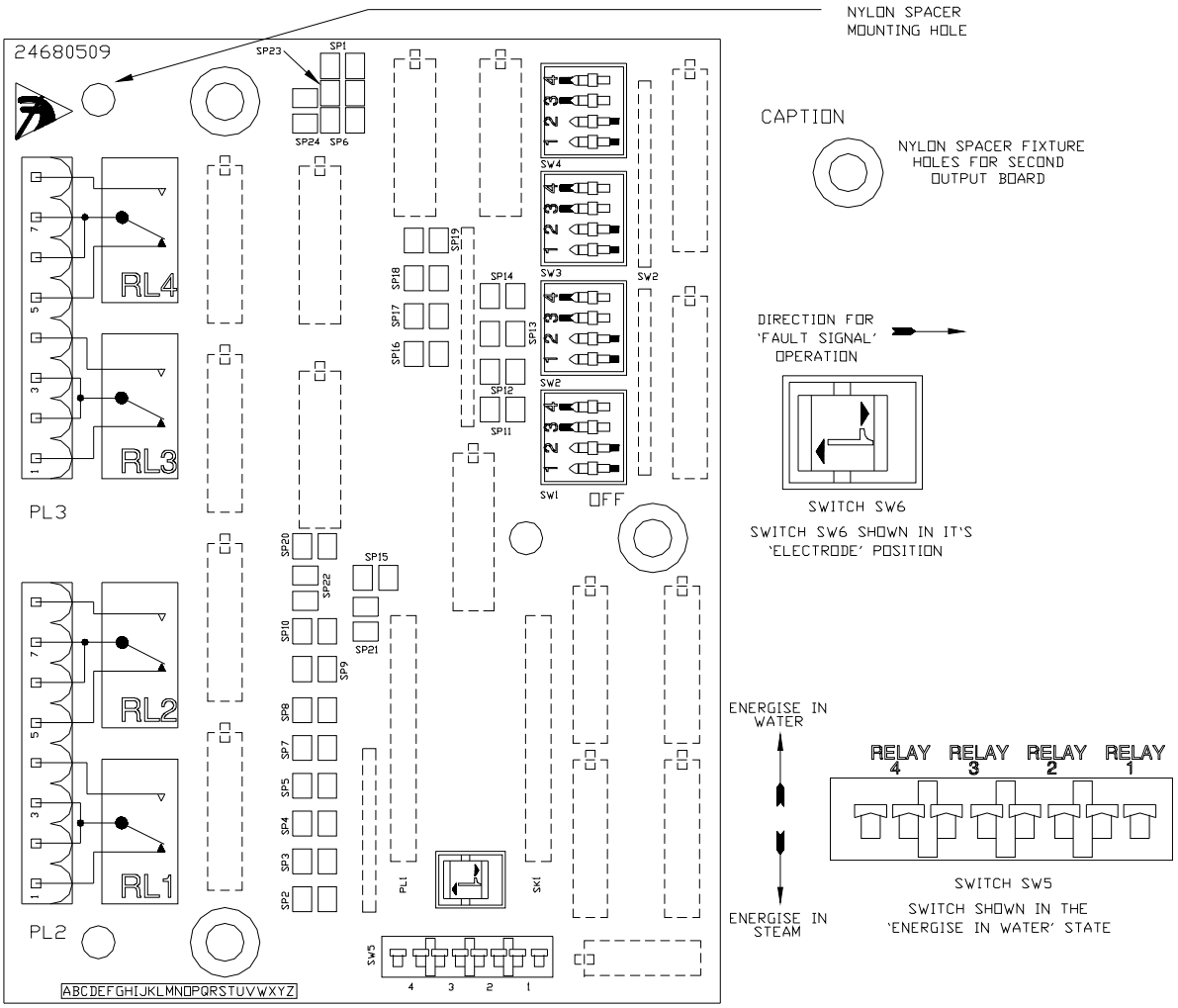



***Figure 3b.1 - View of relay output board showing switch positions and output pin details***

## 3B.3.1 DELAY RELAY OUTPUT BOARD

### 3b.3.1.1 Configuring the Delay Relay Output Board

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Isolate the 2468 electronics enclosure from its power supplies.

2. Gain access to the delay relay output PCB and set the relevant switches for the required function.

### 3b.3.1.2 Electrode/Relay Selection (Relays RL1, RL2, RL3 & RL4) - SW1 to SW4

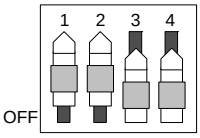
Four identical switches are provided, one for each relay (but see SW6) each having four sets of contacts. This allows coded selection for one of 16 electrodes for each switch and therefore for each relay in the case of the single input card. When dual input cards are fitted, odd numbered electrodes feed into one input card with the even numbered electrodes being fed into the other input card. Each input card then offers any mounted relay output card the choice from its electrode inputs, with the resultant selectivity as shown in Table 3b.1.

| Switch SW1, 5W2, 5W3 or 5W4 Settings for RL1 to RL4 respectively | | | | Electrode Selection | | |
|---|---|---|---|---|---|---|
| Switch Contacts | | | | One Input | Two Input Cards | |
| 1 | 2 | 3 | 4 | Card | Odd I/P Card | Even I/P Card |
| On | On | On | On | 1 | 1 | 2 |
| Off | On | On | On | 2 | 3 | 4 |
| On | Off | On | On | 3 | 5 | 6 |
| Off | Off | On | On | 4 | 7 | 8 |
| On | On | Off | On | 5 | 9 | 10 |
| Off | On | Off | On | 6 | Ii | 12 |
| On | Off | Off | On | 7 | 13 | 14 |
| Off | Off | Off | On | 8 | 15 | 16 |
| On | On | On | Off | 9 | 17 | 18 |
| Off | On | On | Off | 10 | 19 | 20 |
| On | Off | On | Off | 11 | 21 | 22 |
| Off | Off | On | Off | 12 | 23 | 24 |
| On | On | Off | Off | 13 | 25 | 26 |
| Off | On | Off | Off | 14 | 27 | 28 |
| On | Off | Off | Off | 15 | 29 | 30 |
| Off | Off | Off | Off | 16 | 31 | 32 |

***Table 3b.1 - Electrode selections for relays RL1 to RL4***

**Example:** Single Input Board - Electrode 13 selected.

Dual Input Boards: Odd input board - Electrode 25 selected
Even input board - Electrode 26 selected.



### 3b.3.1.3 Relay Energisation ('In Steam' or 'In Water') - SW5

This is a four-channel switch, one channel allocated per relay. The choice presented by each channel switch is whether the relay is energised when the particular electrode is **in water** or energised when that electrode is **in steam**. This switch is highlighted in Figure 3b.1 (on page 3b-6) to provide additional information on channel identity and the switch 'electrode state'.

### 3b.3.1.4 Electrode/Alarm Operation (RL1 function only) - SW6

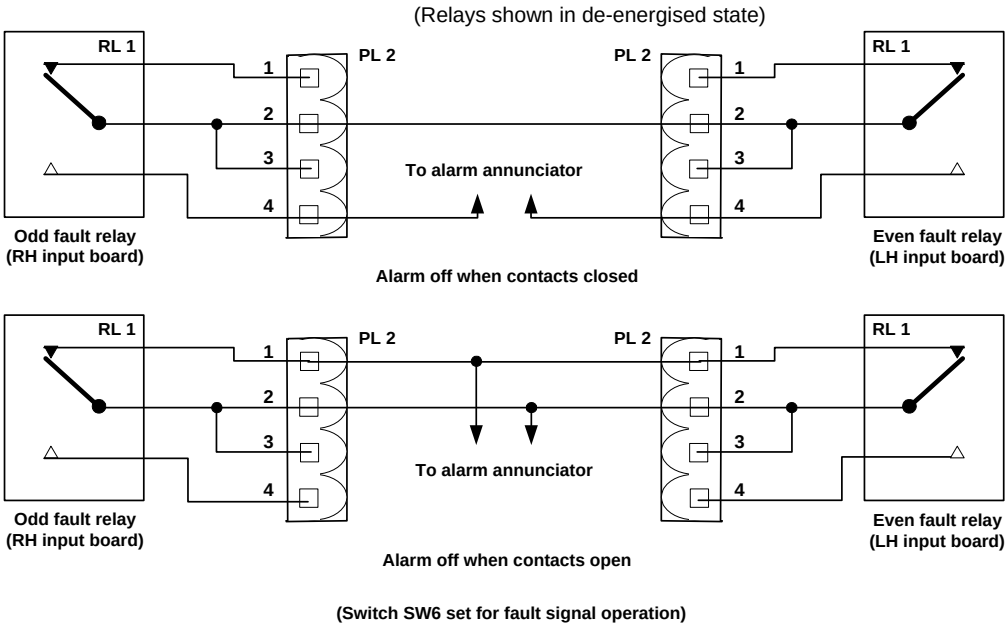
Relay 1 can be configured to receive either an electrode input or it can be used as the 'system fault' relay. The two positions are detailed in Figure 3b.1 (on page 3b-6). When configured as the system fault relay, the **normal** (non-fault) state of the relay is **energised**.

The system fault output connections are shown in the next section.

### 3b.3.1.5 System Fault Output

Relay 1 on each delay relay board can be configured to be a **system fault** relay by setting SW6. When used as a system fault relay the **normal state** of the relay is **energised** and a fault state will **de-energise** the relay.

The relay will only output faults detected by the input board onto which it is installed. With a dual power supply Hydrastep unit, this means it is necessary to used two delay relay boards (one on each input board) to create a **system** fault output.




**Note:** Systems with a local display have an opto-isolated system fault available from the display board.

### 3b.3.1.6 Delay Circuit Configuration

By means of split pad links incorporated in each of the relay delay circuits, delays can be introduced or bypassed and the following delays are made available (see also Figure 3b.2):

| RELAY | SPLIT PAD CONFIGURATION | | | | TIME DELAY (SECONDS) |
|---|---|---|---|---|---|
| 1 | SP5 | SP4 | SP3 | SP2 | |
| 2 | SP10 | SP9 | SP8 | SP7 | |
| 3 | SP14 | SP13 | SP12 | SP11 | |
| 4 | SP19 | SP18 | SP17 | SP16 | |
| SPLIT PAD STATE | ▬ | ▬ | ▬ | □ | 0.8 ± 0.8 |
| | ▬ | ▬ | □ | ▬ | 2.3 ± 0.8 |
| | ▬ | ▬ | □ | □ | 3.9 ± 0.8 |
| | ▬ | □ | ▬ | ▬ | 5.5 ± 0.8 |
| | ▬ | □ | ▬ | □ | 7.0 ± 0.8 |
| | ▬ | □ | □ | ▬ | 8.6 ± 0.8 |
| | ▬ | □ | □ | □ | 10.2 ± 0.8 |
| □ □ = OPEN CIRCUIT | □ | ▬ | ▬ | ▬ | 11.7 ± 0.8 |
| | □ | ▬ | ▬ | □ | 13.3 ± 0.8 |
| | □ | ▬ | □ | ▬ | 14.8 ± 0.8 |
| | □ | ▬ | □ | □ | 16.4 ± 0.8 |
| ▬ = BRIDGED WITH SOLDER | □ | □ | ▬ | ▬ | 18.0 ± 0.8 |
| | □ | □ | ▬ | □ | 19.5 ± 0.8 |
| | □ | □ | □ | ▬ | 21.1 ± 0.8 |
| | □ | □ | □ | □ | 22.6 ± 0.8 |
| | ▬ | ▬ | ▬ | ▬ | 24.2 ± 0.8 |

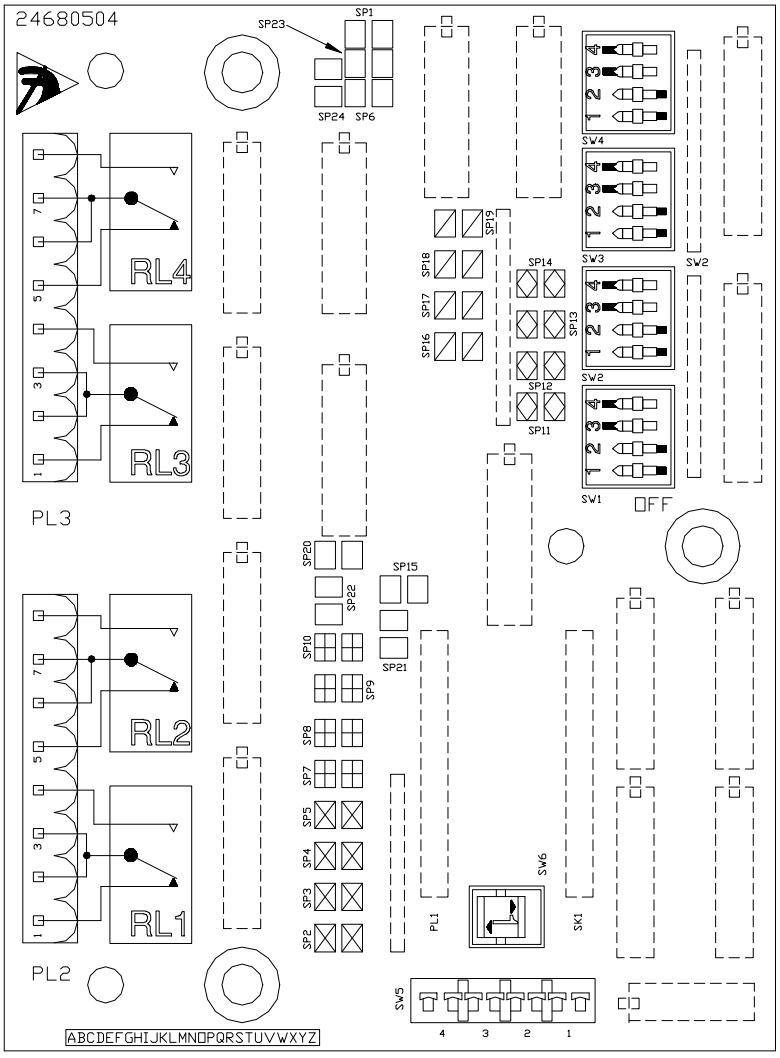
***Table 3b.2 - Split pad functions on relay delay circuits***

### 3b.3.1.7 Configuring the Delay Circuit Split Pads

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Isolate the 2468 electronics enclosure from its power supplies.
2. Split pad bridging may be carried out in-situ, however it may be easier to remove the board from the unit. Gain access to the delay relay output PCB and bridge the required split pads (see Table 3b.2 and Figure 3b.2) with solder, ensuring that the remaining split pads are open-circuit and clean.
3. **Note:** When two output boards are fitted, the upper board will have to be removed temporarily to give access to the split pads of the lower output board.
4. Carry out any necessary re-assembly on the output board(s) and test that the required delay on the relay operations is being achieved.
5. If no further work is required inside the enclosure, close and secure the enclosure lid.

***Figure 3b.2 - View of delay relay output board showing split pad positions***




**Note:** The following split pads must be set as follows:

**For Delayed Operation of the Nominated Relay:**

| | |
|---|---|
| RL1 | SP21 bridged with solder<br>SP15 open-circuited |
| RL2 | SP22 bridged with solder<br>SP20 open-circuited |
| RL3 | SP23 bridged with solder<br>SP1 open-circuited |
| RL4 | SP24 bridged with solder<br>SP6 open-circuited |

**For No Delayed Operation of the Nominated Relay:**

| | |
|---|---|
| RL1 | SP15 bridged with solder<br>SP21 open-circuited |
| RL2 | SP20 bridged with solder<br>SP22 open-circuited |
| RL3 | SP1 bridged with solder<br>SP23 open-circuited |
| RL4 | SP6 bridged with solder<br>SP24 open-circuited |

LEGEND

- RELAY 1 SPLIT PADS
- RELAY 2 SPLIT PADS
- RELAY 3 SPLIT PADS
- RELAY 4 SPLIT PADS
- DELAY OPERATION

### 3B.3.2 ALARM AND TRIPPING FACILITIES

The relay boards provide high and low water level alarm and trip facilities for the 2468 Hydrastep system. Four to eight relays can be made available for each input board fitted.

#### 3b.3.2.1 Philosophy

A requirement in regulations concerning steam raising plant is the provision of an automatic low water level shut-down or trip device. In the 2468 Hydrastep the relay output board provides the required output signals for such devices.

In practical applications of shut-down systems two factors must be considered, the consequences of spurious trips and the non-availability of a trip when required, due to protection system faults.

The following relay output circuits are specific to the 2468 Hydrastep Level Indicator versions.

#### 3b.3.2.2 Relay Interconnections for Alarm/Tripping Systems

It is necessary to open the Hydrastep 2468 Electronic Enclosure to carry out any wiring, therefore care must be taken when working inside the unit.

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

**Note:** Before any relay interconnections are made it is necessary to fulfil any safety regulations governing the plant shutdown procedures.

Since one input board receives inputs from the **odd** numbered electrodes and the other input board receives inputs from the **even** numbered electrodes, interconnections between **odd** and **even** relay boards will be required.

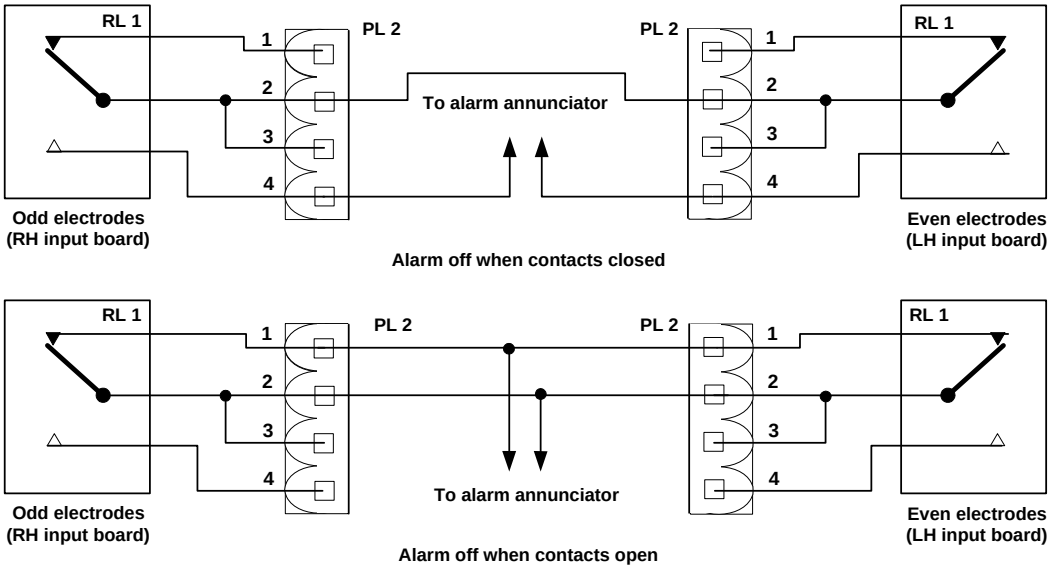
The following are examples of relay configurations used.

### 3b.3.2.3 'One out of Two' Relay Alarm System

Either of the relays involved can cause an alarm when their assigned electrode registers an alarm condition. The alarm condition is selected by switch SW5 to provide relay energisation in water **EW** or energisation in steam **ES**.

#### Case A - Relays normally energised, de-energise either one to trip

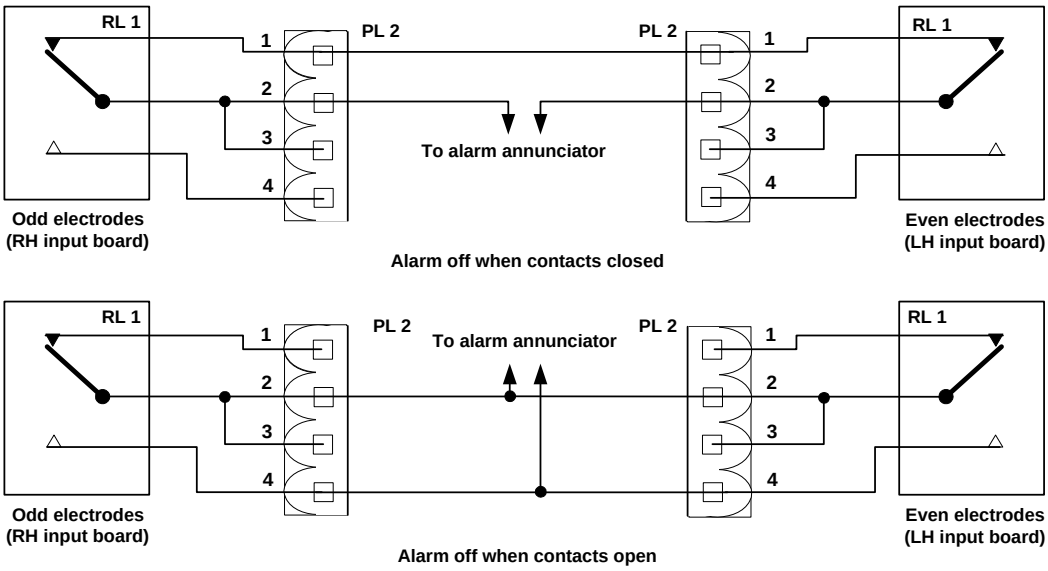
(Relays shown in de-energised state)




**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

#### Case B - Relays normally de-energised, energise either one to trip

(Relays shown in de-energised state)



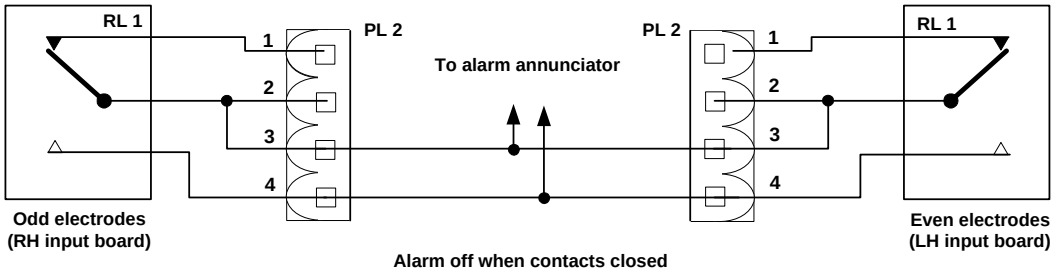

**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

### 3b.3.2.4 'Two out of Two' Relay Alarm System

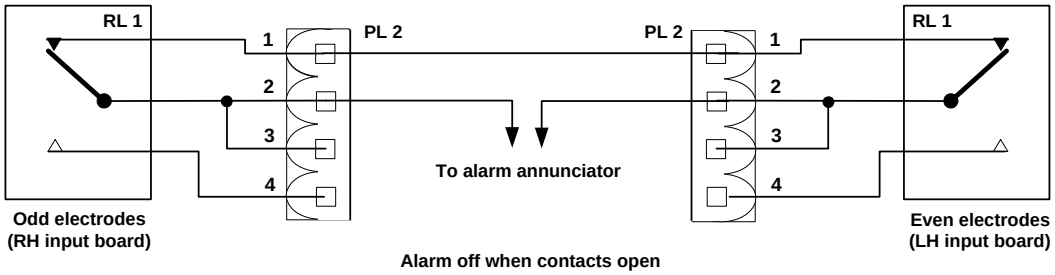
This system requires both relays to operate to cause an alarm when their assigned electrodes register an **alarm** condition.

#### Case A - Relays normally energised, de-energise both to trip

(Relays shown in de-energised state)




**Alarm off when contacts closed**

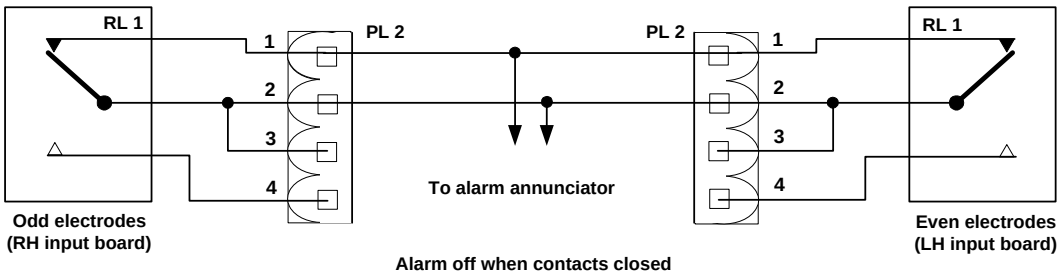



**Alarm off when contacts open**

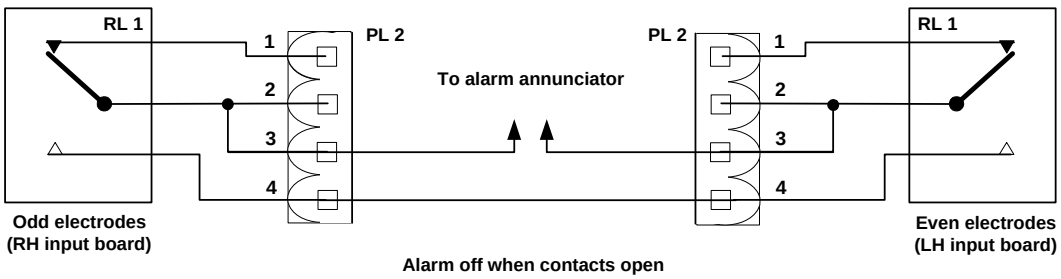
**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

#### Case B - Relays normally de-energised, energise both to trip

(Relays shown in de-energised state)




**Alarm off when contacts closed**



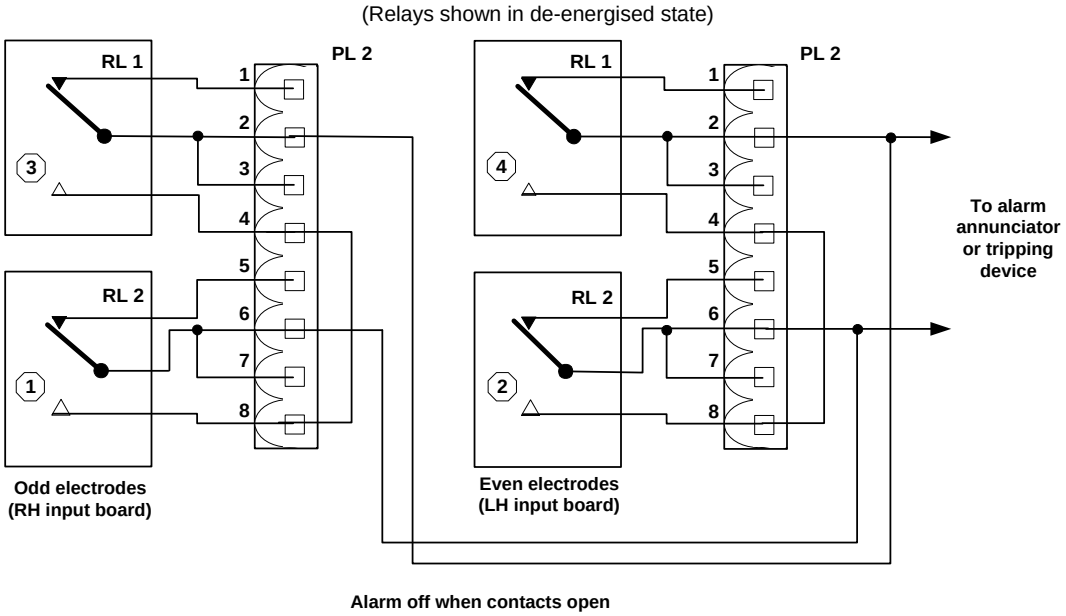

**Alarm off when contacts open**

**(Switch SW5 is set to ES for low level alarms and set to EW for high level alarms)**

### 3b.3.2.5 'Two out of Four' Relay Alarm System

In the following diagrams (5A & 5B) ①②③④ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will perform a **low level** trip at electrode level **3**. For a **high level** trip, using electrode channels **11, 12, 9** and **10** respectively and switch **SW5** set for **ES,** a healthy system would trip at level **10**.

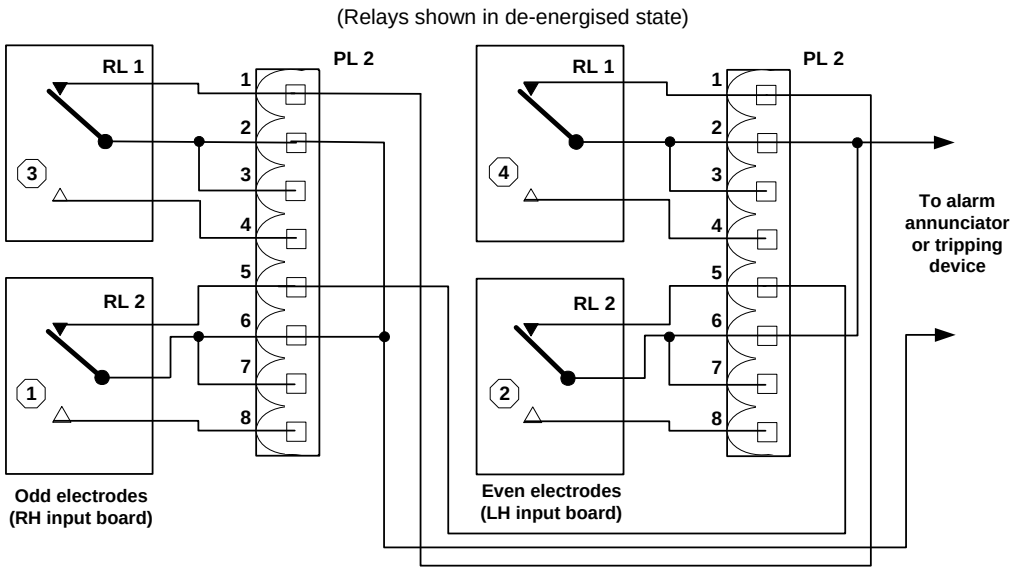
**Case A - Relays normally energised, de-energise one in each pair to trip**




**Alarm off when contacts open**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally energised, de-energise one pair to trip**



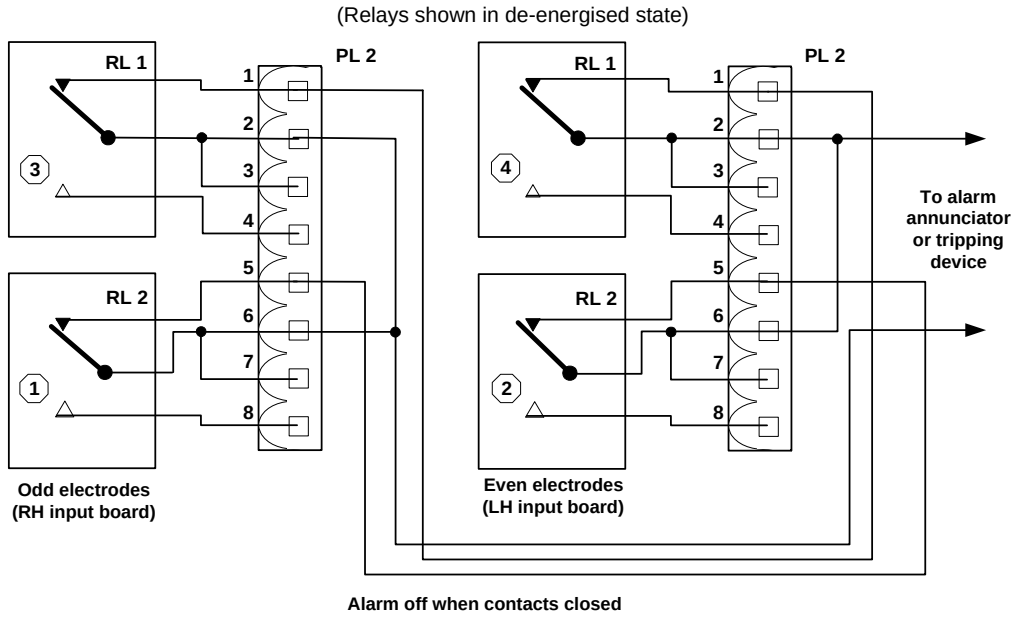

**Alarm off when contacts open**

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

### 3b.3.2.6 'Two out of Four' Relay Alarm System (contd.)

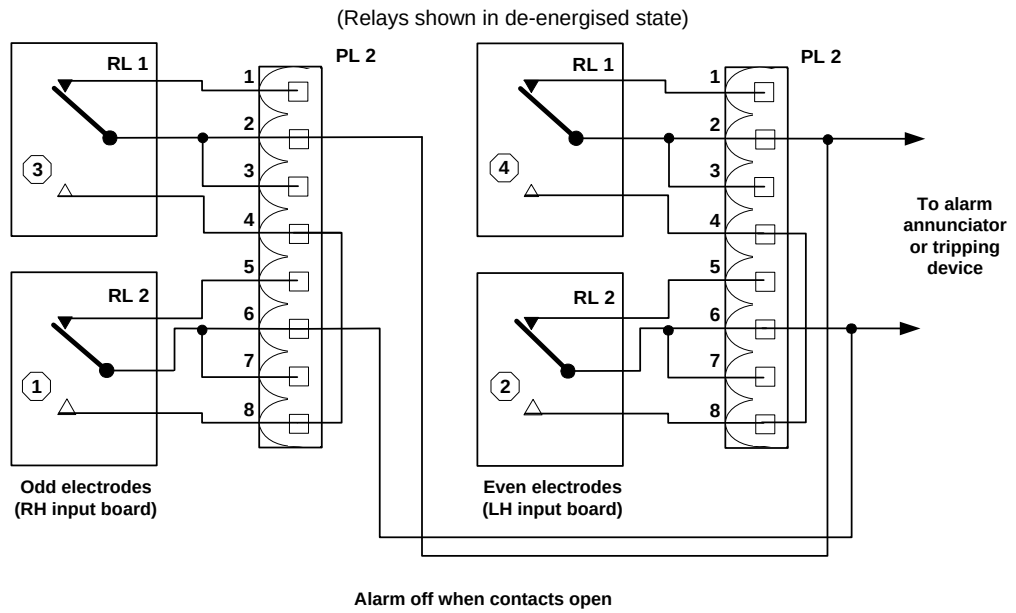
In the following diagrams (6A & 6B) ①②③④ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will perform a **low level** trip at electrode level **2**. For a **high level** trip, using electrode channels **9, 10, 11** and **12** respectively and switch **SW5** set for **ES**, a healthy system would trip at level **11**.

**Case A - Relays normally energised, de-energise one in each pair to trip**




**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally de-energised, energise one in each pair to trip**



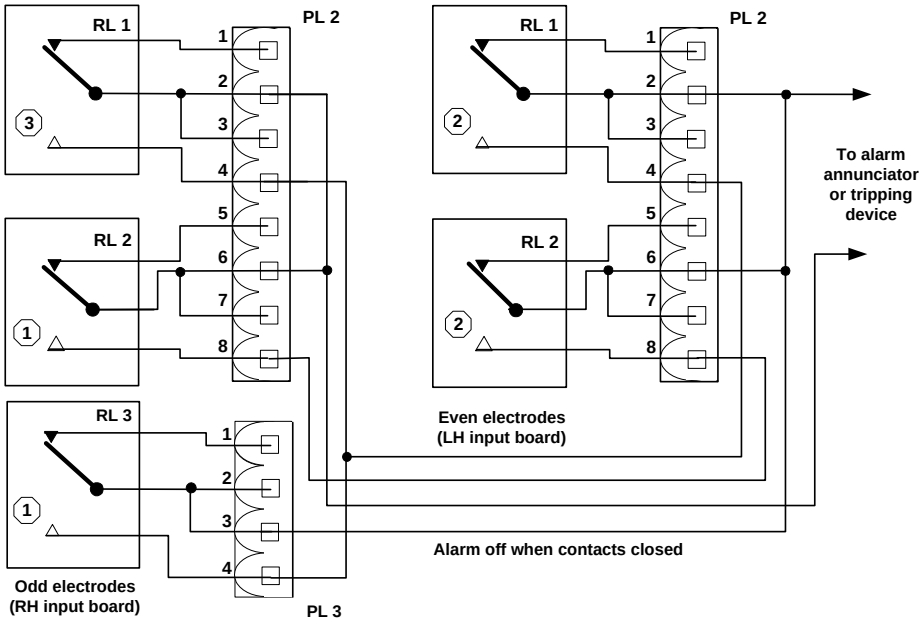

**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

### 3b.3.2.7 'Two out of Three' Relay Alarm System

In the following diagrams (7A & 7B) ①②③ indicate the electrode channel selected for each relay. A fully functioning system (NO FAULTS) will cause a **low level** trip at electrode level **2**. Using high-level electrode channels and **SW5** set to **ES**, the circuit can perform a **high level** trip.
**Note:** Inputs from electrodes 1 & 2 are applied to two separate relays on their respective boards.

**Case A - Relays normally energised, de-energise two to trip**

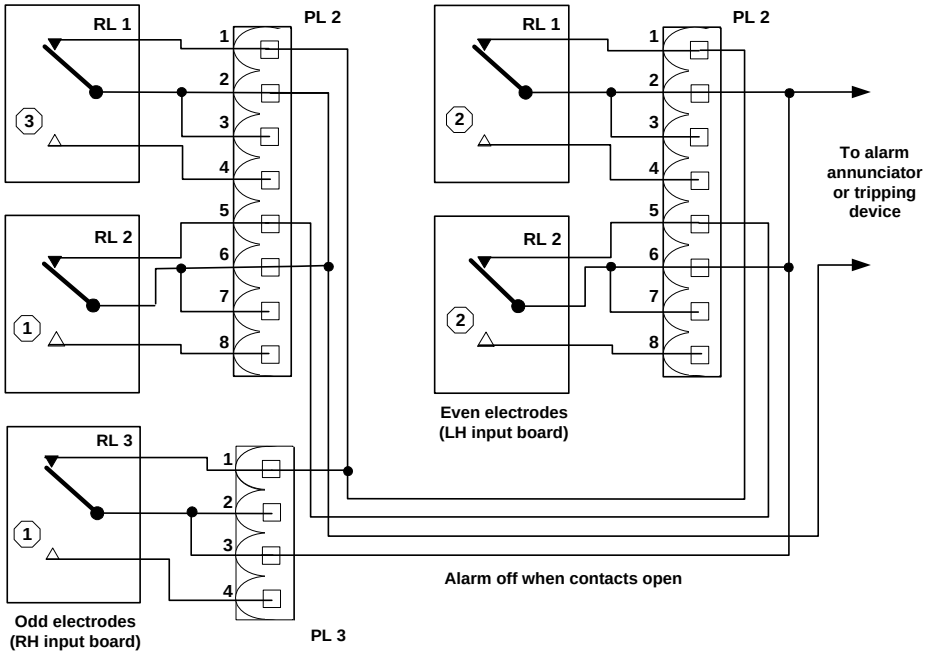
(Relays shown in de-energised state)




**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

**Case B - Relays normally energised, de-energise two to trip**

(Relays shown in de-energised state)




**(Switch SW5 is set to EW for low-level alarms and set to ES for high-level alarms)**

# 3B.4 COMPONENT REPLACEMENT

The delay relay board contains no replaceable circuit components, failure of the board requires replacement of the entire board. The only component that can be replaced is the nylon spacers.

### 3B.4.1 REPLACEMENT OF NYLON SPACERS

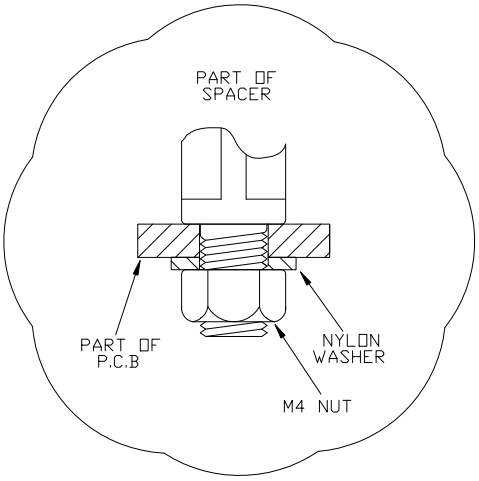
**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

The replacement of nylon spacers fitted to the output board requires access to the non-component side of the PCB.

**Note:** Spacers will only be fitted on the output board if a second output board is to be fitted or has been fitted.

The spacers are secured in their holes by nut and nylon washer. To carry out a spacer replacement, the output board has to be removed from the input board. The procedure adopted is:

1. Isolate the 2468 electronic enclosure from the power supply.
2. Gain access to the PCBs and undo sufficient connections for the removal of the output board containing the defective spacer.
3. Remove the output board(s) by applying pressure to the upper spring-loaded spigots and easing the output board off its spacers a out of its Berg plug/socket connection.
4. Undo the nut and washer securing the faulty spacer and extract it from its hole, see inset diagram.
5. Fit the new spacer in position, align correctly on the board and secure firmly using the M4 nut and nylon washer.
6. Refit the PCB(s) into the enclosure, re-connect the PCB(s) as required and close the enclosure cover. Re-apply power if required.




### 3B.4.2 PARTS LIST - DELAY RELAY OUTPUT BOARD 24680509

The following list items are available as spare parts:

| Item Description | Mobrey Part Number | Item Description | Mobrey Part Number |
|---|---|---|---|
| **Electrical:** | | **Mechanical:** | |
| Delay relay PCB assembly: | 24680509B | Spacer, nylon 15.9 LG | 412012080 |
| Socket 5K2 free (8-way) | 351508100 | Washer, nylon | 411999910 |
| Socket 5K3 free (8-way) | 351503100 | Nut, M4 | 410031020 |

## 3B.5 SPECIFICATION

| | | |
|---|---|---|
| **Outputs:** | 4 x Alarm/Trip Relays | |
| **Relay Contact Rating:** | **ac** | **dc** |
| Maximum voltage: | 250V | 125V |
| Maximum current: | 8A | 8A |
| Maximum switching power: | 1500VA | 240W (≤ 30V)<br>65W (≤ 60V)<br>25W (≤ 125V) |
| For type nA safety: | | 100mA at 30Vdc |
| Maximum initial contact resistance: | 30mΩ | |
| **Time Delay:** | Disabled or 0.8 ± 0.8s to 24.2s ± 0.8s | |

# 3c

# 2468 Opto-isolated Output Board Option

## Contents

**Page No.**

## Illustrations



## Tables

# 3C.1 GENERAL DESCRIPTION

The Opto-isolated Output Board (PCB 24680505) has four opto-isolated outputs and is mounted on top of the input board using 3 nylon spacers. Electrical connection between the two boards is via a plug and a socket (SK1 on the input board and PL1 on the opto-isolated output board).

A second opto-isolated output board may be mounted on top of the first on spacers. Holes have been drilled on all opto-isolated output boards to receive the 3 nylon spacers. The top output board is offset towards the centre of the unit improving the cable layout from the opto-isolated output boards. The spacer fixing holes and mounting holes are illustrated in Figure 3c.1 (on page 3c-6).

**Note:** The term **energised** is used to describe the ON (low resistance) state of the opto-isolated output.

Each of the opto-isolated outputs can be energised by any one of up to 16 electrodes, with an individual choice of being energised when its selected electrode is **in steam** or is **in water**. Furthermore, opto-isolated output 1 can be used to monitor an electrode state or to register an ALARM condition. When set to register the ALARM state, the opto-isolated output is **energised** in the 'system normal' state and **de-energised** when an ALARM condition exists.

This option comes complete with the nylon spacers and two 8-way output sockets.

# 3C.2 INSTALLATION

This sub-section deals with the mechanical and electrical installation of the Opto-isolated Output Board (PCB 24680505) option. In the rest of this chapter the 'opto-isolated output board' title is shortened to 'output board'.

## 3C.2.1 STORAGE & PRE-INSTALLATION INSPECTION

### 3c.2.1.1 Storage Area

The storage area must be dry, dust-free and kept at a reasonable temperature. The storage area should allow for access and inspection of all items of equipment.

### 3c.2.1.2 Pre-installation Inspection

Open the option package and inspect the contents for signs of damage. Check contents for completeness.

### 3C.2.2 MECHANICAL INSTALLATION

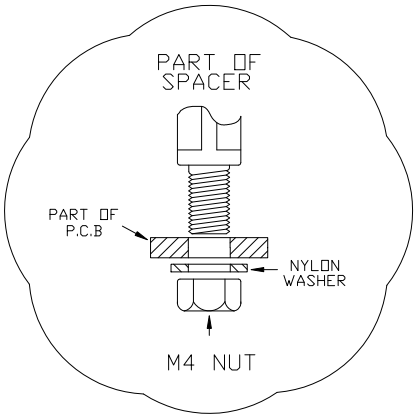
The output board is mounted directly on top of the input board. The input board is supplied with three nylon spacers fitted. The output board is then aligned on its Berg socket/plug interconnection (PL1/SK1) and input board-mounted spacers and pressed home on to the spacers.

#### 3c.2.2.1 Fitting Nylon Spacers to the Opto-Isolated Output Board

The spacers lit into the holes within the white-bordered areas on the output board (see Figure 3c.1 on page 3c-6).

**1.** Fit the nylon spacers into their prepared holes on the output board and lock in position using the nylon washer and M4 nut, see inset diagram.

**2.** Fit the output board on to the spacers and check for correct alignment and adjust if necessary.




#### 3c.2.2.2 Mounting the Opto-Isolated Output Board on to the Input Board

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

This task can be performed on a mounted 2468 electronic enclosure or the enclosure can be removed to a bench for the installation. Here it is assumed that the enclosure is in its normal working location. The procedure for mounting the output board is as follows:

**1.** Isolate the power supply from the 2468 electronic enclosure and open the instrument front cover.

**2.** If two output boards are to be fitted, make sure that the first output board to be fitted has had its nylon spacers fitted before installation. Also ensure the first output board is fully configured before fitting the second output board.

**3.** Ease the pins of the Berg plug PL1 of the output board into the Berg socket SK1 on the input board, checking that the mounting holes on the output board (the holes which are not contained in white bordered areas) are aligned over the fitted spacers and gently press the output board 'home' until the spring-loaded spigot on each spacer is locked firmly on to the output board.

**Note:** When fitting a second output board, use the same procedure described in operation 3 but refer to the components, etc., on the mounted output board.

This concludes the mechanical installation of the output board(s) and should be followed by the electrical installation, If the latter is not to be carried out in the immediate future then the power supply can be reconnected.

## 3C.2.3 ELECTRICAL INSTALLATION

### 3c.2.3.1 PCB Interconnections

Signal interconnection between the input board (PCB 1) and the output board (PCB 5) is direct via the SK1/PL1 12-way Berg connectors. Similarly, interconnection between the dual-mounted output boards uses the same type connectors but the top board's plug PL1 engages in the first output board's socket SK1.

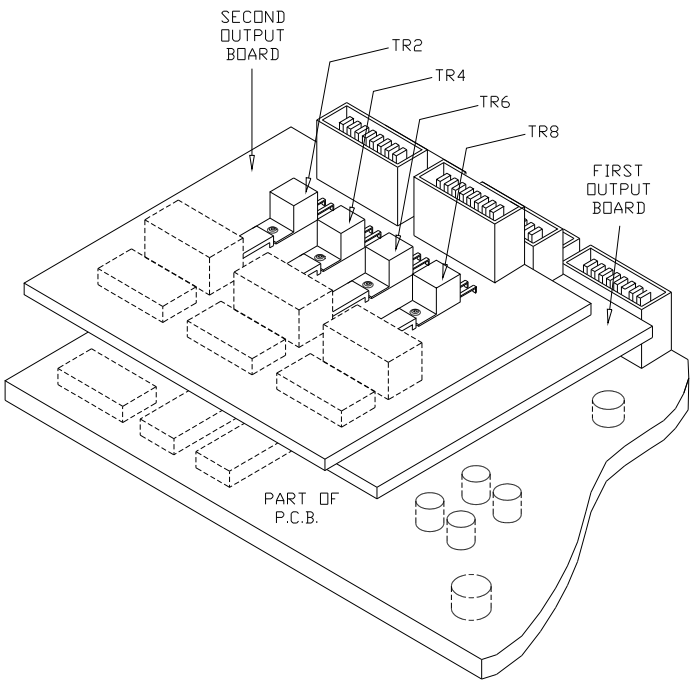
This sub-section deals with the four opto-isolated outputs. Two 8-way sockets are provided with each output board through which the opto-isolated outputs are presented to their external destinations via transistors TRs 2, 4, 6 and 8.

### 3c.2.3.2 Opto-Isolated Output Connections

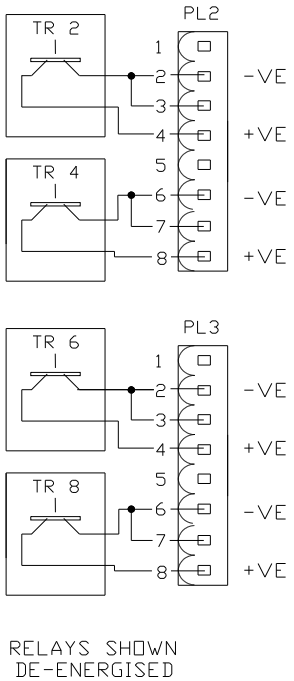
The opto-isolated output states can be taken out of the enclosure via the gland plate (if used) or along with the other cables in suitable trunking. One or more cables can be used at the discretion of the user, however the cables must be screened and the screens terminated at the gland plate.

Since the output board is mounted on top of the input board, the routing of the relay cabling should take the same kind of formation as the electrode cabling, arranged such that the cables do not lie across the PCBs. The layout and plug pin details of the two affected plugs on the output board is given in the diagram on the right, with the required opto-coupler output terminal polarities shown.

When two output boards are fitted, the output terminals of the uppermost output board are offset towards the centre of the input board.




***View illustrating mounting positions of dual opto-isolated boards***




***Opto-isolated output PCB connectors***

# 3C.3 OPTO-ISOLATED OUTPUT BOARD CONFIGURATION

The 24680505 Opto-isolated Output Board has three configuration switches:

- SW6: Selects Electrode or Alarm state for Opto-output 1.
- SW1 - SW4: Selects individual electrode for opto-outputs I to 4.
- SW5: Selects Opto-outputs 1 - 4 to be energised when electrodes **in steam** or **in water**.

Figure 3c.1 provides a view of the output board layout to highlight configuration switches.

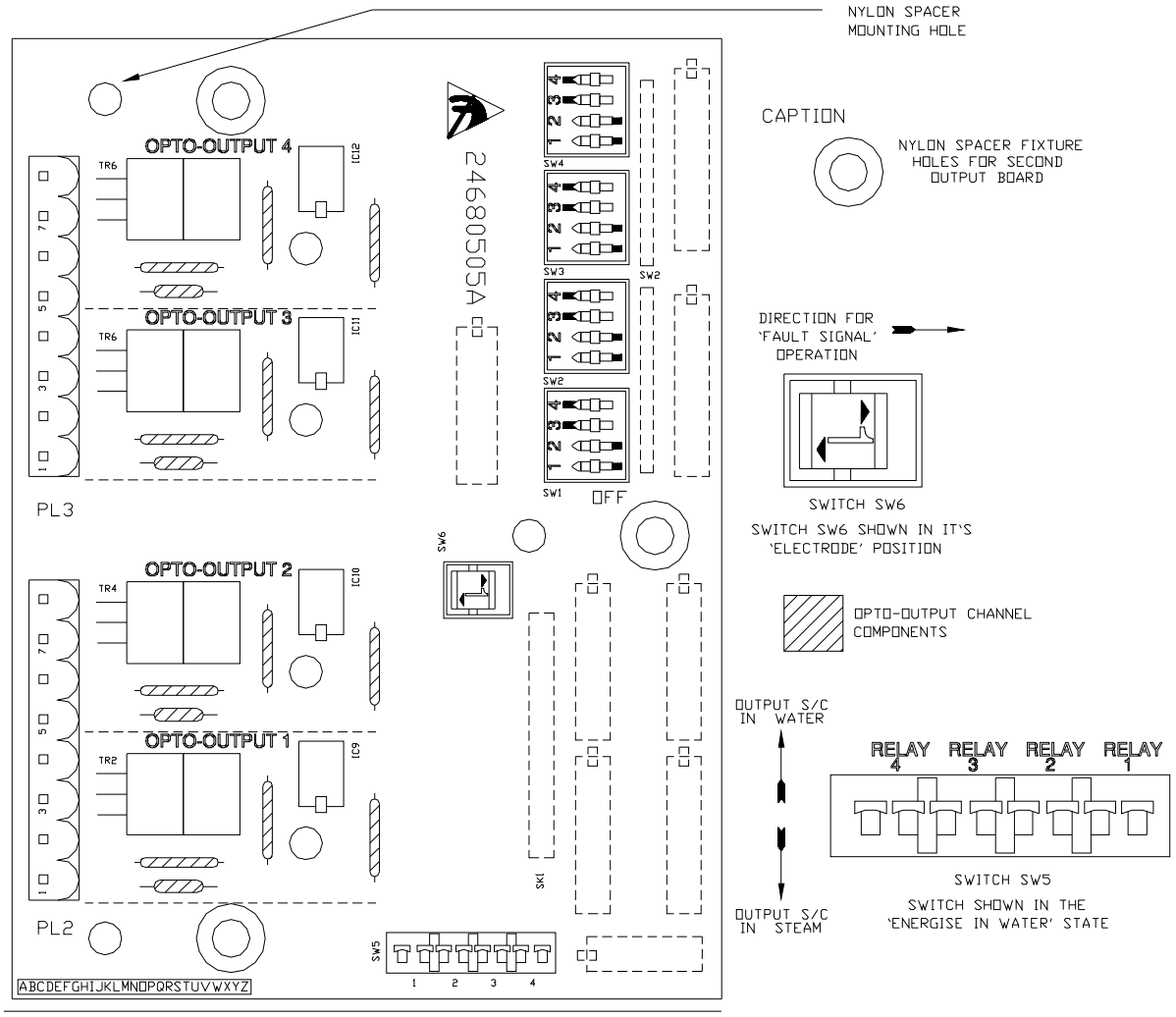



***Figure 3c.1 - View of opto-isolated board showing switch positions and output pin details***

### 3C.3.1 CONFIGURING THE OPTO-ISOLATED OUTPUT BOARD

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

Gain access to the printed circuit board assemblies inside the Hydrastep 2468 enclosure as follows:

**1.** Isolate the 2468 electronics enclosure from its power supplies.

**2.** Gain access to the output PCB and set the relevant switches for the required function.

#### 3c.3.1.1 Electrode/Opto-Output Selection (Opto-1, Opto-2, Opto-3 & Opto-4 Outputs) - SW1 to SW4

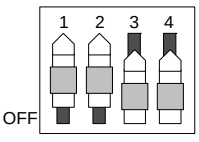
Four identical switches are provided, one for each output (**but see SW6**) each having four sets of contacts. This allows coded selection of any one of 16 electrodes for each switch in the case of the single input card. When dual input cards are fitted, odd numbered electrodes feed into one input card with the even numbered electrodes being fed into the other input card. Each input card then offers any mounted output card the choice from its electrode inputs, with the resultant selectivity as shown in Table 3c.1.

| Switch SW1, SW2, SW3 or SW4 Settings for Opto 1 to Opto 4 respectively | | | | Electrode Selection | | |
|---|---|---|---|---|---|---|
| Switch Contacts | | | | One Input | Two Input Cards | |
| 1 | 2 | 3 | 4 | Card | Odd I/P Card | Even I/P Card |
| On | On | On | On | 1 | 1 | 2 |
| Off | On | On | On | 2 | 3 | 4 |
| On | Off | On | On | 3 | 5 | 6 |
| Off | Off | On | On | 4 | 7 | 8 |
| On | On | Off | On | 5 | 9 | 10 |
| Off | On | Off | On | 6 | 11 | 12 |
| On | Off | Off | On | 7 | 13 | 14 |
| Off | Off | Off | On | 8 | 15 | 16 |
| On | On | On | Off | 9 | 17 | 18 |
| Off | On | On | Off | 10 | 19 | 20 |
| On | Off | On | Off | 11 | 21 | 22 |
| Off | Off | On | Off | 12 | 23 | 24 |
| On | On | Off | Off | 13 | 25 | 26 |
| Off | On | Off | Off | 14 | 27 | 28 |
| On | Off | Off | Off | 15 | 29 | 30 |
| Off | Off | Off | Off | 16 | 31 | 32 |

***Table 3c.1 - Electrode selections for opto-isolated outputs Opto 1 to Opto 4***

**Example:** Single Input Board - Electrode 13 selected.

Dual Input Boards: Odd input board - Electrode 25 selected
Even input board - Electrode 26 selected.



### 3c.3.1.2 Electrode/Alarm Operation (output 1 function only) - SW6

Opto-isolated output from TR2 can be configured to receive either an electrode input or it can be used as the 'system fault' output. The two positions are detailed in Figure 3c.1 (on page 3c-6). When configured as the **system fault** output, the opto-isolated output is **energised** (low resistance) in the normal (non-fault) state and is **de-energised** (high resistance) for a **fault** condition.

The system fault output connections are shown in the next section.

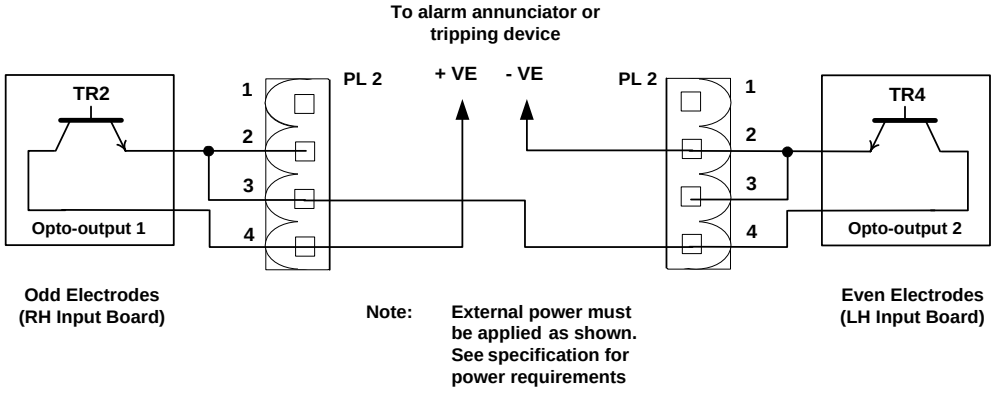
### 3c.3.1.3 Opto-Isolated Output Activation ('In Steam' or 'In Water') - SW5

SW5 is a four-channel switch, one channel allocated per opto-isolated output. The choice presented by each channel switch is whether the output device is **energised** (low resistance) when the particular electrode is **in water (W)** or when that electrode is **in steam (S).** Switch SW5 is highlighted in Figure 3c.1 (on page 3c-6) to provide additional information on channel identity and the switch 'electrode state'.

### 3c.3.1.4 System Fault Output

Opto 1 on each opto-isolated board can be configured to be a **system fault** opto-isolated output by setting SW6. When used as a system fault opto-isolated output the **normal state** of Opto 1 is **low resistance** and a fault state will cause Opto 1 to go into its **high resistance** state.

Opto 1 will only output faults detected by the input board onto which it is installed. With a dual power supply Hydrastep unit, this means it is necessary to used two opto-isolated output boards (one on each input board) to create a **system** fault output.




**(Switch SW6 set for Fault Signal operation)**

**Note:** Systems with a local display have an opto-isolated system fault available from the display board.

### 3C.3.2 ALARM AND TRIPPING FACILITIES

The output boards provide high and low water level alarm and trip facilities for the 2468 Hydrastep system. Four to eight opto-isolated outputs can be made available for each input board fitted.

#### 3c.3.2.1 Philosophy

A requirement in regulations concerning steam raising plant is the provision of an automatic low water level shut-down or trip device. In the 2468 Hydrastep the opto-isolated output board provides the required output signals for such devices.

In practical applications of shut-down systems two factors must be considered, the consequences of spurious trips and the non-availability of a trip when required, due to protection system faults.

The following opto-isolated output (for brevity this output title will be shortened to opto-output) circuits are specific to the 2468 Hydrastep Level Indicator versions.

#### 3c.3.2.2 Opto-Output Interconnections for Alarm/Tripping Systems

It is necessary to open the Hydrastep 2468 Electronic Enclosure to carry out any wiring, therefore care must be taken when working inside the unit.

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

**Note:** Before any opto-output interconnections are made it is necessary to fulfil any safety regulations governing the plant shutdown procedures.

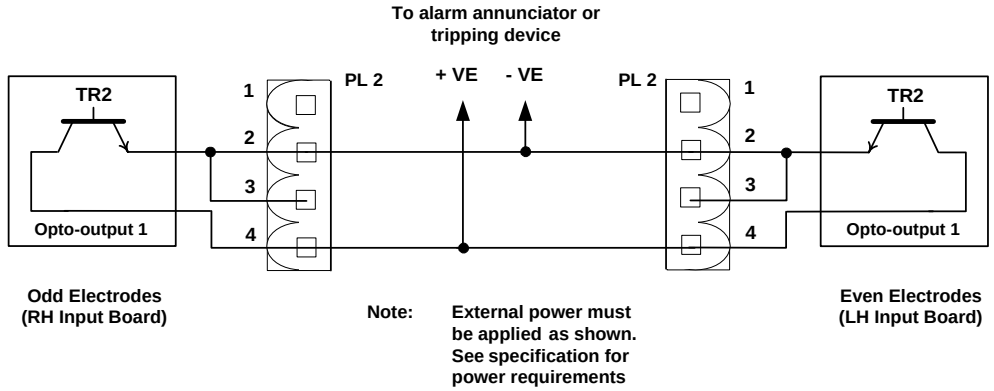
Since one input board receives inputs from the **odd** numbered electrodes and the other input board receives inputs from the **even** numbered electrodes, interconnections between **odd** and **even** opto-isolated output boards will be required. The opto-outputs are normally open circuit and are switched into a conducting mode (short circuit) when their dedicated electrode detects its allotted water/steam state to signal an alarm.

The following are examples of opto-output configurations used.

### 3c.3.2.3 'One out of Two' Opto-output Alarm System

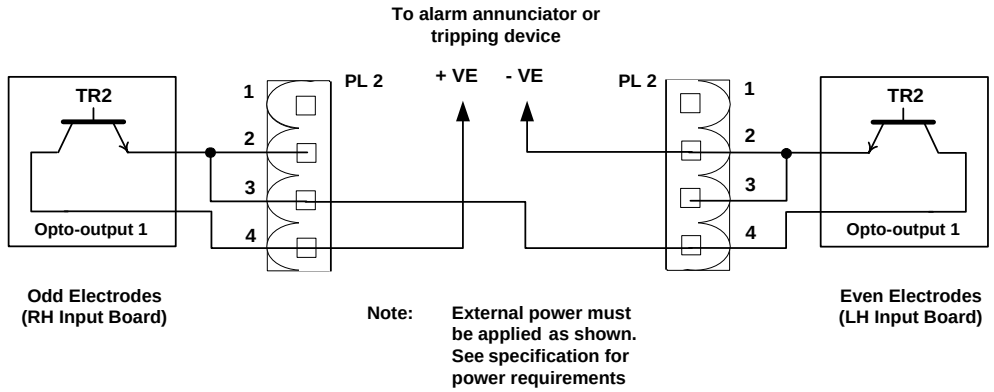
Either of the opto-outputs involved can signal an alarm when their assigned electrode detects a water/steam interface change. The alarm condition is selected by switch SW5 to provide an opto-output in conducting mode in water **W** or in a conducting mode in steam **S**.

**Case A - Opto-output circuit normally open circuit, short circuit either one to trip**




**(Switch SW5 is set to S for low level alarms and set to W for high level alarms)**

**Case B - Opto-output circuit normally short circuit, open circuit either one to trip**

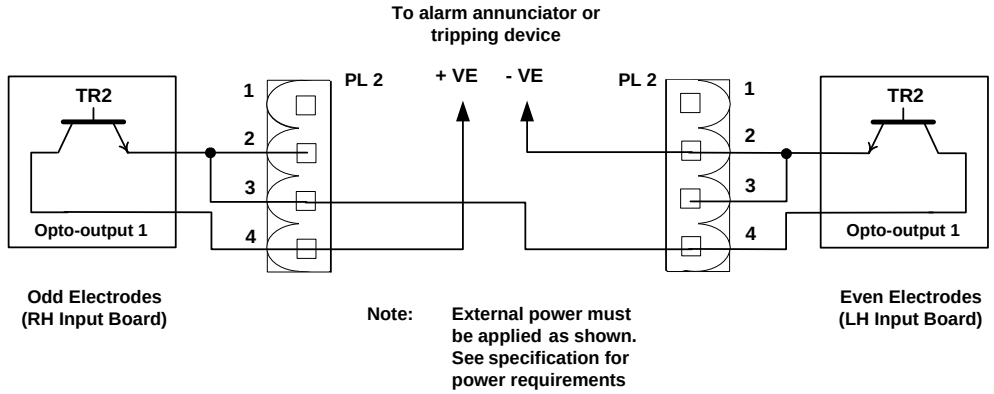



**(Switch SW5 is set to W for low level alarms and set to S for high level alarms)**

### 3c.3.2.4 'Two out of Two' Opto-output Alarm System

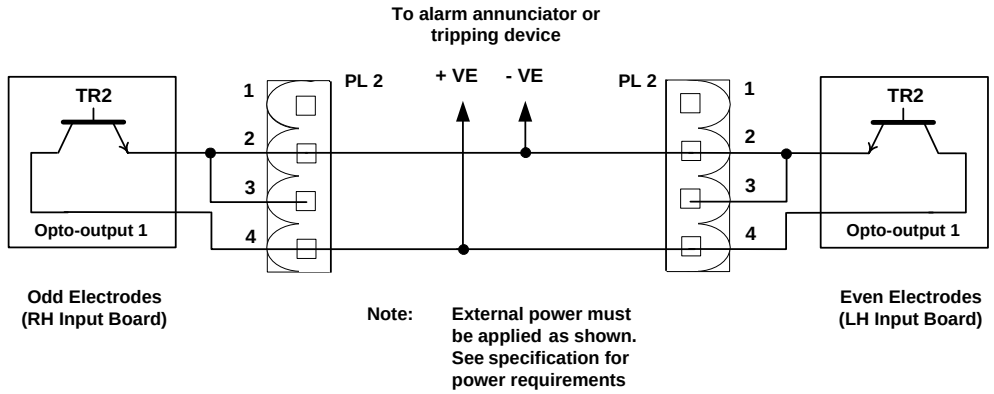
This system requires both opto-outputs to operate to cause an alarm when their assigned electrodes register an alarm condition.

#### Case A - Opto-output circuit normally open circuit, short circuit both to trip




**(Switch SW5 is set to S for low level alarms and set to W for high level alarms)**

#### Case B - Opto-output circuit normally short circuit, open circuit both to trip

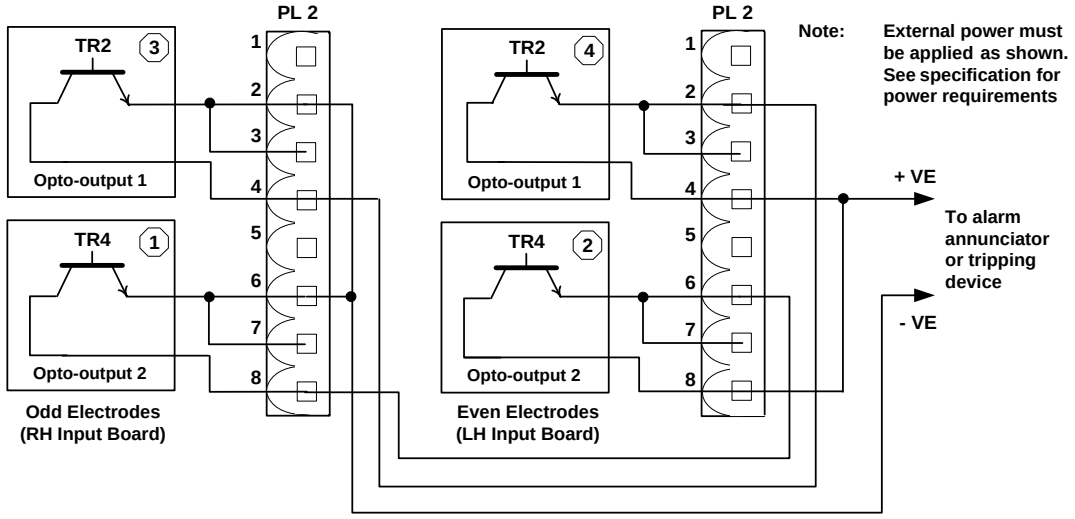



**(Switch SW5 is set to W for low level alarms and set to S for high level alarms)**

### 3c.3.2.5 'Two out of Four' Opto-output Alarm System

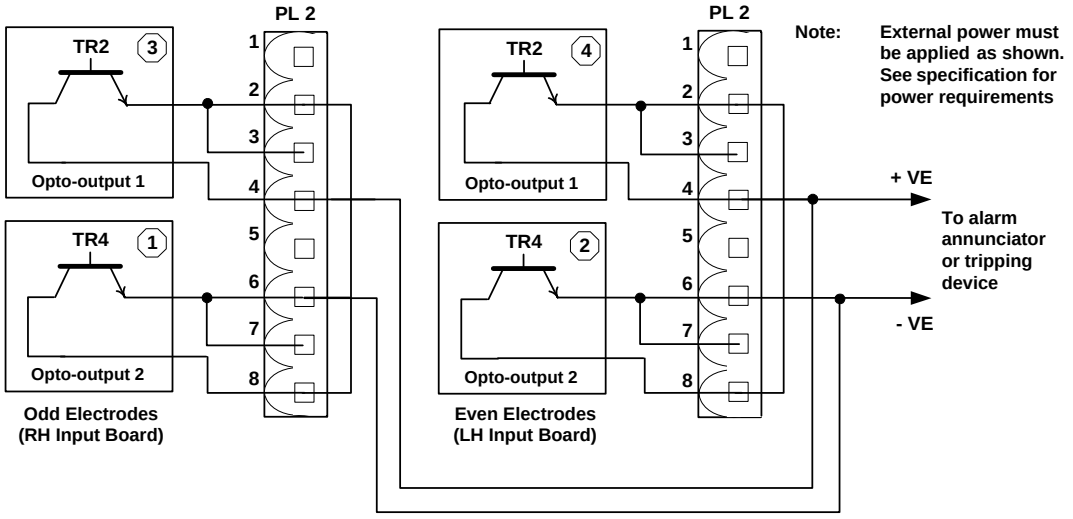
In the following diagrams (5A & 5B) ①②③④ indicate the electrode channel selected for each opto-output. A fully functioning system (NO FAULTS) will perform a **low level** trip at electrode level **3**. For a **high level** trip, using electrode channels **11, 12, 9** and **10** respectively and switch **SW5** set for **W**, a healthy system would trip at level **10**.

**Case A - Opto-output circuit normally open circuit, short circuit one pair to trip**




**(Switch SW5 is set to S for low level alarms and set to W for high level alarms)**

**Case B - Opto-output circuit normally short circuit, open circuit one in each pair to trip**



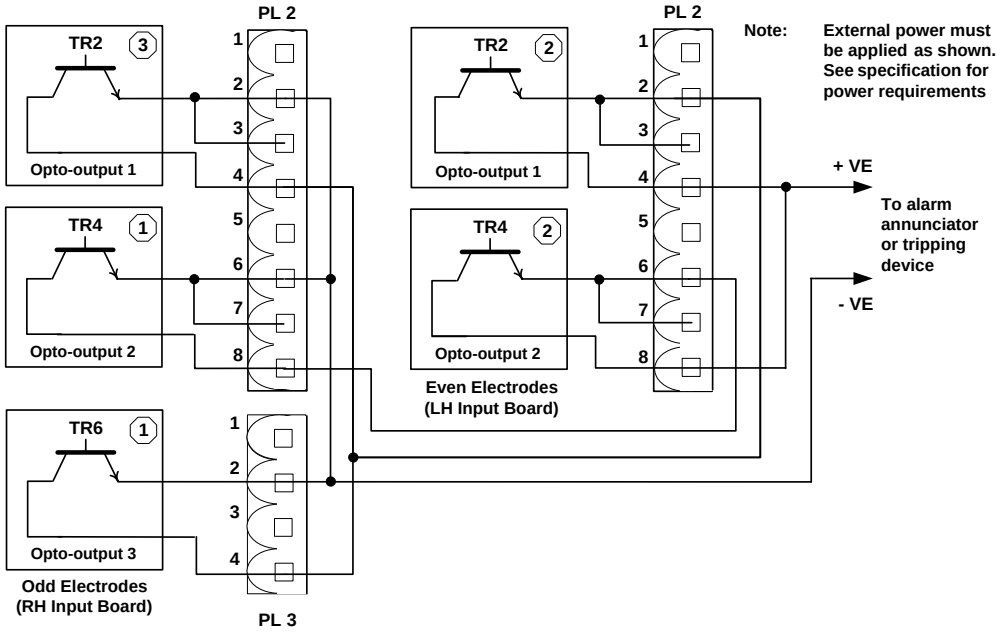

**(Switch SW5 is set to W for low level alarms and set to S for high level alarms)**

### 3c.3.2.6 'Two out of Three' Opto-output Alarm System

In the following diagrams (6A & 6B) ①②③ indicate the electrode channel selected for each opto-output. A fully functioning system (NO FAULTS) will cause a **low level** trip at electrode level **2**. Using high-level electrode channels and **SW5** set to **S**, the circuit can perform a **high level** trip.

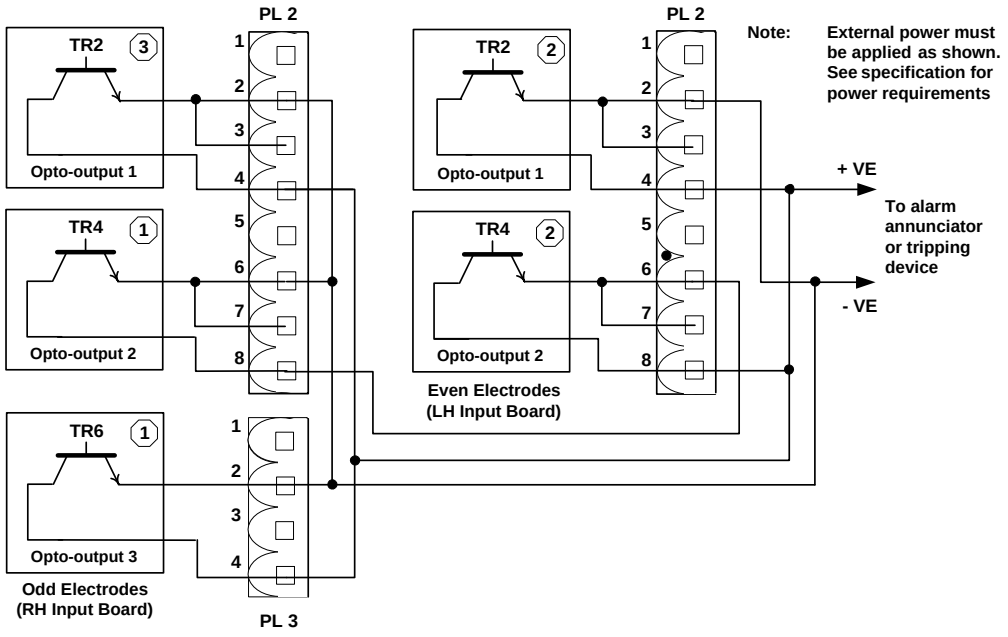
**Note:** Inputs from electrodes 1 & 2 are applied to two separate opto-outputs on their respective boards.

**Case A - Opto-output circuit normally open circuit, short circuit two to trip**




(Switch SW5 is set to S for low level alarms and set to W for high level alarms)

**Case B - Opto-output circuit normally short circuit, open circuit to trip**




(Switch SW5 is set to W for low level alarms and set to S for high level alarms)

# 3C.4 COMPONENT REPLACEMENT

The components used on the opto-isolated output board are fitted using 'surface mount technology' and fault remedial action is by the replacement of the whole output board. The only components fitted to the board that the general user can replace are the nylon spacers.

## 3C.4.1 REPLACEMENT OF NYLON SPACERS

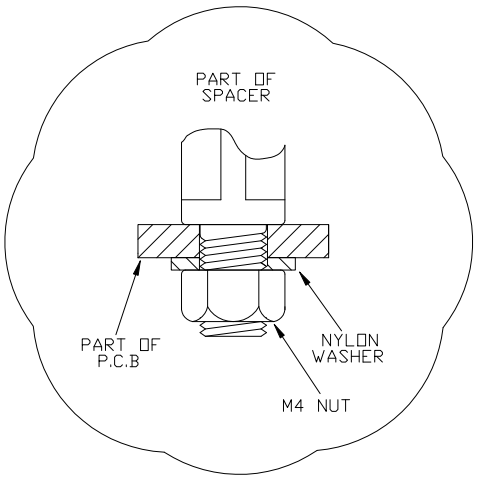
The replacement of nylon spacers fitted to the output board requires access to the non-component side of the PCB.

**Note:** Spacers will only be fitted on the output board if a second output board is to be fitted or has been fitted.

The spacers are secured in their holes by nut and nylon washer. To carry out a spacer replacement, the output board has to be removed from the input board. The procedure adopted is:

**WARNING** **Mains voltages are present in this instrument when power is connected. De-energise before opening front cover.**

1. Isolate the 2468 electronic enclosure from the power supply.
2. Gain access to the PCBs and undo sufficient connections for the removal of the output board containing the defective spacer.
3. Remove the output board(s) by applying pressure to the upper spring-loaded spigots and easing the output board oft its spacers and out of its Berg plug/socket connection.
4. Undo the nut and washer securing the faulty spacer and extract it from its hole, see inset diagram.
5. Fit the new spacer in position, align correctly on the board and secure firmly using the M4 nut and nylon washer.
6. Refit the PCB(s) into the enclosure, re-connect the PCB(s) as required and close the enclosure cover. Re-apply power if required.




## 3C.4.2 PARTS LIST - OPTO-ISOLATED OUTPUT BOARD 24680505

The following list items are available as spare parts:

| Item Description | Mobrey Part Number | Item Description | Mobrey Part Number |
|---|---|---|---|
| **Electrical:** | | **Mechanical:** | |
| PCB assembly: | 24680505A | Spacer, nylon 15.9 LG | 412012080 |
| Socket 5K2 free (8-way) | 351508100 | Washer, nylon | 411999910 |
| Socket 5K3 free (8-way) | 351503100 | Nut, M4 | 410031020 |

## 3C.5 SPECIFICATION

**Outputs:** 4 x Alarm/Trip Opto-isolated outputs

**Opto-Isolated Output Rating:**

| | |
|---|---|
| Maximum Open-circuit Voltage: | 30V dc. |
| Maximum Short-circuit Current: | 1A |
| Short-circuit Voltage Drop: | 1.1V maximum at 1A |
| Open-circuit Leakage Current: | 1mA at 30V dc. |

# 4

# Remote Display Options 24683B, C, & D

## Contents

## Illustrations



## Tables

# 4.1 REMOTE DISPLAY OPTIONS

The 24683B, C, and D Remote Display Units give a repeat display of the water level state and fault alarm state of the Hydrastep 2468 Electronic Gauging System.

Each type of remote display operates in the same way. The only difference between them is in their mechanical construction. The 24683B is a small LED display for panel mounting; the 24683C is a large LED display for panel mounting; and the 24683D is a large LED display for wall mounting, contained in a splash proof box to IP65 (NEMA 4X) standard.

On each type of remote display there are two columns of LEDs, a red column to indicate steam and a green column to indicate water. This provides a clear indication of the water level in the monitored system. The number of LEDs that may be illuminated depends on the number of electrodes being used. To mask the unused LEDs, a blanking panel is provided: this should be fitted on the inside of the front panel. An electrode fault, or a wiring or circuit fault, is indicated by a yellow LED.

The 2468 will drive a maximum of six remote displays, using star or daisy chain connections. One remote display can be powered from the 2468. All other remote displays must be locally powered.

On each type of remote display, connection to the 2468 is made through a 20-way screw clamp terminal block. Access to the terminal block on the 24683B and 24683C is via a cut-out in the rear panel. Access to the terminal block on the 24683D is made via cable glands on one end of the enclosure.

## 4.2 CONFIGURATION

All remote displays can be configured for operation with 8 to 16 electrodes (two LEDs per electrode) or 18 to 32 electrodes (one LED per electrode). Remote displays are supplied ready for operation with 8 to 16 electrodes. If a remote display is required to operate with 18 to 32 electrodes then it must be reconfigured. The procedure for each type of remote display is described below.

### 4.2.1 RECONFIGURING THE 24683B AND 24683C REMOTE DISPLAY

The procedure for reconfiguring the 24683B and 24683C for operation with 18 to 32 electrodes is:

1. Undo the four screws securing the rear panel and remove the panel.
2. Withdraw the decoding PCB from the rear of the display unit. (Some force may be necessary, initially, to disengage the decoding PCB from the LED PCB.)
3. Carefully remove the link headers from sockets LK2 and LK4 on the decoding PCB, by easing them out with a suitable flat-bladed screwdriver. (See Figure 4.1)
4. Fit the link headers, removed in step 3, into sockets LK1 and LK3.
5. Refit the decoding PCB and the rear panel.

**Note:** This figure shows the layout of the decoding pcb fitted to the 24683C and 24683D Remote Displays. The layout of the decoding pcb in the 24683B Remote Display is slightly different, but the arrangement of links LK1-LK4 is the same.

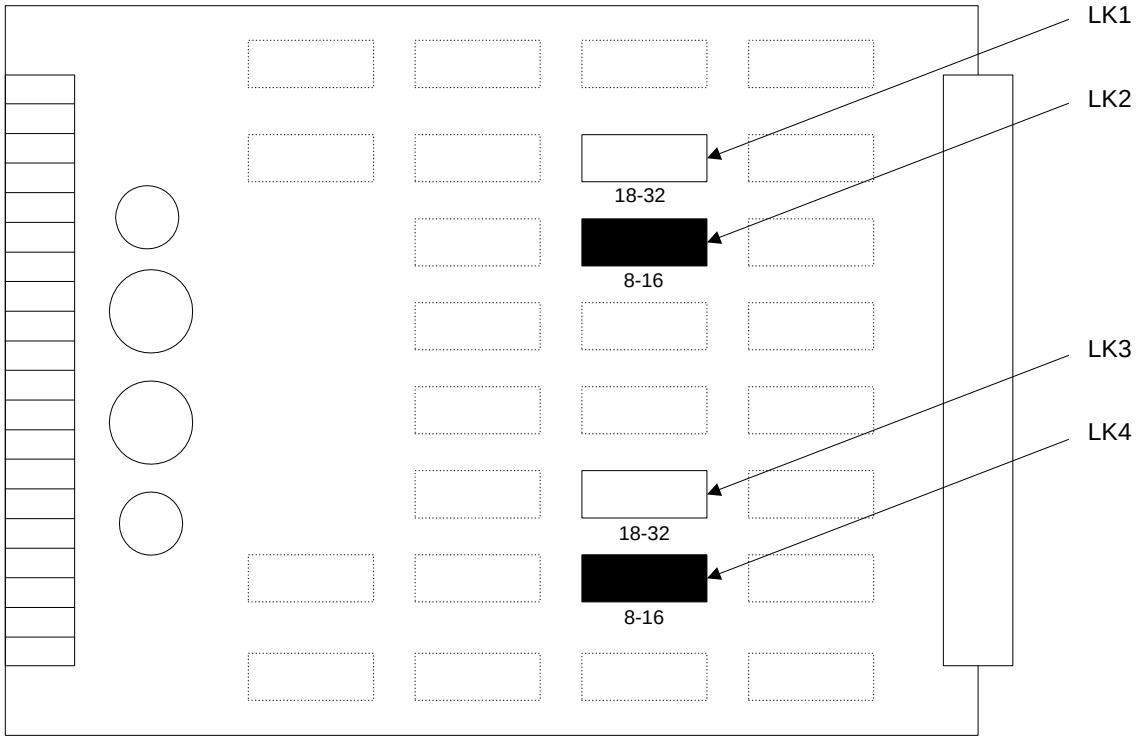



***Figure 4.1 - Location of link headers for selecting the display mode***

### 4.2.2 RECONFIGURING THE 24683D REMOTE DISPLAY

The procedure for reconfiguring the 24683D for operation with 18 to 32 electrodes is:

1. Undo the four screws securing the transparent cover and remove the cover.
2. Undo the four screws securing the front panel and lay the panel carefully away from the top of the box, still connected by the ribbon cable.
3. Carefully remove the link headers from sockets LK2 and LK4 on the decoding PCB, by easing them out with a suitable flat-bladed screwdriver. (See Figure 4.1)
4. Fit the link headers, removed in step 3, into sockets LK1 and LK3.
5. Refit the front panel and the transparent cover.

# 4.3 MECHANICAL INSTALLATION

Of the three types of remote display units, types 24683B and 24683C are intended for panel mounting and type 24683D is intended for wall mounting. The installation procedures for panel and wall mounting are described below.

## 4.3.1 INSTALLING THE 24683B AND 24683C PANEL MOUNTED UNITS

The panel related dimensions for the 24683B and 24683C are:

**Panel thickness:** 24683B = 2mm to 9mm
24683C = 2mm to 20mm

**Aperture:** 24683B = 139mm high × 67mm wide
24683C = 186mm high × 92mm wide

The installation procedure is:

1. Ensure that the panel on which the remote display is to be fitted provides easy access to the electrical connections and is sited in a good viewing position.

2. Cut an aperture in the panel to the dimensions given above and remove any burrs.

3. Remove the clamps (if fitted) from the remote display unit and fit the unit into the aperture from the front of the panel.

4. Refit the clamps to the display unit and secure the unit to the panel.

The two clamps on the 24683B and 24683C each clip onto two metal studs on the case of the unit. Adjust the clamps from the rear of the unit with a suitable flat bladed screwdriver. Tighten the clamps until they press firmly against the panel to hold the unit in place.

## 4.3.2 INSTALLING THE 24683D WALL MOUNTED UNIT

The 24683D Remote Display Unit is contained in an IP65 enclosure that can be fixed to the wall by four mounting brackets. Cables are routed to the internal PCB through glands in the base. The installation procedure is:

1. Place the unit against the surface to which it is to be fixed and mark the positions of the fixing points. These should be positioned on centres 190mm apart horizontally and 305mm apart vertically. Install suitable fixings and secure the unit to the wall.

2. Remove the four screws securing the clear cover of the unit and place the cover carefully to one side.

3. Remove the four screws securing the front panel of the unit and lay the panel, still attached by its ribbon cable, on top of the case.

4. Loosen the cable gland nuts, pass the cables through the glands, prepare the cable terminations, and fit the cable to the terminal block. (See Section 4.4.4 for details.)

5. Ensure that the cables are not strained within the unit, tighten the cable glands, and refit the front panel and clear cover.

# 4.4 ELECTRICAL INSTALLATION

Up to six remote displays may be driven by the Hydrastep 2468 unit. One remote display can be powered from the main unit, but all the others must have a local supply. A remote display has a dual serial data input and a dual power input. When the remote display is powered from the main unit an eight-core cable is required to connect the two units. When a remote display is locally powered, however, a six-core cable will suffice. See the example in Figure 4.4: remote display unit 1 is powered from the main unit and uses an eight-core cable; remote display unit 2 is locally powered and uses a six-core cable. **All cables must be screened to comply with the EMC directive.**

For remote displays powered from the main unit the loop resistance of the power conductors must be less than 27 ohms for an a.c. powered unit or 7 ohms for a d.c. unit. To provide for cable runs of up to 1000 metres, without the use of heavy cables, the main unit and the remote display unit each have internally linked multiple terminals for the power and ground connections. This allows the power and ground lines to be doubled to reduce the loop resistance.

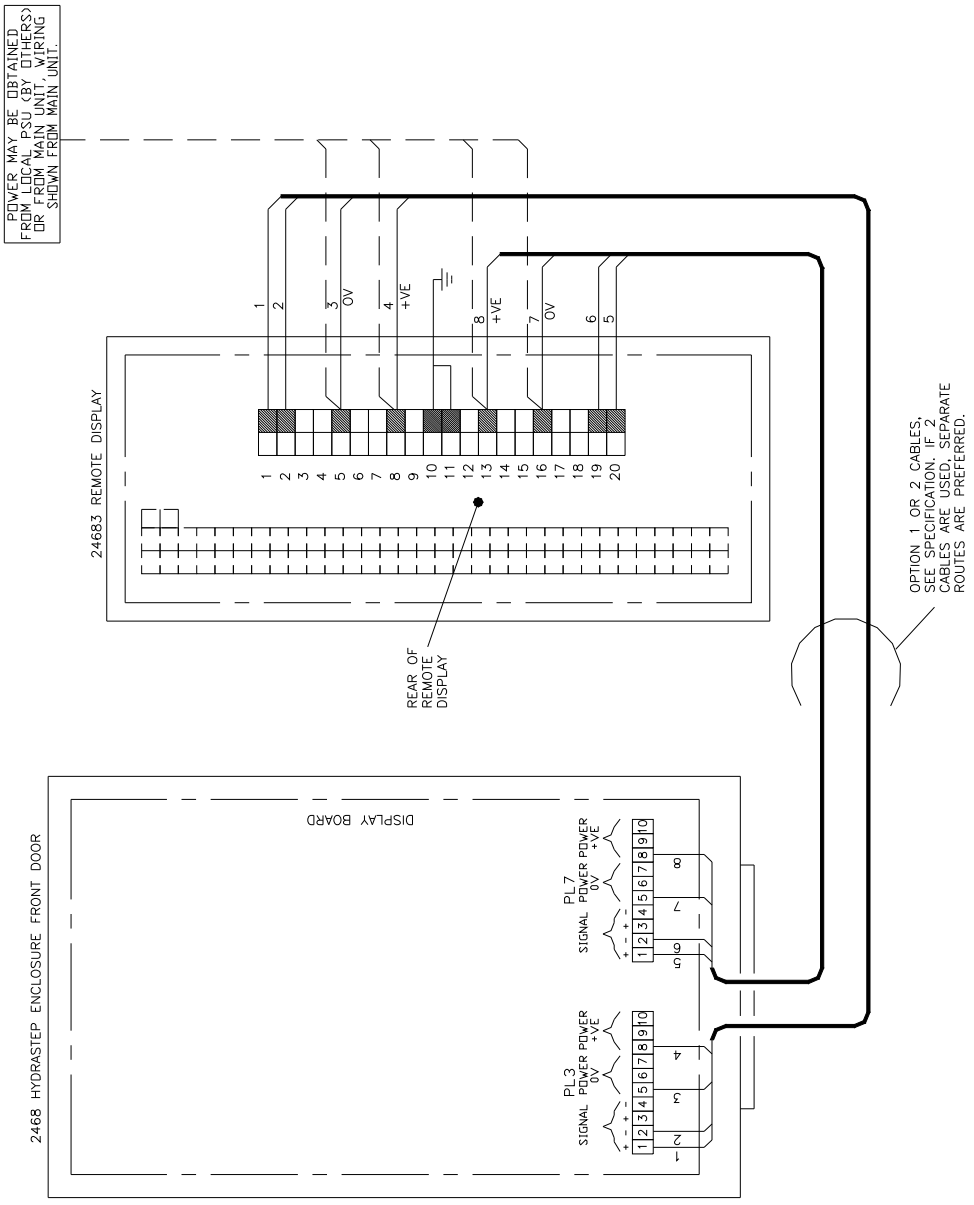



***Figure 4.2 - Interconnection cable for a single remote display***

### 4.4.1 STAR AND DAISY CHAIN CONNECTIONS

Multiple remote display units can be connected to the main 2468 unit in two ways: ‘star’ or ‘daisy chain’. (See Figure 4.3) You can use either or both of these, in whichever way best suits the relative locations of the 2468 unit and the remote displays. The maximum cable length permitted between the 2468 and any remote unit is 1000 metres.

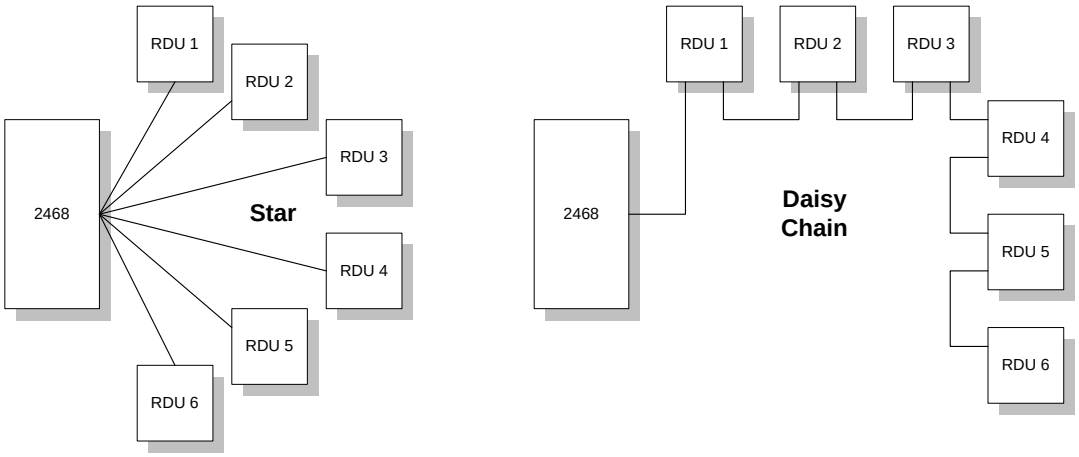



***Figure 4.3 - Star and daisy chain connections of remote displays***

## 4.4.2 EXAMPLE OF A 'STAR CONNECTED' SYSTEM

Figure 4.4 shows two remote displays connected in a 'star'. Where more than one remote display is in use, local supplies with isolated outputs must be used to power the extra unit(s). Up to six remote displays can be supported (less their power requirements): with the full complement of units in use, three signal carrying conductors must be connected to each terminal.

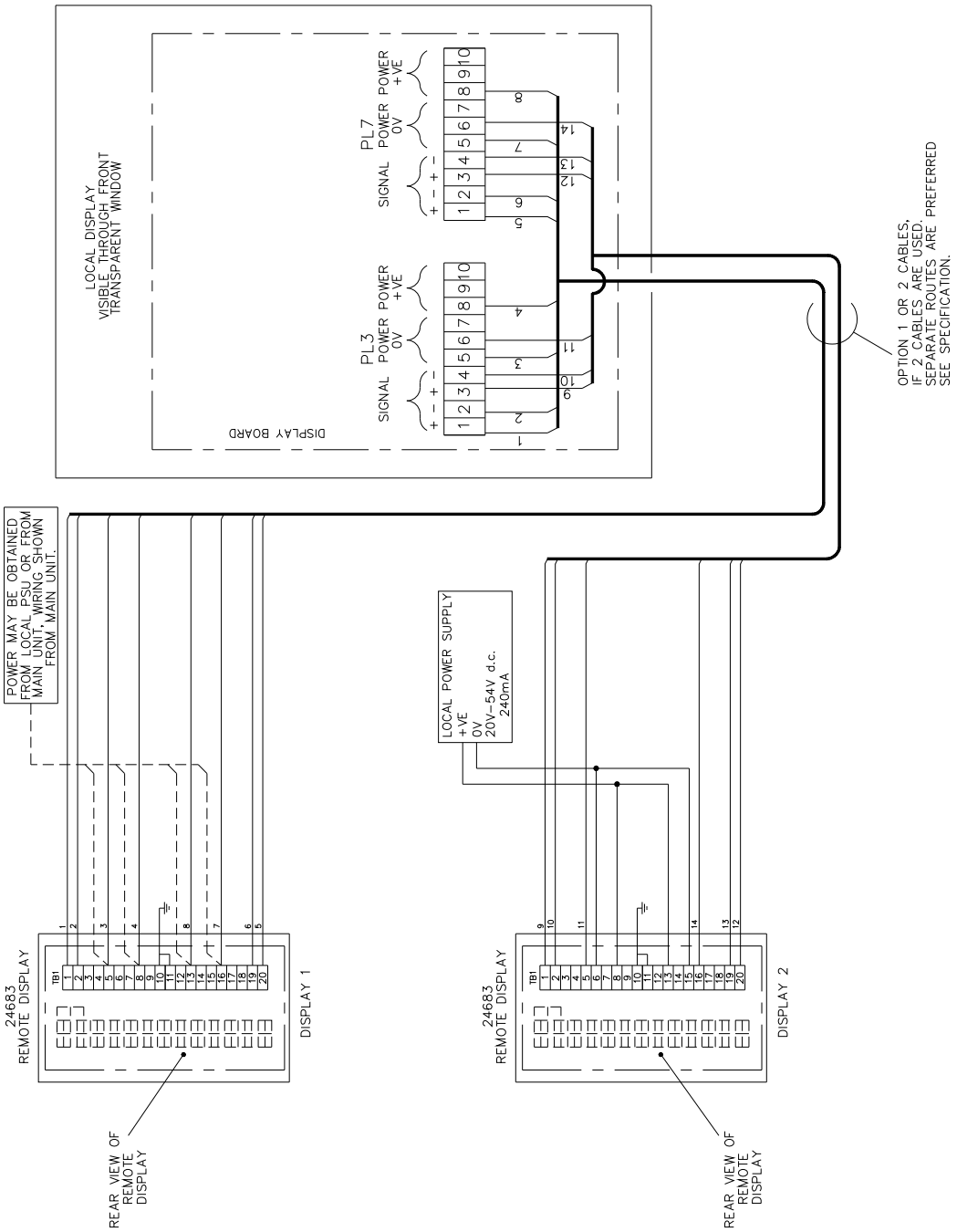



***Figure 4.4 - Star connection example for two remote displays***

## 4.4.3 EXAMPLE OF A `DAISY CHAIN' SYSTEM

Figure 4.5 shows two remote displays connected in a `daisy chain'. Where more than one remote display is in use, local supplies with isolated outputs must be used to power the extra unit(s).

To prevent signal reflections from corrupting the data, it may be necessary to fit termination resistors to the last unit in the chain. The resistor values should match the characteristic impedance of the cable (120Ω, typical). A termination resistor is connected between pins 3 and 4, and 17 and 18, on terminal block TB1. A suitable resistor to use is a ¼W metal film type.

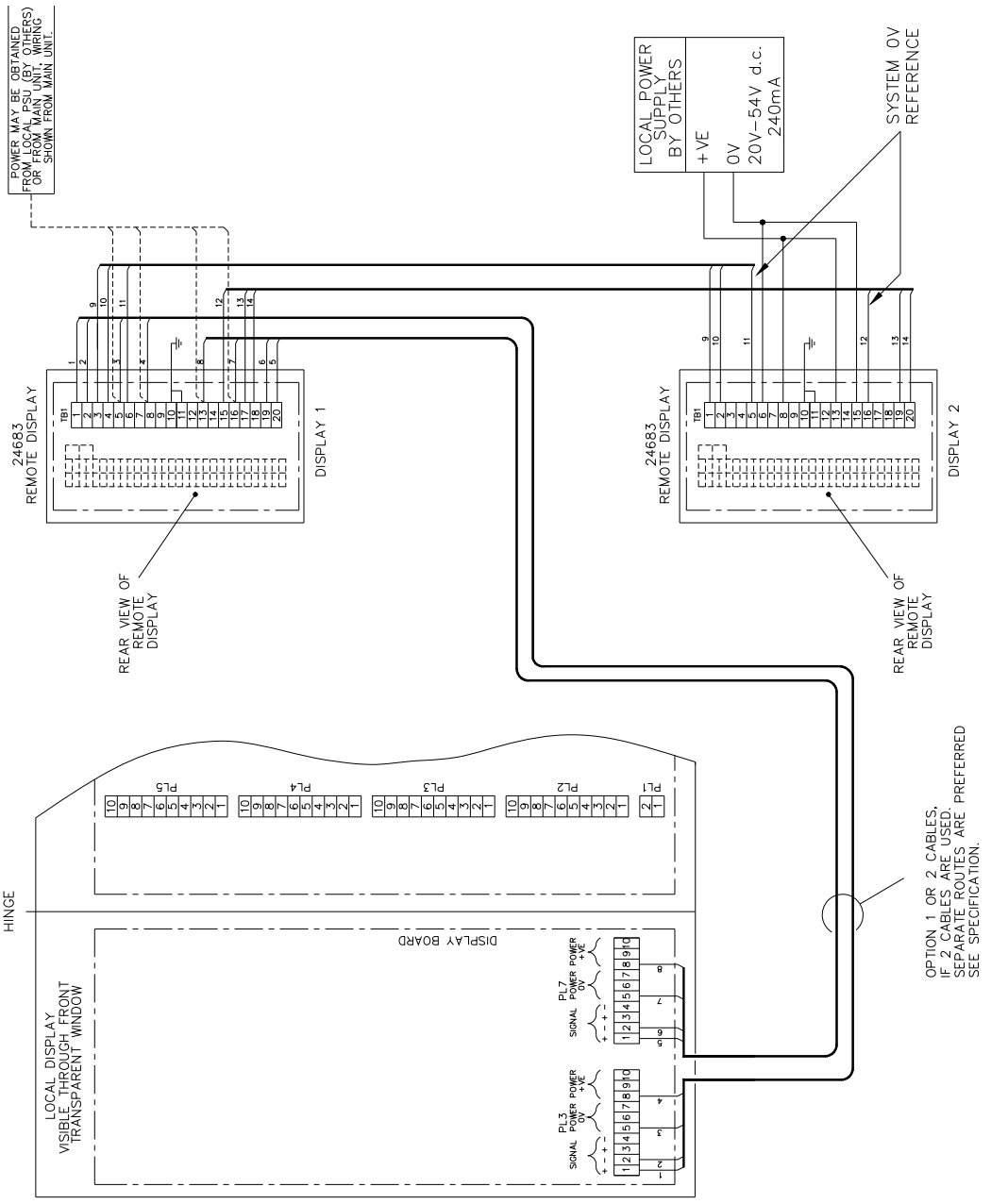



***Figure 4.5 - Daisy chain connection example for two remote displays***

## 4.4.4 CONNECTING CABLES TO THE REMOTE DISPLAY

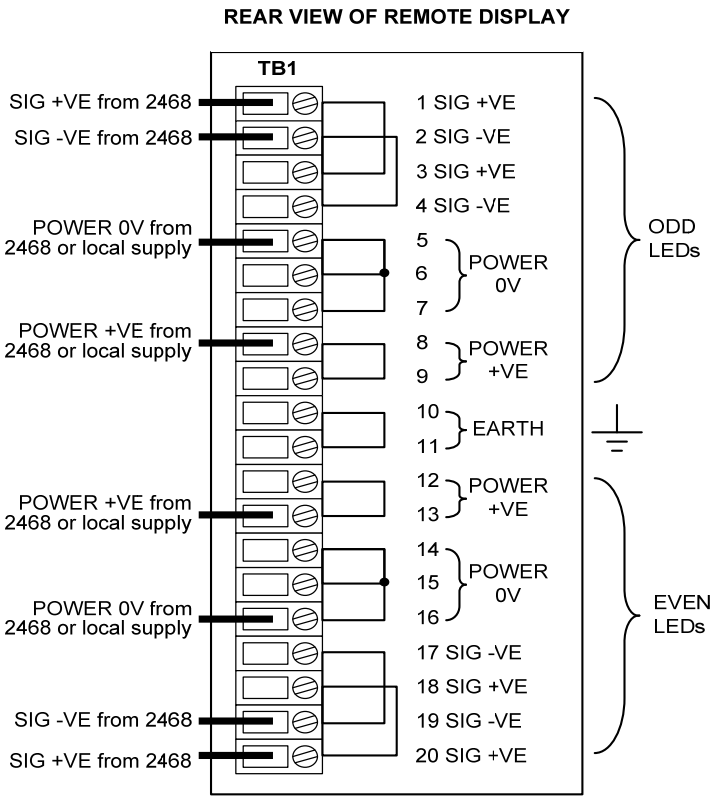
The following procedure can be used for each remote display that is to be connected:

1. Gain access to the remote display terminal block. On the 24683B and 24683C remote displays the terminal block is located at the rear of the unit. The terminal block of the 24683D remote display is located within the unit and must be accessed as described in Section 4.3.2.

2. Prepare the cable ends and fit identity sleeves to the leads.

3. Fit the leads into the respective terminals (see Figure 4.6 for details) and tighten the terminal screws. The interconnections for multiple remote displays are shown in the examples in Figure 4.4 and Figure 4.5.

4. Ensure a stress-free exit for the cable, from the panel, by providing any necessary cable support.




| Terminal | Service |
|---|---|
| 1 & 3 | Signal + VE from 2468 |
| 2 & 4 | Signal - VE from 2468 |
| 5, 6 & 7 | Power 0V from 2468 or local supply |
| 8 & 9 | Power + VE from 2468 or local supply |
| 12 & 13 | Power + VE from 2468 or local supply |
| 14, 15 & 16 | Power 0V from 2468 or local supply |
| 17 & 19 | Signal - VE from 2468 |
| 18 & 20 | Signal + VE from 2468 |
| 10 & 11 | Earth |

**Figure 4.6 - Cable connection details for the remote display**

## 4.4.5 CONNECTING THE DISPLAY CABLES TO HYDRASTEP 2468

**WARNING**: Mains voltages are present in the 2468 Hydrastep unit when power is connected. De-energise before opening the front cover.

The connection procedure is:

1. Ensure a stress-free cable run between the remote display unit and Hydrastep 2468.

2. Gain access to the display board in the 2468. The cable from the remote display requires connecting to connectors PL3 and PL7 on PCB 24680515.

3. Enter the cable through the gland port in the 2468 enclosure (if this is applicable) and ensure a stress-free run inside the enclosure.

4. Prepare the cable ends, fit identity sleeves on the leads and connect them to their respective terminals. See the example in Figure 4.5.

5. Ensure that the cable screen is grounded at the gland plate.

## 4.5 SYSTEM OPERATION

When the system is brought on line check for complete agreement between the remote display and the Hydrastep level indicator display.

## 4.6 FAULT ANALYSIS AND CORRECTIVE ACTION

| Indication | Fault | Analysis and Corrective Action |
|---|---|---|
| No display of odd LEDs (including bottom half of fault LED. | Loss of power to remote display unit. | Check that the wiring to connector PL1 in the remote display unit is correct.<br>With a suitable meter, check that the supply voltage is present at the remote display unit connector. Ensure that the voltage is in the range 14V through 45Vdc.<br>If the unit is locally powered and no voltage is present check the voltage at the local power source.<br>If the unit is powered from the 2468 electronics unit check the voltage between pins 5 and 8 of PL3 on the display board (24680502) of that unit. A voltage of less than 14Vdc indicates the possibility of a short circuit in the power lines or a fault on the display board. Disconnect connector SK3 from the display PCB in the 2468 electronics unit and re-check the voltage between pins 5 and 8 of PL3. If the voltage is less than 18Vdc then the display board in the 2468 electronics unit may be faulty. Replace this board with a serviceable item and check for the correct voltage between pins 5 and 8 of PL3. |
| No display of even LEDs (including top half of fault LED). | Loss of power to remote display unit. | Check that the wiring to connector PL2 in the remote display unit is correct.<br>With a suitable meter, check that the supply voltage is present at the remote display unit connector. Ensure that the voltage is in the range 14V through 45Vdc.<br>If the unit is locally powered and no voltage is present check the voltage at the local power source.<br>If the unit is powered from the 2468 electronics unit check the voltage between pins 5 and 8 of PL7 on the display board (24680502) of that unit. A voltage of less than 14Vdc indicates the possibility of a short circuit in the power lines or a fault on the display board. Disconnect connector SK3 from the display PCB in the 2468 electronics unit and re-check the voltage between pins 5 and 8 of PL7. If the voltage is less than 18Vdc then the display board in the 2468 electronics unit may be faulty. Replace this board with a serviceable item and check for the correct voltage between pins 5 and 8 of PL7. |

***Table 4.1 - Fault Analysis and Correction Chart***

| Indication | Fault | Analysis and Corrective Action |
|---|---|---|
| Bottom half of fault LED illuminated and odd LEDs flashing at 1Hz, or odd LEDs off. | Power present, but loss of serial data. | Check that the wiring to connector PL1 in the remote display unit is correct.<br>If wiring is correct, proceed as follows:<br>1. If a termination resistor is fitted, disconnect this from the end of the daisy chain.<br>2. With an ac voltmeter, check the ac voltage between pins 1and 5, and pins 2 and 5, on PL1.<br>3. An ac voltage is less than 1V indicates a fault on the signal transmission lines. Check back to the previous remote display in the daisy chain or to the 2468 electronics unit, as appropriate. If the correct ac voltages are present at this location then a line break is indicated.<br>4. If the ac voltages are still low then either the lines are short-circuited or there is a board fault. Disconnect the remote displays upstream and re-check the ac voltages. If there is a voltage of less than 1Vac at the 2468 electronics unit (with PL3 removed) then the display board is faulty. Remove this board and fit a serviceable item. |
| Bottom half of fault LED illuminated and even LEDs flashing at 1Hz, or even LEDs off. | Power present, but loss of serial data. | Check that the wiring to connector PL2 in the remote display unit is correct.<br>If wiring is correct, proceed as follows:<br>1. If a termination resistor is fitted, disconnect this from the end of the daisy chain.<br>2. With an ac voltmeter, check the ac voltage between pins 1and 5, and pins 2 and 5, on PL2.<br>3. An ac voltage is less than 1V indicates a fault on the signal transmission lines. Check back to the previous remote display in the daisy chain or to the 2468 electronics unit, as appropriate. If the correct ac voltages are present at this location then a line break is indicated.<br>4. If the ac voltages are still low then either the lines are short-circuited or there is a board fault. Disconnect the remote displays upstream and re-check the ac voltages. If there is a voltage of less than 1Vac at the 2468 electronics unit (with PL7 removed) then the display board is faulty. Remove this board and fit a serviceable item. |

***Table 4.1 (cont.) - Fault Analysis and Correction Chart***

| Indication | Fault | Analysis and Corrective Action |
|---|---|---|
| Flickering Display | Corruption of signal data | Most probably caused by bad shielding (screening) of the remote display cabling or by bad shield connections to ground.<br><br>Check shielding and shield connections. Ensure that only one end of the cable shield is connected to ground.<br><br>If several remote displays are 'daisy chained' together then a termination resistor may be required on the end display. (See Section 4.4.3 in this chapter.) |
| Chequered pattern on red and green LED display | Wrong setting of 'Number of Electrodes' switch on 2468 display board. | Refer to Section 2.3 in Chapter 2 and ensure that the switch is set correctly. If the display still shows a chequered pattern then a circuit fault exists on the 2468 display board. Remove this board and fit a serviceable replacement. |
| On/off pattern on red and green LEDs. | Wrong setting of 'Number of Electrodes' switch on 2468 display board, or wrong setting of links LK1, LK2, LK3 and LK4 on the 24683BB decoding pcb. | As above.<br><br>If a fault is not found, check the link setting on the 24683BB and reset the links if necessary. |
| Indication not displayed for lower electrodes. | As above. | As above. |
| Each electrode represented by only one LED when 16 or less electrodes are used. | As above. | As above. |
| LEDs display an irregular red/green pattern. | As above. | As above. |

***Table 4.1 (cont.) - Fault Analysis and Correction Chart***

# 4.7 COMPONENT REPLACEMENT

Hydrastep remote display units contain no user-replaceable electronic components. Board failure requires the faulty PCB to be removed and returned for service and a serviceable PCB to be fitted in its place. A list of replacement parts is given in Table 4.2.

The procedure for replacing a PCB in a remote display is:

1. Ensure that the Hydrastep 2468 unit is switched off.

2. Gain access to the interior of the remote display unit. The method depends on the type of remote display being serviced:

   **For a 24683B:** Remove the cables from terminal block TB1 at the rear of the unit. Remove the clamps. Withdraw the unit from the front of the mounting panel and lay on a clean surface. Pull off the bezel from the unit front panel, unscrew and remove the side panel, and lift off the front and rear panels, and use a suitable flat bladed screwdriver to prise apart the PCB interconnecting edge connectors. Both PCBs can now be removed from their securing slots in the unit case.

   **For a 24683C:** Remove the cables from terminal block TB1 at the rear of the unit. Remove the clamps. Withdraw the unit from the front of the mounting panel and lay on a clean surface. Remove the front and rear panels. Both PCBs can now be removed from the unit case.

   **For a 24683D:** Remove the unit clear cover and the front panel. The LED display and the decode PCB can now be accessed and it can easily be seen which screws and connections it is necessary to remove in order to remove the faulty board(s).

3. Fit the serviceable PCB(s), following the reverse order to that given in step 2.

| Item | Mobrey Part Number |
|---|---|
| ***For 24683B:*** | |
| LED PCB assembly | 24680514A |
| Decode PCB assembly | 24680513B |
| Header (for 8-16, 18-32 electrode operation) | 399100390 |
| Holding bar (two off, with two knurled knobs) | 460202260 |
| ***For 24683C:*** | |
| LED PCB assembly | 24680519A |
| Decode PCB assembly | 24680520A |
| Header (for 8-16, 18-32 electrode operation) | 460202260 |
| ***For 24683D*** | |
| LED PCB assembly | 24680521A |
| Decode PCB assembly | 24680522A |
| Header (for 8-16, 18-32 electrode operation) | 460202260 |

***Table 4.2 - Remote Display Replacement Parts***

# 4.8 SPECIFICATION

## REMOTE DISPLAY UNITS

**INDICATION** Red/green 6mm×3mm LEDs

**CASE STYLE** 24683B and 24683C: Panel mounting;
24683D: Rugged enclosure, to IP65/NEMA 4X

**DIMENSIONS** 24683B: 144mm×72mm×200mm deep (5.67”×2.83” ×7.87”)
24683C: 192mm×96mm×209mm deep (7.56”×3.7” ×8.23”)
24683D: 302mm×186mm×175mm deep (11.89”×7.32” ×6.89”)

**PANEL CUT-OUT** 24683B: 139mm×67mm
24683C: 186mm×92mm (7.32”×3.62”)

**POWER SUPPLY** Derived from 2468 electronics unit or 20V - 54Vdc, 240mA
Absolute maximum limits at remote display terminals: 16V to 60Vdc

**TERMINALS** Screw-clamp

## CABLES

**Note:** The following cables fulfil the minimum requirements. Heavier cables may be used. Maximum gauge accepted by connectors is 16AWG (1. 5mm$^2$).

| **Powered from 2468 electronics (up to 1000m from 2468 unit) BASEEFA conformity*** | **1.5mm$^2$, 7×0.53mm individually shielded, 5-pair. Overall shield. Galvanised steel wire armour. One cable required. (Mobrey Part No.480121230)** |
|---|---|
| Unit locally powered (up to 1000m from main unit) | 22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 2-pair twisted (Belden type No. 8723). Two cables required.<br>22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 3-pair twisted (Belden type No. 8777). One cable required. |
| Powered from 2468 electronics (up to 250m from 2468 unit) | 22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 2-pair twisted (Belden type No. 8723). Two cables required.<br>22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 4-pair twisted (Alpha Wire type No. 6054C). One cable required. |
| Powered from 2468 electronics (up to 500m from 2468 unit) | 22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 3-pair twisted (Belden type No. 8777). Two cables required.<br>22 AWG (0.324mm$^2$, 7×0.25mm) individually shielded, 6-pair twisted (Belden type No. 8778). One cable required. |
| Powered from 2468 electronics (up to 1000m from 2468 unit) | 18 AWG (0.826mm$^2$, 16×0.25mm) individually shielded, 3-pair twisted (Belden type No. 9773). Two cables required.<br>22 AWG (0.826mm$^2$, 16×0.25mm) individually shielded, 6-pair twisted (Belden type No. 9774). One cable required. |

***** The main Hydrastep 2468 unit is approved for operation in a hazardous environment to EExnA T4. Compliance with this approval requires that armoured cable is used to connect a remote display to the main unit. A remote display must not be used in a hazardous environment.

mobrey

# Hydrastep Pressure Parts

## Operating Manual

| | |
|---|---|
| Part No: | 24675030 |
| Status: | B |
| Issue: | A |
| Authors: | J. Smith / M. Le-Fevre / RCD |
| Date: | March 2006 |

# About this manual

This manual describes various procedures involved in the installation of the Hydrastep water columns, their attachments and the electrodes used in determining the level of water in the column.

## Part 2 - Pressure Parts

Chapter 1 is a general introduction to the Hydrastep system of water level determination.

Chapter 2 describes the water column and its components. The preparation, installation of the water column on to the boiler, acid and steam purging of the boiler system and the fitting of the electrode sensors.

Chapter 3 details the fault repair procedures carried out on the system pressure parts and their commissioning.

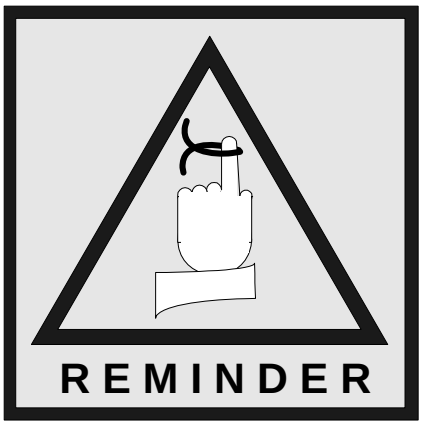
Chapter 4 provides a general description of the pressure parts used in the Hydrastep systems.

Chapter 5 details the Pressure Parts specifications.

***CAUTION: The procedures described in this manual do not overrule any mandatory regulations and procedures applied on site regarding the installation, testing and safety precautions affecting the specific Hydrastep System.***

The objective of this manual is to describe various procedures involved in the installation of the water columns, their attachments and the electrodes used in determining the level of water in the column as required by the following Hydrastep Systems.

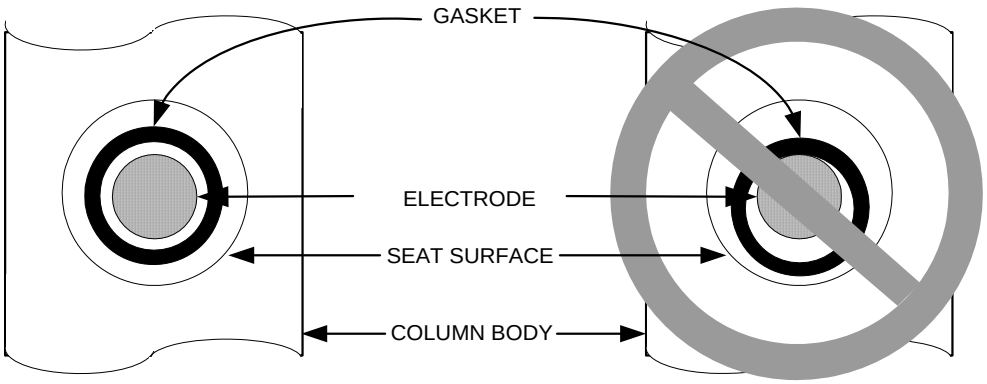
Commissioning the water column and limited component repair procedures on the system pipework are also covered.




# ELECTRODE INSTALLATION

**THREADED ELECTRODE(S), PART Nos. 459600602 & 459600802**

MAKE SURE THAT THE COMPRESSION GASKET IS REGISTERED IN THE PROBE RECESS PRIOR TO TIGHTENING THE ELECTRODE. THIS CENTRES THE GASKET TO THE PROBE.




**CORRECT** **INCORRECT**


**THE HYDRASTEP VESSEL AND PROBE SYSTEM PROVIDES A SELF-FLUSHING FEATURE THAT PREVENTS THE ACCUMULATION OF DEBRIS IN THE VESSEL.**

**THIS ELIMINATES THE NEED FOR PERIODIC BLOWING DOWN OF THE VESSEL.**

**DO NOT BLOW DOWN THE HYDRASTEP VESSEL IF A BLOCKAGE IS SUSPECTED.**

**REFER TO THE APPROPRIATE MANUAL SECTION FOR PROPER DIAGNOSTIC PROCEDURES IF BLOCKAGE PROBLEMS ARE SUSPECTED.**

# Part 2 - Hydrastep Pressure Parts

# 1
# General Introduction



### Illustrations

## 1.1 PRINCIPLE OF OPERATION

The Hydrastep systems have been designed as electronic alternatives to conventional visual water gauges on boilers, giving more reliable and safer water level indication.

The system is based on the significant differences in resistivities of water and steam over the range 100°C (212°F) to 370°C (698°F). (Series 3 super-critical components are used up to 560°C, 1040°F)

A vertical row of electrodes is installed in the water column which forms a side arm attached to a boiler arid aligned, typically, such that an equal number of electrodes appear above and below the normal water level, see Figure 1.1. The resistance measurement is made between the insulated tip of the electrode and the wall of the column. The *cell constant*, defining the actual resistance measured, is determined by the length and the diameter of the electrode tip and the water column bore. In practice, the *cell constant* is chosen so that the resistance in water is less than 100k ohms, with a consequent resistance in steam of greater than 10M ohms.

Since the resistivities of water and steam are substantially different, the system is simple and requires minimum setting up adjustments. It is not critical in terms of power supply variations, ambient temperature changes, etc., resulting in a highly reliable system.

Figure 1.1 shows the resistance-measuring cell complete with installed electrode. Figure 1.2 and Figure 1.3 show examples of the Low Pressure (120bar, 1740p.s.i.) and the Series 3 and Super 3 High Pressure (210bar, 3045p.s.i. & 300bar, 4350p.s.i.) Water Columns respectively.

## 1.2 WATER LEVEL INDICATION

Each electrode is connected to its own electronic measurement channel where the resistance value measured decides which of two Light Emitting Diode (LED) drive circuits is energised. The LEDs are presented in two columns, one column of **green** LEDs (illuminated for water) and one column of **red** LEDs (illuminated for steam) indicating the water level.

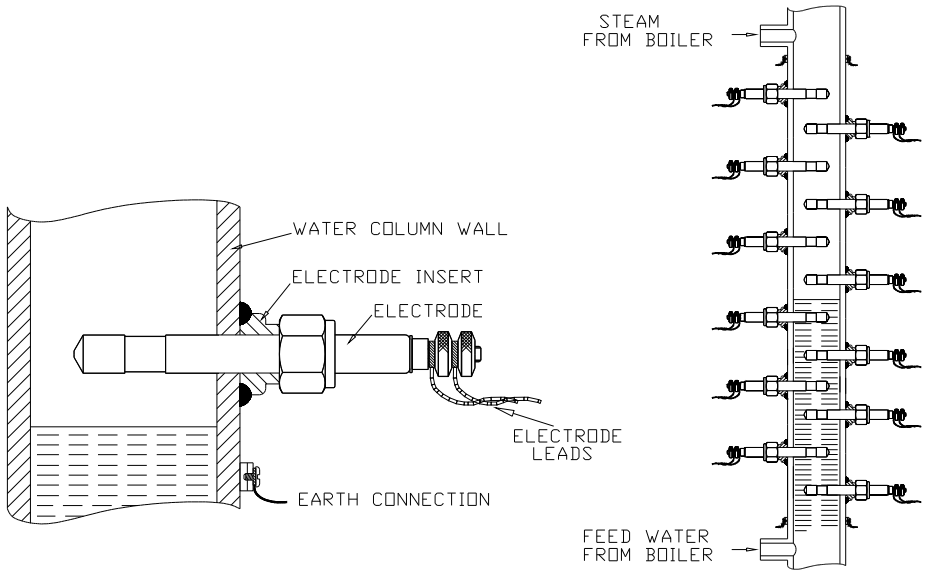



***Figure 1.1 - Schematic of high pressure resistance measuring cell and electrodes***

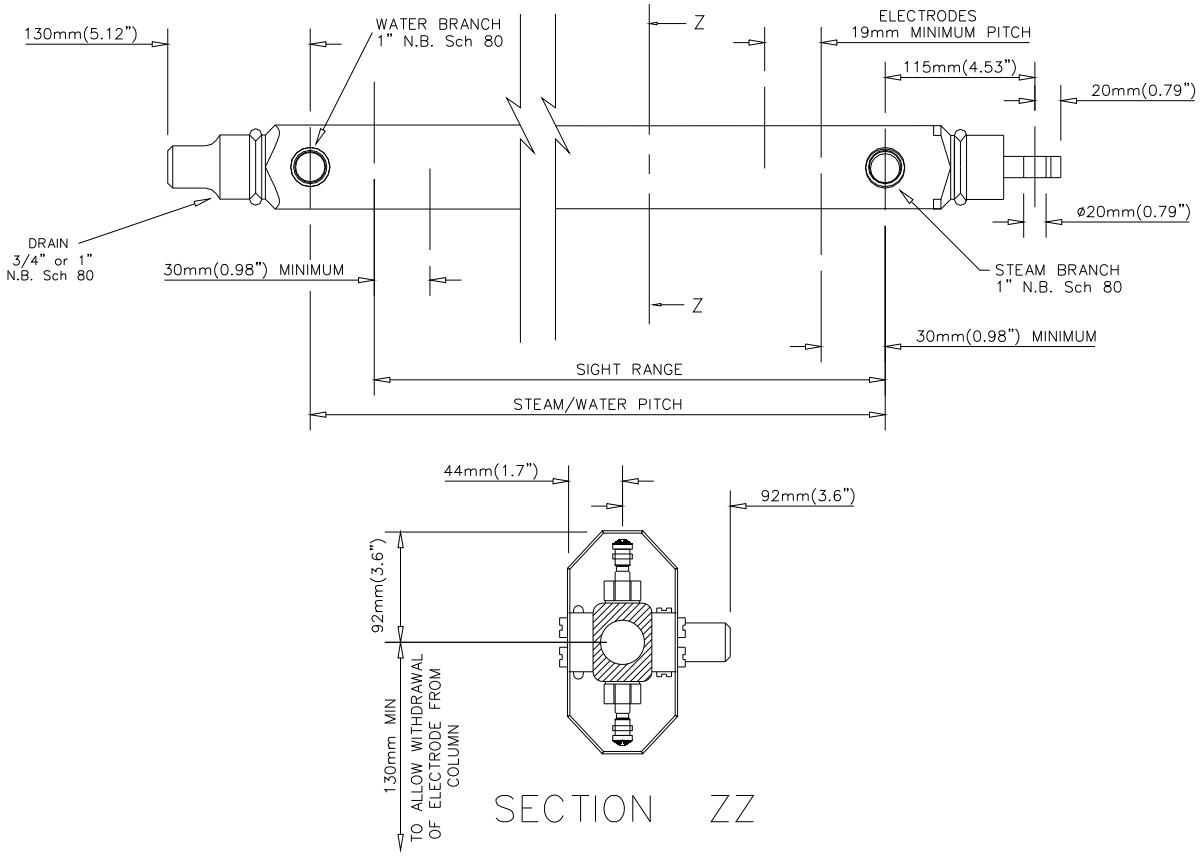



***Figure 1.2 - Low pressure water column (120bar, 1740psi)***

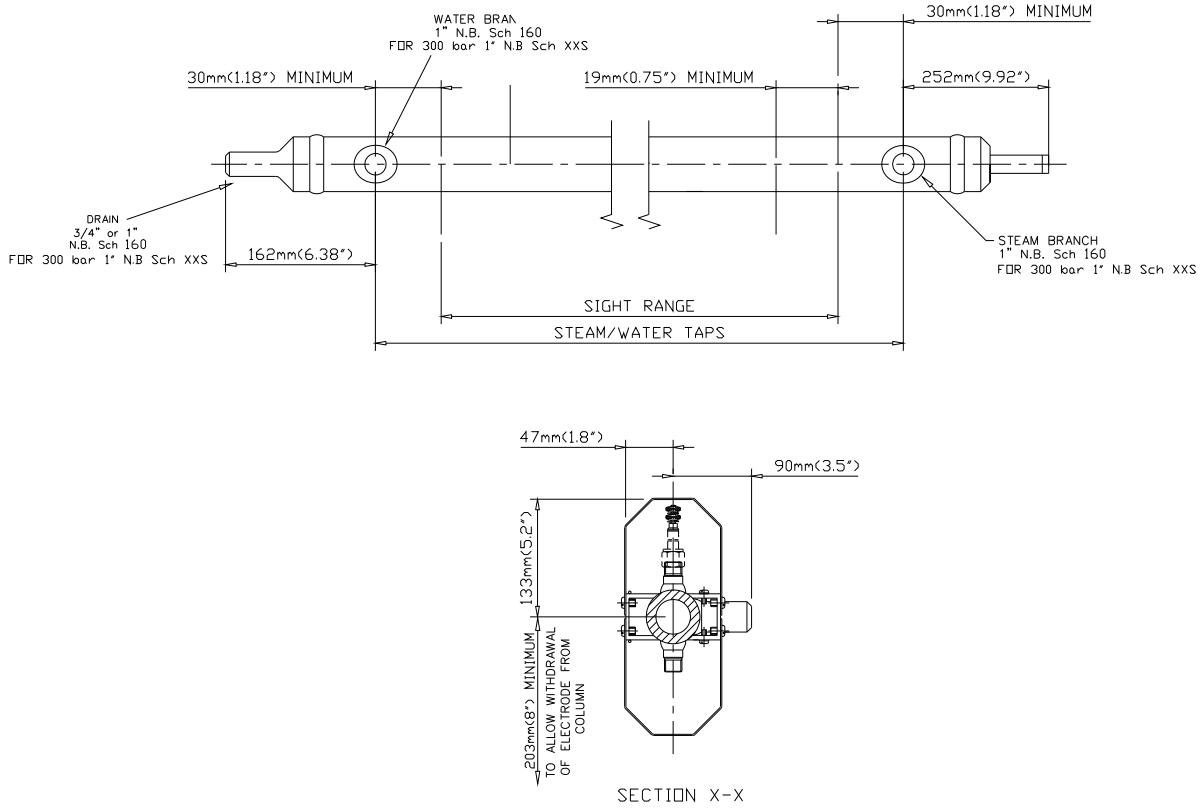



***Figure 1.3 - High pressure water column (210 bar, 3045psi and 300 bar, 4350psi)***

# 2
# Installation Procedures

## Contents



## Illustrations

## 2.1 SCOPE OF PROCEDURES

The procedures apply to the Hydrastep Boiler Drum Water Level Equipment supplied by Mobrey, who are responsible, under their supply contract, for delivery of all items of the above equipment listed in the delivery schedules.

Mobrey are not responsible for handling, storage, installation and protection of equipment on-site. However, the procedures define the requirements for these activities which must be complied with to allow Mobrey to meet their contractual obligations for the efficient performance of equipment supplied by them.

The items of equipment are listed in detail on the 'Packing Note' that is issued with the equipment to the site.

## 2.2 STORAGE

### 2.2.1 AMBIENT CONDITIONS

The storage area must be dry, dust-free and under cover. Storage conditions should be controlled within the temperature range of 10°C to 40°C (50°F to 104°F) with a maximum of 80% R.H.

### 2.2.2 PHYSICAL PROTECTION

The equipment shall be stored, where possible, in the original or robust packages to prevent accidental mechanical damage. The equipment shall be stored on shelving or racks above ground level as further protection from mechanical damage and to eliminate dampness.

### 2.2.3 INSPECTION

If the equipment is to be stored for a long period, suitable access is to be provided so that regular inspection can take place. These inspections should check for signs of physical deterioration, and should take place at least every three months.

### 2.2.4 HANDLING PRECAUTIONS

The water columns are heavy and lifting equipment suitable for hoisting up to 50kg should be used, both for inspection and carriage. The electrodes should be handled with considerable care, both for inspection and installation. The electronic units should be protected from electrostatic damage, induced via signal input terminals.

## 2.3 INSTALLATION OF WATER COLUMN

The Water Column is delivered with all electrode ports fitted with plastic inserts. These inserts should not be removed until the electrodes are due to be installed.

The water column is delivered along with the correct number of electrodes of the relevant pressure type (high or low) and complete with gaskets or ferrules and fixing nuts, where applicable. The electrodes should only be fitted to the column after all erection and electrical work is completed and the water column is ready to be commissioned.

**Caution:** It is essential that the electrodes are NOT fitted until the acid and steam purging of the boiler drum has been completed. However, if it is essential that the Hydrastep be used to gauge the water level during acid cleaning, a sacrificial set of electrodes must be used for this task with a new set of electrodes provided for installation before normal operation is started. **Sacrificial electrodes should be discarded.**

The water column is provided with a lifting eye at its upper end to be used for support from the local site superstructure.

Before fitting the water column, the following points must be checked:

a) Ensure that access to work on this part of the plant is clear and that the Column isolating Valves have been fitted to the Steam and the Water connections on the Drum and are ready to have the water column welded to them. All steam isolation valves should be fitted with their spindles horizontal.

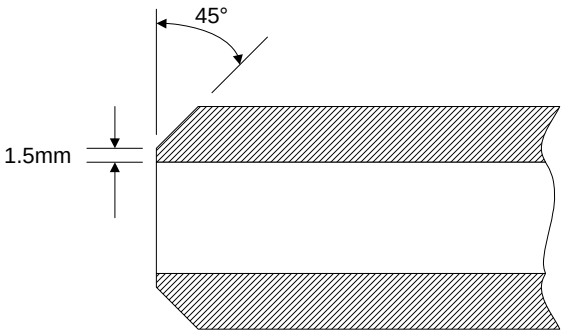
b) Check that items of hardware required for supporting the water column are available and that the suspension points on the superstructure have been installed.

c) Water columns are normally supplied with a lifting/support eye, but where this is not the case, alternative support must be provided.

d) The water column and associated pipework are secured to resist sympathetic vibrations from surrounding plant.

e) Ensure that the relevant installation diagrams, support services including that of an approved welder, and suitable welding plant are available.

**Note:** All joints in pipework must be welded, tested and inspected in accordance with the approved welding procedure documents. Ideally, this should be to ASME B & PVC Section IX Welding Qualifications, but Local Regulations may otherwise apply. To minimise errors due to temperature difference between the water in the boiler drum and the water in the Hydrastep column, the length of the pipework between the drum and the Hydrastep column should not exceed 2 metres. Paths should be as straight and direct as possible.




| | | |
|---|---|---|
| For HP (210 bar) | Material: | SA106B |
| | Size: | 1" N.B, Sch. 160 pipe dim. |
| For HP (300 bar) | Material: | SA479 - 316 |
| | Size: | 1" N.B, Sch. XXS PPE |
| For LP | Material: | SA106B |
| | Size: | 1" N.B, Sch. 80 pipe dim. |

***Figure 2.1 - Universal weld profile***

The Steam and Water connections on the water column must be set to position the water column at the correct level before they are welded in place, Figure 2.2 gives an example of the water column installation. Normally, the water level of the drum will be between electrodes 6 and 7 for a twelve port water column. However, due to the physical or operating conditions, this could be offset. The steam leg must slope downwards to the water column with a minimum gradient of 1 in 50 to ensure condensate circulation. The water leg must slope downwards to the drum to prevent water from being trapped at the bottom of the water column.

**Caution:** Care must be exercised to ensure that the pipework is not allowed to take the unsupported weight of a standard water column. The weight of the column and its associated pipework are fully supported - there must not be any load on the welded pipework attachment points.

Installation should commence with the support of the column, see Figure 2.3. The water column is attached to the supports which will carry the weight of the water column and allow it to be accurately aligned with the drum steam and water connections before and during the welding operation.

After the welding to the connecting pipework, valves and the fitting of the drain pipework is complete, a further check on the level alignment must be carried out and adjustments made, if necessary.

The water connection to the water column must be fully insulated by lagging. The steam connection must also be lagged, but a minimum length of 0.5 metre of the steam leg must be left unlagged where the steam leg joins the water column (see Figure 2.2).

Lagging the water column will reduce the density error, provided that 0.5 metre minimum of the steam leg is left unlagged.

If errors in the water level indication are observed, it may be necessary to lag the water column, either up to NWL or for it's full length, depending on the ambient conditions prevailing at the site. Suitable lagging, part number 450601450, is available from Mobrey.

When the installation of the water column has been completed, precautions must be taken to protect it against damage during the installation of adjacent plant and pipework.

**Note:** Particular attention must be paid to the protection of the electrode sealing surfaces in the column against foreign bodies or weathering. For this purpose the following sealing plugs should be fitted as appropriate:

| | |
|---|---|
| L.P. Sealing Plug | Part No. 24569A |
| Series 3 Sealing Plug | Part No. 450600880 |

**Caution:** If there is any possibility of the ambient temperature at drum level falling below zero °C for any period when the boiler is not operational, it is ESSENTIAL that the water column is isolated, drained and vented to prevent ice-expansion damage to the electrodes in the column. Ice-expansion damage can also affect adjacent valves.

For instructions regarding the assembly of electrodes in the water column, see Chapter 3, sub-section 3.1.4 (low pressure electrodes) and 3.1.5 (high pressure electrodes).

## 2.4 INSPECTION OF MECHANICAL INSTALLATION WORK

When the mechanical installation work has been completed, the site surveillance staff may be required to inspect the work and the equipment, such as the installation of the electronics unit and the installation of the water column, checking particularly the level relative to the drum, before releasing it for electrical work and cabling.

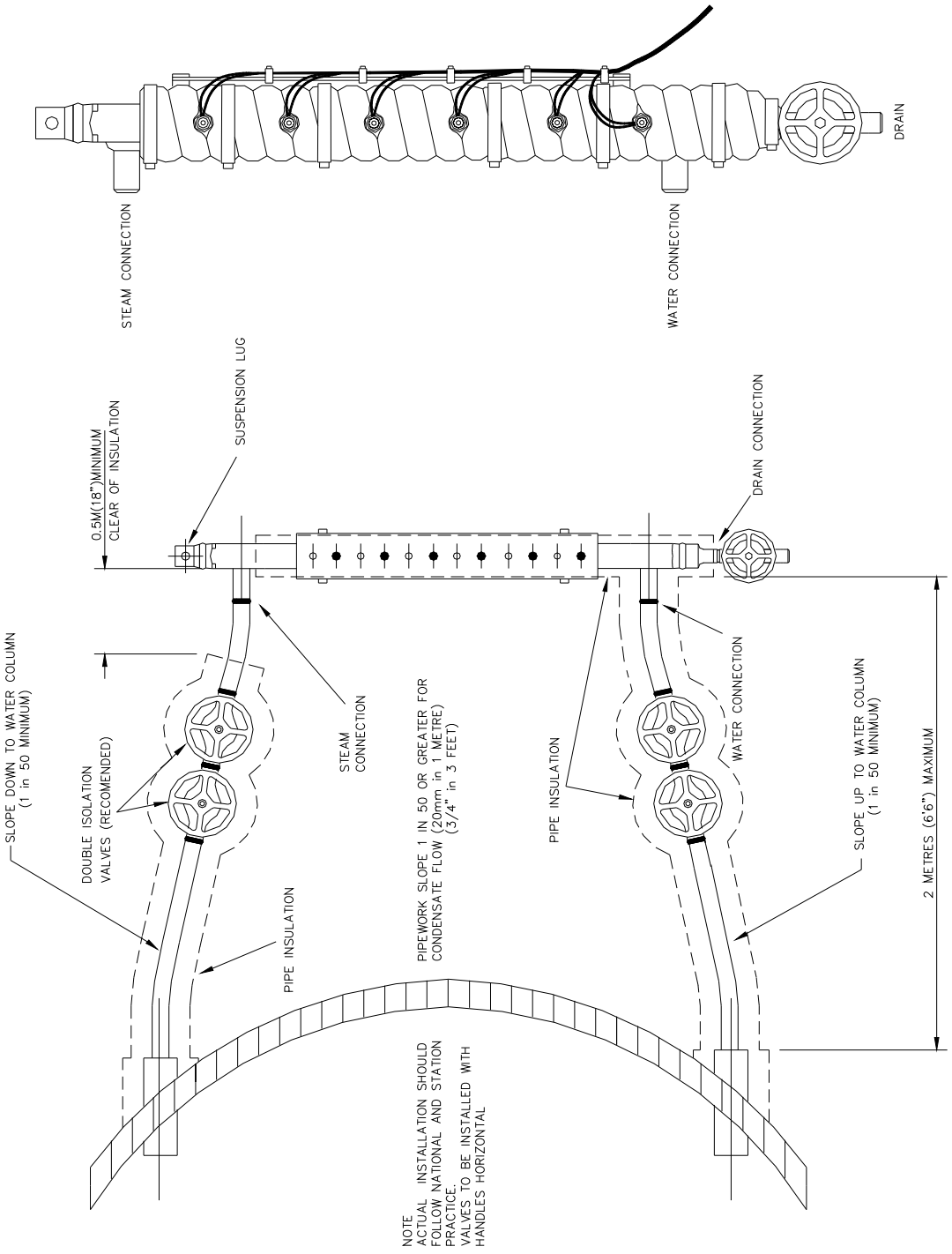



***Figure 2.2 - Typical water column installation, showing optional column lagging.***

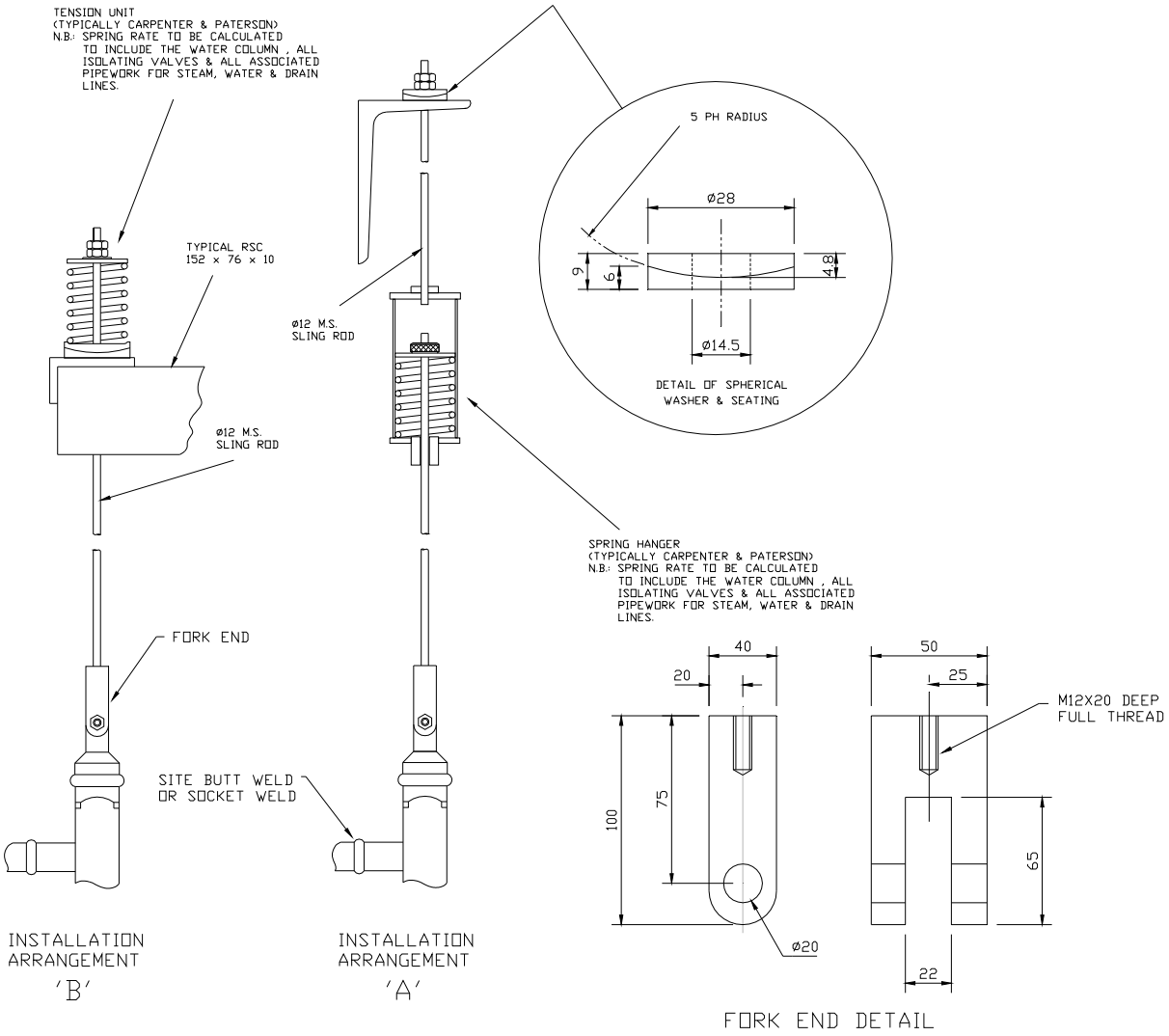



***Figure 2.3 - Typical water column suspension***

# 3
# Fault Repair and Commissioning

## Contents



**Note:**

THERE IS NO NEED TO BLOW WATER COLUMN DOWN WHEN COMMISSIONING. THE SYSTEM CONTINUOUSLY FLUSHES THE WATER COLUMN.

# 3.1 BACKGROUND

With any steam/water detection gauge, a partial blockage or leak within the pressurised system may result in incorrect water level indication. The Hydrastep water column design is such that density errors in water level indication (due to the water temperature in the column being lower than the water temperature in the boiler drum) are minimised for the temperatures and pressures specified. This is achieved by stimulating condensate flow in the upper part of the column by omitting lagging on the column steam pipe. The flow of condensate maintains the temperature of the water column close to that of the boiler drum.

**Caution:** If a serious “blow” occurs, immediate attention is required. Ensure that the column or manifold is VALVED OFF AS SOON AS POSSIBLE otherwise any resulting electrode seat erosion may require the removal of the column or manifold for re-machining of the ports. Site machining of the water column is possible and satisfactory results can usually be obtained (for small leak damage).

## 3.1.1 SAFETY PRECAUTIONS 

a) Ensure that tripping, where fitted, is disabled and that the operators are briefed to expect erroneous indications or alarms.

b) Ensure that you know the valve positions and other procedures BEFORE working on the water column.

c) Allow the water column to cool before changing electrodes and check for signs of steam at the drain to ensure complete isolation.

d) Wear industrial gloves to change electrodes.

e) On Low-level Tripping Schemes, either electro-mechanical interlocks or recognised procedures MUST be applied to ensure that draining the column does not cause a spurious trip.

f) Refit the electrode covers before pressurising the column.

g) It is strongly recommended that a ‘HOT’ notice is attached to the water column in a prominent position.

h) Ensure that all safe working practices for the media and processes concerned are followed during the installation and maintenance of the equipment.

i) If the equipment is likely to come into contact with aggressive substances, it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection both mechanical and electrical are not compromised.

j) The equipment, both mechanical and electrical, must not be used as a support for other equipment or personnel.

k) Both mechanical and electrical content of the system must be protected from impact.

l) The Hydrastep installation is not protected by integral over pressure relief valves. Where fitted directly to a boiler installation, ensure the Hydrastep water column and associated pipework are protected from over pressurisation by the boiler safety valves.

## 3.1.2 WATER COLUMN ISOLATION

After obtaining authority to isolate the column:

a) Close off the steam and water isolating valves.

b) Where the column is connected to a closed drain, open the drain valve and, when the pressure equalises, close the drain valve.

c) Check for no-pressure condition of water column. A failure to cool and a re-filling of the water column would indicate a pressure condition. Alternatively, carefully unscrew the first electrode and look out for the presence of steam.
**Warning:** Great care is required during the check on the first electrode.
Where a separate atmospheric drain is used, open the drain valve and leave it open.

d) Proceed with the work required.

## 3.1.3 ELECTRODE AND ELECTRODE SEAL LEAKS

The distinction between electrode/insert seal and electrode/insulator leaks is often difficult to determine prior to removal of the electrode, unless the leak is small. Steam wisps which appear to come from between the outside of the electrode body and the gasket indicate a seal leak, steam appearing through the external ceramic insulator suggests that the electrode itself is faulty. Even if the electrode is in water, the water temperature in an operating system will cause the water to flash off to steam as atmospheric conditions are reached.

**Caution:** Do not attempt to cure a leaking seal on a low pressure electrode by overtightening the electrode clamping nut. The most probable fault for low pressure electrodes lies in damage to the sealing washer. The correct degree of compression on this washer is inherent in its design. Tightening beyond this point will only cause damage to the electrode or to the water column.

### 3.1.3.1 Low Pressure Electrodes

The correct procedure on low pressure electrodes for repairing either a seal or an electrode failure is to remove the knurled nut(s) and disconnect the electrode lead(s). Next, remove the electrode complete with its sealing washer from the column. A thorough examination of the electrode and washer is likely to give a more positive identification of the cause of the leak. However, unless it can be definitely established that the electrode was not at fault, it is advisable to fit a new electrode at this stage. To assist in identifying a seal leak, this may be caused by:

a) Failure to remove the old washer on a previous occasion before inserting the replacement washer and electrode.

b) Re-using an old and already compressed washer instead of a new one.

c) Failing to ensure that the land and the recess in the electrode port were clean and undistorted at the last inspection.

**Note:** When installing low pressure electrodes, ensure that the threads in the electrode port are free of loose particles. Lightly coat the electrode threads with anti-seize compound (Part No. 830007220). Insert the electrode, ensuring that the new gasket is centred in the electrode groove, and tighten the electrode with a torque wrench to 40 lbft (55Nm). After 15 minutes, re-tighten the electrode with the torque wrench set to 40 lbft (55Nm). The maximum torque is 50 lbft (68Nm) so **DO NOT OVERTIGHTEN**.

Where scoring or erosion of the electrode port seat has occurred in the water column, the seat can be re-cut to acceptable standards using a service tool as listed below.

- Service Tool 246791AA – for use with electrodes 246781A* and 246781Z* only
- Service Tool 246722AA – for use with electrode 246782A* only

### 3.1.3.2 High Pressure Electrodes

In the case of high pressure electrodes, sealing is performed by a taper form on the electrode body. The act of tightening the electrode clamping nut compresses the taper form into the port sealing taper, thereby effecting a pressure seal. For these electrodes, the condition of the electrode port sealing surface is of great importance, and the tightening procedure is given to prevent damage to the electrode or the water column electrode port. Should a leak develop, the electrode must be removed and both the port and taper seating surfaces examined for signs of surface deterioration.

### 3.1.3.3 Tightening Procedure For High Pressure Electrode Installation

a) Ensure the electrode is clean and the electrode port bore is clean and free of debris.

b) Lightly coat the column port thread with anti-seize compound (Part No.: 830007220).

c) Assemble the electrode to the column port and tighten the electrode nut until the electrode will not rotate in its seat.

d) Finally, tighten the electrode nut a further $^{1}/_{8}$ to ¼ turn to complete the procedure.

**NOTE:** The final $^{1}/_{8}$ to ¼ turn corresponds to a torque level of between 28lbft (35Nm) and 47lbft (60Nm). $^{1}/_{8}$ turn is the **recommended** tightening condition. ¼ turn is the **maximum** allowable, and the tightening torque used must be the **minimum** to achieve this. Failure to comply with this limitation may cause damage to the port or to the electrode, due to over tightening.

If necessary, where the sealing surfaces can be recovered by simple cleaning practices, the old electrode can be refitted and tightened to within the maximum torque value given and the system pressure tested. However, it is recommended that the best solution to minimise the system ‘down time’ is to fit a new electrode.

Where scoring or erosion of the sealing seat has occurred in the water column port, this can be re-cut to acceptable standards using the Service Tool 246791AA or 246722AA (see above).

## 3.1.4 PROCEDURE FOR CHANGING THE LOW PRESSURE ELECTRODES AND GASKETS

Carry out the isolation procedure as detailed in sub-section 3.1.2. Ensure that the tripping is disabled (see ‘Safety Precautions, sub-section 3.1.1). There is no need to switch off the Hydrastep electronic equipment; then:

a) Remove the electrode cover guard, taking care to avoid knocking the electrodes.
**Note:** Remove only one electrode at a time (avoids risk of incorrect reconnection).

b) Disconnect the leads, extract the electrode and the gasket carefully without damage to the seat face.

c) Inspect the column seat, making sure that it is free of loose particles and is not pitted or corroded.

d) Carefully unpack the new electrode and check that there is no damage to the ceramic insulators or to the sealing gasket.

e) Assemble the new electrode to the water column as detailed in sub-paragraph 3.1.3 for low pressure electrodes, paragraph d.

f) Refit the electrical lead(s) and guard. Recommission as detailed later in this Chapter.

### 3.1.5 PROCEDURE FOR CHANGING HIGH PRESSURE ELECTRODES

Carry out the isolation procedure as detailed in sub-section 3.1.2. Ensure that the tripping is disabled (see 'Safety Precautions', sub-section 3.1.1). There is no need to switch off the Hydrastep electronic equipment; allow system about 20 minutes to cool down, then:

a) Remove the electrode cover guard, taking care to avoid knocking the electrodes.
**Note:** Remove only one electrode at a time (avoids risk of incorrect reconnection)

b) Disconnect the leads, extract the electrode carefully without damage to the seat face.

c) Inspect the column seat, remove any scaling or residue taking care not to damage the seat.

d) Carefully unpack the new electrode and check that there is no damage to the ceramic insulators or to the seating ferrules.

e) Lightly coat the electrode threads with anti-seize compound (Part No.: 830007220) and assemble the new electrode to the water column as detailed in sub-section 3.1.3 for high pressure electrodes.

**Note:** At the first pressure/temperature test, check for leaks and tighten electrode nut as necessary, **but not exceeding ¼ turn from the 'nipped electrode' condition.**

f) Refit the electrical lead(s) and guard. Recommission as stated in section 3.2.

## 3.2 WATER COLUMN COMMISSIONING OR RECOMMISSIONING

The method given allows the column to fill slowly with condensate from the steam leg through a 'cracked' steam valve and for subsequent warming to continue at a controlled rate as the water is forced back through the 'cracked' water valve.

**Caution:** DO NOT BLOW WATER COLUMN DOWN

a) Notify the unit operator of the intention to commission the column, in accordance with recognised procedures.

b) Check that the electrode guard is in place.

c) Close the drain valves.

d) Crack open the steam valve. Check with the display or the unit operator that the column fills with condensate slowly (10 to 15 minutes).

e) Crack open the water isolating valve. Check with the unit operator that the water level is falling (1 to 2 minutes) to approximately normal water level and allow to stabilise and heat up for 15 minutes.

f) Open the water valve fully.

g) Open the steam valve fully.

### 3.2.1 VENT AND DRAIN VALVE REPAIRS

These will usually involve replacement of the gland packing or regrinding of the seat, and should follow the normal practice for the particular valve types concerned. If it is necessary to replace an entire valve, ensure that the new valve is correctly orientated for its sealing direction.

### 3.2.2 WATER COLUMN TRANSIENT RESPONSE

Starting with the water level at or below mid-gauge, note the lowest 'steam' indicating channel at this stage and fully close the water isolating valve nearest the water column quickly. Time the rise in water level due to the condensate flow until the topmost channel changes to a 'water' indication. Now re-open the water isolating valve fully and quickly. Time the fall in water level, from the 'change to steam' at the topmost level to the 'change to steam' at the channel immediately above the lowest channel to indicate steam at the start of the measurements.

The measured times should be similar to those obtained when the Hydrastep was first commissioned, provided that the drum operating conditions are similar. The usual times are in the region of 60 seconds for the rising levels and 5 to 15 seconds for the falling levels. Any serious variation from these times for a 'standard length column' suggests either a partial blockage or the water valve failing to seal properly.

**Note**: A 'standard length column' is 550mm (22 inches) sight range. Larger sight ranges will proportionally extend the water level rise and fall times.

### 3.2.3 WATER COLUMN OR PIPEWORK BLOCKAGE

If a blockage, either partial or complete, is diagnosed from the response times, isolate the column as described in 'Water Column Isolation', sub-section 3.1.2. With the drain valve open, slowly open the steam isolating valve until the steam line is completely cleared. Close the steam valve fully. Slowly open the water isolating valve until the water line is also completely cleared. Close the water valve fully. Close the drain valve and re-check the transient response. If the response times are still seriously in error, it is probable that the steam or water valve is not seating or opening properly and needs re-seating.

**Note:** Ensure that all valves are left correctly set and locked.

### 3.2.4 WATER COLUMN LIFE

The water column life may be reduced if the water quality is not monitored and kept chemically inert and pure. The end user is advised to pay particular attention to this water quality requirement to safeguard the longevity of the Hydrastep pressure parts.

# 4
# Unit Description

## Contents

**Page No.**



### Illustrations

## 4.1 LOW PRESSURE ELECTRODES

These electrodes can be used for pressures of 50bar (725psi) for 459600802 units, and up to 120bar (1740psi) for 459600602 units - see Chapter 5 for Specifications. They are used with the low pressure version of the Hydrastep water column shown in Figure 1.2 (in Chapter 1, Part 2 of the manual).

Fitting instructions are supplied on the electrode package. Electrode details for this version are shown in Figure 4.1.

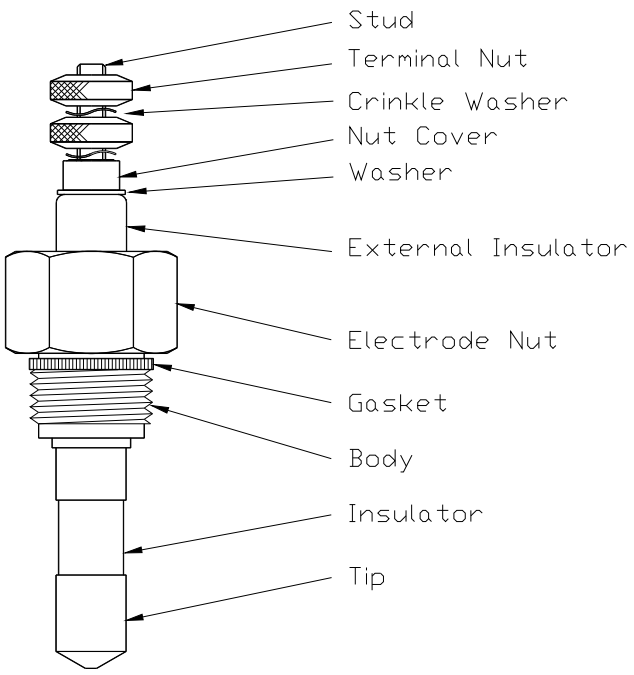



***Figure 4.1 - Low pressure electrode***

## 4.2 HIGH PRESSURE ELECTRODES

High pressure electrodes can be used for pressures in the range 50bar (725psi) to 300bar (4350psi) –see Chapter 5 for Specifications. These electrodes are used with the high pressure water column shown in Figure 1.3 (in Chapter 1, Part 2 of the manual). The fitting instructions for high pressure electrodes are included within the electrode package.

High pressure electrodes are supplied complete with ferrules fitted. See Figure 4.2.

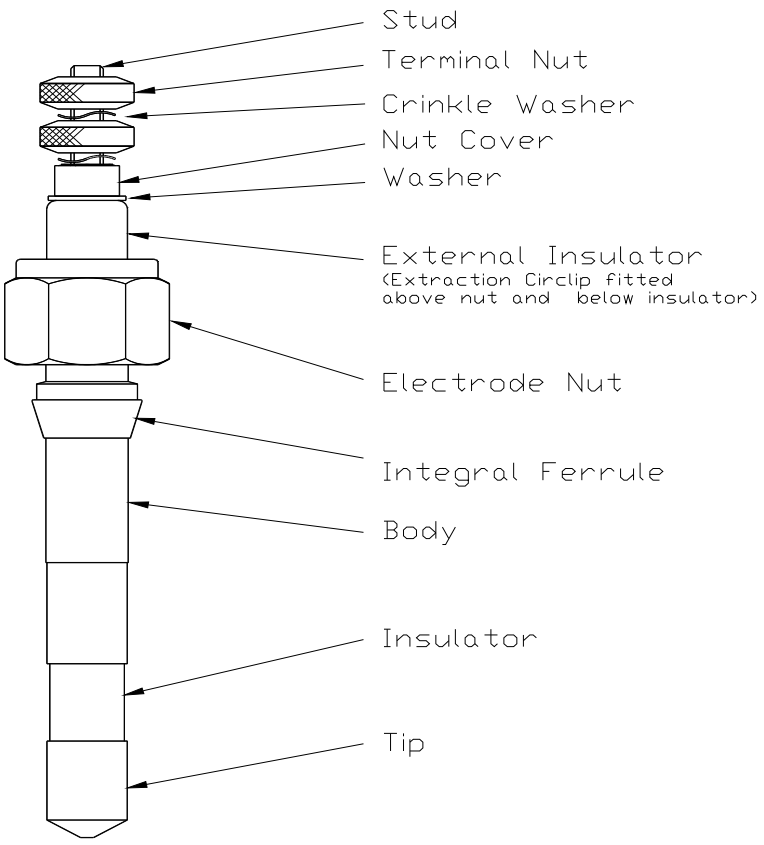



***Figure 4.2 - High pressure electrode***

## 4.3 WATER COLUMN (L.P.)

The low pressure water column is manufactured from carbon steel, extruded rectangular hollow bar. The electrode ports are drilled and fitted with 'helicoil' inserts to accept the electrodes. This thread system gives greater strength than if the electrodes were mounted directly into tapped ports. Corrosion of the threads is minimised since the 'helicoil' inserts are made of stainless steel.

The top cap and the drain components of the water column are manufactured from forged carbon steel bar, the drain components being available in ¾" and 1" sizes. A lug is machined on the top cap to accept a vertical forked member for support of the water column when in situ.

The steam and water connections are made from 1" N.B SCH 80 carbon steel pipe with weld preps already machined to weld the water column to the steam system.

The electrode covers are fabricated from stainless steel with support blocks attached to the column body. The covers are held in place by screw fasteners.

The complete assembly is of welded construction, with the welding to ASME IX requirements. The materials and design are to ASME B31.1.

The completed water column undergoes pressure proof tests at 150% of duty pressure after manufacture.

For further details on the water column dimensions, etc., refer to Figure 1.2 in Chapter 1, part two of the manual.

## 4.4 WATER COLUMN (H.P.)

The high pressure water column is manufactured from 2" NB SCH XXS carbon steel pipe. The inserts used are made from high grade stainless steel and are welded into position on the water column body.

The top cap and the drain components of the water column are manufactured from forged carbon steel bar, the drain components being available in ¾" and 1" sizes. A lug is machined on the top cap to accept a vertical forked member for support of the water column when in situ.

The steam and water connections are made from 1" N.B SCH 160 carbon steel pipe with weld preps already machined to weld the water column to the steam system.

The electrode covers are fabricated from stainless steel with support blocks attached to the column body. The covers are held in place by screw fasteners.

The complete assembly is of welded construction, with the welding to ASME IX requirements. The materials and design are to ASME B31.1.

The completed water column undergoes pressure proof tests at 150% of duty pressure after manufacture.

For further details on the water column dimensions, etc., refer to Figure 1.3 in Chapter 1, part two of the manual.

## 4.5 WATER COLUMN (H.P. SUPERCRITICAL)

The high pressure water column is manufactured from 2" NB SCH XXS stainless steel pipe. The inserts used are made from Stainless steel and are welded into position on the water column body.

The top cap and the drain components of the water column are manufactured from forged stainless steel, the drain components being available in ¾" and 1" sizes. A lug is machined on the top cap to accept a vertical forked member for support of the water column when in situ.

The steam and water connections are made from 1" NB SCH XXS stainless steel pipe with weld preps already machined to weld the water column to the steam system.

The electrode covers are fabricated from stainless steel with support blocks attached to the column body. The covers are held in place by screw fasteners.

The complete assembly is of welded construction, with the welding to ASME IX requirements. The materials and design are to ASME B31.1.

The completed water column undergoes pressure proof tests at 150% of duty pressure after manufacture.

For further details on the water column dimensions, etc., refer to Figure 1.3 in Chapter 1, part two of the manual.

# 5
# Unit Specifications - Hydrastep

## 5.1 ELECTRODES

**Type 459600602**
Complete with sealing gasket: Metaflex.
Screw in type M18 x 1.5
Insulator: Zirconia ceramic
Rating 120 bar (1740 psi) at 370°C (698° F)
pH range 7-11
Hydrostatically tested to 180 bar (2610 psi) at ambient temp.

**Type 459600802**
Complete with sealing gasket: Metaflex.
Screw in type M18x 1.5
Insulator: PTFE or Teflon
Rating 50 bar (725 psi) at 260° C (500° F)
pH range 7-13.5
Hydrostatically tested to 155 bar (2247 psi) at ambient temp.

**Type 246785A:**
Complete with ferrule sealing
25mm AF nut, thread $\frac{7}{8}$" x 20 tpi UNEF form (Swagelok or Parker)
Insulator: High purity alumina ceramic
Rating 300 bar (4350 psi) max. at 560°C (1040° F)
pH range 7-11
Hydrostatically tested at 450 bar (6525 psi) at ambient temp.
Note: For Super Critical Applications Only.

**Type 246782A:**
Complete with ferrule sealing
22mm AF nut, thread ¾" x 20 tpi UNEF form (Swagelok or Parker)
Insulator: PTFE or Teflon
Rating 50bar (725 psi) at 260° C (500° F)
pH range 7-13.5
Hydrostatically tested at 155 bar (2247psi) at ambient temp.

**Type 246784A:**
Complete with ferrule sealing
22mm AF nut, thread ¾" x 20 tpi UNEF form (Swagelok or Parker)
Insulator: PTFE or Teflon coated ceramic
Rating 300bar (4350 psi) at 260° C (500° F)
pH range 7-13.5
Hydrostatically tested at 450 bar (6525psi) at ambient temp.

**Type 246781Z:**
Complete with ferrule sealing
22mm AF nut, thread ¾" x 20 tpi UNEF form (Swagelok or Parker)
Insulator: Zirconia ceramic
Rating 210 bar (3045 psi) at 370° C (698° F)
pH range 7-11
Hydrostatically tested at 315 bar (4568 psi) at ambient temp.

## 5.2 WATER COLUMNS

| | |
|---|---|
| **Type Low Pressure:** | Rating 120bar (1740psi) at 343° C (650° F) |
| **Type High Pressure: (Series III)** | Rating 210bar (3045psi) at 370° C (698° F) |
| **Type High Pressure: (Super III)** | Rating 300bar (4350psi) at 560° C (1040° F) |

# Part 3

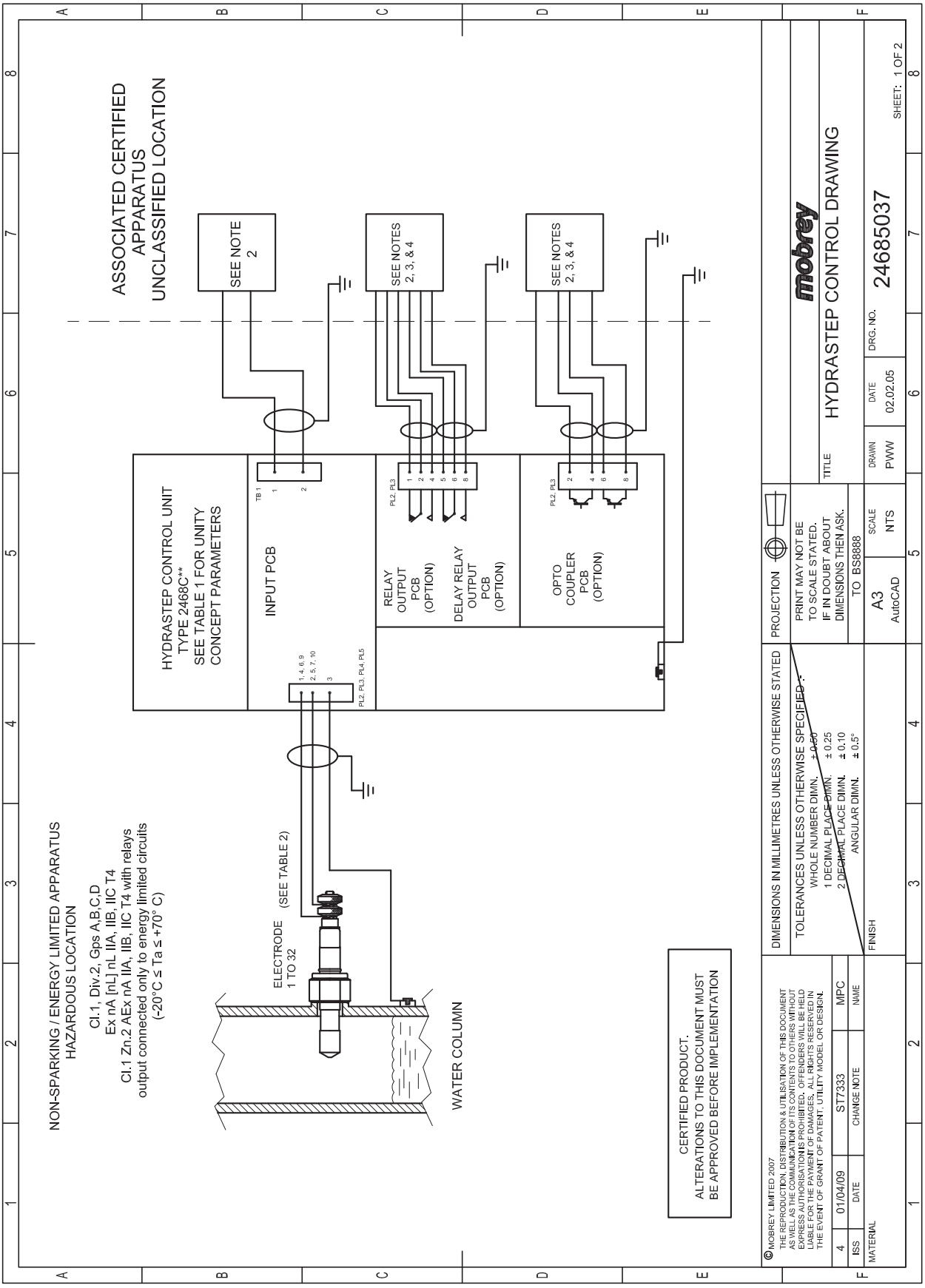
## Hydrastep 2468CA, CB, CC & CD
## Electronic Gauging System

# A
# CSA Certified

## A.1 GENERAL

All drawings in this manual are given here for planning purposes only. Before commencing with implementation, reference should always be made to the **current issue** of the appropriate drawings. Contact the factory for details.

| No. | Drawing Ref. | Description |
|---|---|---|
| **1.** | 24685037 Sheet 1 of 2 | Hydrastep Control Diagram – CSA Certified Connections |
| **2.** | 24685037 Sheet 2 of 2 | Hydrastep Control Diagram – Associated Notes |




**Drawing 24685037 Sheet 1 of 2: Hydrastep Control Diagram, CSA Certified Connections**

1 2 3 4

TABLE 1

| INPUT POWER SUPPLY | |
|---|---|
| MAXIMUM INPUT VOLTAGE (Um) DEPENDING ON MODEL CONFIGURATION | 110V AC, 240V AC OR 24V DC |
| **OUTPUT ENTITY PARAMETERS** | |
| **RELAY PCB (PL2, PL3)** | |
| MAXIMUM INPUT VOLTAGE (Ui) | 30V |
| MAXIMUM INPUT CURRENT (Ii) | 100mA |
| INTERNAL CAPACITANCE (Ci) | 0.0nF |
| INTERNAL INDUCTANCE (Li) | 0.0mH |
| MAXIMUM POWER INPUT (PI) | 3.0W |
| **OPTO-COUPLER PCB (PL2, PL3)** | |
| MAXIMUM INPUT VOLTAGE (Ui) | 30V |
| MAXIMUM INPUT CURRENT (Ii) | 1.0A |
| INTERNAL CAPACITANCE (Ci) | 0.0nF |
| INTERNAL INDUCTANCE (Li) | 0.0mH |
| MAXIMUM POWER INPUT (Pi) | 3.0W |

TABLE 2

| ELECTRODE TYPE NO. | MAX.PRESSURE (BAR) | MAX.TEMPERATURE (° C) |
|---|---|---|
| 246782A* | 50 | 260 |
| 4596008*** | 50 | 210 |
| 4596006*** | 120 | 370 |
| 4596002*** | 200 | 370 |
| 246781Z* | 210 | 370 |
| 246784A* | 300 | 260 |
| 246781A* | 300 | 560 |

CERTIFIED PRODUCT.
ALTERATIONS TO THIS DOCUMENT MUST BE APPROVED BEFORE IMPLEMENTATION

NOTES:

1) INSTALLATION OF EQUIPMENT, INCLUDING ANY GROUNDING ARRANGEMENT, TO BE IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE, RECOMMENDED PRACTICE FOR INSTALLATION OF ENERGY LIMITED CIRCUITS, OR THE ENERGY LIMITED EQUIPMENT INSTALLATION PRACTICE IN THE COUNTRY OF USE

2) THE APPARATUS SHALL BE PROTECTED BY A DEVICE THAT WILL ENSURE THAT IT IS NOT SUBJECTED TO VOLTAGE TRANSIENTS THAT EXCEED 40 % OF THE NOMINAL SUPPLY VOLTAGE. IT SHALL NOT BE CONNECTED TO BRANCH CIRCUITS GREATER THAN 15A

3) ANY ASSOCIATED CERTIFIED EQUIPMENT WITH ENERGY LIMITED OUTPUT WHOSE ENTITY CONCEPT PARAMETERS MEET THE REQUIREMENTS OF TABLE 1

4) THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF ENERGY LIMITED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN THE APPROVED VALUES OF Uo AND Io OF THE ASSOCIATED CERTIFIED APPARATUS ARE LESS THAN OR EQUAL TO Ui AND Ii OF THE ENERGY LIMITED APPARATUS AND THE APPROVED VALUES OF Co AND Lo OF THE ASSOCIATED CERTIFIED APPARATUS ARE GREATER THAN THE TOTAL VALUES Ci AND Li OF ALL THE ENERGY LIMITED APPARATUS INCLUDING ALL CABLE.

5) CABLE CAPACITANCE AND INDUCTANCE PLUS THE ENERGY LIMITED APPARATUS UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (LI) MUST NOT EXCEED THE ALLOWED CAPACITANCE (Co) AND INDUCTANCE (Lo) INDICATED ON THE ASSOCIATED CERTIFIED APPARATUS FOR THE HAZARDOUS LOCATION

6) THE INDIVIDUAL CIRCUITS SHALL BE SCREENED AS SHOWN

7) CAUTION - SUBSTITUTION OF COMPONENTS MAY IMPAIR THE SAFETY OF THIS EQUIPMENT. DO NOT OPEN ENCLOSURE WHILE ENERGISED

8) INSTALLATION TO ENSURE; MINIMUM ENVIRONMENTAL PROTECTION OF IP54, PROTECTION FROM UV LIGHT AND PROTECTION FROM STATIC CHARGE BUILD-UP ON WINDOW. CLEAN ONLY WITH A DAMP CLOTH



DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED

TOLERANCES UNLESS OTHERWISE SPECIFIED :-
WHOLE NUMBER DIMN. ±0.50
1 DECIMAL PLACE DIMN. ±0.25
2 DECIMAL PLACE DIMN. ±0.10
ANGULAR DIMN. ±0.5°

| ISS | DATE | CHANGE NOTE | NAME |
|---|---|---|---|
| 4 | 01/04/09 | ST7333 | MPC |

MATERIAL

FINISH

PROJECTION

PRINT MAY NOT BE TO SCALE STATED IF IN DOUBT ABOUT DIMENSIONS THEN ASK.

TO BS8888

mobrey

TITLE HYDRASTEP CONTROL DRAWING

| A4 AutoCAD | SCALE NTS | DRAWN PWW | DATE 24/11/05 | DRG. NO. 24685037 | SHEET: 2 of 2 |
|---|---|---|---|---|---|

A B C D E F

**Drawing 24685037 Sheet 2 of 2: Hydrastep Control Diagram, Notes for Sheet 1**

# Hydrastep 2468

**Operating Manual**
24685034, Rev. AE
June 2011



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