CHURCHILL CONTROLS
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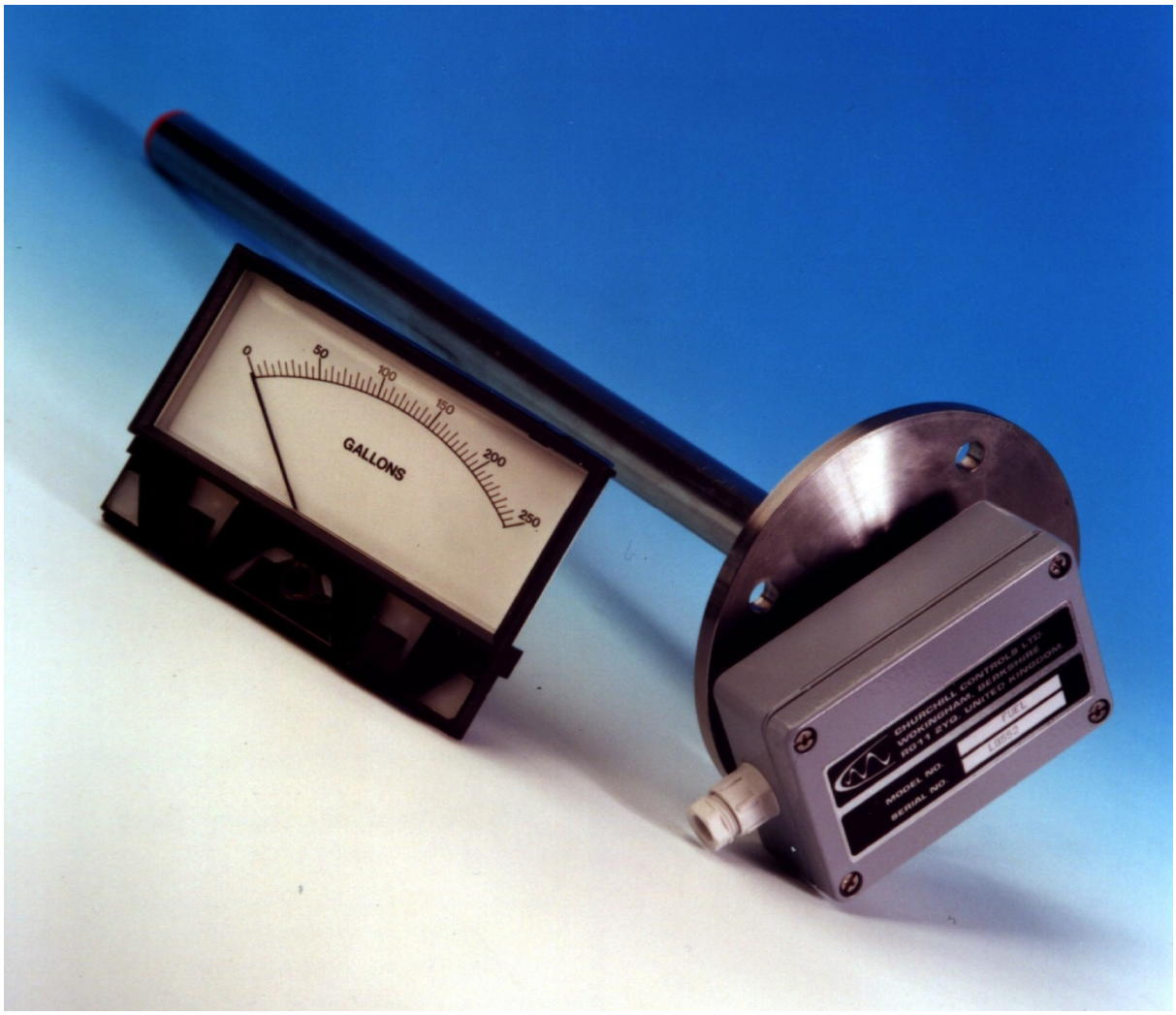
MK 1 Boat Gauge

Electronic Capacitive Tank Gauge

Owner Handbook and Installation Instructions



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1.0 Owners Information.

This instrument measures electronically the depth of fuel oil or water in a tank. It is capable of high accuracy and years of trouble-free operation when installed and calibrated in accordance with the instructions given in this manual.

The instrument consists of three principal parts as follows:

- The tank sender unit, which has been manufactured to suit the depth of the tank.
- The indicating meter.
- A "Trim Card" which normally mounts on the rear of the meter.
- Or optional "Trim Trip Card" with Hi-Lo level trip outputs for indicators

The trim card and the tank sender unit are interconnected by a three-core screened cable, and the power supply (12v or 24v DC) which should be fused, is connected to a terminal block on the trim card.

There are two models of the sender unit; the 'internal' model for mounting inside the tank, and the 'external' model for outside mounting, (see Fig 1). In both cases the sender unit comprises a tubular electrode assemble at the top of which is mounted an electronic head. The internal sender is suspended inside the tank from a flange fitting at the top. The external one is positioned near the tank to be gauged, and a small-bore tube is connected between the lower side of the tube of the sender and the lower end of the tank or feed pipe. In both cases fluid fills the sender electrode to the same level as that in the tank and in doing so alters the electrical capacitance of the electrode. This change is sensed by the electronic head and a proportional voltage output is delivered as a current to the indicating meter.

A connection on the circuit card with the electronic head is set up prior to despatch depending on whether the instrument is required for use on water or fuel oil. **An instrument which has been set for use on fuel oil cannot be used on water and vice versa.**

The trim card carries two pre-set controls, one for instrument zero and the other for instrument span. These controls are set up at the works prior to despatch to suit the sender length and the working fluid. In order to preserve the calibration of the system, the trim card must be used with the tank gauge with which it was calibrated. The serial number is marked on both items and these should be checked on installation. In practice it is often found that the working range of fluid depth in the tank is slightly different from the works calibration, and small adjustments to the controls may be required, and full instructions are given.

2.0 INSTALLATION INSTRUCTIONS

2.1 Electrical Connections to the head (all models)

Where access to the sender unit is likely to be difficult after installation, it is recommended that the cable is connected to the head before installation is commenced, to gain access to the electrical connections, remove the lid of the head by releasing the four retaining screws.

The cable required is three core screened round cable having outside diameter between 3 and 5mm. Round cable is essential to ensure a good seal to the cable entry gland (suitable cable is STV electronic Service stock No.38710B).

Pre-form the cable by cutting the free end to a convenient length and stripping back the insulation. To insert the cable first dissemble the gland by unscrewing the compression nut and removing the black rubber gland. Thread the compression nut on to the cable followed by the gland (it may be necessary to clear the central hole in the gland). Thread the cable through the gland body and push the gland and compression nut into position. Tighten the nut sufficiently to make a **good moisture proof seal.** Make the electrical connections to the 3-way terminal block as illustrated in Fig.2.

When replacing the cover ensure that the rubber gasket is in good condition and seals effectively. Where the sender is likely to be exposed directly to rain or sea water it is recommended that a smear of MS4 silicone grease is applied both to the cable before insertion in the gland, and to the lip of the box before screwing the lid into place.

2.2 Installation – Internal Model

The sender unit requires the tank to be provided with a tank pad to the dimensions shown in Fig 4. For high speed craft where the attitude of the tank can change when the vessel is underway, and also to minimise the effects of pitch and roll, the tank pad should be positioned as near as possible to the centre of the tank see Fig 3. The sender is lowered into position and retained by means of nuts and washers on the four studs. Ensure that these are well tightened and make an effective seal between the flange and the pad by means of the neoprene gasket provided. Alternatively, a sealant, may be used between the flange and pad, but care must be taken to ensure that the sealant is not allowed to obscure the vent hole in the top of the tubular body.

2.3 Installation – External Model

For high speed craft where the attitude of the tank can change when the vessel is under way, also the minimise the effects of pitch and roll, the instruments should be positioned as near as possible to the mid-point of the tank. See Fig.3.

Positioning of the sender in the vertical direction must be such that the liquid when at its lowest level fills the sender to a point 22mm or more above the lower side tube. The exact positioning is not critical since the zero of the instrument can be adjusted electrically after the installation is complete.

For installations where the DC supply has a positive earth, or is fully isolated, the bodies of externally mounted gauges should be isolated form earth. In such cases the mounting brackets/ clips and the connecting hoses should be non-conduction.

If the sender is connected to a ‘T’ in a fuel feed line to a delivery pump, it must be connected as near as possible to the tank connection point, and the connection tube must be looped down as shown is Fig 1. There will be a slight pressure reduction at this point due to the suction of the delivery pump,

and the depth of the loop should be greater than the suction head at the connection point. This is to ensure that when the fluid level is at its lowest there is no danger of air being sucked into the delivery line through the gauge.

The sender should be fixed into position by means of two pipe clips or 'U' bolts clamped around the electrode assembly and as far apart as possible. The sender can be mounted at any convenient angle provided that the highest and lowest fluid levels in the tank lie between the levels of the two side arms of the sender. Ensure that the pipe clips or 'U' bolts grip the sender unit firmly.

Pipe connections can be made to the sender side arms by means of conventional compression type connectors, or in the case of plastic tubes by forcing it over the outside of the side tubes and retained by means of a crimped band.

2.4 Installation of the Indicating Meter.

Fixing hole dimensions for the two alternative forms of meter available are shown in Fig.2. The trim card mounts on the rear of the meter by means of the terminal screws. It should be mounted in position with the terminal blocks lowermost as shown. Ensure that the board is sandwiched between two of the terminal nuts provided and makes good electrical connection. Do not tighten the board directly against the recessed stud in the meter body. Electrical connections are shown in Fig.2. The cables connecting to the terminal block should be supported by means of cleats to the rear of the panel in such a manner as to prevent any strain being applied to the trim unit.

3.0 Calibration

3.1 To read 0-100%

The standard indication meters supplied with a scale reading 0-100% have the zero and 100% calibration marks displaced form the true zero and full-scale positions of the meter movement. These meters are easily identifiable by the wide black marks on at the zero and full-scale point of the scale.

These instruments offer two important advantages to the user. Firstly, since the 0% level indication position on the scale is elevated slightly from the mechanical zero of the instrument; a 'tank empty' condition cannot be confused with power-off or an instrument fault condition. Secondly, if an instrument fault condition arises which causes the meter to read to full scale, it will read above the 100% indication and cannot be confused with a 'tank full' condition.

There are basically two ways of checking the calibration of the sender. One is to fill the main tank with fuel or water from empty to full, but if this is not possible one must resort to the use of a temporary external vessel, e.g. a length of plastic drain pipe filled with the appropriate fluid. In the latter case the gauge sender unit is raised and lowered in the fluid by an amount equal to the range of fluid under normal working conditions in the tank.

Commence with the tank filled to its lowest usable level or with the transducer projecting into the

vessel of fluid by a similar amount. The level will be that which just covers the feed pipe in the tank. Adjust the zero-set control at the rear of the trim unit by means of a small screwdriver, until the meter reads at the lower edge of the thick black band at the zero end of the scale. Then fill the tank to its highest usable level or immerse the sender in the vessel of fluid, to a similar level, and adjust the span control on the trim unit until the meter reads 95%. Then without changing the amount of fluid, or the depth of immersion of the sender unit, re adjust the zero control to make the instrument read 100% (i.e. at the lower end of the thick black band at the full-scale end of the scale). Seal the controls by means of a small dab of varnish or other sealing material. The boat gauge is now ready to use, but in the case of the externally calibrated gauge, when the sender unit is withdrawn from the vessel of fluid re-check the zero reading.

If a non-standard or special meter is employed which used the standard zero and full-scale points of the movement (i.e. does not have the thick band as described above), then the procedure is slightly simpler than that given above. Fill the tank (or immerse the gauge) to the lowest usable level and adjust the zero-set control until the meter reads at its zero point. Next, fill the tank to its highest usable level (or immerse the instrument to the same level) and adjust the span control until the meter reads full scale. No further adjustment should be necessary.

3.2 To read in Volumetric units

The following procedure entails filling the tank from empty via a metering pump and assumes that the zero and span of the gauge are correctly set as described above.

Fill the tank to its lowest usable level and check that the instrument reads zero. The tank should now be filled in a number of equal increments. Ensure that each increment is a rational number if gallons (or Litres) and that a minimum of five increments is required to fill. For example. A 600 gallon tank would conveniently be divided into six units of 100 gallons. Read the meter at the completion of each increment to the nearest 1% and record the result.

The completed calibration sheet should be returned to the supplier who will then supply (and fit if required) a replacement meter scale correctly calibrated in the required units.

4.0 Steel Flanges

When specially ordered, instruments can be fitted with mid steel or stainless-steel flanges in place of the standard P/V.C. flange. These flanges are electrically isolated from the body by means of plastic spacers and a thin shim of PTFE fill inserted into the central fixing hole. This isolation is important for installations where the negative pole of the supply is not connected to the vessel's earth.

5.0 Fault Finding

All gauges are fully tested before leaving the works and the calibration of each one is set to match the gauge sender length. The calibration may need slight adjustment on installation as described in the

previous section. If the gauge does not function correctly, measure the voltage with a DC voltmeter at the terminal blocks on the trim unit as follows:

1. At the 'power' terminal block the voltage should be equal to the battery voltage of the vessel
2. At the 'gauge' terminal block the voltage between terminals + and – should be in the range 7.8 - 8.6 volts.

In both cases check that the polarity of the voltage is correct. Wrong polarity indicates wrong wiring.

Incorrect connections will prevent the gauge from working but will not cause permanent damage.

6.0 Replacement of Head Card

Release the connections to the terminal block and unsolder the red wire from the terminal pin labelled 'TX'. Release the two retaining screws at the opposite corner of the card and the card can then be removed from the head box.

When mounting the new card ensure that a good earth connection is made between the back of the circuit board and the earthing point in the head box at the point furthest from the terminal block. The circuit card has an area of exposed circuit foil at this point for this purpose, and this should be clean and free of grease. The earthing point in the box should similarly be clean.

Mount the card and solder the red wire to the 'TX' terminal pin. Check that there is a wire link between the pin 'P' and one or two of the numbered pins to match that on the removed car. Alternativity the following table gives details on the correct link position for various depth ranges and fluids.

Remake the terminal block connections and replace the lid ensuring that the rubber sealing gasket is clean and in good condition.

Details of link settings on Tank Sender Head Card			
OIL		WATER	
Length	Link	Length	Link
200mm - 400mm	P --> 1	20mm - 75mm	P --> 1
400mm - 1.5m	P --> 2	75mm - 225m	P --> 2
1.5m - 2.2m	P --> (1 & 2)	225mm - 650mm	P --> 3
Greater than 2.2m	P --> 3	650mm - 925mm	P --> (2 & 3)
		925mm – 1.8m	P --> 4
		1.8m – 2.5m	P --> (3 & 4)

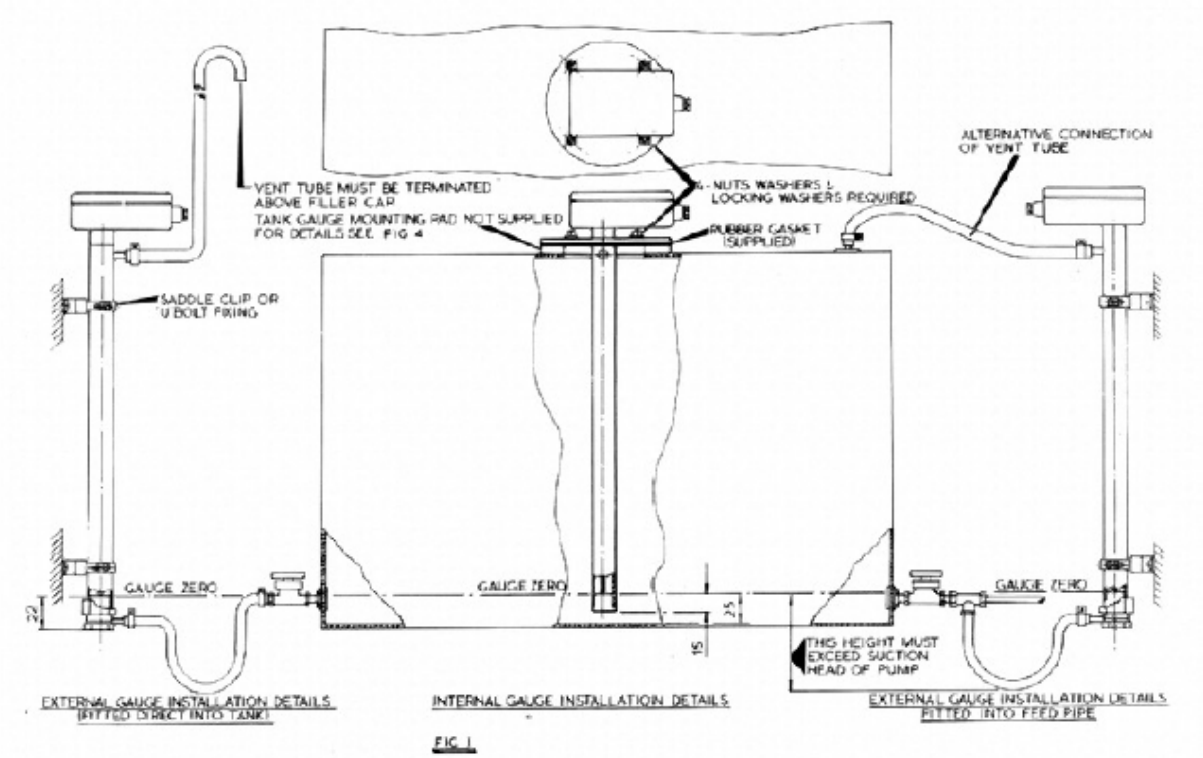

VENT TUBE MUST BE TERMINATED ABOVE FILLER CAP
TANK GAUGE MOUNTING PAD NOT SUPPLIED FOR DETAILS SEE FIG 4
NUTS WASHERS & LOCKING WASHERS REQUIRED
RUBBER GASKET (SUPPLIED)
ALTERNATIVE CONNECTION OF VENT TUBE
SADDLE CLIP OR U BOLT FIXING
GAUGE ZERO
GAUGE ZERO
GAUGE ZERO
22
15
25
THIS HEIGHT MUST EXCEED SUCTION HEAD OF PUMP
EXTERNAL GAUGE INSTALLATION DETAILS FITTED DIRECT INTO TANK
INTERNAL GAUGE INSTALLATION DETAILS
EXTERNAL GAUGE INSTALLATION DETAILS FITTED INTO FEED PIPE

FIG 1

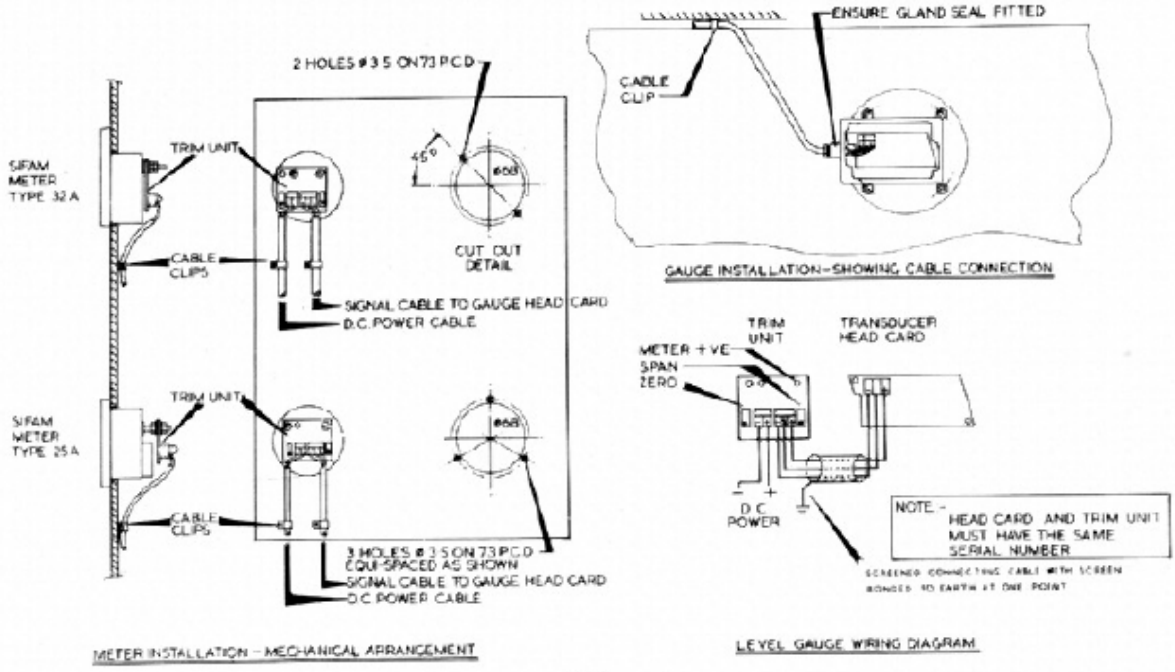

2 HOLES ø 3.5 ON 73 P.C.D
SIFAM METER TYPE 32 A
TRIM UNIT
CABLE CLIPS
45°
60°
CUT OUT DETAIL
SIGNAL CABLE TO GAUGE HEAD CARD
D.C. POWER CABLE
SIFAM METER TYPE 25 A
TRIM UNIT
CABLE CLIPS
3 HOLES ø 3.5 ON 73 P.C.D EQUI-SPACED AS SHOWN
SIGNAL CABLE TO GAUGE HEAD CARD
D.C. POWER CABLE
METER INSTALLATION - MECHANICAL ARRANGEMENT
ENSURE GLAND SEAL FITTED
CABLE CLIP
GAUGE INSTALLATION - SHOWING CABLE CONNECTION
TRIM UNIT
TRANSDUCER HEAD CARD
METER +VE
SPAN
ZERO
D.C. POWER
NOTE -
HEAD CARD AND TRIM UNIT MUST HAVE THE SAME SERIAL NUMBER
LEVEL GAUGE WIRING DIAGRAM

FIG 2

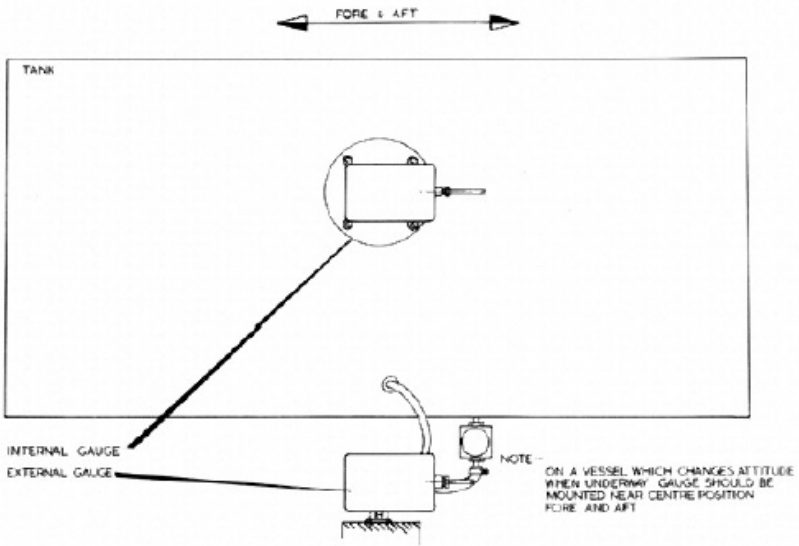
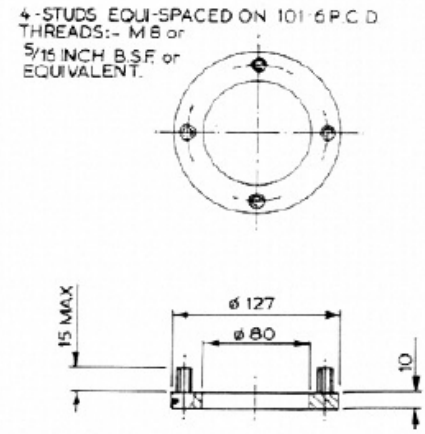


FIG 3



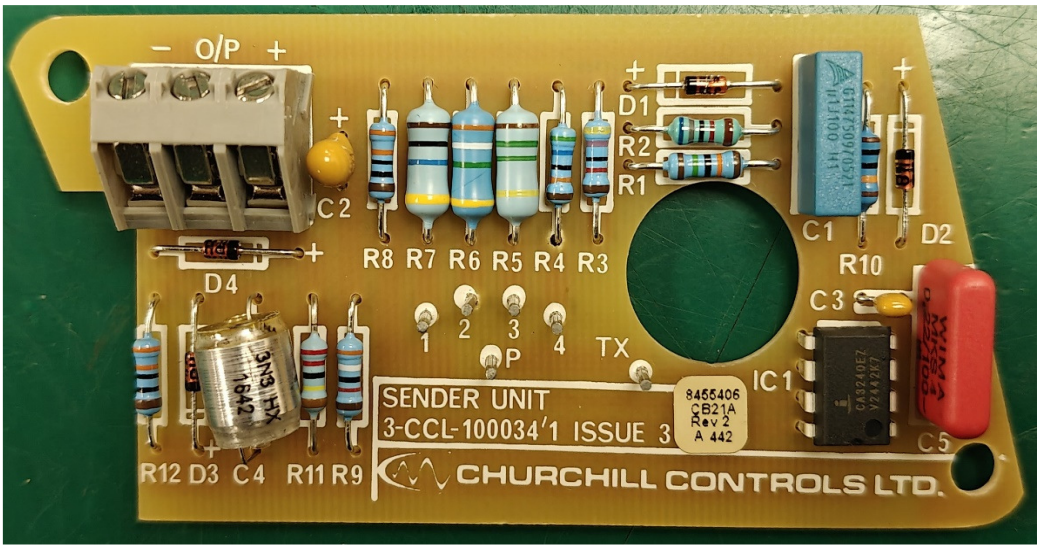
NOTE THIS ITEM IS NOT SUPPLIED
DRAWING FOR INFORMATION ONLY

FIG 4

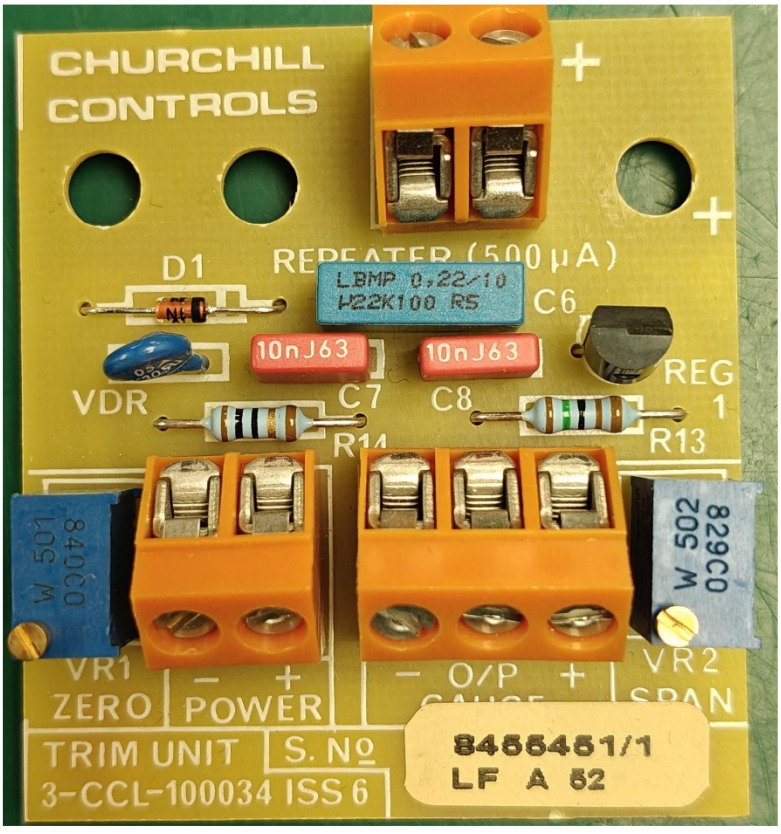
7.0 Spares List

Description	Part No.	Internal Plastic Flange	Internal Steel Flange	External
Tank Unit				
Circuit card	CB21A	1	1	1
Head box	E2F1	1	1	1
Cable gland	CA13	1	1	1
Cable gland back nut	CA14	1	1	1
PVC collar 19mm-long	TX5D1			1
PVC collar 12mm-short	TX5D	1		
PVC collar 10.5mm-metal flange	TX5D3		1	
PVC collar 1.5mm-metal flange	TX5D2		1	
PTFE insulating tape	SA19		1	
PVC mounting flange	TX4D	1		
Mild steel mounting flange	TX6L		1	
Stainless steel mounting flange	TX6P		1	
Neoprene flange gasket	TX4F	1	1	
Body assembly	For replacement specify length	1	1	
Bottom hose connection assembly	TX6N			1
Connection hose ¼" bore, 1 metre	2556-4			1
Nozzle adapter ¼"	Wade AP1006/3			1
Hose clips	Wade OCB			1
Pipe clips	TX6E			2
Pipe clips ext. rod	TX6E1			2
Pipe clip mtg. base	TX6E2			2
Indicator Unit				
Milliammeter 500µA scale 0-100%	P120			
Trim card	CB20A			
Trim Trip Card	CB21A			

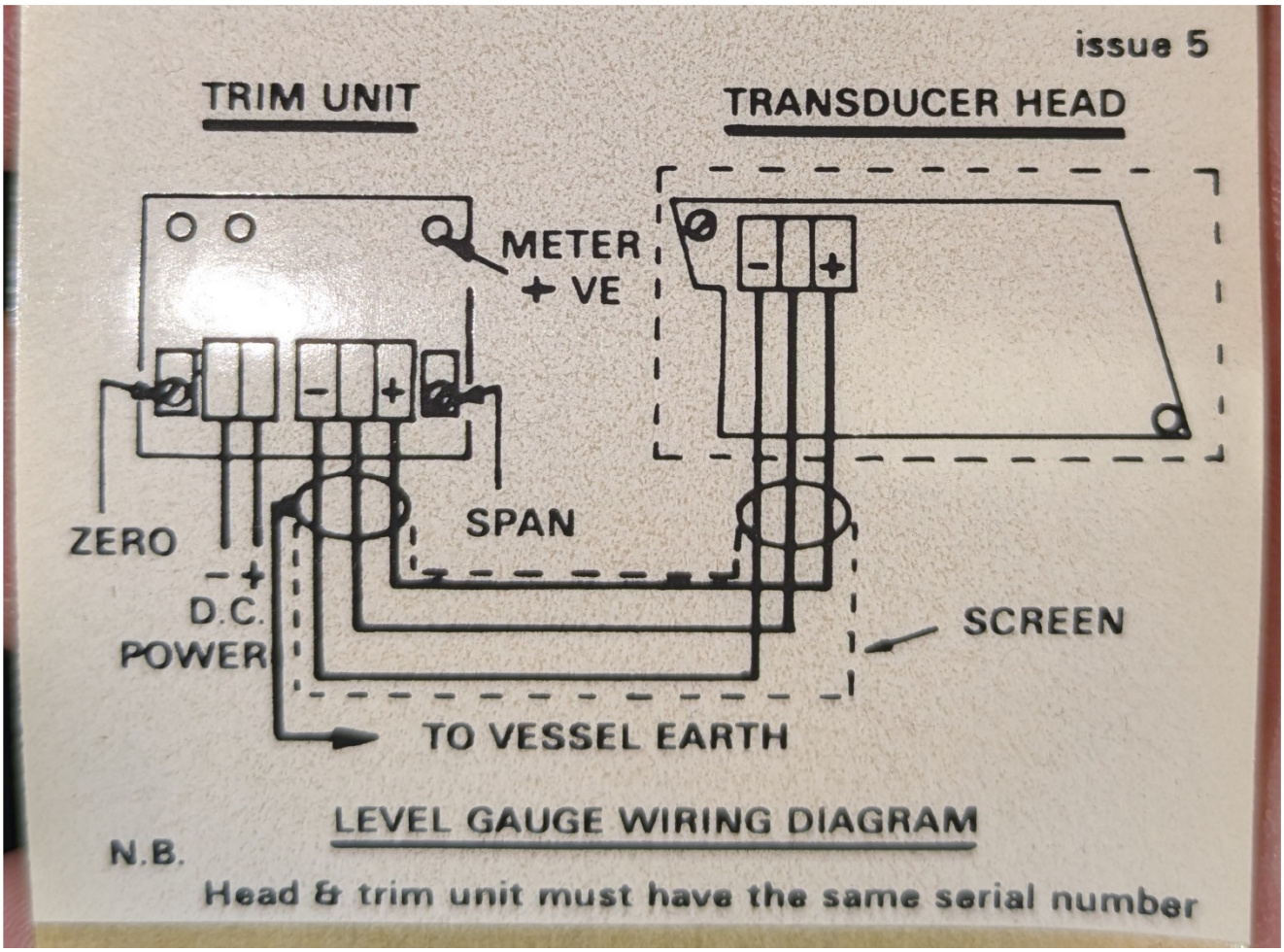
CB21A Head Card



CB20A Trim Card



Head Card to Trim Card Wiring

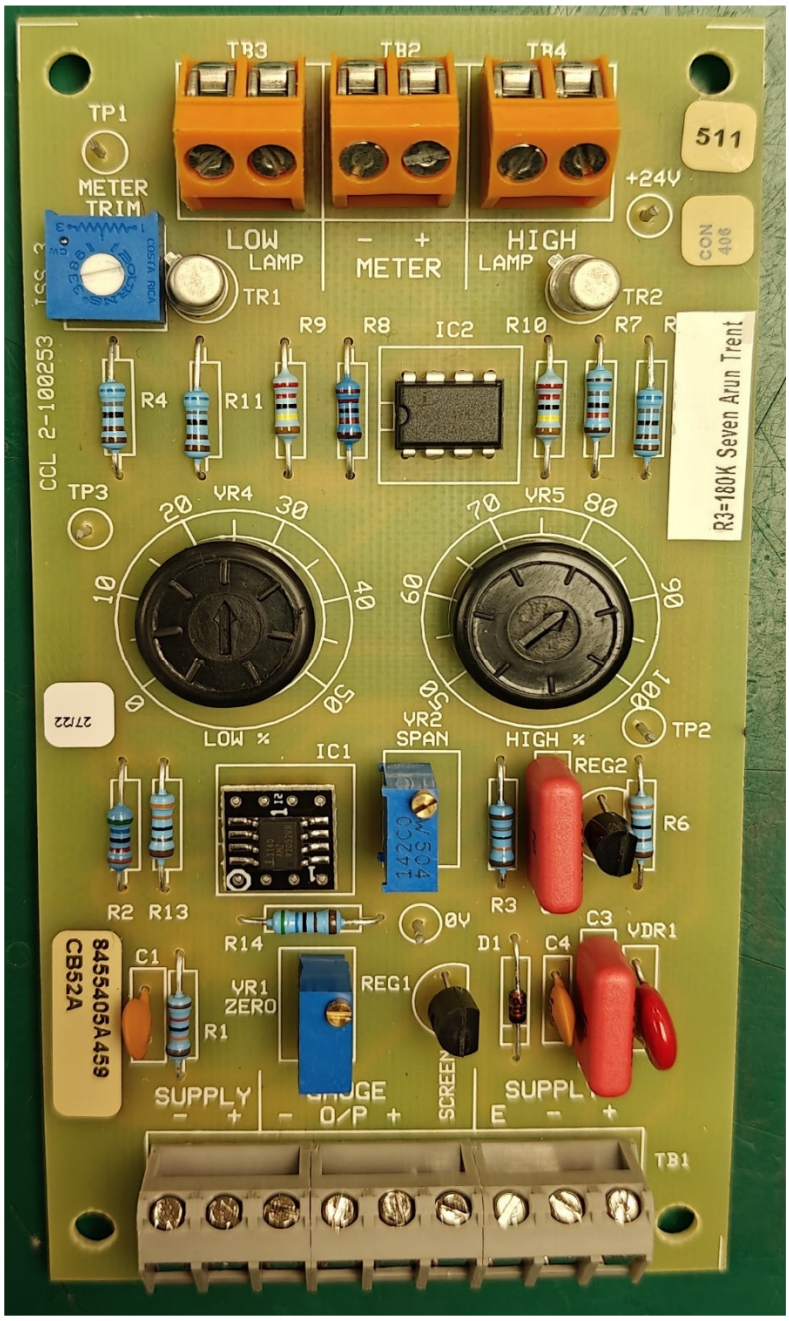


Notes:

The cable SCREEN at “Transducer Head” end should be terminated using a solder tag under one of the internal PCB mounting bolts to the metal screening can housing.

P120 Meter (Right hand side) with respective bezel in front.

Optional CB52A Trim/Trip Card (Length of probe to be specified when purchased)



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