Metron Capacitance Level Controls

Installation & Setting up Instructions

Comprising

MK372 Indicator/Controller
Metron Level Sensing Electrode

Index

1.0 OVERVIEW OF THE SYSTEM

The MK372 wall mounted indicator/controller used with the Metron Electrode provides digital indication of level and four control/alarm relays fully programmable over the range being measured. An isolated retransmission current signal is available to drive further digital or analogue indicators or for input to PLC and BMS systems. A fifth relay to indicate system failure is fitted for use if required.

The Metron Electrode houses a plug-in Transmitter Module within the terminating head which connects to the MK372 via a two core screened cable. The module is fully encapsulated, all adjustments being made at the MK372.

1.1 The Four Basic Electrode Types.

MKCP2

Insulated rod for conducting liquids such as water etc., Max Length = 3metres

MKCP3

Concentric tube with bare inner electrode for non-conducting liquids such as oil etc.,Max Length = 3 metres

MKCP4

Concentric tube with insulated electrode for conducting liquids with inner electrode insulated. Max length = 3 metres

MKCP201

Insulated cable electrode and weight for conducting liquids. Max length 10 metres

The Electrodes

Electrode has been carefully packed. If damage is discovered please report it to us right away. Handle the electrode with care paying particular attention not to damage the plastic sheath of insulated electrodes. Do not bend.

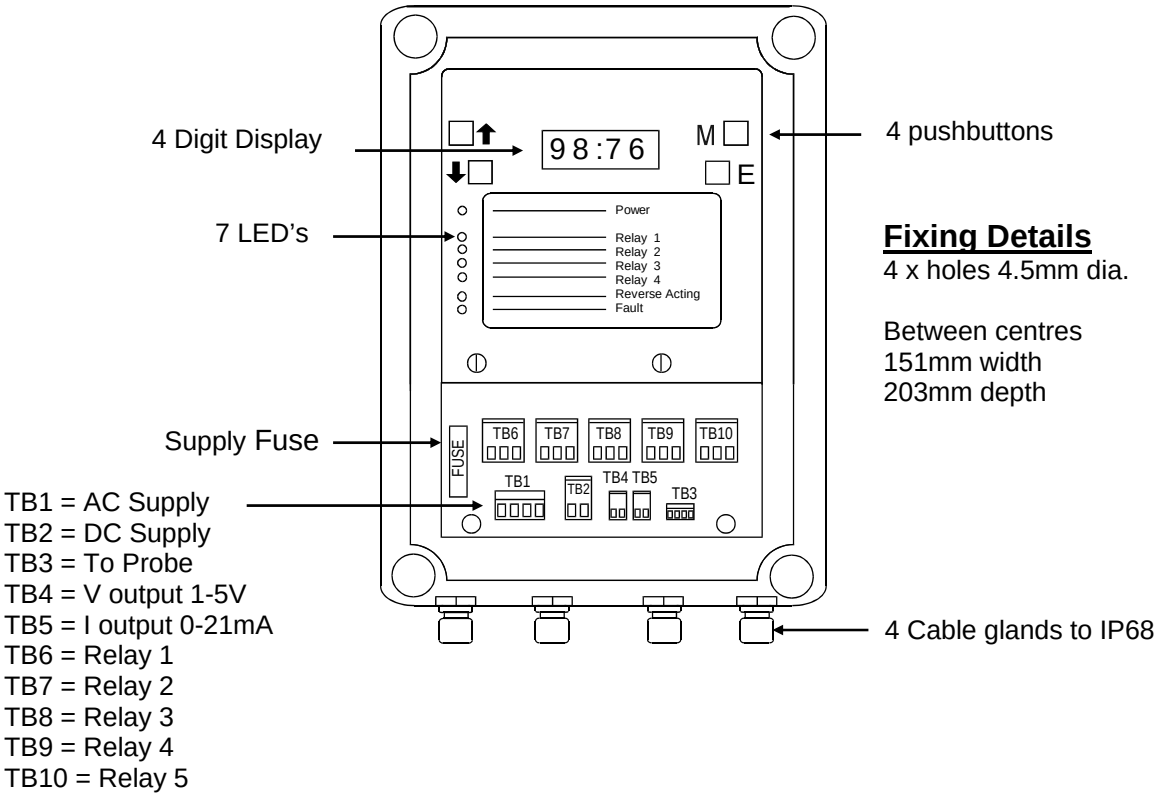
2.0 General Specification - MK372 Indicator/Controller

Technical Data

Display	4 digit 9mm LCD Configurable between 0.100 and 9999. The decimal point can be positioned to suit
Input	Within the range 0-25mA (min span 2mA). Input circuit fully isolated.
Input resistance	12 – 54 ohms depending on range
Zero Suppression	A live zero can be set anywhere within the range
Accuracy	Better than 1% for 4-20mA input
Resolution	0.1%
Input supply	110v/23v, 50Hz or nominal 24vDC

Outputs

Sensor supply	Nominal 24vDC for loop powered transducer fully isolated from the input and supply. Current limiting at 30mA
Four Control Relays	Volt free changeover rated 5A resistive @240vAC. Each having fully adjustable hysteresis with programmable fail to safe action.
One Failure relay	Volt free changeover rated 5A resistive @240vAC. De-energized on loss of, or excess current in a loop-powered system. De-energized for lost echo with the Sondaloop.
L.E.D.'s	4 x 'Relay energized' 1 x 'Supply On' 1 x 'Reverse Acting' retransmission 1 x 'Fault' (flashing on failure condition)
Re-transmission	Programmable within 0-21mA. Max loop resistance 1000 ohms. Voltage output 1-5V when set for 4-20mA. Outputs fully isolated from input & supply
Enclosure	Weather resistant to IP66 Clear polycarbonate fascia 220(H) x 168(w) x 107(D) mm.

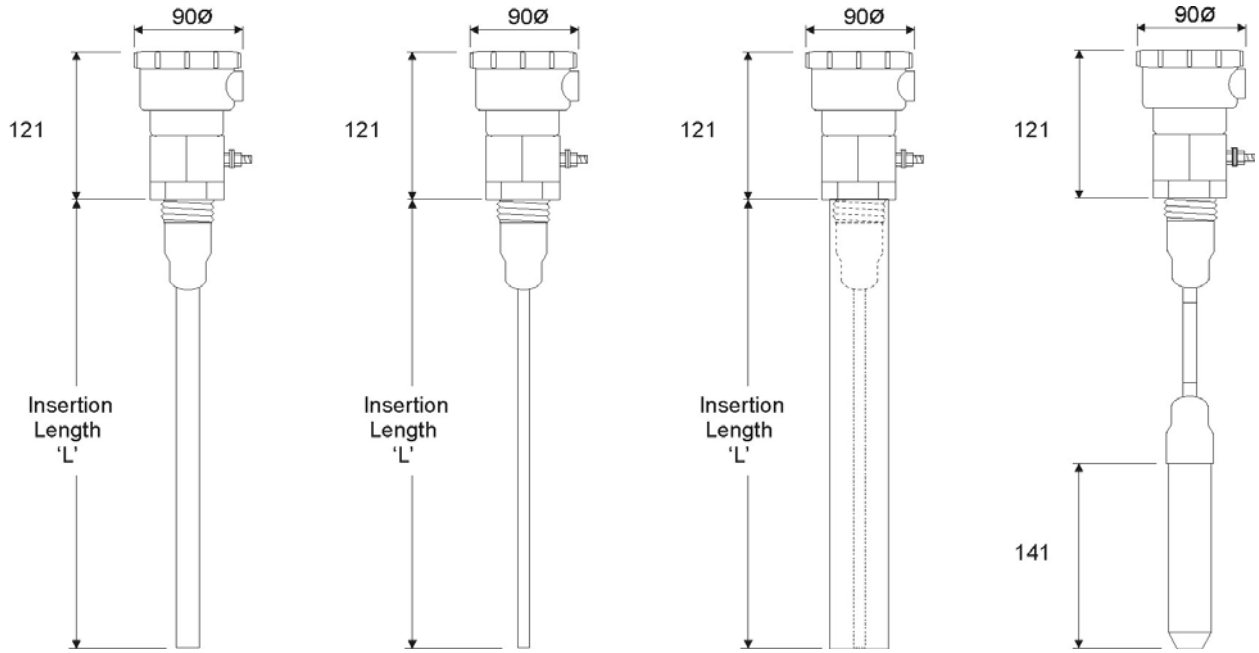


Fixing Details
4 x holes 4.5mm dia.

Between centres
151mm width
203mm depth

3.0 General Specification – Metron Probes

Metron MKFCP	2	3	4	201
Measuring Range	0.5 – 3m	1 – 3m	0.5 – 3m	3m +
Supply	From Flexilevel2			
Output	To Flexilevel2 (Approx 3 – 23mA)			
Combined non Linearity hysteresis & repeatability	+/- 1.5% Full Scale BSL			
Temperature Compensation	Over the range			
Operating temperature	- 20 to 60 degrees C			
Max Process Temperature	100 degrees C			
Weatherproof	IP66			IP67
Gland thread	M20			
Connection	1 inch BSP			
Material of Construction	Polypropylene housing Polypropylene for insulated electrodes Stainless steel 316L for bare electrodes Upvc shroud & polyurethane cable for FCP201 PTFE heatshrink sleeving & spacers			
Connecting cable	2 core cable 16/0.2 screened cable			



4.0 Installation of Equipment

Electrodes are usually mounted vertically in the vessel. Where the mounting point is metal, there must be good electrical connection with electrode mounting boss

Where the vessel contents are Electrical Non-Conducting such as fuel or lubricating oils, hydrocarbons etc. A concentric is normally supplied. This type of electrode can be mounted anywhere in the vessel avoiding incoming flow and excessive turbulence. The concentric electrode can be used in either metal or non metal vessels. Where the electrode is not of the concentric type, electrode position is important and advice should be sought from Metron f.m.c..

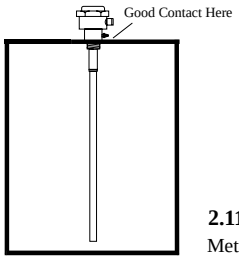
Where the vessel contents are Electrically Conducting such as most water based liquids the electrode should be mounted clear of the vessel side and away from any incoming flow. A stainless steel bracket is available is available for fixing to a vertical surface and holds the electrode 150mm from the side. Drawing No 2657 refers.
The electrode mounting boss must have good electrical contact with the contents of the vessel in order to provide the 'earthy' reference necessary for capacitance operated systems. This can be achieved using one of the following methods:
Mounting the electrode directly to a metal vessel. (see diagram 2.11)
Connecting the 'earth stud' of the mounting boss to existing metal in the vessel providing this extends down below the tip of the electrode. This may be a pipe or metal ladder etc.(see diagram 2.12)

Install an 'earthing' electrode such as Hawker HPE7 having a bare stainless steel electrode rod. (see diagram 2.13).

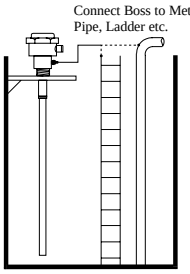
The Concentric Electrode having an Insulated Inner Electrode has an outer sleeve extending from the boss and is therefore complete in itself. (see diagram 2.14).

For turbulent conditions it may be necessary to mount the electrode within a stilling pipe, particularly the Flexible Cable type. If the pipe is metal it must be connected to the electrode mounting boss, if the pipe is plastic an earthing wire must be used down the length of the pipe and connected to the mounting boss. A stainless steel wire with weight can be supplied for this .For insulated rod electrodes, a stainless steel steady bracket is available and can be used with the mounting bracket to hold an electrode 150mm from a vertical surface. See drawing No 2657

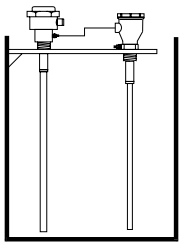
Examples for obtaining the 'earthy reference (see 2.1).



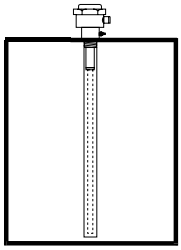
2.11
Metal Tank



2.12
Concrete Sump



2.13
Concrete Sump
or Plastic Tank



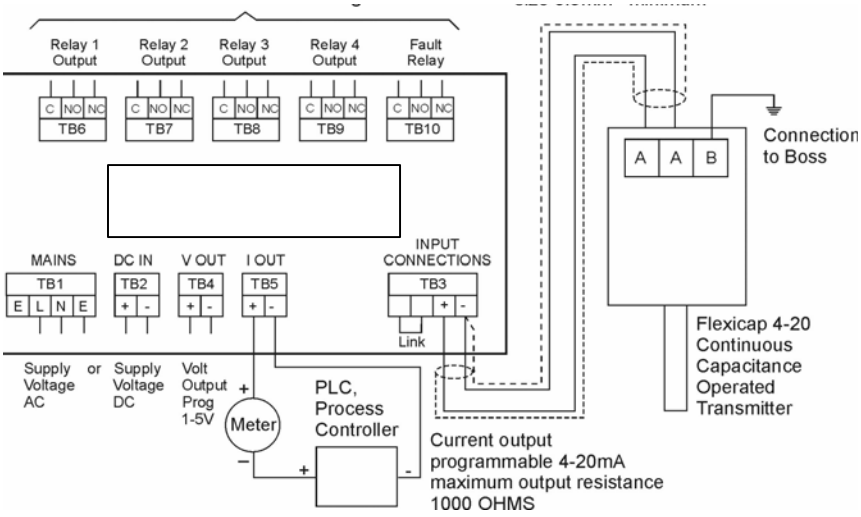
2.14
Plastic Tank
or Drum

4.1 The MK372 Indicator Controller

Fix the MK372 to the wall using M4 screws and connect it to the mains supply preferably through an isolator. Cable glands are already fitted so no drilling of the enclosure is needed.
Connect the MK372 Controller to the capacitance transmitter using the 2 core screened instrument cable, connector size 0.5mm² minimum.

Connect the relay volt free contacts (either NC or NO) to contactors for latching pump control or to the alarm function. (Where contactors are used it is advisable to fit a suppression circuit to prevent the induced back EMF damaging the PCB mounted relays.

5.0 Setting up the System



Connection details for MK372 and Metron Transmitter

The Probe and MK372 should be installed and interconnecting cables completed. Turn power on to the MK372 controller and wait 2 minutes. This allows all components to stabilise and will also power the Probe. The system is now ready for programming. For some applications such as in water the system can be factory set.

Scaling the Level

There are no adjustments to be made in the POrobe. There are 4 operations in setting up the MK372 etc. However you need to give a 4mA tank empty signal from the Probe to the MK372. This must be done with the Probe mounted in the empty tank. When you have set up the tank empty signal you need to set up the MK372 to accept the 4mA (low current Ilo?) signal.

Now you fill the tank to its maximum depth for the Probe to generate its 20mA tank full signal and the MK372 to accept the tank full (high current Ihi?) signal.

Now the 4-20mA input signal from the Probe to the MK372 is complete you can complete setting up the MK372.

6.0 Programming the System.

6.1 Scaling the Level – Tank Empty (4mA)

With the Probe installed in the empty tank, programme MK372 as follows:

Operation	Display	Notes
Press M	Number freezes	Colon stops flashing
Press ↑↓↑↓	I L o ?	This is the 4mA input signal
Press E	XXXX	This number is not important
Press E	donE I L o ?	You have now stored the 4mA input signal from the Probe.
Press M	X.X : XX	Flashing Colon. System is running

Now fill the tank to its maximum depth. Programme MK372 as follows:

6.2 Scaling the level Tank Full (20mA)

Operation	Display	Notes
Press M	Number freezes	Colon stops flashing
Press ↑↓↑↓	I L o ?	
Press ↑	I H I ?	This is the 20mA input signal
Press E	XXXX	This number is not important
Press E	donE I H i ?	You have now stored the 20mA input signal from the Flexicap.
Press M	X.X : XX	Flashing Colon. System is running

You have now set the empty and full level.

6.3 Setting the Display for the MK37I2 Controller/Indicator

There are two settings – the position of the decimal point and the maximum reading when the tank is full. The maximum reading can be the level, volume or a percentage of the depth.

Operation	Display	Notes
Press M	X.X : XX	Colon stops flashing
Press ↑↓↑↓	I L o ?	This is the 4mA input signal
Press ↑	I H I ?	This is the 20mA input signal
Press ↑	P E r C	Percentage of tank full.
Press E	1 0 0.0	Select 100.0 as tank is full
Press E	d o n E P e r C	You have stored the tank full as a reading
Press ↑	F S d	Position for decimal point
Press E	d E C. P	Position the Decimal point using the arrow keys. Scroll ↑↓
Press E	X.XXX	Shows the chosen position of decimal point Select max reading for Full tank . This should be 4mA point minus 20mA point. Scroll ↑↓ for maximum reading for tank full.
Press E	d o n E F S d	You have now stored the display reading for maximum depth
Press M	X.X : XX	Flashing Colon. System is running

6.4 Setting the Four relays 1 – 4 for the MK372

Operation	Display	Notes
Press M	X.X : XX	Colon stops flashing
Press ↑↓↑↓	I L o ?	This is the 4mA input signal
Press ↑	I H i ?	This is the 20mA input signal
Press ↑	P E r C	Percentage of tank full.
Press ↑	F S d	Position of decimal point
Press ↑	r L 1	First relay set point
Press E	O n	Set the on position
Press E	XX.X	Scroll ↑↓ to select the On position as a percentage of depth
Press E	O F F	Set the OFF position
Press E	XX.X	Scroll ↑↓ to select the OFF position as a percentage of depth
Press E	d o n E r L 1	First relay has now been set
Press ↑	r L 2	Second relay set point. Repeat as above
Press M	X.X : XX	Flashing Colon. System is running

6.5 Setting the Fault Relay

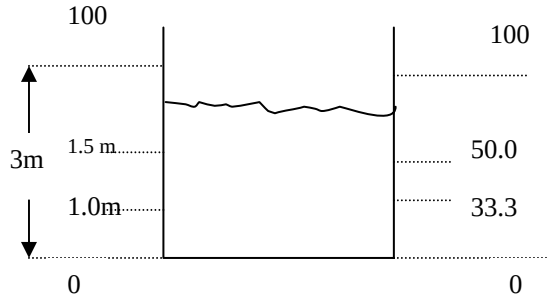
There is no programming for the fault Relay. TB10 is a volt free changeover contact. For an external alarm connect between the common (c) and normally open (NO) contacts.

6.6 Examples of setting up a relay as a percentage of depth

If we assume the depth is 3 metres.
You want to set a relay to come ON at1.5 metres and go OFF at 1.0 metres

To set the ON = $\frac{1.5}{3.0} \times 100 = 50$

to set the OFF = $\frac{1}{3.0} \times 100 = 33.3$



In this example the ON point is above the OFF point so the relay is set to fail to safe Low

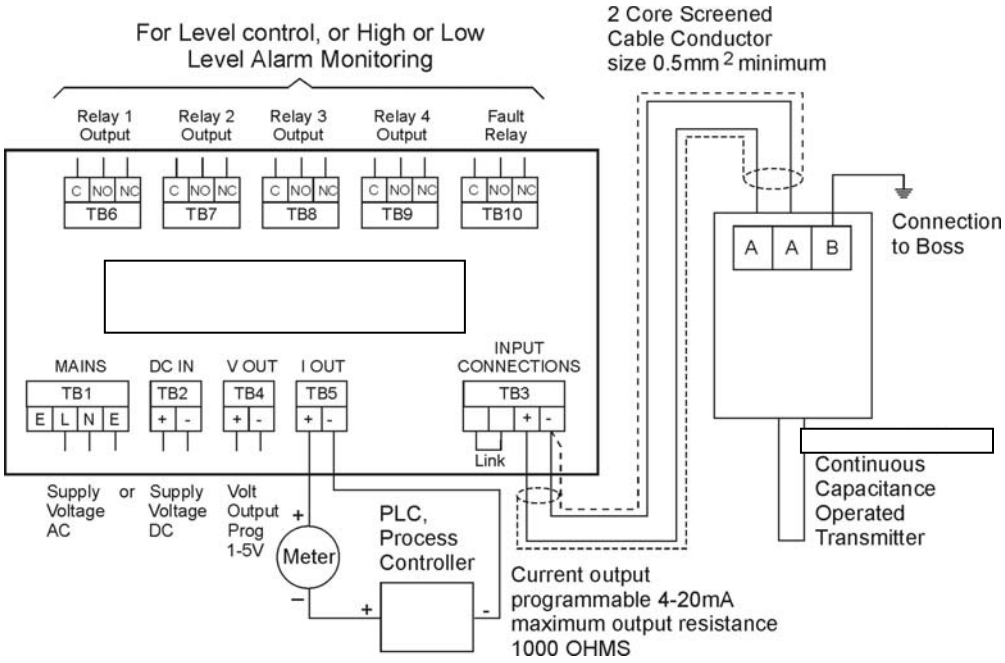
If we assume a depth of 6 metres
The ON point is 1.2m
The OFF point is 2.3M

$\frac{1.2}{6.0} \times 100 = 20.0$ $\frac{2.3}{6.0} \times 100 = 38.3$

In this example the ON point is below the OFF point and the relay is set to fail to Safe High

6.7 Setting up the re-Transmission 4-20mA output signal from the MK372

Connect a Multi-meter to TB5 to monitor the output current.



The Current output can be set within the range 0 – 21mA. The ideal range of 4 – 20mA makes best use of the diagnostic facilities of the Probe and the MK372.

Operation	Display	Notes
Press M	X.X : XX	Colon stops flashing
Press ↑↓↑↓	I L o ?	This is the 4mA input signal
Press ↑	I H i ?	This is the 20mA input signal
Press ↑	P E r C	Percentage of tank full.
Press ↑	F S d	Position of decimal point
Press ↑	r L 1	First relay set point
Press ↑	r L 2	Second relay set point
Press ↑	r L 3	Third relay set point
Press ↑	r L 4	Fourth relay set point
Press ↑	4 n A	Set the 4mA output
Press E	X X X X	Scroll ↑↓ using the arrow keys so you get a 4mA reading on the multi-meter
Press E	d o n E 4 n A	You have stored the 4mA output signal
Press ↑	20 n A	Set the 20mA output
Press E	X X X X	Scroll ↑↓ using the arrow keys so you get a 20mA reading on the multi-meter
Press E	d o n E 20 n A	You have stored the 20mA output signal
Press M	X.X : XX	Flashing Colon. System is running

6.7.1 There is an option to invert the 4-20mA re-transmission signal

Operation	Display	Notes
Press M	X.X : XX	Colon stops flashing
Press ↑↓↑↓	I L o ?	
Press ↓	r E v ?	This is the Reverse current output option
Press E	F o r	Forward acting (normal)
Press ↑	R E v	Reverse acting (inverted output)
Press ↑	F o r	You have returned to your first option. Make your selection
Press E	d o n E r E v ?	Forward acting option chosen in this example
Press M	X.X : XX	Flashing Colon. System is running

With the tank at maximum level the MK372 should be displaying maximum depth and the current source showing 20mA. If the tank is not full then the current reading should be linear to the display
Eg If the tank is half full. The normal depth would be 3 metres

Display reading = 50% of 3 metres = 1.5m
Current output = (50 % of 16mA) + 4mA = 12mA

7.0 Fault finding

Possible causes of spurious results:

'Wet coating' due to rag, paper or weed wrapping round the electrode or forming a coating on it.

Viscous products clinging to the electrode. This may sometimes be overcome by using P.T.F.E. coated electrodes.

Fluids with low conductivity (such as distilled water) where variations in the conductivity and temperature can be problematical.

Acids having varying water content and where the conductivity and temperature varies.

Foam if dense, which can coat the electrodes as in (5.1) above.

Note that the presence of steam and condensate are not usually problems.

System does not work

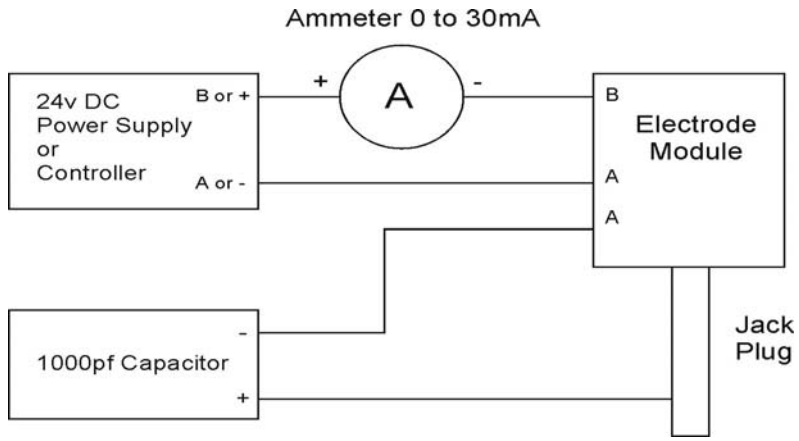
Check power input to the MK372.

Check continuity of cables between Probe and MK372 and that all connections are good.

Unplug the transmitter from the Probe. Check that the output across terminals ‘A’ and ‘B’ is approximately 28-30v D.C.

Measure the current between the ‘B’ terminals of the MK372 and the transmitter. This should be between 1.5mA and 3mA.

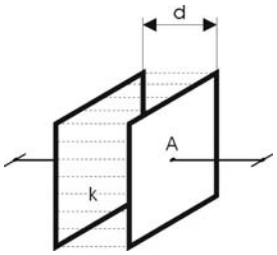
Connect a 100pF capacitor between terminals ‘A’ of the transmitter and its jack plug. Check the current should have increased to between 18 and 22mA.



8.0 PRINCIPLE OF OPERATION

The electrode in the 'Probe' represents a capacitor and the small change in its capacitance with varying level is used to produce a milliamp output, which is proportional to level. This is registered in the 'MK372' control unit.

A capacitor consists of two metal plates insulated from each other and spaced apart.
The insulating material between the plates is called the dielectric, even if this is just air or vacuum.



The electrical capacitance C of a capacitor is the amount of electric charge it can store and this depends on three items.
The value of the Dielectric Constant K of the insulation between plates.
The area of the plates A
The distances between the plates d

And the relationship is expressed by C=K A/d.

The greater the value of K and A the greater the capacitance.
The greater the value of d the smaller the capacitance.

For accurate and stable results, the greatest capacitance change possible is required.

Non electrically conducting products such as oil, diesel fuel, hydrocarbon etc., rely on the dielectric constant, and the higher the value of K, the greater the capacitance change.

Electrically conducting products such as water and many acids rely on the area of the plates. To prevent the capacitor plates being short-circuited, a fully insulated electrode must be used.

Conducting liquids :	Water = average K = 80
	Sulphur Dioxide = 17.6
Non-conducting liquids:	Air, Steam, Gases, Vacuum = approx. 1
	Glycerine = 47