



## **Microflex LR – Integral** (Ultrasonic Level Measurement)

# **Installation & Operation Instruction Manual**



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## USER MANUAL

### MICROFLEX LR LONG RANGE LEVEL TRANSMITTERS

#### 1. GENERAL DESCRIPTION

The Microflex LR – Integral Transmitter is capable of non-contact level measurement over distances of up to 60 metres, depending on the application. The Integral is an intelligent, system approach to measurement of solids and liquids with maximum performance combined with a display and keypad.

The Integral is available with four different transducers for ranges of 10, 20, 40 and 60 metre operation. Each configuration is available as a 2-wire, DC powered 4-20mA loop (MI2) or 2, 3 and 4 wire DC and AC powered (MI3) with a combination of Modbus, 2 relays, 4-20mA and PC comms outputs.

The transmitter must be mounted directly above the surface of the material to be monitored.

Ultrasonic pulses are transmitted to the surface of the material to be monitored and reflected back to the transmitter. The time period between transmission and reception of the pulses is directly proportional to the distance between the transmitter and the material.

Since the speed of sound through air is affected by temperature, a temperature sensor is integrated into the face of the transmitter to improve accuracy.

The Integral transmitter is suitable for measuring the following on solids and liquids:

- a) Ullage space or distance to material
- b) Material level
- c) Volume measurement
- d) Material percentage
- e) Flow of liquids in open channels

#### **WARNING**

**Do not open the transmitter terminal cover or remove any connection whilst the power is ON.**

**REFER TO 'ATEX Safety & Operating Instructions Manual'  
IF INSTALLING IN A HAZARDOUS AREA**

## 1.1 Microflex LR Integral

The Integral Transmitter is an easy-to-use level transmitter available with four (4) different high power, low frequency front ends, capable of reliably tracking the level of solids and liquids under difficult conditions, programmed via a 4 button keypad and an integral menu driven display.

The transmitter is available with a choice of 2 relay switches, 4-20mA or Modbus outputs; up to 32 instruments can be networked together.

If specified, the instruments are available approved for ATEX EEx ia Zone 0 gases & Zone 20 dusts (24Vdc only) or ATEX Dust Protection only, Zone 20.

Remote programming of the product is available via Hycontrol's Vision System II software and all the instruments can be connected via the Hycontrol Link to a Service Engineer in the Redditch office to analyse and overcome any problems which may be experienced in the field, without incurring any expensive call-out charges.



## 2. INSTALLATION GUIDE

The Integral transmitters are designed to be screwed directly into a flange on a tank. For long range and dusty applications, the use of a focaliser on the underside of the flange improves the concentration of the signal and ensures that spurious signals are eliminated.

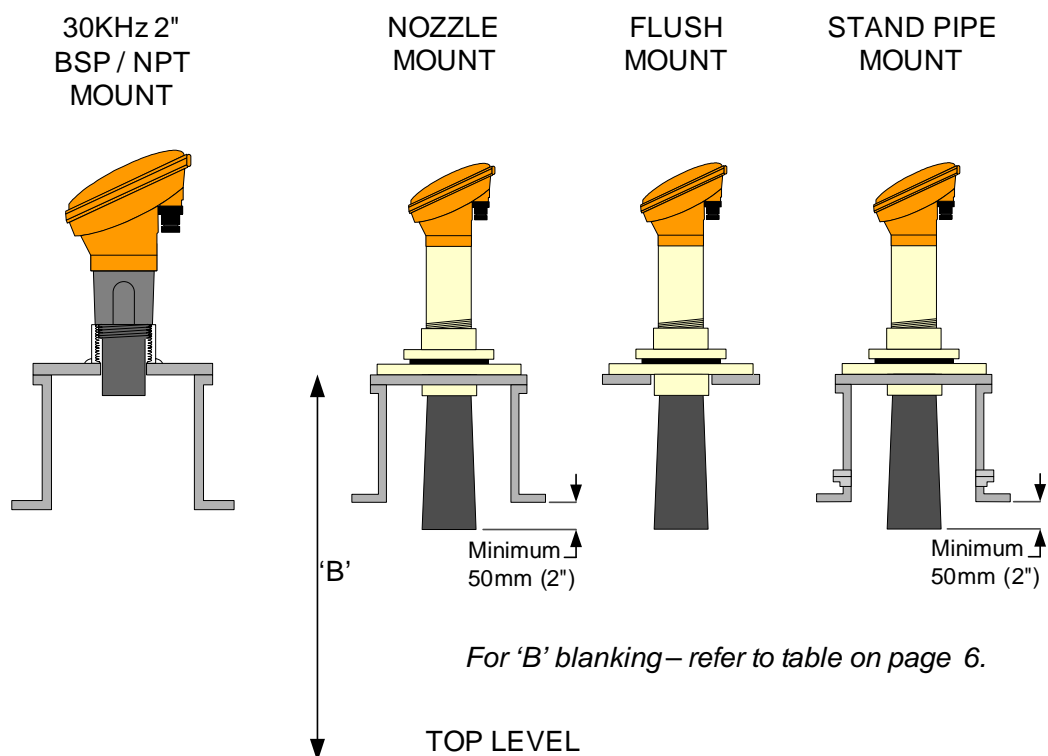
### 2.1 Installation Position

Ensure that the mounting surface is not subject to vibration and is not in close proximity to high voltage power cables, contactors or drive controls. The unit should not be mounted in a confined space where temperature might exceed the safe working temperature  $-20^{\circ}\text{C}$  to  $+60^{\circ}\text{C}^*$ . If the unit is mounted outside it should be protected from direct sunlight or severe weather conditions.

When using a focaliser cone, ensure that it protrudes at least 50mm into the vessel.

The transmitter must be installed to ensure a clear line of sight from the radiating face to the product being monitored. Refer to diagrams on Page 6.

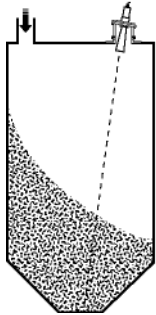
Avoid mounting near fill points, ladders, baffles, agitators etc.



\*For ATEX temperature classifications see ATEX Safety & Operating Instructions Manual.

## Transmitter Mounting

### SOLID (Granular)



Aim transmitter at point of outfeed.

### LIQUID



Transmitter should be as perpendicular to product as practicable.

### DUAL OUTFEED



Use two transmitters and wire and program as shown in Appendix A to avoid cross-talk.

### POWDER



Mount away from infeed

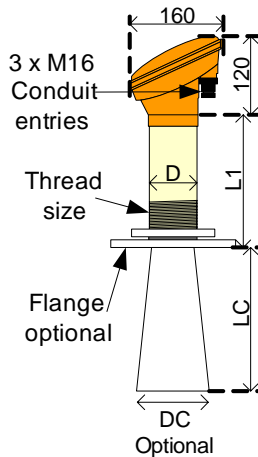
## 2.2 Installation Dimensions

MI2 Two wire loop powered transmitter with display and 4-20mA output.

MI3 2, 3 or 4 wire transmitter with display and can have PC Comms, Modbus and Relay output.

MI2 Two wire transmitter with display

MI3 2, 3 or 4 wire transmitter with display and 2 relays



Range Metres	L1	LC Optional	D	DC Optional	Thread Size	Flange Optional
10	177	-	50	-	2"	-
20	255	275	75	98	3"	4"
40	410	413	89	236	3.5"	10"
60	687	460	89	236	-	10"

Flange Options: ANSI, DIN or JIS

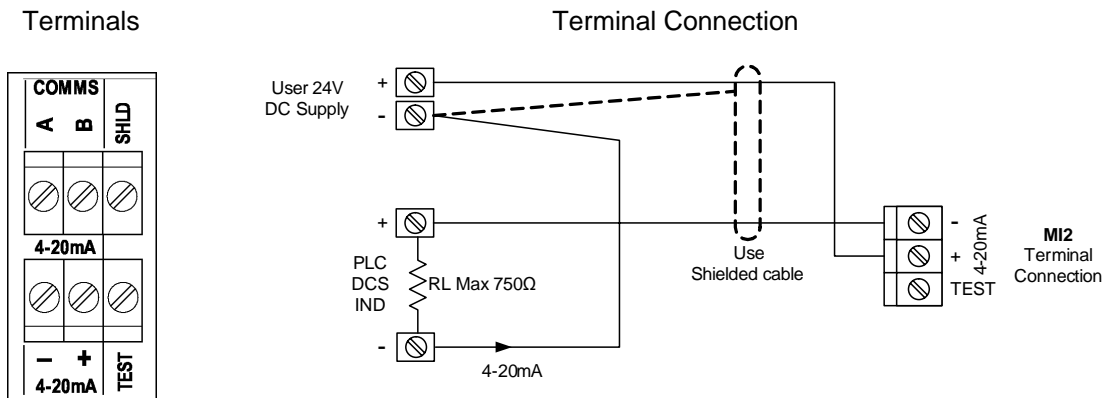
Dimensions for 10, 20, 40 & 60 metre range

Ensure that the transmitter face always has the minimum Blanking Distance above the highest product level in the tank. See table below.

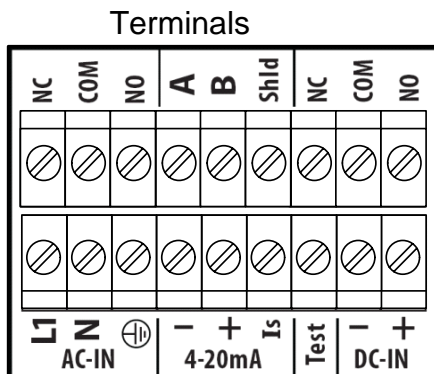
TRANSMITTER	MINIMUM DISTANCE	
	Minimum	Nominal
MI__10	0.35m (1.2ft)	0.5m (1.6ft)
MI__20	0.5m (1.6ft)	0.8m (2.6 ft)
MI__40	1.0m (3.3ft)	1.3m (4.2 ft)
MI__60	1.2m (4ft)	1.5m (5 ft)

## 2.3 Installation Wiring

### 2.3.1 Wiring Diagram – MI2 – 2 wire Loop Powered Transmitter



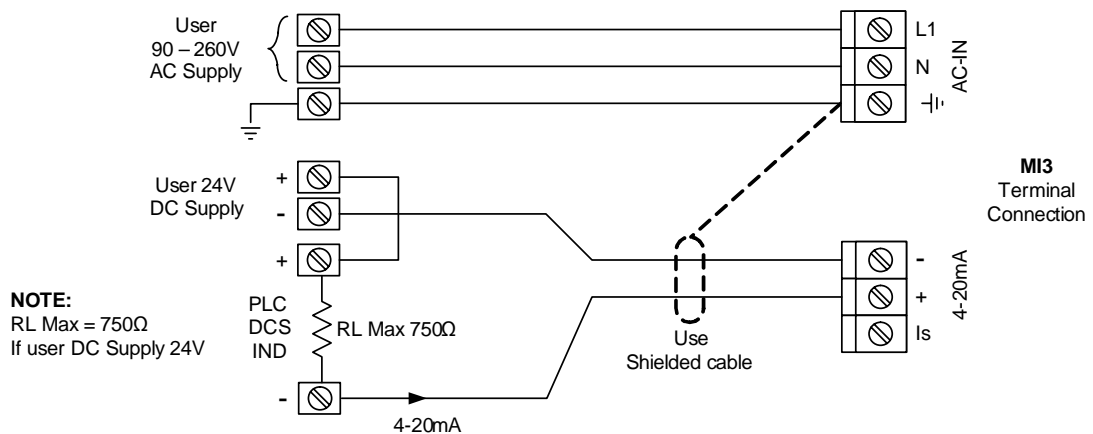
### 2.3.2 Wiring Diagram – MI3 – Transmitter with 2 relays & 4-20mA Outputs



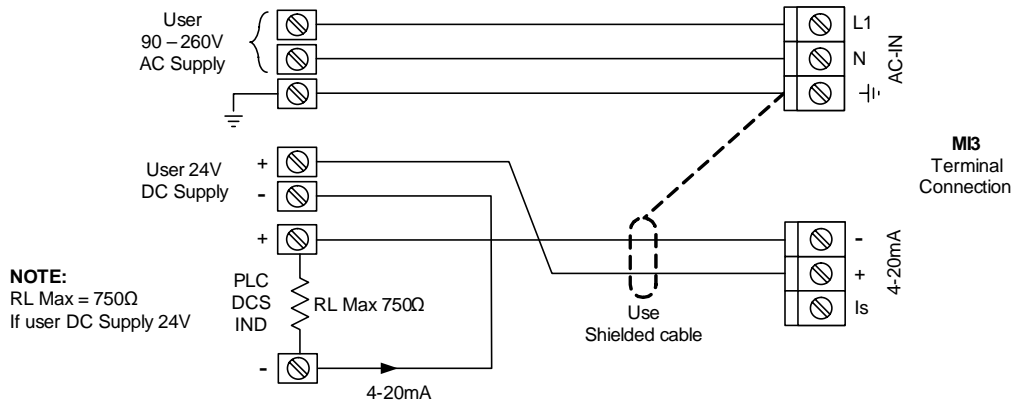
See Appendix A for 'Test' function.

#### 2.3.2.1 MI3 – Terminal Connections for AC Supply

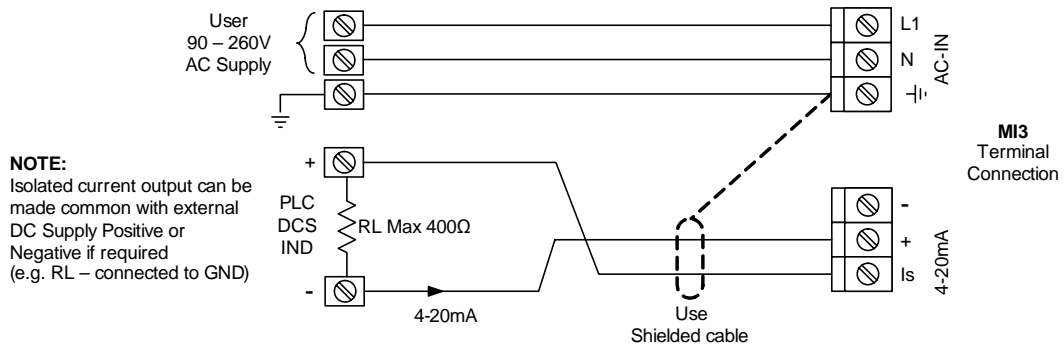
a) Modulating from User's External DC Supply (RL to Pos.)



b) Modulating from User's External DC Supply (RL to Neg.)

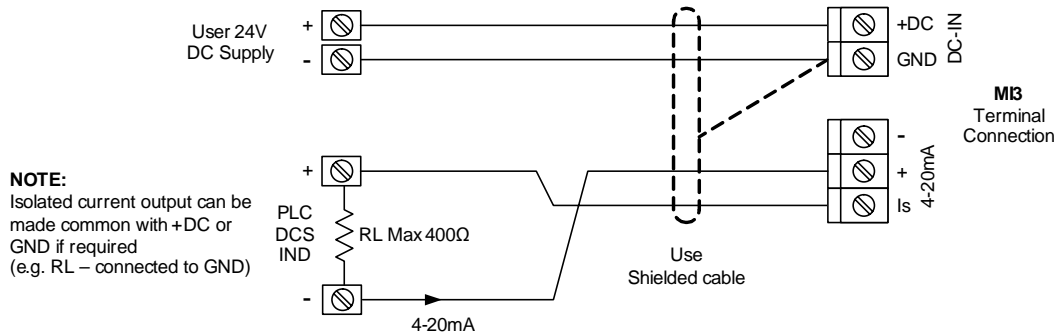


c) 4 Wire DC – Driving from Internal Isolated Supply (Is)

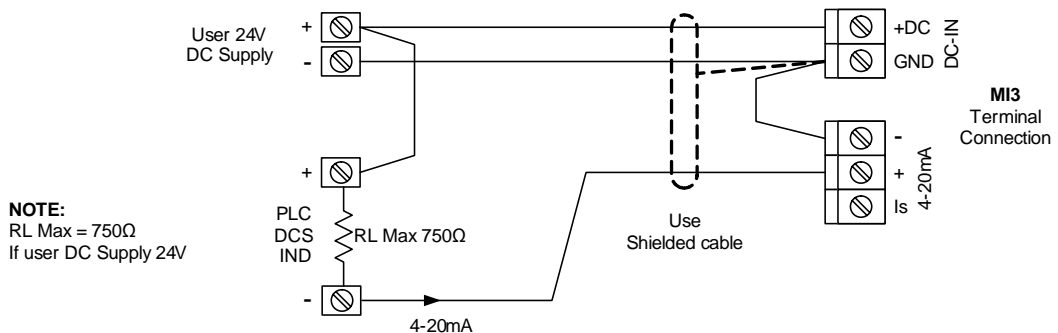


2.3.2.2 MI3 – Terminal Connection for DC Supply

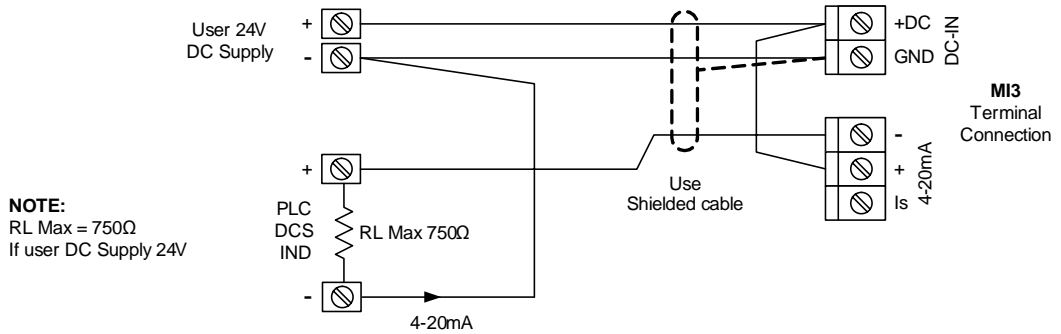
a) 4 Wire DC – Driving from Internal Isolated Supply (Is)



b) 3 Wire DC – Modulating from Common User Supply (RL to +DC)



c) 3 Wire DC – Modulating from Common User Supply (RL to GND)

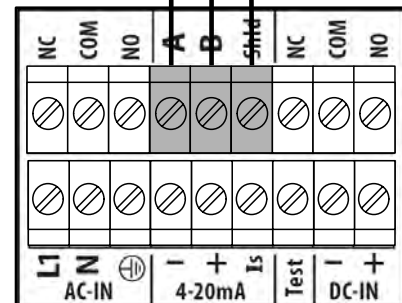
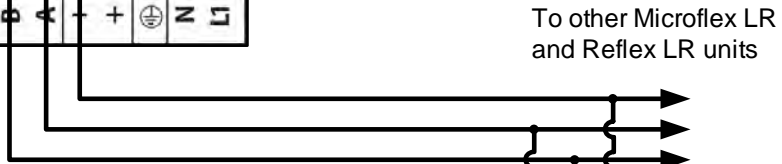
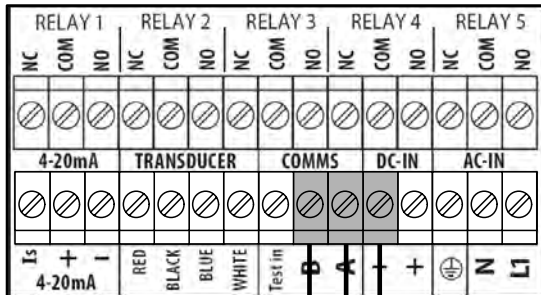


2.4 Hycontrol Link GSM Connection

The Hycontrol Link is a separately powered GSM module which enables Hycontrol Service Engineers to interrogate and programme any MI3 transmitter.

The following diagram shows how to wire it to the MI3.

Hycontrol Link Terminal


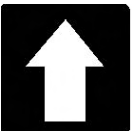




MI3 Series Transmitter (2 Relays)

### 3. PROGRAMMING – Integral via 4 button & display

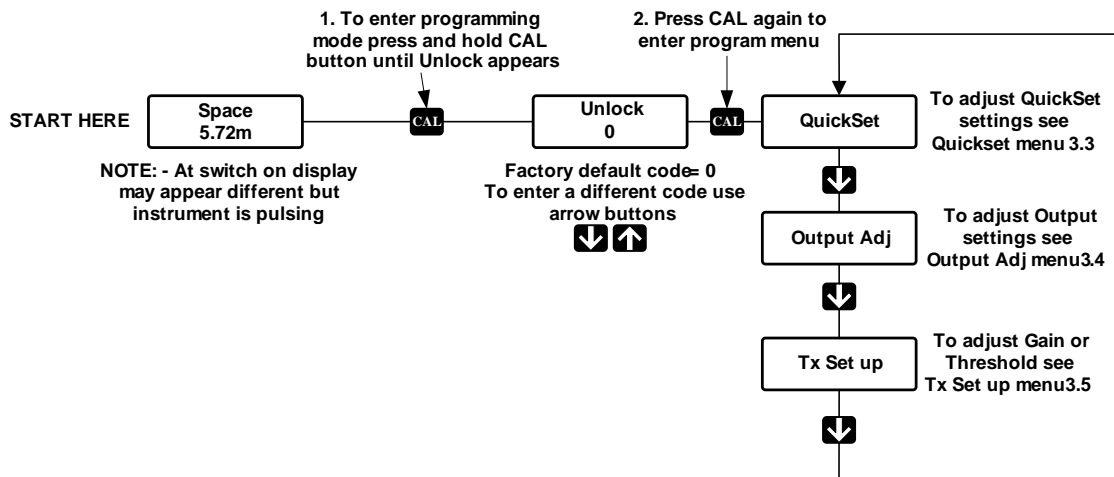
#### 3.1 Entering Data

All software adjustments are achieved via the four PUSH BUTTONS on the front panel of the Transmitter.

	(A)	Press for 3 secs – this interrupts normal operations to allow access to customized options and enables headings and functions to be edited. <b>IN SET-UP</b>
	(B)	Momentary press – saves selected value. Press and hold – scrolls through set-up menus and parameters.
	(A)	Increases displayed value.
	(B)	Scrolls up through software set-up options.
	(A)	Decreases displayed value.
	(B)	Scrolls down through software set-up options.
	(A)	One press takes the user back one step. Press twice when all selections are finished.
	(B)	Stores the current set-up in memory and checks the validity of the software selections, then returns the instrument to normal operating condition.

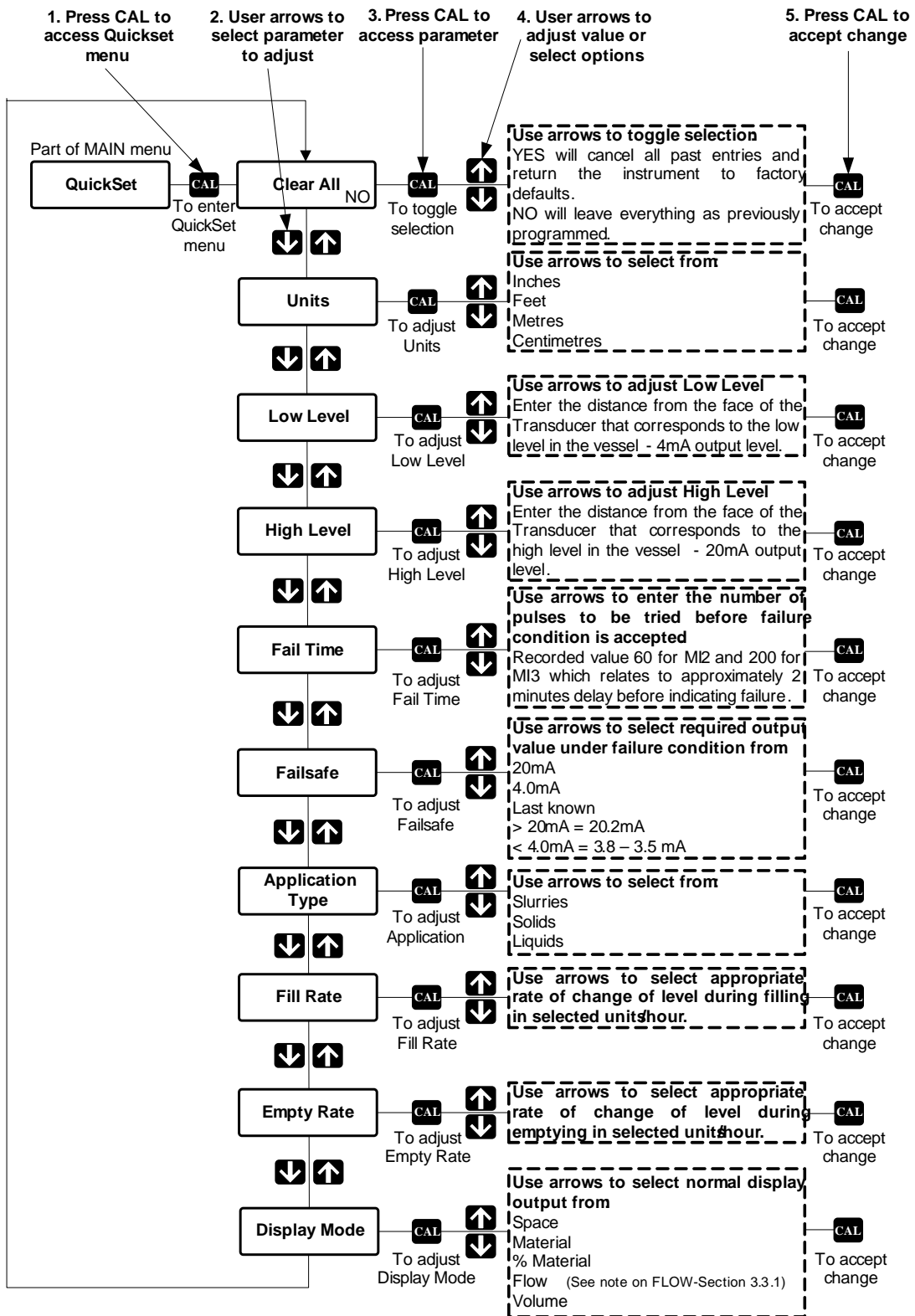
Use these 4 buttons along with the following ‘software tree’ to customize the instrument for your application.

#### 3.2 To access main menu



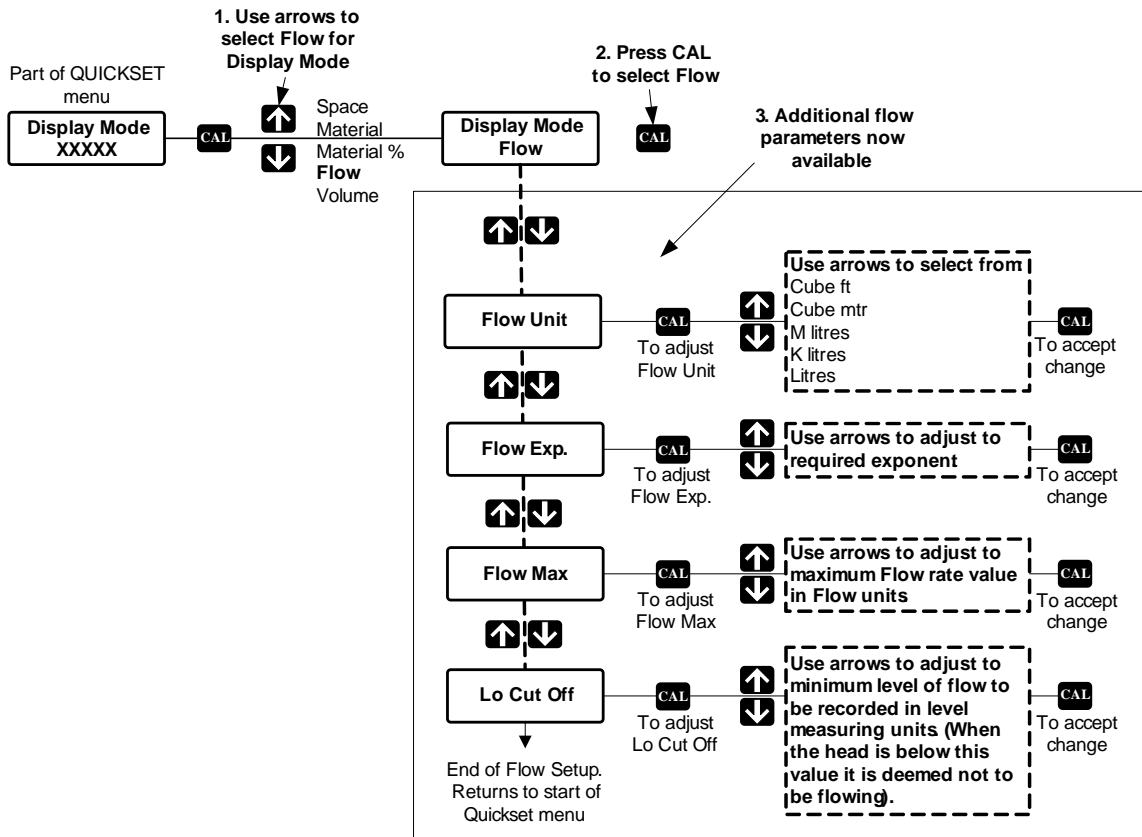
### 3.3 Entering Basic Data – QUICKSET

Go to QUICKSET and enter the values for the specific application.



### 3.3.1 Flow

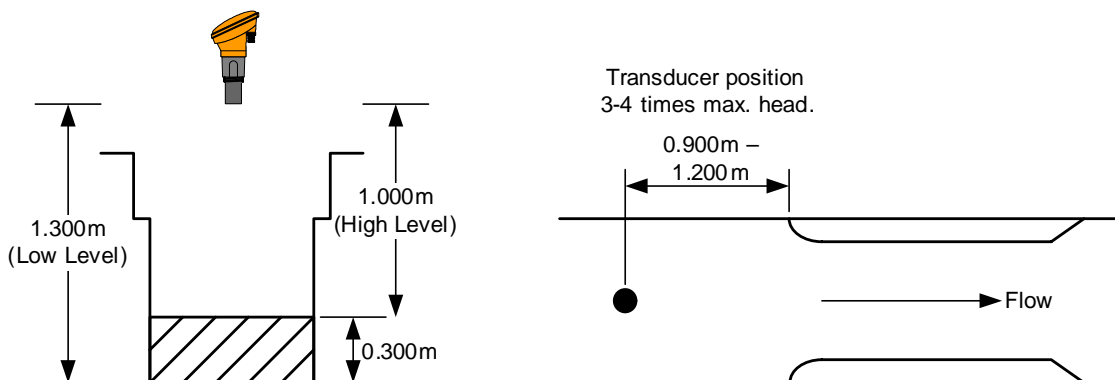
In the QUICKSET menu, Section 3.3 select Flow as the Display Mode to allow open channel flow using  $q = kh^n$ . This enables 4 additional parameters allowing the instrument to be programmed for flow.



#### Example

**3/2 Rectangular flume, with a maximum flow of 150 l/s at head 0.3m, with a bottom of flume level of 1.30m. Low cut off of 0.010 m.**

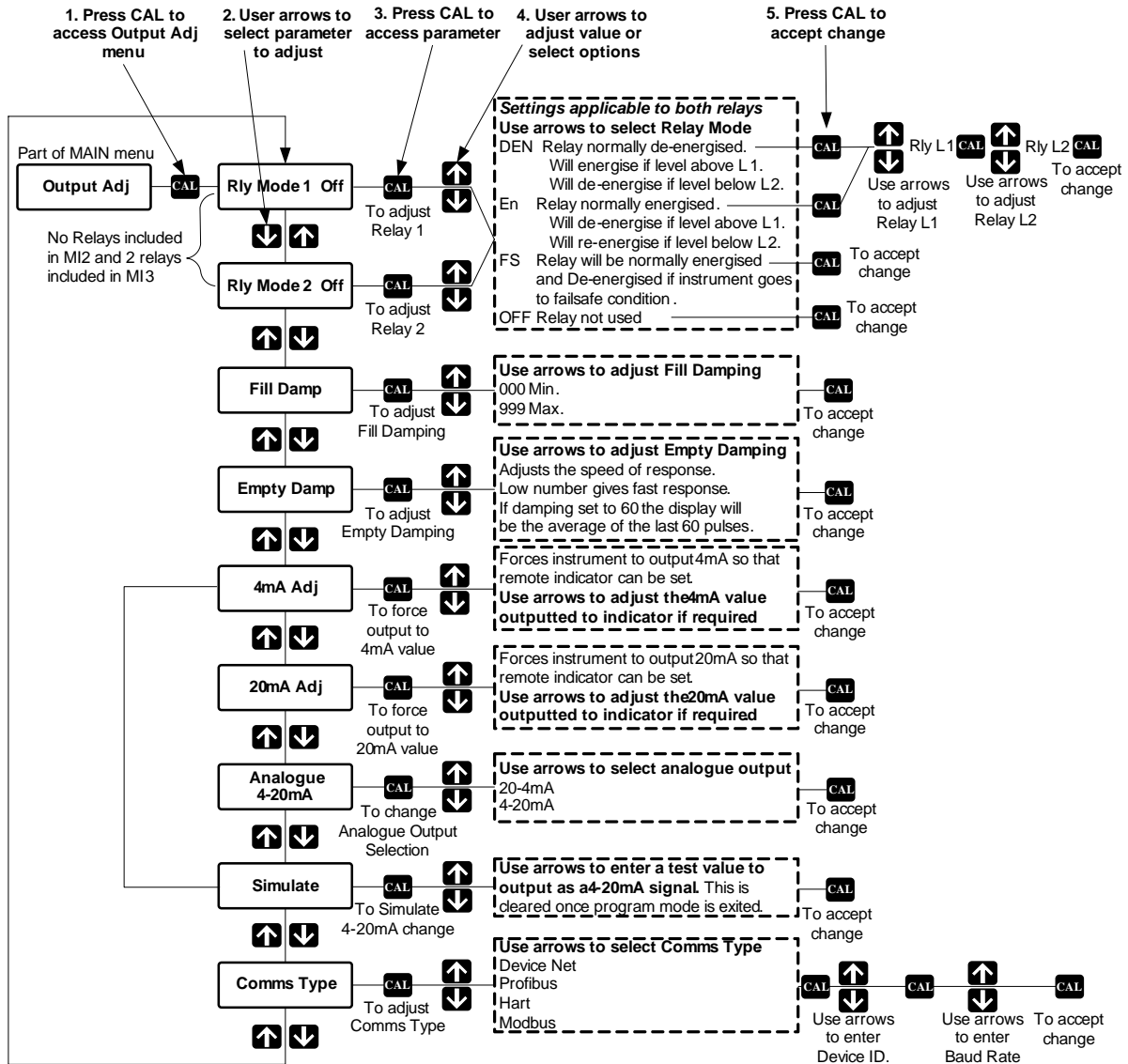
1. Select the required Flow Unit - **Litres**
2. For a 3/2 Rectangular flume enter a Flow Exp. (n) of **1.50**.
3. Enter the maximum flow value **150 l/s** that corresponds to the maximum head of 0.3m in Flow Max (Low level – High level).
4. Enter Lo Cut Off of **0.010 m**.
5. Ensure that the Low Level value in Quickstart menu is 1.30m from transducer face.
6. Ensure that the High Level Value in Quickstart menu is 1.00m from transducer face.



### 3.3.2 Volume

Volume can only be programmed via the Hycontrol Vision System II programming software package - please refer to Hycontrol office for further information.

### 3.4 Set-up – Output Adjustments



**\*Press RUN twice to exit program mode and revert to normal operation**

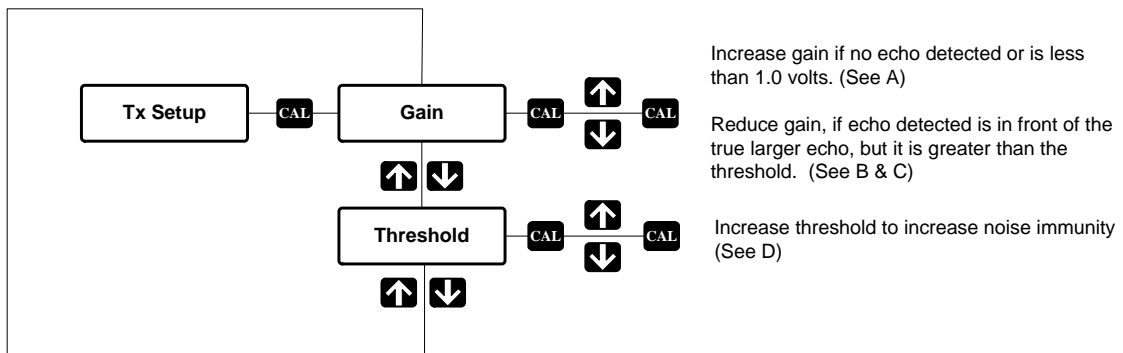
### 3.5 Tx Set-up for Gain and Threshold

It is only necessary to change the Tx Set-up for Gain and Threshold in difficult applications, usually associated with level control of solids products.

- 3.5.1. If, after completing the entry of all Quick Start (Section 3.3) and Output Adjustments (Section 3.4), the instrument is monitoring the level correctly then do not adjust the Tx Set-up parameters.



Do go into Diagnostic Display (Section 3.6) and check that the echo size “S” in volts is stable at approximately 1.0 to 2.0 volts.

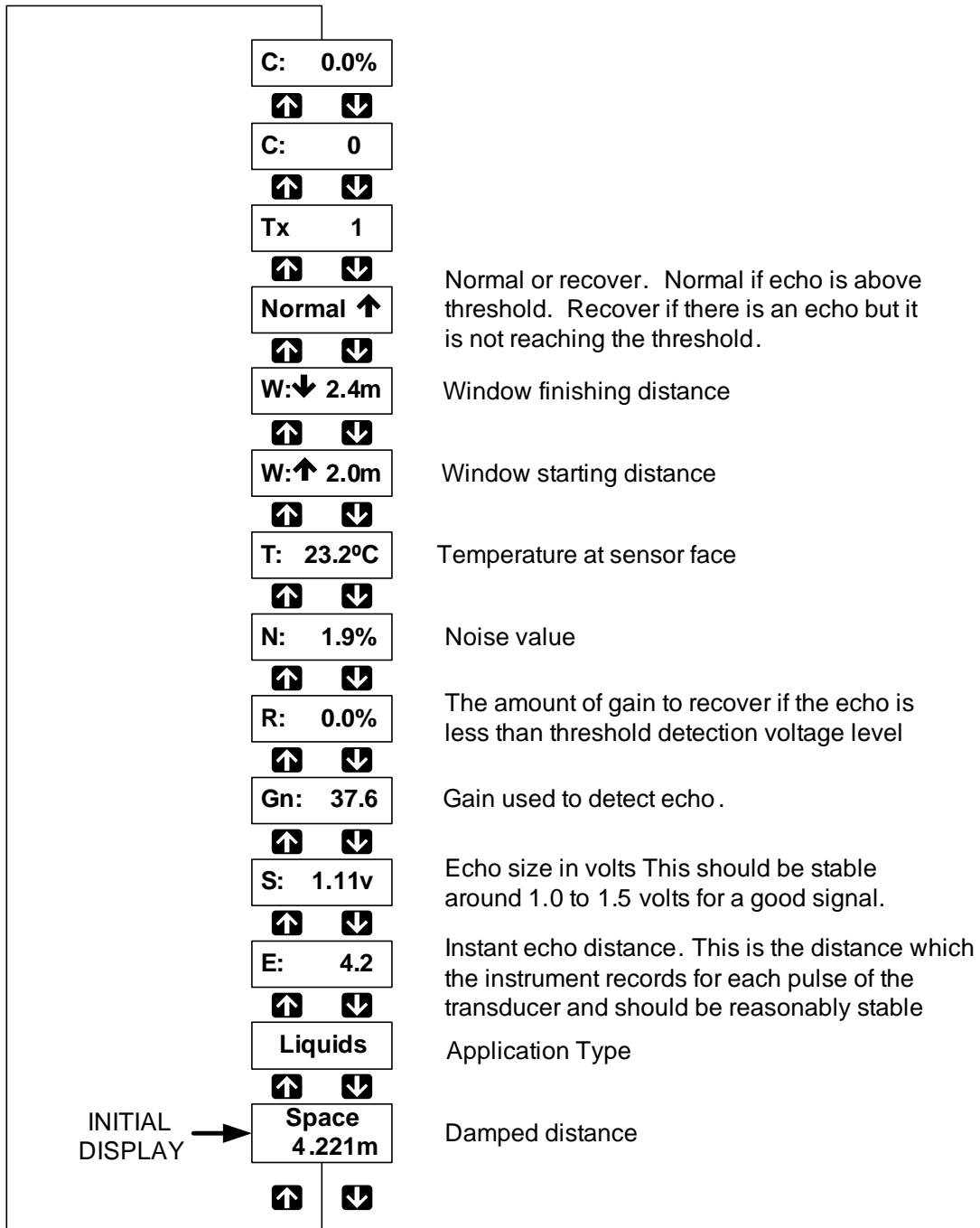
- 3.5.2 If the instrument is not reading the correct level or the echo size “S” is unstable then go into Tx Set-up (See 3.2) Gain “GN” and adjust “Gain” as follows:



- A. If no echo is detected or the echo size “S” in volts is below 1.0 volt, then increase “Gain” until the echo is detected and “S” equals 1.0 volt minimum.
- B. If the instrument is detecting an echo which is closer to the transducer than the true level, then reduce gain until the correct level is detected. Now check that the echo size “S” is still at least 1.0 volt. If it is below this level contact Hycontrol – it may be that the transducer position is not optimal.
- C. If the echo size “S” is unstable, flicking between two echoes, then increase gain until the echo stabilizes on an incorrect close echo. Note the “Gain” and then reduce the value by 30. This will give the best gain “GN” to use to avoid any close in echoes. Check to ensure that echo size “S” is between 1.0 and 2.0 volts.
- D. Threshold is rarely adjusted unless there is a problem during filling. On occasions the echo, caused by the fill-stream, may be large enough and constant enough for it to be above the threshold setting. This would show itself as a closer unwanted echo. If this occurs, check the size of the unwanted echo “S” in diagnostics and adjust the “Threshold” voltage above the echo size seen during filling.

### 3.6 Diagnostic Display

If you press the  or  push buttons when the instrument is in its normal RUN mode, the following diagnostics are available.



## 4. GENERAL SPECIFICATION

<b>Instrument Type</b>	: <b>Microflex LR Integral (MI)</b>
<b>Power Supply</b>	: 2 wire 4-20mA loop (MI2) or 2,3,4 wired AC/DC (MI3)
<b>Range</b>	: Up to 60 metres
<b>Blanking</b>	: Variable from 0.3 metres (dependent on instrument type)
<b>Process media</b>	: Liquids or Solids
<b>Analogue Output</b>	: 4-20mA into 750 Ohm Ext. Supply. 400 Ohm Int. Supply.
<b>Power Supply</b>	: 12 - 30V DC 90 - 260V AC
<b>Relays</b>	: 2 Form C SPDT rated 0.5 amp at 240V AC (MI3)
<b>Resolution</b>	: 1mm up to 20 metre range 4mm from 20-60 metre range
<b>Accuracy</b>	: +/- 0.25% of maximum range
<b>Operating temperature</b>	: -40°C to + 80°C *
<b>Ambient temperature</b>	: Electronics -40°C to + 80°C *
<b>Display</b>	: 2 line 8 digit LCD
<b>Enclosure</b>	: Integral System IP67
<b>Key Pad</b>	: Integral 4 button
<b>Mounting</b>	: MI__10 2" NPT or BSPT MI__20 4" Flanged ANSI, DIN or JIS MI__40/60 10" Flanged ANSI, DIN or JIS
<b>Weight</b>	: 2kg - 15kg depending on instrument type
<b>Cable Entries</b>	: M16 Cable Glands
<b>Comms</b>	: Modbus (MI3 option) Multi-drop capability (up to 32 units) Vision System II Software Package Hycontrol GSM Link (GSM/CDMA connectable)

\*For ATEX models refer to ATEX Safety & Operating Instructions Manual.

## 5. PART NUMBER SELECTION:- MICROFLEX LR INTEGRAL

<b>MODEL</b>	Microflex LR Ultrasonic Level Transmitters		
<b>M12</b>	Integral 2 wire transmitter with display and no relays (Select output type in additional communications)		
<b>M13</b>	Integral 2, 3, & 4 wire transmitter with display and 2 relays		
<b>Power Supply</b>			
<b>B</b>	12-30V DC		M12 or M13
<b>U</b>	Universal power supply 90-260V AC / 24V DC		M13 only
<b>Measuring Range - Transducer Frequency</b>			
<b>10</b>	30kHz	10m max	
<b>20</b>	20kHz	20m max	
<b>40</b>	10kHz	40m max	
<b>60</b>	5kHz	60m max	
<b>Process Temperature - Transducer Facing Material</b>			
<b>S</b>	Standard Temperature ~ Dry product ~ Polyolefin face, 10 & 5KHz		
<b>T</b>	Standard temperature ~ Wet atmosphere ~ Teflon face, 30 & 20KHz		
<b>Transducer Housing Material</b>			
<b>4</b>	Polypropylene	20, 10 & 5KHz	
<b>6</b>	Teflon	30KHz	
<b>Process Connection</b>			
<b>FA</b>	ANSI Flange		
<b>FD</b>	DIN Flange		
<b>FJ</b>	JSI Flange		
<b>SB</b>	BSP		30KHz only
<b>SN</b>	NPT		30KHz only
<b>XX</b>	Not required		
<b>Process Connection Size</b>			
<b>02</b>	2 inch thread		30KHz only
<b>04</b>	4" Flange only		Standard on 20KHz
<b>06</b>	6" Flange only		
<b>08</b>	8" Flange only		
<b>10</b>	10" Flange only		Standard on 10KHz & 5KHz
<b>XX</b>	Not required		
<b>Flange Material</b>			
<b>4</b>	Polypropylene		
<b>6</b>	Teflon		
<b>7</b>	Carbon Fibre		
<b>X</b>	Not required		
<b>Z</b>	Special		
<b>Cone</b>			
<b>XX</b>	Not required		
<b>04</b>	4"		
<b>10</b>	10"		
<b>Cone Material</b>			
<b>4</b>	Polypropylene		
<b>6</b>	Teflon		
<b>7</b>	Carbon Fibre		
<b>8</b>	Polyurethane		
<b>X</b>	Not required		
<b>Z</b>	Special		
<b>Approvals</b>			
<b>X</b>	Without		
<b>A</b>	ATEX EEx ia* M12 only not M13		
<b>D</b>	ATEX DIP* M12 & M13		
<b>Additional Communications</b>			
<b>S</b>	Switch 2 relays		M13 only
<b>A</b>	4/20 mA only		M12 or M13
<b>M</b>	Modbus 4/20mA		M13 only
<b>H</b>	HART		M12 only
<b>I</b>	HART isolated		M13 only
<b>W</b>	Modbus only		M13 only
<b>X</b>	No additional comms		
<b>A</b>	Typical Part Number		

\*For ATEX models refer to ATEX Safety & Operating Instructions Manual.

## 6. LABELLING INFORMATION.

Standard label fitted to all Microflex LR Integral Transmitters.



## 7. MODBUS REGISTER LIST

### BASIC MODBUS SPAN AND DIAGNOSTIC REGISTERS FOR HYCONTROL MICROFLEX LR SERIES INSTRUMENTS

Hycontrol Microflex LR series units communicate using '2 wire' (plus Ground) RS485 connection, and can be connected in 'multi-drop' configurations.

**Protocol: Modbus RTU (2 wire)**

**Speed: 19200 Baud**

**Data bits: 8**

**Parity: None**

**Stop Bits: 1**

Hycontrol Microflex LR series units act as 'slave' devices on a Modbus network.

Units are shipped from the factory with a default Modbus address of 1. The Modbus address of any unit can be changed individually if units are to be connected in a multi-drop network. Each address number must only be used once on any network (possible addresses are 1...255).

Diagnostic Block (*Read Only*): \*Can be read as Singles or any Block wholly within the limits of this range of addresses\*

40124 -	LOW LEVEL span set point in mm
40125 -	HIGH LEVEL span set point in mm
40126 -	DISPLAYED DISTANCE (DISTANCE) in mm
40127 -	NOT USED
40128 -	NEW DISTANCE (E-DISTANCE) in mm
40129 -	CONFIRM DISTANCE (C-DISTANCE) in mm
40130 -	ECHO SIZE in Volts/102
40131 -	GAIN at Echo detection point in %/7.5
40132 -	NOT USED (Gain Limit)
40133 -	RECOVER GAIN currently being used in %/7.5
40134 -	NOISE in %/7.5
40135 -	TEMPERATURE in Degrees K/10 ((DegreesC+273.2)/10)
40136 -	NOT USED
40137 -	CONFIRM COUNTER current value
40138 -	HOLD COUNTER current value
40139 -	NOT USED
40140 -	WINDOW FORWARD POSITION in mm
40141 -	WINDOW BACK POSITION in mm

**Identity Information (Read Only): \*MUST Read as SINGLES-NOT BLOCKS\*:**

- 40002 - SERIAL NUMBER raw number
- 40003- TYPE NUMBER raw binary values- bits defined as listed here:
  - Bit0- Power Configuration- '0'= 234 wire  
'1'= 2 wire
  - Bit1- Range/Resolution- '0'=Standard(60m/1mm)  
'1'=Long(175/4mm)
  - Bit5- Mechanical Config- '0'=Remote  
'1'=Integral
- 40004- AMPLIFIER SOFTWARE VERSION raw number/100
- 40005- AMPLIFIER MODBUS ID raw number
- 40006- AMPLIFIER MODEL NUMBER- values defined as listed here:
  - 0-Ultrasonic Air
  - 1-Sonar
  - 7-N/A
  - 8-N/A
  - 9-N/A
- 40402- TRANSDUCER SERIAL NUMBER raw number
- 40403- TRANSDUCER MODEL NUMBER raw number (tx freq. in kHz)
- 40404- TRANSDUCER SOFTWARE VERSION raw number/100
- 40405- TRANSDUCER MODBUS ID raw number

**Span Adjustment (Read/Write) \*MUST Read/Write SINGLES-NOT BLOCKS\*:**

- 40013 - LOW LEVEL span set point in mm
- 40014 - HIGH LEVEL span set point in mm

**RELAY Function Adjustment (Read/Write) \*MUST Read/Write SINGLES-NOT BLOCKS\*:**

- 40052- Relay 1 Mode setting- values defined as listed here:
  - 0-OFF
  - 1-FS (Failsafe)
  - 2-EN (Energise on Level)
  - 3-DEN (De-Energise on Level)
- 40053- Relay 2 Mode setting- values defined as listed for Relay 1 above
- 40054- Relay 3 Mode setting- values defined as listed for Relay 1 above
- 40055- Relay 4 Mode setting- values defined as listed for Relay 1 above
- 40056- Relay 5 Mode setting- values defined as listed for Relay 1 above
- 40036- Relay 1 L1 set point in mm
- 40037- Relay 1 L2 set point in mm
- 40038- Relay 2 L1 set point in mm
- 40039- Relay 2 L2 set point in mm
- 40040- Relay 3 L1 set point in mm
- 40041- Relay 3 L2 set point in mm
- 40042- Relay 4 L1 set point in mm
- 40043- Relay 4 L2 set point in mm
- 40044- Relay 5 L1 set point in mm
- 40045- Relay 5 L2 set point in mm

**Extended Params (Read/Write) \*MUST Read/Write SINGLES-NOT BLOCKS\*:**

- 40060- DISPLAY UNITS parameter setting- values defined as listed here:
  - 0-Frequency (Hz) \*Not valid for level instruments\*
  - 1-Pressure (kPa) \*Not valid for level instruments\*
  - 2-Pressure (PSI) \*Not valid for level instruments\*
  - 3-Millimetres
  - 4-Centimetres
  - 5-Metres
  - 6-Feet
  - 7-Inches
- 40015- FAILSAFE MODE parameter setting- values defined as listed here:
  - 0- 3.5mA
  - 1- 3.8mA
  - 2- 20.2mA
  - 3- Last Known
  - 4- 4.0mA
  - 5- 20.0mA
- 40016- FAILSAFE TIME parameter setting- in seconds
- 40017- APPLICATION TYPE parameter setting- values defined as listed here:
  - 0-Liquid
  - 1-Solid
  - 2-Slurry
  - 3-Position
- 40018- FILL RATE parameter setting- in metres per hour/10
- 40019- EMPTY RATE parameter setting- in metres per hour/10
- 40020- DISPLAY MODE parameter setting- values defined as listed here:
  - 1-Volume
  - 2-Flow
  - 3-Material %
  - 4-Material
  - 5-Space
  - 6-Differential Output
  - 7-Average Material
- 40065- FLOW UNITS parameter setting- values defined as listed here:
  - 32-Litres
  - 33-Kilolitres
  - 34-Megalitres
  - 35-Cubic Metres
  - 36-Cubic Feet
- 40031- FLOW EXPONENT parameter setting- in raw units/100
- 40032- FLOW MAX parameter setting- in selected flow units per second/10
- 40033- LOW CUT OFF parameter setting- in mm
- 40033- OFFSET parameter setting- in mm (0-5000)
- 40021- LOCK CODE parameter setting- raw number
- 40022- FILL DAMPING parameter setting- raw number
- 40023- EMPTY DAMPING parameter setting- raw number

- 40064- ANALOG mode parameter setting- values defined as listed here:  
           0- 4-20mA (4mA low, 20mA high- standard)  
           1- 20-4mA (20mA low, 4mA high- inverted)
- 40448- GAIN parameter setting in %/7.5  
 40449- GAIN STEP parameter setting in %/7.5  
 40450- DISTANCE STEP parameter setting in mm  
 40451- THRESHOLD parameter setting in Volts/100  
 40452- BLANKING parameter setting in mm  
 40453- EMPTY DISTANCE parameter setting in mm  
 40454- TEMPERATURE ADJ parameter setting- raw number  
 40455- DISTANCE ADJ parameter setting in mm  
 40456- VELOCITY parameter setting Value/10000  
 40457- MAP DISTANCE parameter setting in mm  
 40458- MAP USED parameter setting in mm  
 40461- MAP MARGIN parameter setting in %/7.5  
 40434- RECOVER FIRST parameter setting in %/7.5  
 40435- RECOVER MAX parameter setting in %/7.5  
 40436- RECOVER INCREMENT parameter setting in %/7.5  
 40437- WINDOW parameter setting in mm  
 40438- WINFWD INC parameter setting in mm  
 40439- WINBACK INC parameter setting in mm  
 40440- CONFIRM parameter setting- raw number  
 40441- HOLD parameter setting- raw number  
 40442- TX VOLTAGE parameter setting in V/413.25  
 40445- NOISE SWITCH parameter setting in %/7.5  
 40446- ECHO WIDTH parameter setting in mm  
 40433- SEARCH FIRST parameter in %/7.5  
 40034- MOVEMENT parameter setting in mm  
 40419- SLOPE DIST parameter setting in mm  
 40420- SLOPE INC parameter setting in %/7.5  
 40421- DETECTOR parameter setting in V/1240.7  
 40422- GAIN STEP1 parameter setting in %/7.5  
 40423- DISTANCE STEP1 parameter setting in mm  
 40424- GAIN STEP2 parameter setting in %/7.5  
 40425- DISTANCE STEP2 parameter setting in mm  
 40426- GAIN MAX parameter setting in %/7.5  
 40427- PULSE POWER parameter setting- raw number  
 40428- PULSE RATE parameter setting- raw number  
 40429- FREQUENCY parameter setting- raw number  
 40430- FILTER parameter setting- raw number  
 40431- ADVANCED FILTER parameter setting- raw number  
 40026- I-WASTE parameter setting in mA/1000  
 40035- I-CHARGE parameter setting in mA/37.22

## 8. ASSEMBLY OF FLANGE AND CONES.

### 05, 10 & 20KHz – Transducer Assembly Process

1. Remove red cap (including cardboard).



2. Screw the flange assembly fully down onto the cone (as far down as it will go until the parts are tightly fastened).



3. Screw the transducer tightly down onto the flange and cone assembly.

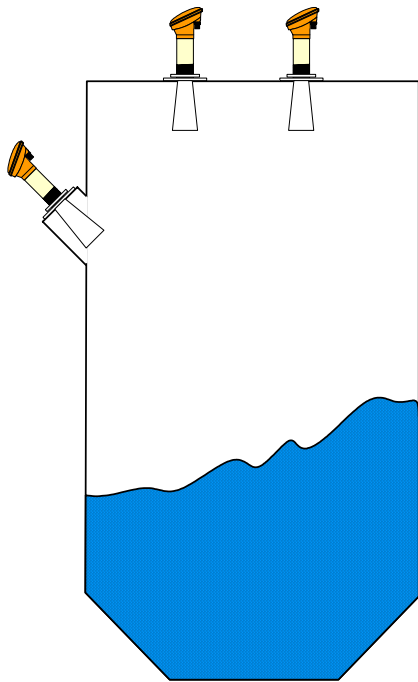


4. Tighten the locking ring down to the flange to fix the components in place.



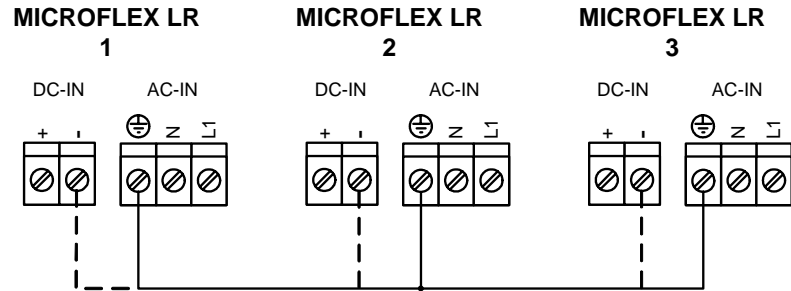
COMPLETED  
ASSEMBLY

## APPENDIX A. CROSS TALK PREVENTION



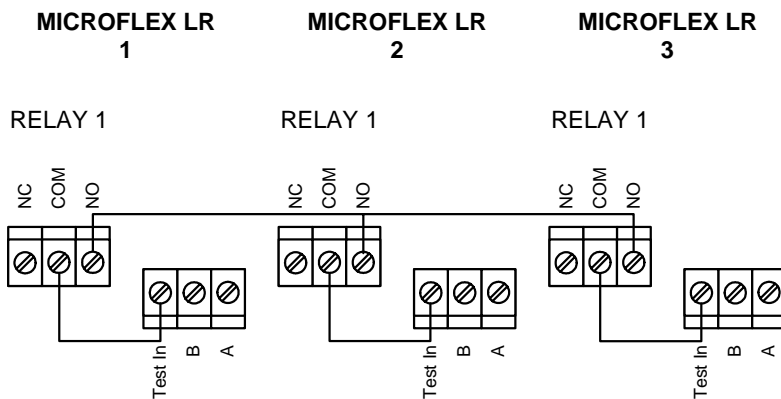
### Setup

1. Units to be linked must have a common ground connection, or wire between '⊕', or 'DC -' terminals (parallel connection of all units).



**NOTE:-** '⊕' and 'DC IN-' are electrically the same

2. At each unit, wire a connection between Relay 1 'COM' terminal and the terminal labelled 'TEST'. See *below*.
3. Wire a connection between the Relay 1 'NO' terminal on each unit linked together (parallel connection of all units). See *below*.



4. In the software setup of each unit, program 'RlyMod1' (Relay Mode 1) parameter to 'FS' (Failsafe) mode in Output Adjust menu. (You could use a different relay number in the same way if relay 1 is needed for another function).

The units will now be linked so that they cannot crosstalk.

## **Theory**

The 'TEST' terminal acts as an input when the unit is about to pulse, and will cause the instrument to enter a paused state (not pulse) if you apply a connection to ground. Each unit also drives its own 'TEST' terminal to ground when it is busy pulsing. These two functions combined mean that if two or more units have their 'TEST' terminals connected in parallel, and share a common ground, then at any time when one is pulsing, it will ground the 'TEST' terminals of all units it is connected to, and temporarily pause them until it is finished, then release them. The next unit, which is ready to pulse, then does the same thing in turn, and the process repeats.

The connections above also include the normally open contact of a relay programmed into Failsafe mode in line with the 'TEST' terminals. The function of this is simply to prevent a possible lock up of the whole system if one unit has a problem (such as power failure). Any time that a unit is in the failed state, it will be disconnected by the relay from the other units, so they can continue working together.