BEKA associates

# BA526 2-wire 4/20mA combined analogue and digital indicator for use in safe areas

*Instruction manual*

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## 1 Description

The BA526 is a panel mounting loop powered 4/20mA combined analogue and digital indicator for use in safe areas. The one hundred segment vertical bargraph enables a user to quickly assess the input current, make comparisons with adjacent indicators and monitor trends, while the digital display shows the input current in accurate engineering units.

The BA526 is loop-powered by the 4/20mA input current, but only introduces a 1.1V drop which allows it to be installed into almost any current loop. No additional power supply or battery is required.

An optional square root extractor may be fitted to linearise the output from 4/20mA flow transmitters which have a square law characteristic such as those operating from orifice plates and venturi tubes.

## 2 Application

The BA526 indicator will operate in series with any 4/20mA current loop providing that the loop can tolerate the additional 1.1V drop introduced by the indicator.

When designing a loop it is only necessary to add the voltage drop caused by the BA526 to the other voltage drops caused by transmitters and loads, and to ensure that the sum of all the voltage drops in the loop is less than the minimum power supply voltage.
Fig 1 shows a BA526 connected to a process measuring loop. Considering the voltage drops around the loop:

| | |
|---|---|
| Min operating voltage of 2-wire Tx | 10.0V |
| Max voltage drop caused by controller | 5.0V |
| Max voltage drop caused by BA526 indicator | 1.1V |
| Max voltage drop caused by cable resistance | 0.4V |
| | 16.5V |

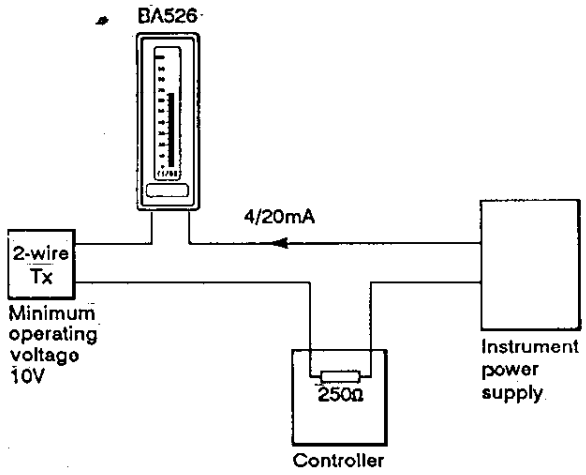


Fig 1 BA526 in process measuring loop

The instrument power supply must therefore have a minimum output of 16.5V at 20mA.
The BA526 may also be driven directly from any instrument with a 4/20mA output as shown in Fig 2. Again it is only necessary to ensure that the voltage capability of the 4/20mA current source is greater than the voltage drops caused by the indicator and cable resistance.

The BA526 incorporates protective components to prevent damage by non-repetitive transient currents of up to 30A for 15ms. However, when connected to long overhead or underground cables it may be necessary to install a surge protection unit close to the indicator, if the cable is likely to be subjected to high transient currents induced by lightning or electrical switch gear.

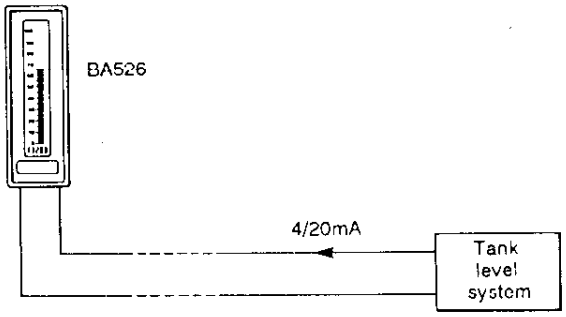


Fig 2 BA526 displaying output from level measuring system

## 3 Installation

### 3.1 Location

The BA526 is housed in a standard DIN case which may be installed into any panel providing the environmental limits shown in the specification are not exceeded. The instrument front panel provides IP65 protection which

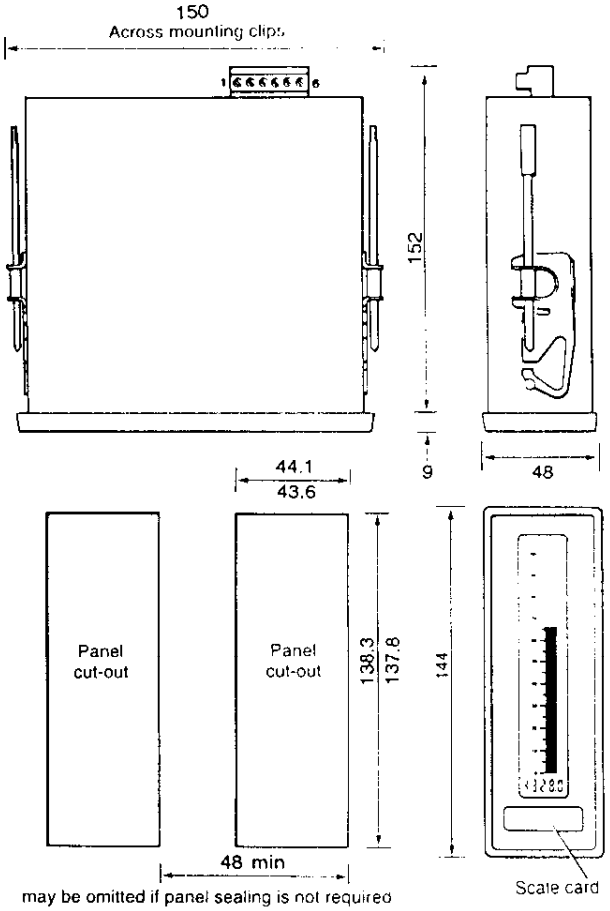


Fig 3 Dimensions

prevents the ingress of dust and liquids. When the joint between the instrument and the mounting panel must also be sealed, great care should be taken to ensure that the panel aperture is within the tolerances shown in Fig 3 and that the edges of the aperture are flat. The neoprene gasket supplied with the BA526 will seal this joint, however if conditions are not ideal we recommend that the interface is sealed with a liquid gasket such as silicone rubber.
When sealing between the front and rear of the panel is not required the larger aperture specified in DIN43700 may be used.
For maximum mounting density without panel sealing, any number of instruments may be mounted in a common aperture ((N x 42) -3)mm wide, where N is the number of indicators.

### 3.2 Installation procedure

1. Insert the indicator into the panel from the front ensuring that the gasket is correctly positioned.

2. Fit a panel mounting clip to the top and bottom of the instrument and tighten until the indicator is secure.

3. Connect the loop wiring to the terminal block as shown in Fig 4. To ease installation the terminal block can be removed from the instrument by gently pulling.

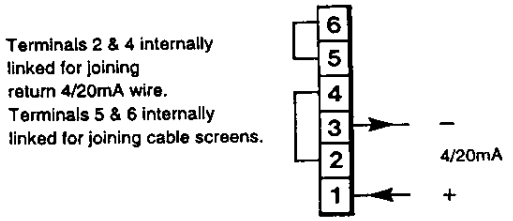


Fig 4 Terminal connections

## 4 Calibration

The calibration of the digital display is fully adjustable so that the instrument can be set to display in engineering units any variable represented by the 4/20mA current. A dummy trailing zero may be selected to increase the maximum display to 19990.

The analogue bargraph is preset to display 0% with 4mA input and 100% with 20mA input. A small amount of adjustment is available which may be used to compensate for any drift or change in span when a root-extractor board is added or removed.
The span and zero potentiometers for the digital display are accessible through two holes in the rear panel, recalibration not requiring changes to the position of links can therefore be accomplished in situ without removing the indicator from its case.

### 4.1 Removal of Indicator from case

To obtain access to the calibration links the indicator must be removed from its case, this can be done with or without the BA526 mounted in a panel. Unscrew the four M2 screws in the corners of the rear panel. Disconnect or unplug the field wiring and gently withdraw the instrument from the case as shown in Fig 5.

### 4.2 Calibration controls

The locations of the calibration controls and links are shown in Fig 6.

### Zero Adjustment

Zero is defined as the figure displayed by the digital indicator with a 4.000mA input current. The zero may be adjusted to any figure between -1000 and 1000. The position of the suppression/elevation links determines whether a positive or negative number is displayed.

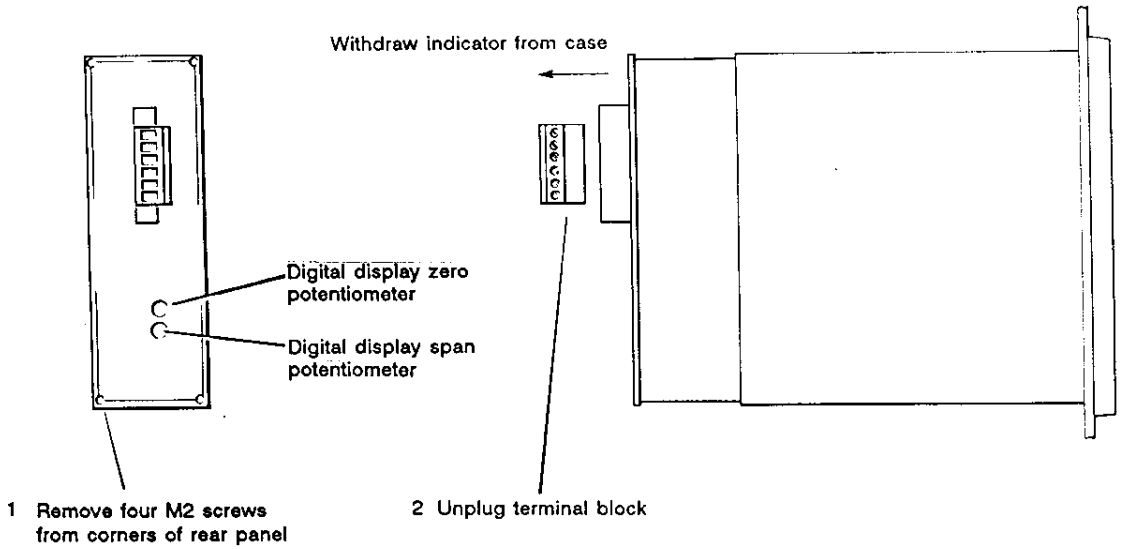


Fig 5 Removing indicator from case

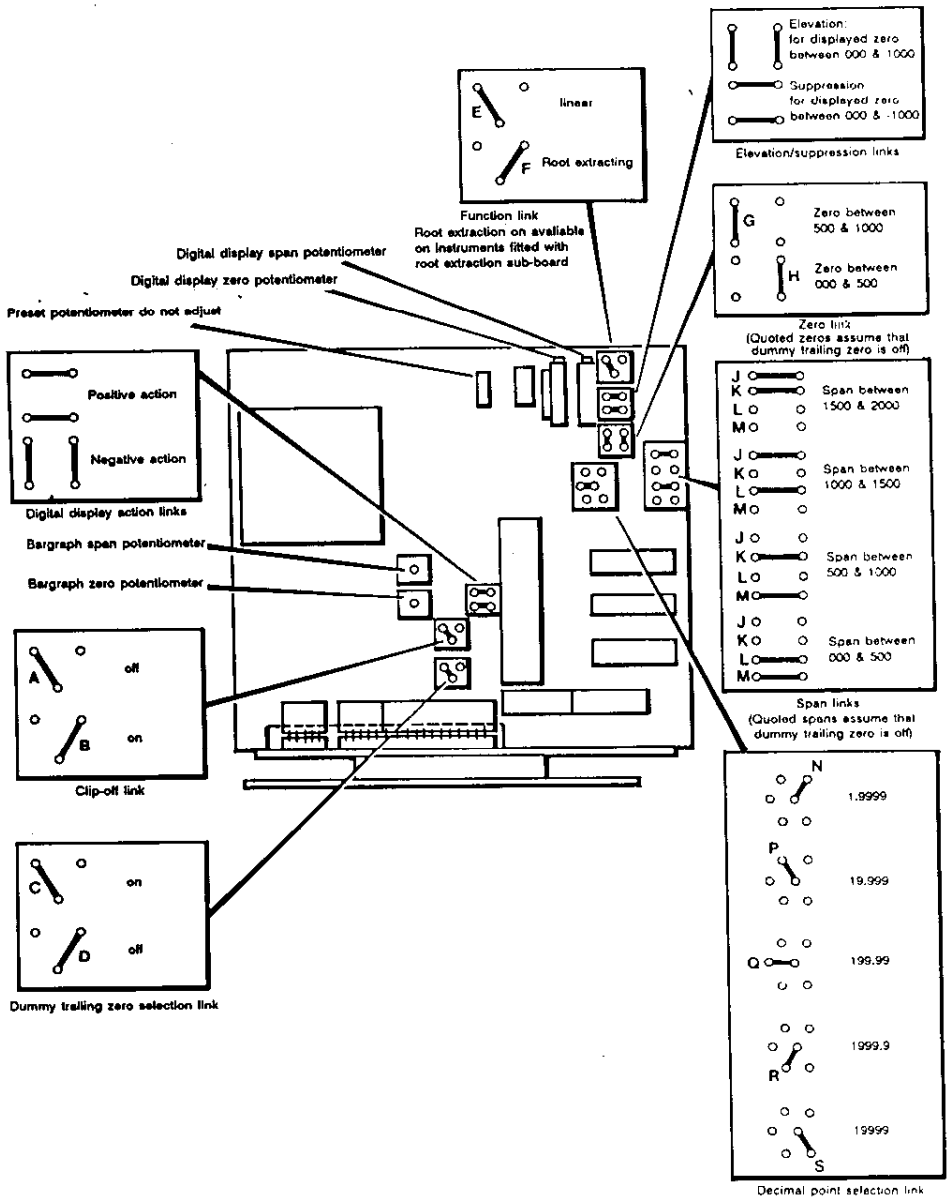


Fig 6 Positions of calibration controls and links

With the suppression/elevation links in the suppression position, the indicator can be adjusted to display any number between -1000 and 000 with a 4mA input. With the suppression/elevation links in the elevation position, the indicator can be adjusted to display any figure between 000 and 1000 with a 4mA input.

The zero potentiometer has two ranges. With the zero link in the 'H' position the zero potentiometer will adjust the figure displayed by the indicator with a 4mA input between 000 and 500. With the zero link in position 'G' the potentiometer will adjust the zero between 500 and 1000.

**Span Adjustment**
Span is defined as the difference between the number displayed with a 4.000mA input and the number displayed with a 20.000mA input. The span may be adjusted to any figure between 000 and 2000.
The span has four equal ranges which are selected by the position of links 'J', 'K', 'L' and 'M'

**Display Action**
The position of the display action solder-in links determine whether the digital display increases or decreases with increasing input current. The analogue bargraph is not affected by the position of these links.

**Dummy Trailing Zero**
A dummy trailing zero can be added after the 3½ digit display to increase the range of engineering units which can be represented.

**Decimal Point**
The position, or absence, of the displayed decimal point on the digital display is defined by the position of the decimal point selection link.

**Linear/Square Root Extraction**
This link selects the square root extractor sub board when fitted.

**Clip-Off**
Clip-off, which is intended for use with the square root extractor, forces both the analogue and digital displays to zero when the input current falls below 4.04mA (5% flow).

### 4.3 Calibration procedure for a linear indicator

The first step is to interpret the required digital display calibration and determine the position of the plug-in links. It is then only necessary to set the exact zero and span of the indicator using the two potentiometers accessible through the rear panel.

For example if the indicator is required to display:

25.0 with a 4.000mA input
and 180.0 with a 20.000mA input

Ignoring the decimal place this corresponds to:

A zero of 250 positive
A span of 1550
Display action positive
Trailing dummy zero off
A decimal point before the least significant digit
Linear
Clip-off off

The following adjustments are required:

**Step 1**
The indicator is required to display a positive zero therefore the suppression/elevation links should be put in the elevation position.

**Step 2**
The required zero is 250, therefore the zero link should be put into the 'H' position.

**Step 3**
The required span is 1550, therefore the span links should be put into the 'J' and 'K' positions.

**Step 4**
The required digital display does not exceed 1999 so the dummy trailing zero is not required. The trailing zero link should therefore be put in the 'D' position.

**Step 5**
The decimal point is required before the least significant digit, therefore the decimal point selection link should be put in the 'Q'position.

**Step 6**
The transfer function of the indicator is linear so the linear/square root-extracting link should be placed in the 'E' position.

**Step 7**
Clip-off is not required for a linear indicator so this link should be placed in the 'A' position.

**Step 8**
With 4.000mA input current adjust the zero potentiometer until the indicator displays 25.0

**Step 9**
With 20.000mA input current adjust the span potentiometer until the indicator displays 180.0

**Step 10**
Repeat steps 8 and 9 until both calibration points are correct. The span and zero controls are almost independent, it should therefore only be necessary to repeat each adjustment two or three times.

### 4.4 Square root extractor

The square root extractor sub board enables the BA526 to display square law flow signals in linear engineering units. The root extractor provides linearisation between 4.16 and 20mA, so the indicator will accurately display the flow in linear units between 10 and 100% of full flow. The linearisation continues to operate with slightly reduced accuracy down to 2.5% of maximum flow. To mask flowmeter inaccuracies the link selectable clip-off forces both displays to zero when the flow falls below 5% (4.04mA)..

Most flowmeters and the square root extractor in the BA526 operate with reduced accuracy below 10% of maximum flow. The indicator zero control should therefore be adjusted to give the required display at 4.16mA, which corresponds to 10% of maximum flow. The zero control must not be adjusted to give a zero display at 4mA.

For reference the following table shows the output current from a non-linearised flowmeter.

| % of full flow | Current output mA |
|---|---|
| 2.5% | 4.01mA |
| 10% | 4.16mA |
| 25% | 5.00mA |
| 50% | 8.00mA |
| 75% | 13.00mA |
| 100% | 20.00mA |

### 4.5 Calibration procedure for an indicator with square root extractor

As with a linear indicator it is first necessary to interpret the required digital display calibration and determine the position of the plug-in links. It is then only necessary to adjust the zero and span potentiometers to give the required display at 10 and 100% of flow.

For example, if the BA526 is required to display the 20mA output from a flowmeter as 18000 Litres per minute, this corresponds to:

A span of 18000 (1800 plus dummy trailing zero)
Display action positive
Trailing dummy zero on
Decimal point absent
Square root extracting
Clip-off on

The following adjustments are required:

**Step 1**
When root extraction is used the BA526 may not have zero suppression or elevation. The zero suppression/elevation links should always be put in the elevation position and the zero link in the 'H' position.

**Step 2**
The required span is 1800 plus a dummy trailing zero, therefore the span links should be put into the 'J' and 'K' positions.

**Step 3**
The required digital display exceeds 1999 so the dummy trailing zero is required. The trailing zero link should therefore be put in the 'C' position.

**Step 4**
No decimal point is required therefore the decimal point selection link should be put in the 'S'position.

**Step 5**
Square root extraction is required so the linear/root-extracting link should be placed in the 'F' position.

**Step 6**
Clip-off is required so this link should be placed in the 'B' position.

**Step 7**
With 4.160mA input current adjust the zero potentiometer until the indicator displays 1800

**Step 8**
With 20.000mA input current adjust the span potentiometer until the indicator displays 18000

**Step 9**
Repeat steps 7 and 8 until both calibration points are correct.

### 4.6 Over and under-range

If the digital display range is exceeded ie. below -1999 or above 1999 ignoring the dummy trailing zero, the three least significant digits will be blanked. Under-range is indicated by -1bbb and over-range by 1bbb, or -1bbb0 and 1bbb0 respectively if the dummy trailing zero has been selected. Note: A blank digit on the display is denoted by 'b' in this manual.
The bargraph displays an arrow pointing upwards when the input current exceeds 20.08mA Below 4mA a single negative segment is activated between 3.76 and 3.92mA, below 3.76mA the bargraph is blanked.

### 4.7 Calibration of the bargraph

Two preset potentiometers allow the span and zero to be adjusted by a few percent to compensate for drift and variations in span when changing between linear and root extraction.

#### 4.7.1 Linear

The following adjustments are required:

**Step 1**
With 3.92mA input current adjust the bargraph zero potentiometer until the bargraph just starts to make a transition from 0% to -1%.

**Step 2**
With 19.92mA input current adjust the bargraph span potentiometer until the bargraph just starts to make a transition from 100% to 99%.

**Step 3**
Repeat steps 1 and 2 until both calibration points are correct.

#### 4.7.2 Square root extracting

The following adjustments are required:

**Step 1**
With 4.16mA input current which is equivalent to ten percent of maximum flow, adjust the bargraph zero potentiometer until the 10% bar of the bargraph is on.

**Step 2**
With 19.92mA input current adjust the bargraph span potentiometer until the bargraph just starts to make a transition from 100% to 99%.

**Step 3**
Repeat steps 1 and 2 until both calibration points are correct.

## 5 Maintenance

### 5.1 Fault finding during commissioning

If a BA526 indicator fails to function during commissioning the following procedure should be followed:

| Symptom | Cause | Solution |
|---|---|---|
| No displays | Incorrect wiring to indicator | Correct wiring error, indicator will not be damaged by reversed connections. |
| Indicator displays 1 or 1bbb0 if dummy zero is activated | Positive over-range | The digital indicator has been incorrectly calibrated & is trying to display a number greater than 1999 or 19990 if the dummy zero is activated. |
| Indicator displays -1 or -1bbb0 if dummy zero is activated | Negative over-range | The digital indicator has been incorrectly calibrated & is trying to display a number less than -1999 or -19990 if the dummy zero is activated |
| Unstable analogue or digital display | 4/20mA input current contains large ripple current | Reduce ripple current |
| | Insufficient voltage to operate indicator ie. less than 1.1V | Check supply voltage & drops caused by all components in the loop |

### 5.2 Fault finding after commissioning

If a BA526 indicator fails after it has been operating correctly, the following procedure should be followed.

**ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE**

| Symptom | Cause | Solution |
|---|---|---|
| No displays, no voltage across indicator terminals | Short or open circuit in loop wiring, or fault in indicator | Check all wiring |
| Unstable analogue or digital display | 4/20mA current has developed a large ripple current | Check supply voltage & drops caused by all components within the loop |

If the above procedure does not reveal the cause of the fault, it is recommended that the indicator is removed from the panel and replaced with another BA526. This can be achieved quickly by unplugging the terminal block from the suspect indicator and plugging it into a replacement.

### 5.3 Servicing

The BA526 can be easily calibrated on site, so a single spare indicator may be used to replace any instrument which is damaged or fails.

We recommend that except under exceptional circumstances faulty indicators are returned to our factory or local agent for repair. However, if this is not possible we will provide service information for the instrument.

### 5.4 Warranty

Indicators which fail within the warranty period should be returned to BEKA Associates or the local agent from whom the instrument was purchased. It is helpful if a brief description of the fault symptoms can be provided.

## 6 Accessories

### 6.1 Scale Card

The BA526 has a window below the digital display to hold a card showing the units of measurement eg. Litres, The BA526 can be supplied with any legend specified by the customer at the time of ordering.
If a printed scale card is not requested, a blank scale card will be supplied which can easily be marked on site by removing the indicator from its enclosure as shown in Fig 5.

### 6.2 Tagging

The BA526 can be supplied with a thermally printed tag strip screwed to the rear of the indicator case. This tag is not visible from the front of the instrument after installation.

## 7 Customer Comments

BEKA Associates is always pleased to receive comments from customers about products and services. All communications are acknowledged and whenever possible suggestions are acted upon.

## Appendix 1: Product specification

| | | |
|---|---|---|
| **Input** | | |
| Current | | 4 to 20mA |
| Voltage at 4mA | | Less than 0.7V at 20°C |
| 20mA | | Less than 1.0V at 20°C<br>1.1V at -20°C |
| Overrange | | ±200mA will not cause damage |
| **Display** | | |
| Type | | Multiplexed liquid crystal |
| Analogue | | 103 segment bargraph 95mm long |
| Digital | | 3½ active digits 5.5mm high, plus dummy trailing zero selected by a plug-in link. |
| Span | (without dummy zero) | For 4 to 20mA input adjustable between:<br>000 and ±1999 |
| Zero | (without dummy zero) | Adjustable between:<br>000 and ±1000 |
| Polarity | | Automatic minus sign |
| Decimal point | | 1 of 4 positions or absent, selected by internal plug-in link. |
| Overrange | | 3 least significant active digits blanked |
| **Accuracy** | | |
| At 20°C including non-linearity & hysteresis | | |
| Analogue display | | ±0.5% |
| Digital display | | ±1 digit ignoring dummy trailing zero. |
| Temperature effect on: | | |
| Analogue display | | Typ ±0.5% between -10 and +55°C |
| Digital display | | |
| Span | | Typ 50ppm, max 100ppm/°C |
| Zero | | Typ 0.05 digit ±100ppm/°C<br>Max 0.1 digit ±200ppm/°C |
| Series mode rejection | | |
| Analogue display | | Typ ±0.5% error for 1mA pk to pk 50or 60Hz signal. |
| Digital display | | Typ 1 digit error for 1mA pk to pk 50 or 60Hz signal. |
| **Environmental** | | |
| Operating temperature | | -10 to +55°C |
| Humidity | | To 95% at 40°C |
| **Mechanical** | | |
| Case | | 48 x 144mm DIN enclosure<br>Front IP65<br>Rear IP20 |
| Terminals | | Screw clamp for 0.5 to 1.5mm cables |
| Weight | | 0.5kg |
| **Accessories** | | |
| Square root extractor | | Plug-in card to linearise output from differential flow transmitters with link selectable clip-off below 4.04mA (5% flow) |
| Span | (without dummy zero) | For 4 to 20mA input adjustable between:<br>000 and 1999 |
| Zero | (without dummy zero) | At 4mA input both displays show zero |
| Accuracy<br>At 20°C including non-linearity & hysteresis between 4.16 and 20mA (10 to 100% flow) | | |
| Analogue display | | ±16µA at input ±1 segment |
| Digital display | | ±16µA at input ±1 digit ignoring dummy trailing zero. |
| Typeset scale card | | Blank scale card fitted to each indicator, can be supplied typeset with units of measurement. |
| Tag plate | | Thermally printed tag strip screwed to rear of indicator. |

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