BEKA associates

BA527 & BA528
4/20mA 4½ digit indicators
for use in safe areas

Instruction manual

CONTENTS

1 Description

2 Operation
2.1 Controls
2.2 Square root-extractor

3 Application

3.1 Electrical system design

4 Installation

4.1 Mounting
4.2 Installation procedure

5 Calibration

5.1 Calibration controls
5.2 Calibration sequence for a linear input
5.3 Calibration sequence for a square law input

6 Maintenance

6.1 Fault finding during commissioning
6.2 Fault finding after commissioning
6.3 Servicing
6.4 Warranty

7 Accessories

7.1 Scale card
7.2 Tagging

8 Customer comments

Appendix 1 Product specification

1 Description

The BA527 and BA528 are 2-wire panel mounting 4½ digit indicators for use in safe areas.
The two models are electrically identical, differing only in display and enclosure size:

Model	Display height	Bezel size
BA527	10mm	48 x 96mm
BA528	20mm	72 x 144mm

The indicators are loop-powered from the live-zero signal, but only introduce a 1.1V drop which allows them to be installed into almost any 4/20mA current loop. No additional power supply or battery is required.

The main application of the BA527 and BA528 is to display a measured variable or control signal in the process area. The span and zero are independently adjustable, so that the indicator can be calibrated to display any variable represented by the 4/20mA current in engineering units.

Both indicators incorporate a square root-extractor to linearise the output of 4/20mA flow transmitters which have a square law characteristic ie. those operating from orifice plates and venturi tubes. A flow signal can therefore be displayed in linear engineering units.

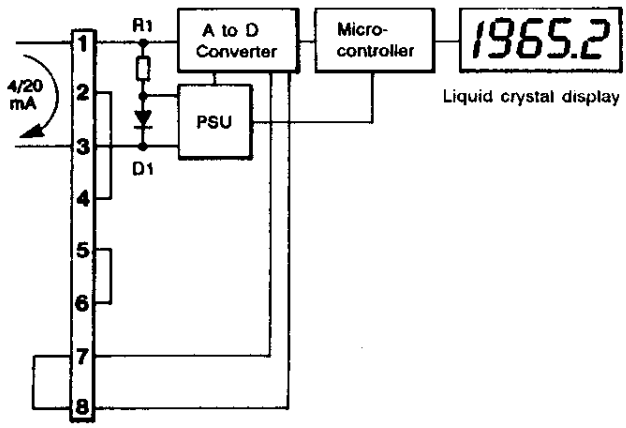


Fig 1 Block diagram of indicator

2 Operation

The BA527 and BA528 incorporate a microcontroller which enables the user to calibrate and select different display modes via three push button switches located on the front panel. To prevent accidental or unauthorised recalibaration, the function of these switches can be limited by the removal of a link from the input terminal block at the rear of the indicator. Function and calibration information will be stored by the indicator for at least five years without a 4/20mA signal connected.

A simplified diagram of the indicator is shown in Fig 1. The 4/20mA current flows through resistor R1 and forward biased diode D1. The voltage developed across D1 is multiplied by a switch mode power supply and used to power the instrument. The voltage developed across R1, which is proportional to the 4/20mA input current, provides the input signal which is amplified and processed by the microcontroller.

Each time a 4/20mA current is applied to the instrument initialisation is performed. After a short delay the following display sequence occurs:

-1.8.8.8.8	Lamp test; all segments displayed for 0.5 seconds.
Blank display	For 0.5 seconds
Normal display	Using calibration information stored in memory.

On completion of initialisation, the indicator automatically enters the display mode using the calibration information stored in the memory. After five minutes the instrument will enter an automatic self-check routine during which a P will be displayed. This routine takes approximately ten seconds and is repeated every thirty minutes.

2.1 Controls

The push button switches on the front panel of the BA527 and BA528 indicators have two operating modes, one for calibration and one for display. Linking terminals 7 and 8 on the rear terminal block puts the switches into the calibration mode, removing the link puts the switches into the display mode. Except when frequent range changes are required, it is recommended that the indicator is operated in the display mode (terminals 7 and 8 unlinked) so that the calibration function of the switches is inhibited.

Calibration mode (terminals 7 and 8 linked)

The indicator will display the 4/20mA signal in engineering units as previously calibrated. The three front panel switches have the following functions:

%P	Initiates calibration
▲ and ▼	Select display functions and adjust span and zero. See section 5 for step by step calibration information

Display mode (terminals 7 and 8 not linked)

%P	While this button is pushed, the indicator will display the input current as a percentage of the indicator span. When the button is released the display in engineering units will return.
▼	While this button is pushed the indicator will display the number which the indicator has been calibrated to display with a 4mA input current. When the button is released the normal display in engineering units will return.
▲	While this button is pushed the indicator will display the number which the indicator has been calibrated to display with a 20mA input current. When the button is released the normal display in engineering units will return.

The three front panel push buttons have additional functions which can be used in both the calibration and display modes ie. with and without terminals 7 and 8 linked together.

▲ ▼ When these two buttons are pushed together the indicator performs an autocalibration during which the display shows P. This is an automatic routine taking about ten seconds after which the indicator returns to its initial display.

%P ▲ ▼ When these three buttons are pushed together the indicator will reset and go through the initialisation sequence.
NB. resetting during calibration causes any new settings to be lost.

2.2 Square root-extractor

A linear or square root transfer function is selected by a plug-in link located within the indicator. The square root-extractor provides accurate linearisation of a square law signal produced by a flow transmitter operating from an orifice plate or venturi tube, thus enabling the indicator to display flow in linear engineering units.

3 Application

The BA527 and BA528 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.
Both instruments can display a linear or square law signal.

3.1 Electrical System Design

The indicator is connected in series with the 4/20mA current loop and introduces a voltage drop of less than 1.1V at 20mA. When designing a loop it is therefore necessary to add this voltage to the other voltage drops caused by transmitters and loads, and to ensure that the sum of all the voltage drops is less than the minimum power supply voltage. Figure 2 shows a process loop where a 2-wire transmitter is driving a controller.

Considering the total voltage drop around the loop:

Minimum operating voltage of 2-wire Tx	10.0V
Maximum voltage drop caused by controller	5.0V
Maximum voltage drop caused by indicator	1.1V
Maximum voltage drop caused by cable resistance	0.4V
	16.5V

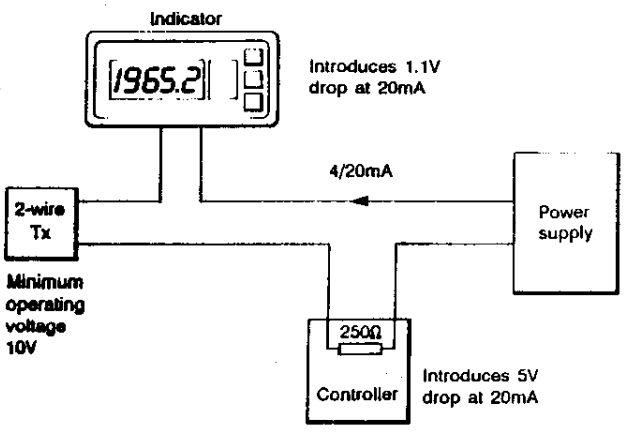


Fig 2 Indicator providing indication in a control loop

The instrument power supply must therefore have a minimum output voltage at 20mA of greater than 16.5V.

The indicators may also be driven directly from any instrument with a 4/20mA output to provide a remote indication. Figure 3 shows an indicator connected to the auxiliary 4/20mA output of a gas analyser. Again, it is only necessary to ensure that the voltage capability of the auxiliary 4/20mA output is greater than the voltage drop of the indicator plus any voltage drops caused by cable resistances.

The indicators incorporate 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 it is considered that the cable is likely to be subjected to high transient currents from lightning or electrical switch gear.

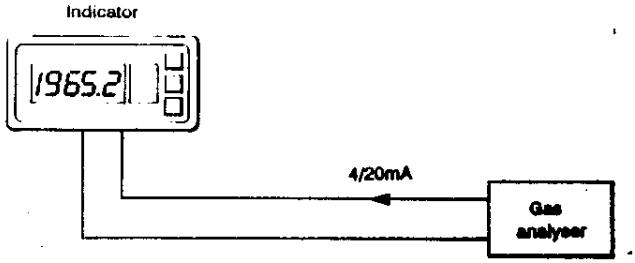


Fig 3 Indicator providing remote indication

4 Installation

4.1 Mounting

The indicators are housed in standard DIN cases which may be installed into any panel, providing the environmental limits shown in the specification are not exceeded.

4.2 Installation Procedure

i. Insert the indicator into the aperture from the front of the panel. Ensure that the gasket is positioned between the indicator and the panel, and that it is not twisted.

ii Clip a retaining bracket to each of two opposite sides of the instrument as shown in Figure 4 and tighten the two retaining bracket screws until the indicator is secure. Do not overtighten.

iii Connect the loop wiring to the terminal block as shown in Figure 5. To ease installation the rear terminal block can be removed from the instrument by gently pulling.

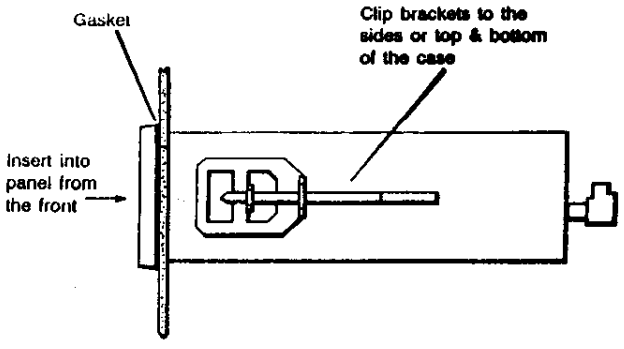


Fig 4 Installation in panel

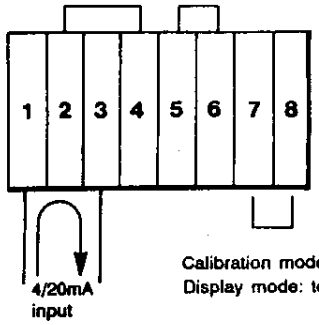


Fig 5 Terminal connections

5. Calibration

Indicators are supplied calibrated as requested. If calibration information is not supplied with the order, instruments are set to display 0.00 at 4mA and 100.00 at 20mA with a linear input and a resolution of one digit.

5.1 Calibration controls

Linear or square law input current

A linear or square root transfer function is selected by a plug-in link located within the indicator. The square root-extractor provides accurate linearisation of a square law signal produced by a flow transmitter operating from an orifice plate or venturi, which enables the indicator to display the flow signal in linear engineering units.

Zero adjustment

Zero is defined as the figure displayed with a 4.0000mA input current. The zero may be adjusted between -19999 and 19999.
When using the root-extractor the indicator must display zero with a 4mA input.

Span adjustment

Span is defined as the difference between the number displayed with a 4.0000mA input and the number displayed with a 20.0000mA input. The span may be adjusted to any value between 0 and ±19999 in the linear mode, and 0 to +19999 in the root-extracting mode.
In the linear mode the display at 20mA may be less than the display at 4mA to provide reverse acting indication ie. the indicator display decreases as the input current increases.
Note: When calibrating the indicator, the actual display at 20mA is shown, not the span.

Decimal point

A decimal point can be displayed between any of the digits, or may be omitted.

Display resolution

Resolution of the indicator can be adjusted to provide a stable display in noisy applications. One, two, five or ten digit resolution may be selected.

5.2 Calibration sequence for a linear input

When recalibrating a BA527 or BA528 indicator the complete calibration sequence must be followed even if only one parameter is to be changed. If at any point during the calibration sequence an incorrect entry is made, the indicator can be reset by pushing all three front panel switches at the same time. This returns the indicator to the display mode, and restores the calibration which existed before recalibration was attempted.

The BA527 and BA528 indicators have a maximum span of 19999, one least significant digit is equivalent to 0.005% of span or 0.8μA change in the 4/20mA input current. To achieve maximum accuracy with large spans, appropriate calibaration equipment must be used.

Before starting recalibration, link terminals 7 and 8 on the rear terminal block to put the front panel switches into the calibration mode.

Position of the linear/square root extactor link

The plug-in link which selects a linear or a square-root transfer function is located within the indicator. To gain access, remove the four corner M2 screws from the rear panel, and slide the indicator about 5cm out of the enclosure. The position of the plug-in link is shown in Fig 6. If the transfer function of the indicator needs to be changed, carefully reposition the link using a pair of long nosed pliers.

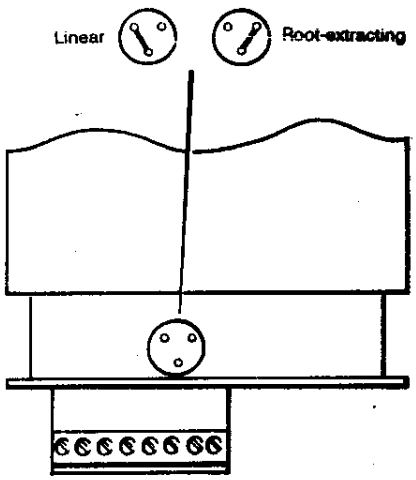


Fig 6 Position of linear/root-extraction link

Position of the decimal point

To initiate calibration, press and hold the button marked %P until the display shows P. On completion of this self check, the indicator will display a flashing decimal point in the position previously selected. If no decimal point was selected on the previous calibration, all the decimal points will flash. To change the position, press and hold the ▲ or ▼ button until the decimal point moves to the required position or is absent, if no decimal point is required.

Display resolution

Press and hold the %P button until the indicator displays the number of digits resolution previously selected. To change the resolution, press and hold the ▲ or ▼ button until the required resolution is displayed. 1, 2, 5 or 10 digit resolution may be selected.

If the zero and span of the indicator are not to be changed, the new decimal point and display resolution settings may be stored in permanent memory at this point in the calibration sequence. If the span and zero of the indicator are to be changed, all information is transferred to the permanent memory at the end of the calibration sequence. Press and hold the %P button until the indicator displays 4, immediately release the button and the indicator will display an alternating E and 4. This shows that the calibration sequence may either be concluded or continued.

Exit from the calibration sequence

Press and hold the ▲ or ▼ button until the display returns to the normal display mode. The new decimal point and display resolution settings will be stored in permanent memory.

OR to recalibrate the display

Span and zero adjustments are made by setting each digit of the display in turn, starting with the 1000's digit and ending with the least significant digit. To make calibration easy, the digit being adjusted will carry to the next most significant when it is incremented above 9 or below 0. For example, incrementing the 1000's digit above 9, causes the the most significant half digit (the leading 1 of the 4½ digit display) to be activated.

Zero adjustment

Adjust the input current from the calibration source to exactly four milliamps, then press the %P button until the display changes to show the existing zero setting.

The 1000's digit will flash to show that this, and the most significant half digit, may be adjusted by pressing the ▲ or ▼ button. To set the 100's digit press and hold the %P button until the 100's digit flashes. Immediately release the button and adjust the digit using either the ▲ or ▼ button. Repeat for the next two digits until both are set to the required figures.

Span adjustment

While the least significant digit is flashing following completion of the zero adjustment, press and hold the %P button until the indicator displays a flashing 20. Adjust the input current from the calibration source to exactly 20mA, and again press and hold the %P button until the existing span setting is displayed.

The 1000's digit will flash to show that this, and the most significant half digit, may be adjusted by pressing and holding the ▲ or ▼ button. To set the 100's digit press and hold the P button until the 100's digit flashes. Immediately release the button and adjust the digit using the ▲ or ▼ button. Repeat for the next two digits until both are set to the required figures. When the least significant digit has been set, again press the %P button until the indicator displays E which shows that all the calibration information is being stored in the permanent memory. When complete the indicator will automatically return to the display mode.

Note: When calibrating the indicator, the actual display at 20mA is shown, not the span.

If no further calibration adjustments are required, remove the link between terminals 7 and 8 to prevent accidental or unauthorised recalibration.

5.3 Calibration sequence for a square law input

When recalibrating a BA527 or BA528 indicator the complete calibration sequence must be followed even if only one parameter is to be changed. If at any point during the calibration sequence an incorrect entry is made, the indicator can be reset by pushing all three front panel switches at the same time. This returns the indicator to the display mode, and restores the calibration which existed before recalibration was attempted.

The root-extractor provides linearisation of the flow signal between 4.04 and 20mA, so the indicator will accurately display the flow in linear engineering units between 5 and 100% of full flow. Below 4.04mA the indicator will display zero.

Before starting recalibration, link terminals 7 and 8 on the rear terminal block to put the front panel switches into the calibration mode.

Position of the linear/square root extactor link

The plug-in link which selects a linear or square-root transfer function is located within the indicator. To gain access remove the four corner M2 screws from the rear panel, and slide the indicator about 5cm out of the enclosure. The position of the plug-in link is shown in Fig 6. If the transfer function of the indicator needs to be changed, carefully reposition the link using a pair of long nosed pliers.

Position of the decimal point

To initiate calibration, press and hold the button marked %P until the display shows P. On completion of this self check, the indicator will display a flashing decimal point in the position previously selected. If no decimal point was selected on the previous calibration, all the decimal points will flash. To change the position, press and hold the ▲ or ▼ button until the decimal point moves to the required position, or is absent if no decimal point is required.

Display resolution

Press and hold the %P button until the indicator displays the number of digits resolution previously selected. To change the resolution press and hold the ▲ or ▼ button until the required resolution is displayed. 1, 2, 5 or 10 digit resolution may be selected.

If the zero and span of the indicator are not to be changed, the new decimal point and display resolution settings may be stored in permanent memory at this point in the calibration sequence. If the span and zero of the indicator are to be changed all information is transferred to the permanent memory at the end of the calibration sequence. Press and hold the %P button until the indicator displays 4, immediately release the button and the indicator will display an alternating E and 4. This shows that the calibration sequence may either be concluded or continued.

Exit from the calibration sequence

Press and hold the ▲ or ▼ button until the display returns to the normal display mode. The new decimal point and display resolution settings will be stored in permanent memory.

OR to recalibrate the display

Span and zero adjustments are made by setting each digit of the display in turn, starting with the 1000's digit and ending with the least significant digit. To make calibration easy, the digit being adjusted will carry to the next most significant digit when it is incremented above 9 or below 0. For example, incrementing the 1000's digit above 9, causes the the most significant half digit (the leading 1 of the 4½ digit display) to be activated.

Zero adjustment

When using the root-extractor the indicator will always display zero with a 4mA input current. No zero elevation or suppression may be applied. Adjust the input current from the calibration source to exactly four milliamps, then press the %P button until the display changes to 0000 with the most significant digit flashing. Press and release the %P button three times until 0000 is displayed with the least significant digit flashing. This completes the zero adjustment.

Although the display has not been changed, this routine, which must be completed with an accurate 4mA input current, to ensure that the percentage function operates correctly.

Span adjustment

While the least significant digit of the display is flashing following completion of the zero adjustment, press and hold the %P button until the indicator displays a flashing 20. Adjust the input current from the calibration source to exactly 20mA, and again press and hold the %P button until the current span setting is displayed.

The 1000's digit will flash to show that this, and the most significant half digit, may be adjusted by pressing and holding the ▲ or ▼ button. To set the 100's digit press and hold the %P button until the 100's digit flashes. Immediately release the button and adjust the digit using the ▲ or ▼ buttons. Repeat for the next two digits until both are set to the required figures. When the least significant digit has been set, again press the %P button until the indicator displays E which shows that all the calibration information is being stored in the permanent memory. When complete the indicator will automatically return to the display mode.

Note: When calibrating the indicator, the actual display at 20mA is shown, not the span.

If no further calibration adjustments are required, remove the link between terminals 7 and 8 to prevent accidental or unauthorised recalibration.

6 Maintenance

6.1 Fault Finding During Commissioning

If the indicator fails to function during commissioning the following procedure should be used:

Symptom	Cause	Solution
No display	Incorrect wiring to indicator	Correct wiring error, indicator will not be damaged by reversed connections
Indicator displays HHHH	Positive over-range	The indicator has been incorrectly calibrated & is trying to display a number greater than 19999 or I/P current is greater than approx 20.5mA.
Indicator displays LLLL	Negative over-range	The indicator has been incorrectly calibrated & is trying to display a number less than -19999 or I/P current less than approx 3.5mA.
Unstable display. More than ±1 digit of jitter.	4/20mA input current contains large ripple current	Reduce ripple content or reduce resolution of the indicator
	Insufficient voltage to operate indicator ie. less than 1.1V	Check supply voltage & voltage drops caused by all components within the loop
Continuous reset or no initialisation sequence	4/20mA input current too low	Check input current and ensure that it is greater than 3.5mA
Front panel switches do not give desired display	Incorrect fitting of calibration enable link	Refer to section 2.1

6.2 Fault Finding After Commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

If an indicator fails after it has been operating correctly, the following procedure should be used:

Symptom	Cause	Solution
No display, no voltage across terminals	Short or open circuit in wiring, or fault in indicator	Check all wiring
Unstable display More than ±1 digit of jitter	4/20mA current has developed large ripple component	Find source of ripple and if necessary reduce indicator resolution
	Insufficient voltage to operate indicator ie. less than 1.1V	Check supply voltage & 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 unit. This can be achieved quickly by unplugging the terminal block from the suspect indicator and plugging it into the replacement unit.

6.3 Servicing

The indicators have been designed so that they can easily be replaced without disturbing the field wiring. The indicators can be calibrated on site, so a single spare instrument is therefore able to replace any indicator which fails. BEKA Associates and most distributors maintain a stock of indicators which can be used if a customer is unable to justify purchasing a spare.

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

6.4 Warranty

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

7 Accessories

7.1 Scale Card

The indicators have a window on the right hand side of the liquid crystal display to hold a card showing the units of measurement e.g.°C, bar, RPM. Indicators can be supplied with scale cards printed with any units specified by the customer at the time of ordering. If a printed scale card is not requested when the indicator is ordered, a blank card will be provided.

Scale cards can easily be marked or changed on site as follows:

i Remove the indicator from its case - see Fig 7
ii Carefully remove scale card.
iii Mark legend onto scale card using a stencil or transfer.
iv Replace scale card in correct position and secure.
v Reassembly the indicator.

7.2 Tagging

Indicators can be supplied with a thermally printed plastic tag plate screwed to the rear of the enclosure. This tag is not visible from the front of the instrument after installation.

8 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.

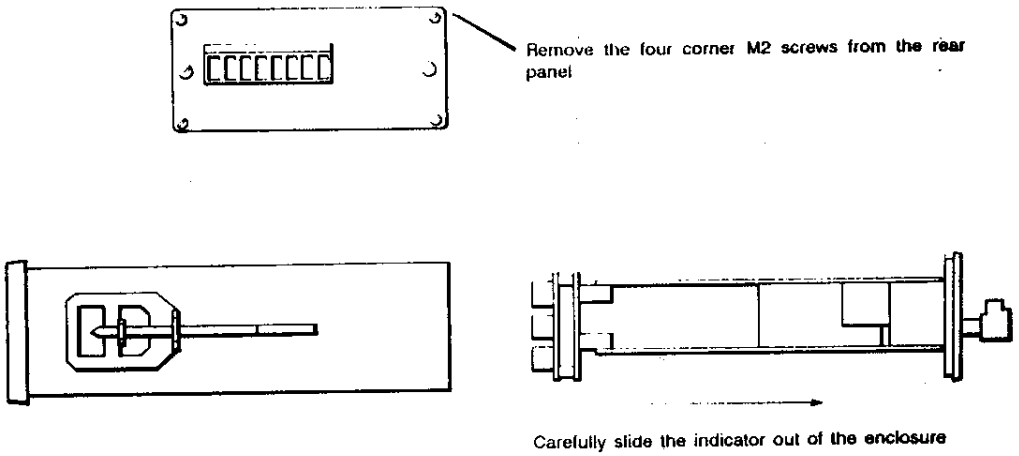


Fig 7 Removal of indicator from enclosure

APPENDIX 1: Product Specification

Input

Current	4 to 20mA
Voltage drop at 4mA	Less than 0.7V at 20C
Voltage drop at 20mA	Less than 1V at 20°C Less than 1.1V @ -20°C
Overrange	±200mA max.

Display

Type	4½ digits (-19999 to 19999) BA527:10mm high display BA528:20mm high display
Span	Adjustable between: Linear input 0 and ±19999 Square law input 0 and 19999
Zero	Adjustable between: ±19999 with 4mA input linear inputs only
Polarity	Automatic minus sign
Decimal point	1 of 4 positions, or absent
Reading rate	1.25 per second linear input 1 per second square law input
Overrange	Indicates HHHH for readings greater than +19999 or approx 20.5mA input current.
Underrange	Indicates LLLL for readings less -19999 or approx 3.5mA input current.

Calibration Terminals 7 & 8 linked

Front panel push buttons set:

Display calibration	Display at 4 & 20mA
Display resolution	1, 2, 5 or 10 digits
Decimal point	1 of 4 positions or absent

Internal plug-in link selects: Linear or square law input

Calibration Inhibit Terminals 7 & 8 not linked

Front panel push buttons select:

Display with 4mA input
Display with 20mA input
Display as a percentage of span

Accuracy

At 20C including non linearity & hysteresis

Linear input	±0.02% of display ±1 digit
Square law input	±16μA at input ±1 digit for input currents between 4.04 and 20mA (5 to 100% of flow)

Temperature effect on:

Zero	Less than 25ppm of span/°C
Span	Less than 50ppm of span/°C
Series mode rejection	Less than 0.025% of span error for 1mA pk to pk 50/60Hz signal
RF rejection	Less than 0.8% of span error for 10V/m field strength between 27 & 1000MHz

Environmental

Operating temperature	-20 to +60°C
Humidity	to 95% RH @ 40°C
Front of enclosure	IP65
Rear of enclosure	IP54

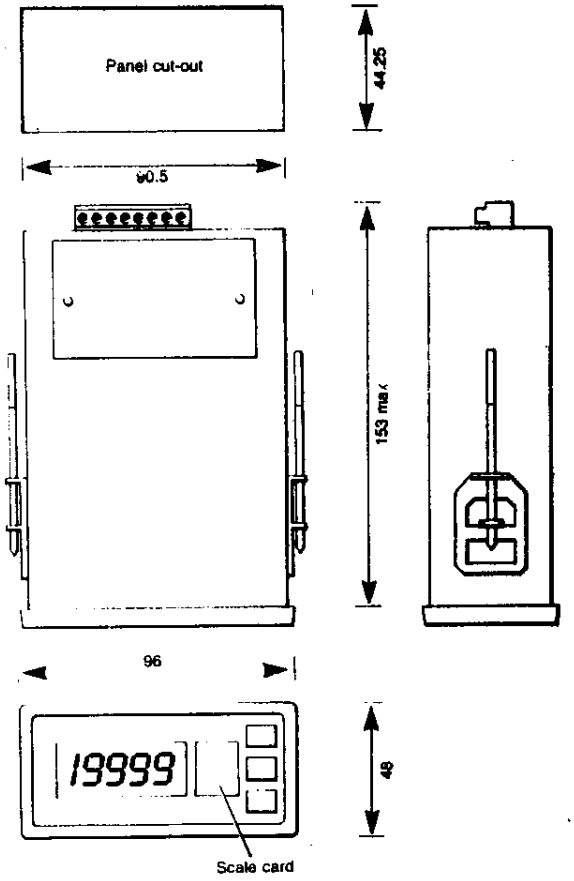
Mechanical

Terminals	Screw clamp for 0.5 to 1.5mm Terminal block removable
Weight	BA527 0.4kg BA528 0.6kg
Dimension	BA527 48 x 96 x 146mm BA528 72 x 144 x 146mm

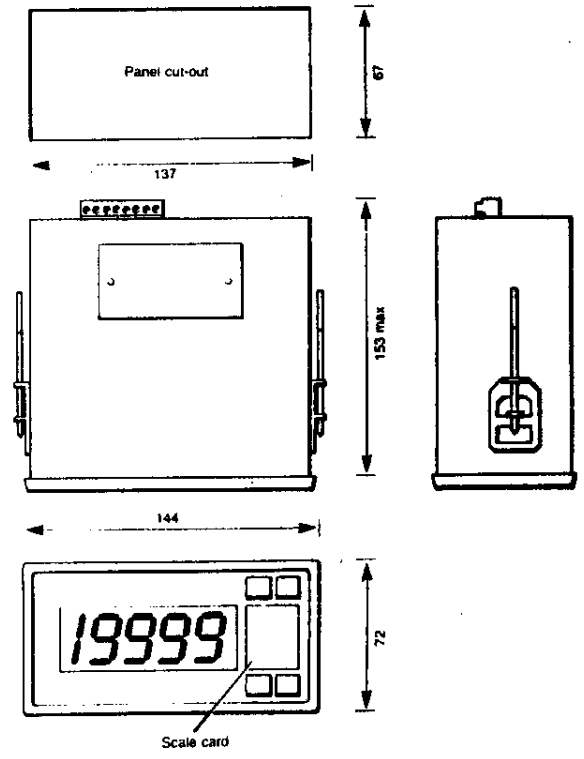
Accessories

Typeset scale card	Specify legend required Note: blank scale card supplied if typesetting is not requested
Tag plate	Thermally printed plastic tag plate screwed to rear of indicator

Dimensions(mm) **BA527**



BA528



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