BEKA associates

BA327B & BA328B intrinsically safe 4/20mA 4½ digit indicators

Instruction manual

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1 Description

The BA327B and BA328B are intrinsically safe 2-wire panel mounting 4½ digit indicators for use in hazardous areas. The two models are electrically identical, differing only in display and enclosure size:

Model	Display height	Bezel size
BA327B	10mm	48 x 96mm
BA328B	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 BA327B and BA328B 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 in engineering units any variable represented by the 4/20mA current.

The indicators have been certified intrinsically safe by BASEEFA to the CENELEC standard. Both comply with the requirements for simple apparatus, and the certificate permits them to be connected to almost any certified intrinsically safe loop without the need for additional certification.

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.

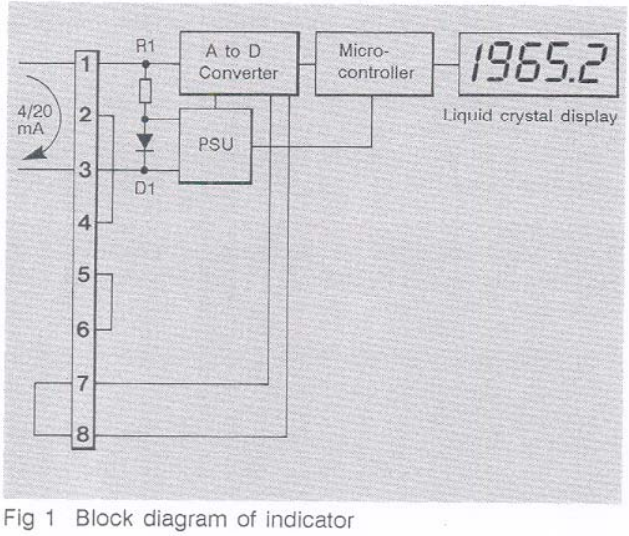


Fig 1 Block diagram of indicator

2 Operation

The BA327B and BA328B 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 indicators 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 BA327B and BA328B 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.

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.

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.

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 BA327B and BA328B 4½ digit intrinsically safe loop powered indicators are high performance instruments which may be connected to almost any hazardous area 4/20mA loop without additional certification. Although the BA327B and BA328B may be used in safe areas, the non certified BA527 and BA528 are recommended for safe area applications.

When designing a hazardous area loop incorporating a BA327B or BA328B indicator, it is necessary to consider both the dc operating conditions and the intrinsic safety compatibility of all the components within the loop. Sections 3.1, 3.2 & 3.3 contain detailed descriptions of the CENELEC certification requirements, and section 3.4 describes typical applications.

3.1 CENELEC Intrinsic safety certificate
The BA327B and BA328B digital indicator have been certified intrinsically safe by BASEEFA to BS5501:Part 1: 1977 EN50 014 and BS5501: Part 7: 1977 EN50 020. The certificate is a variation of the certificate issued for an existing range of 3½ digit indicators.
The BA327B and BA328B carry the Community Mark and, subject to local Codes of Practice, may be installed in any of the CENELEC member countries ie. Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. This instruction manual describes installations which conform with the UK Code of Practice BS5345: Part 4: 1977. When designing systems for installation outside the UK, the local code of practice should be consulted.

A reduced copy of the BASEEFA apparatus certificate for the BA327B and BA328B is included as Appendix 2 of this manual, full size copies are available from BEKA Associates and our overseas representatives.

The certificate for the BA327B and BA328B states that:

> 'For intrinsic safety considerations the output parameters at the apparatus terminals do not exceed those specified in Clause 1.3 of BS5501: part 1 1977 EN50 014'

Clause 1.3 of BS5501: Part 1: 1977 EN50 014 says:

> 'Devices in which none of the values 1.2V, 0.1A 20μJ or 25mW are exceeded need not be certified or marked'

This type of apparatus is known as non energy-storing or simple apparatus.

The BASEEFA certificate is therefore saying that although the BA327B and BA328B contain energy-storing components, they have been designed such that the energy which can be released via the two terminals is less than that specified in Clause 1.3 of EN50 014. The indicator may therefore be installed into certified intrinsically safe loops without invalidating the original certification of the loop. For this reason the BA327B and BA328B only have an apparatus certificate, no system certificate has been issued or is required, because the system certificate of the loop into which the indicator is connected remains valid.

The BASEEFA apparatus certificate allows the BA327B and BA328B indicators to be connected to any intrinsically safe circuit whose output parameters do not exceed the following:

$$I_{max:out} = 200mA$$
$$W_{max:out} = 0.85W$$

The circuit parameters are determined by the Zener barrier or the intrinsically safe isolator powering the loop. The certification documents and manufacturers literature for the barrier or isolator will list the output parameters, it is only necessary to check that these figures are below the maximum permitted parameters for the BA327B and BA328B shown above. In practice, the parameters are not restrictive, and allow the indicators to be connected to almost all intrinsically safe 4/20mA loops.

When two single channel Zener barriers each of the same polarity are connected to a two wire circuit, the output parameters of each channel must be below the permitted parameters specified on the BA327B and BA328B certificate.

If the safety description of the barrier or intrinsically safe isolator is expressed as a voltage and resistance, eg. 28V 300Ω, $I_{max:out}$ and $W_{max:out}$ can be calculated as follows:

$I_{max:out}$ = maximum current which can flow around the loop under fault conditions.

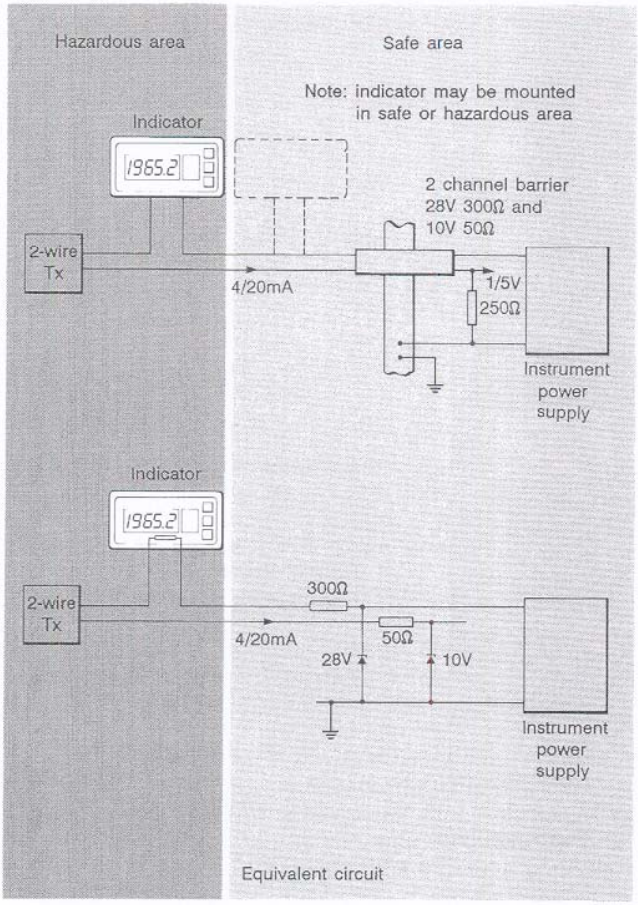
$$I_{max:out} = \frac{\text{maximum voltage of terminating Zener diode}}{\text{minimum resistance of terminating resistor} + 15.4}$$

Where 15.4Ω is the infallible resistance between the indicator terminals.

$W_{max:out}$ = maximum power which can be transferred into the hazardous area by each Zener barrier or isolator when perfectly matched.

$$W_{max:out} = \frac{V_{max} \text{ of terminating Zener diode} \times I_{max:out}}{4}$$

Fig 2 shows how these calculations are applied for a two channel barrier.



Barrier safety descriptions from manufacturers specification
(One 2-channel barrier or two single channel barriers)

	Max Zener voltage	Min terminating resistance
28V channel	28.0V	300.0Ω
10V channel	10.0V	50.0Ω

Considering the 28V channel:

$$I_{max:out} = \frac{28}{300.0 + 15.4} = 88.78mA$$

$$W_{max:out} = \frac{28.0 \times 88.78}{4} = 0.62W$$

Considering the 10V channel:

$$I_{max:out} = \frac{10}{50.0 + 15.4} = 152.91mA$$

$$W_{max:out} = \frac{10.0 \times 152.91}{4} = 0.38W$$

$I_{max:out}$ and $W_{max:out}$ for each channel are below 200mA and 0.85W specified on the BASEEFA certificate. The indicator may therefore be safely connected to the loop without the need for additional certification.

Fig 2 Example of calculations required to establish if a BA327B or BA328B may be safely connected to an intrinsically safe loop.

3.2 Zones and gas groups

The BA327B and BA328B have been certified EEx ia IIC T5, which means that when connected to a suitable system, they may be installed in:

Zone 0 explosive gas-air mixture continuously present.
Zone 1 explosive gas-air mixture likely to occur in normal operation.
Zone 2 explosive gas-air mixture not likely to occur, and if it does will only exist for a short time.

and may be used above ground (group II) with gases or vapours in gas groups:

Group IIA propane
Group IIB ethylene
Group IIC hydrogen

having a temperature classification of:

T1 450°C
T2 300°C
T3 200°C
T4 135°C
T5 100°C

This means that the BA327B and BA328B may be installed in all Zones and used with most common industrial gases.

NOTE: If the certification of the system to which the indicator is connected is more restrictive, then these restrictions also apply to the indicator eg. If the system is certified for use in Zones 1 and 2, then the indicator may only be installed in these Zones.

3.3 Cable parameters

The BASEEFA certificate for the BA327B and BA328B specifies the maximum equivalent capacitance and inductance between the two terminals of the indicator.

These are:

Ceq = 20nF
Leq = 2μH

These figures must be subtracted from the maximum cable capacitance and inductance permitted by the system certificate of the loop into which the indicator is installed. Both reactances are small compared with permitted cable parameters for most Zener barriers and isolators. Only when 28V devices are used with IIC gases will the permitted cable capacitance, and hence the cable length, be significantly reduced.

3.4 Electrical System Design

In addition to the intrinsic safety requirements described in previous sections, the electrical system design must be considered. The indicator is connected in series with the 4/20mA current loop and introduces a voltage drop of up to 1.1V at all input currents between 4 and 20 mA. When designing a loop it is therefore necessary to add this voltage to the other voltage drops caused by Zener barriers and loads, and to ensure that the sum of these voltages is less than the minimum power supply voltage. Fig 3 shows a typical hazardous area measurement loop protected by a two channel Zener barrier. Considering the voltage drops around the loop:

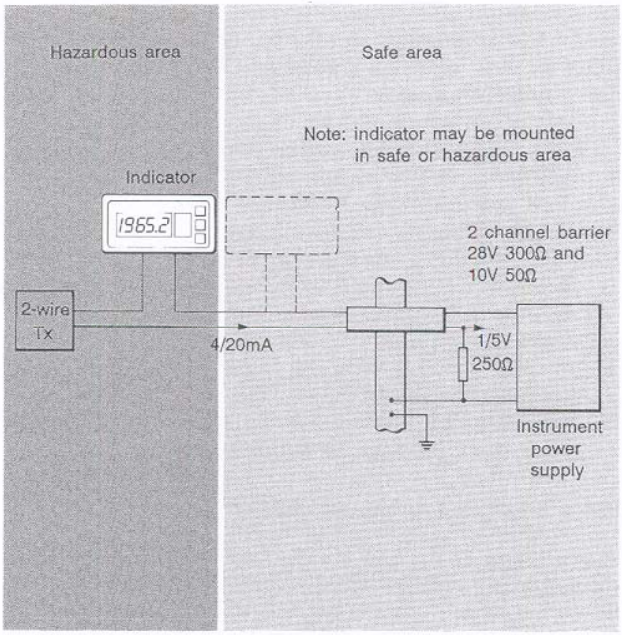


Fig 3 Hazardous area measurement loop

Minimum operating voltage of 2-wire Tx	10.0V
Maximum voltage drop caused by 250Ω load	5.0V
Maximum voltage drop caused by 28V 300Ω barrier (340Ω end to end resistance x 20mA)	6.8V
Maximum voltage drop caused by 10V 50Ω barrier (85Ω end to end resistance x 20mA)	1.7V
Maximum voltage drop caused by cable resistance (10Ω x 20mA)	0.2V
Maximum voltage drop caused by indicator	1.1V
Total maximum voltage drop around the loop	24.8V

The instrument power supply voltage must therefore be above 24.8V but below 25.5V which is the maximum working voltage of the 28V 300Ω channel of the Zener barrier.

The Zener barrier may be replaced by a certified intrinsically safe isolator which eliminates the need for a high integrity earth connection. Again the voltage drops around the loop should be added together to ensure that there is sufficient voltage to operate the transmitter and the indicator.

The indicators may also be driven via an intrinsically safe interface from any instrument with a 4/20mA output, to provide a remote indication in a hazardous area. The interface may be a Zener barrier or intrinsically safe isolator providing that it complies with the requirements specified in the BASEEFA certificate which are explained in sections 3.1, 3.2 & 3.3 of this manual.

If one side of the 4/20mA signal may be earthed, a single channel Zener barrier provides the lowest cost solution. If the 4/20mA signal is not isolated, two Zener barriers or a certified isolator must be used. Again, it is necessary to ensure that the voltage capability of the 4/20mA signal is sufficient to drive the indicator, plus the voltage drops introduced by the Zener barrier(s) or isolator.

Fig 4 shows the alternative circuits which may be used.

3.5 Other certifications

In addition to CENELEC certification, the BA327B and BA328B are being approved by other national authorities outside Europe. Please refer to BEKA Associates or our local representative for details.

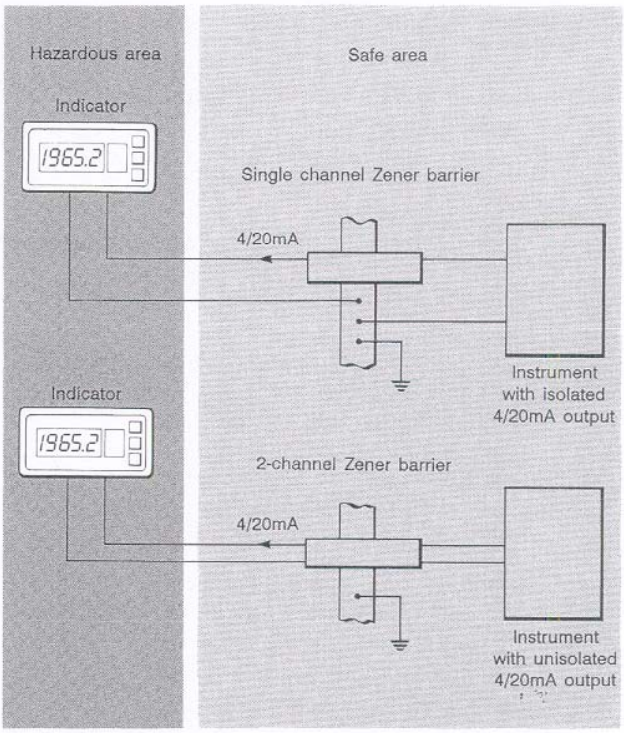


Fig 4 Alternative circuits for remote indication in a hazardous area

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 5 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 6. To ease installation the rear terminal block can be removed from the instrument by gently pulling.

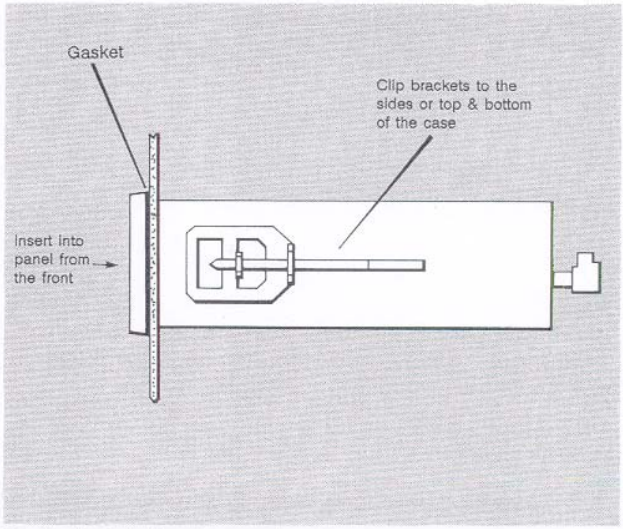


Fig 5 Installation in panel

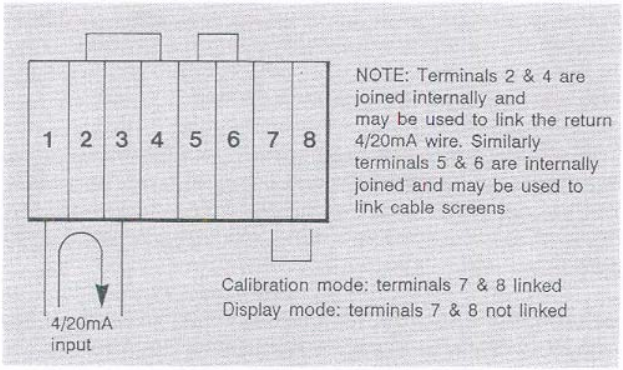


Fig 6 Terminal connections

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 BA327B or BA328B 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 BA327B and BA328B 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 calibration 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 7. If the transfer function of the indicator needs to be changed, carefully reposition the link using a pair of long nosed pliers.

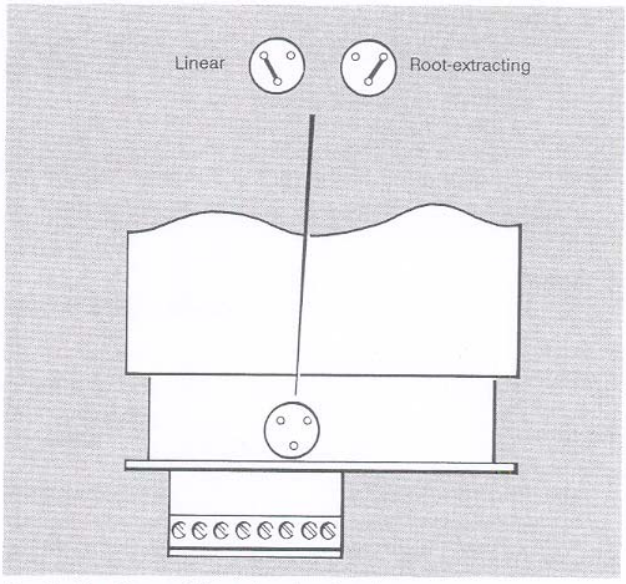


Fig 7 Position of linear/root-extraction link

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 BA327B or BA328B 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 7. 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 calibaration 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, ensures 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 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 8
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. 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.

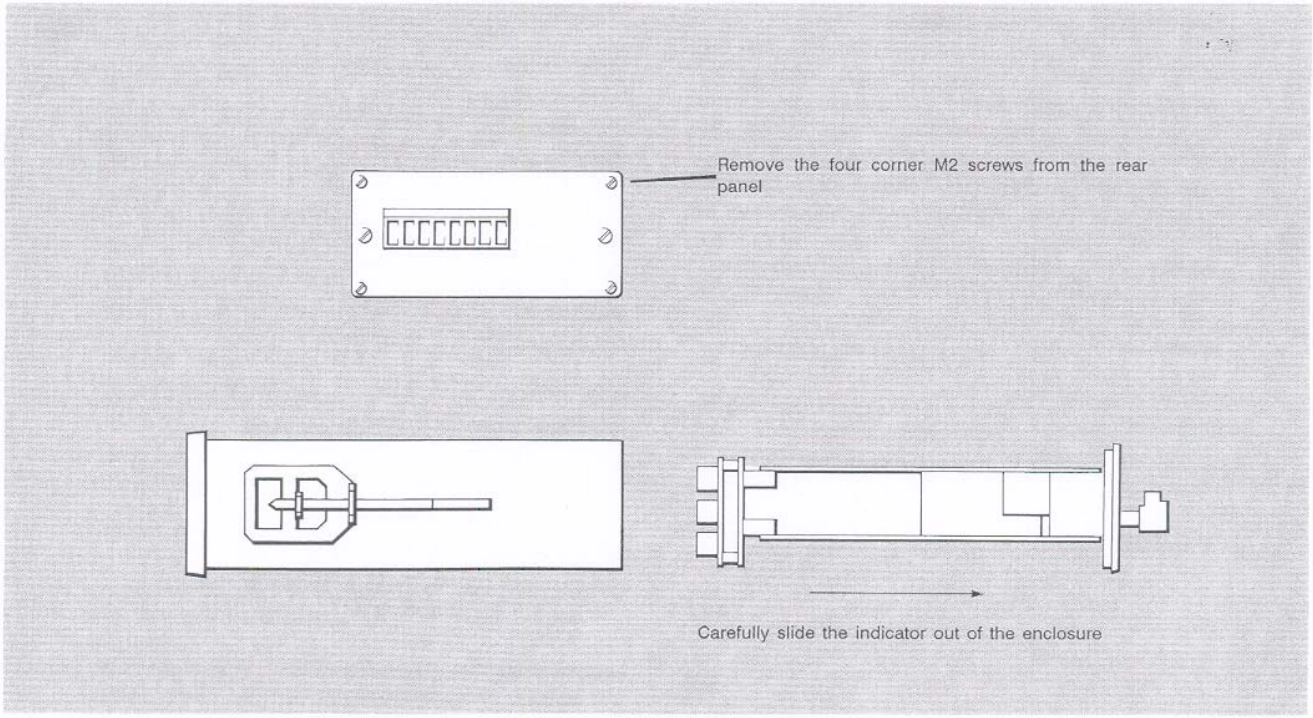


Fig 8 Removal of indicator from enclosure

APPENDIX 1: Product Specification

Input

Current	4 to 20mA
Voltage drop at 4mA	Less than 0.7V at 20°C
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) BA327B:10mm high display BA328B: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 than 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 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 20°C 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

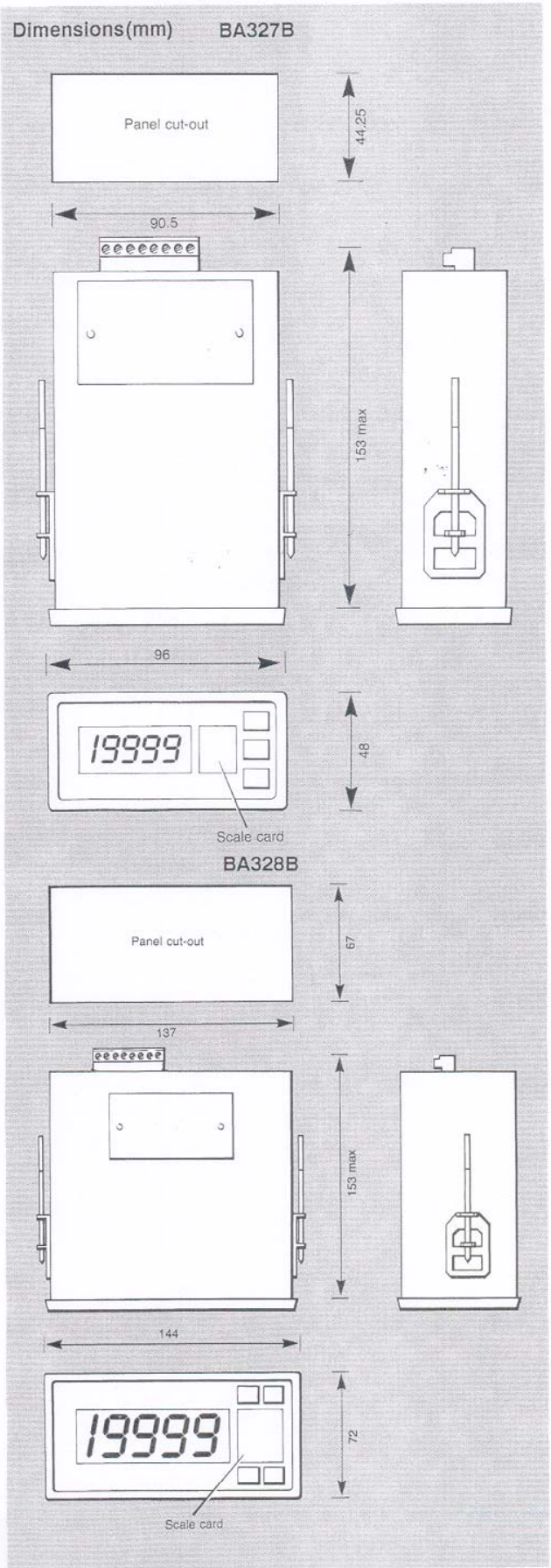
Operating temperature	-20 to +60°C
Humidity	to 95% RH @ 40°C
Front of enclosure	IP65
Rear of enclosure	IP54

Mechanical

Terminals	Screw clamp for 0.5 to 1.5mm Terminal block removable
Weight	BA327B 0.4kg BA328B 0.6kg
Dimension	BA327B 48 x 96 x 146mm BA328B 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



Appendix 2: BASEEFA certificate

The BA327B and BA328B certificate is a variation of the certificate for the BA303B 3½ digit indicator. Reduced copies of these certificates are shown in this Appendix, full size copies are available from BEKA Asociates and our overseas representatives.

Health & Safety Executive

BASEEFA

British Approvals Service for Electrical Equipment in Flammable Atmospheres

1. **CERTIFICATE OF CONFORMITY**

2. BAS No Ex 832399 dated 27 January 1984

3. This certificate is issued for the electrical apparatus:

   A BA303B 4/20mA DIGITAL METER

4. manufactured and submitted for certification by:

   BEKA ASSOCIATES
   of Hitchin, Herts

5. This electrical apparatus and any acceptable variation thereto is specified in the Schedule to this Certificate and the documents therein referred to.

6. BASEEFA being an Approved Certification Body in accordance with Article 14 of the Council Directive of the European Communities of 18 December 1975 (76/117/EEC) confirms that the apparatus has been found to comply with harmonised European Standards.

   BS 5501:Part 1:1977 EN50 014
   BS 5501:Part 7:1977 EN50 020

   and has successfully met the examination and test requirements which are recorded in confidential Test Report

   ERA Ref 3627/066, Rev 1 dated January 1984
   (Held on File No SFA 12/716/01)

7. The apparatus marking shall include the code

   EEx ia IIC T4 (T_{amb} = 60°C)

File No. SFA 16/263/01

B HILL
DIRECTOR

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BASEEFA Harpur Hill Buxton Derbyshire SK17 9JN Tel 0298 6211 Telex 668113 RLSD G

Certificate BAS No Ex 832399 dated 27 January 1984

8. The supplier of the electrical apparatus referred to in this certificate has the responsibility to ensure that the apparatus conforms to the specification laid down in the Schedule to this certificate and has satisfied routine verifications and tests specified therein.

9. This apparatus may be marked with the Distinctive Community Mark specified in Annex II to the Council Directive of 6 February 1979 (Doc 79/196/EEC). A facsimile of this mark is printed on sheet 1 of this certificate.

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This certificate is granted subject to conditions applicable to the Approval Service, it does not necessarily indicate that the apparatus may lawfully be used in particular industries or circumstances.

CERTIFICATE OF CONFORMITY (Ex) **SCHEDULE**

NUMBER Ex 832399
DATED 27 January 1984

APPARATUS

A BA303B 4/20mA DIGITAL METER is designed to display the current in a 4/20mA signal loop.

The circuit is arranged on five printed circuit boards in an aluminium alloy enclosure which provides a Degree of Protection of at least IP20.

Intrinsic safety is assured by limitation of capacitance, suppression of inductance by shunt components, internal voltage limitation, and limitation of input current and power.

The apparatus must be connected to an intrinsically safe circuit whose output parameters do not exceed the following :-

$I_{max:out}$ = 215mA d.c.

$W_{max:out}$ = 1.1W

The equivalent resistance of the apparatus terminals is 15.4 ohm minimum in normal operation and 24 ohm maximum under fault conditions. The internal segregation of the meter satisfies the requirements for a peak voltage of 60V.

The equivalent output parameters of the apparatus are :-

$U_{max:out}$ = 1.2V

$I_{max:out}$ = 75mA

$W_{max:out}$ = 20mW

C_{eq} = 0.015μF

L_{eq} = 2μH

For intrinsic safety considerations the output parameters at the apparatus terminals do not exceed those specified in Clause 1.3 of BS 5501 : Part 1 : 1977, EN50 014. The equivalent capacitance and inductance are the result of r.f. suppression components directly connected to the apparatus terminals.

DRAWING

Number	Issue	Date	Description
CI303-001 Sheets 1-9 & 11-16	2	Oct 1983	Certification information

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Original BA303B apparatus certificate

BASEEFA

British Approvals Service for Electrical Equipment in Flammable Atmospheres

CERTIFICATE OF CONFORMITY VARIATION

THIS IS TO CERTIFY THAT CERTIFICATE BAS No. Ex 832399

Held by BEKA ASSOCIATES LIMITED

of Hitchin. SG5 2DD

for the BA303B 4/20mA DIGITAL METER

is hereby extended to apply to apparatus designed and constructed in accordance with the specification set out in the Schedule of the said Certificate but having the variation specified in the attached Schedule.

A copy of this Supplementary Certificate shall be attached to the original certificate.

Code: see schedule

File No: EECS 0121/02/003

ERA Report: 3627/578 dated June 1992

CERTIFICATE BAS No Ex 832399/6

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3786/52

I M CLEARE
DIRECTOR EECS
30 June 1992

EECS CERTIFICATION SERVICE

Electrical Equipment Certification Service
[illegible] Buxton, Derbyshire SK17 9JN, United Kingdom
Tel: 0298 79514 Telex 668113 RLSD G

HSE Health & Safety Executive

BASEEFA

Schedule

Certificate of Conformity BAS No Ex 832399/6 dated 30 June 1992

VARIATION SIX

To permit the following changes to form a BA327B 4/20mA DIGITAL METER

i) Modification to the electrical circuit to incorporate a microcontroller, an EEPROM and calibration circuit.

ii) Re-numbering some of the safety components.

iii) Values of capacitors C5 (was C3), C6 (was C4) each 1 μF ± 20% and C1, 22 μF -10% + 50% changed to 47 μF - 20% + 50%.

iv) Addition of R5 and R6, each 15 Ω ± 1% fitted in series with C5 and C6 respectively.

v) Addition of suppression capacitors.

vi) Change of maximum input parameters from $I_{max:in}$ = 215mA d.c. and $W_{max:in}$ = 1.1W to $I_{max:in}$ = 200mA d.c. and $W_{max:in}$ = 0.85W.

The revised apparatus coding is EEx ia IIC T5 (Tamb = 60°C).

vii) Modifications to the printed circuit board layouts.

viii) The electronic components re-arranged on to five printed circuit boards and housed within a plastics enclosure.

ix) Change of terminals for external use from Klippon Type GSE5 to Klippon Type SL8-H and BL8.

The equivalent parameters are unchanged and the above changes do not affect the intrinsic safety of the unit.

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BASEEFA

Schedule

Certificate of Conformity BAS No Ex 832399/6 dated 30 June 1992.

DRAWINGS

Number	Issue	Date	Description
CI327-01 Sheets 1 to 18	2	April 92	Certification Information

VARIATION SEVEN

To permit the printed circuit boards containing electronic components to be housed within a larger plastics enclosure with a larger display module this forming a BA328B 4/20mA DIGITAL METER.

DRAWINGS

Number	Issue	Date	Description
CI328-01 Sheets 1 to 18	1	April 92	Certification Information

VARIATION EIGHT

To permit the electronic components to be re-arranged on to four printed circuit boards and housed within an aluminium alloy enclosure or a plastics enclosure thus forming a BA324B 4/20mA DIGITAL METER.

DRAWINGS

Number	Issue	Date	Description
CI324-01 Sheets 1 to 18	1	April 92	Certification Information

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Certificate for BA327B and BA328B