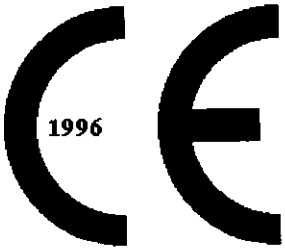
BEKA associates

BA304B intrinsically safe 2-wire 4/20mA digital indicator

Instruction manual

CONTENTS



This product meets the essential protection requirements of Council Directive 89/336/EEC and has been tested to EN50 081-1:1992 pr EN50 082-2:1991

A Declaration of Conformity is available on request.

1 Description

The BA304B is a 2-wire digital indicator which displays the current flowing in a 4/20mA process loop in engineering units. The indicator is powered from the live-zero signal, but only introduces a 1.1V drop which allows it to be installed into almost any 4/20mA current loop. No additional power supply or battery is required.

The main application of the BA304B is to display a measured variable or control signal in the process area. The zero and span of the display are independently adjustable so that the indicator can be calibrated to display any linear variable represented by the 4/20mA signal; for example, temperature, pressure, level or actuator position.

The BA304B has been certified intrinsically safe by BASEEFA to the CENELEC standard. As the indicator is non energy-storing, the intrinsic safety certificate permits it to be connected to almost any certified intrinsically safe 4/20mA loop without the need for additional certification.

The BA304B can be supplied in an epoxy painted aluminium or a glass reinforced plastic (GRP) enclosure. Both enclosures have an armoured glass window and provide IP65 protection.

2 Operation

The BA304B indicator is a 2-wire device which is powered by the current it is measuring, it therefore does not require an additional power supply and may be used like a conventional moving coil meter. Figure 1 shows a simplified block diagram of the indicator.

The 4/20mA current flows through resistor R1 and forward biased diode D1. The voltage developed across D1 is multiplied by the switch mode power supply and used to power the amplifier and liquid crystal display. The voltage developed across R1, which is proportional to the 4/20mA input current, provides the input signal to the display amplifier. Low power MOS semiconductors are used throughout the indicator. The total power consumption is less than 3 milliwatts, which enables the voltage drop introduced into the 4/20mA loop to be less than 1.1V.

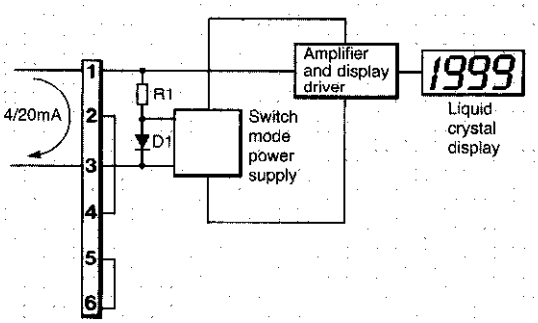


Figure 1 Simplified block diagram of BA304B.

3 Application

The BA304B indicator will operate in any non hazardous 4/20mA current loop, providing that the loop can tolerate the additional 1.1V drop introduced by the indicator. For hazardous area applications it is also necessary to ensure that the intrinsic safety output parameters of the loop do not exceed those specified on the BA304B certificate. These limits are not restrictive and in practice, the BA304B may be connected to almost all certified 4/20mA current loops without the need for additional certification. However, it is necessary to consider each hazardous area application carefully to ensure that the installation of the BA304B indicator will not degrade the safety of the loop.

The following examples illustrate some common applications.

3.1 Electrical system design for non hazardous area installations

The BA304B is connected in series with the 4/20mA current loop and introduces a voltage drop (or burden), 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.

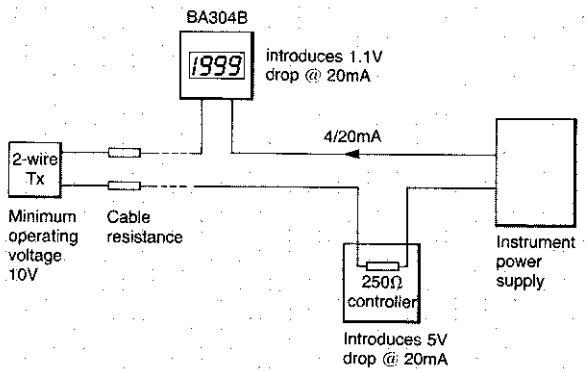


Figure 2 Non hazardous area control loop.

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 BA304B indicator	1.1V
Maximum voltage drop caused by cable resistance	0.4V
	16.5V

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

The BA304B may also be driven directly from any instrument with a 4/20mA output to provide a remote indication. Figure 3 shows a BA304B 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 BA304B incorporates protective components to prevent it being damaged 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.

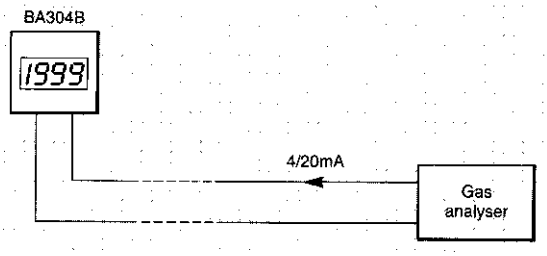


Figure 3 BA304B providing remote indication of gas analyser output.

3.2 Explanation of intrinsic safety certification

The BA304B digital indicator has been certified intrinsically safe by BASEEFA to BS5501: Part 1: 1977 EN50 014 and BS5501: Part 7: 1977 EN50 020. The indicator bears the Community Mark and, subject to local Codes of Practice, may be installed in any of the CENELEC member countries i.e. 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 always be consulted.

A reduced copy of the BASEEFA apparatus certificate for the BA304B is included as Appendix 1 of this manual, full size copies are available from BEKA Associates.

The BA304B intrinsic safety certificate 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 BA304B contains energy-storing components, it has 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 BA304B only has 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 BA304B indicator to be connected to any intrinsically safe circuit whose output parameters do not exceed the following:

$I_{max:out}$ = 215mA
$W_{max:out}$ = 1.1W

The equivalent resistance at the BA304B terminals is:

15.4 ohms minimum in normal operation
24.0 ohms maximum under fault conditions

In practice these requirements are not restrictive and allow the BA304B to be connected to almost all intrinsically safe 4/20mA loops. The following example illustrates how to determine if a particular loop complies with the requirements. Figure 4 shows the equivalent circuit of an intrinsically safe measurement loop incorporating a 2-wire transmitter, BA304B indicator and a two channel Zener barrier. $I_{max:out}$ is the maximum current which can flow around the loop under fault conditions and is defined by the characteristics of the Zener barrier. In a loop protected by two barriers, or by a two channel barrier, each barrier or channel should be considered separately.

The safety description of a Zener barrier specifies the maximum voltage of the terminating Zener diode and the minimum resistance of the terminating resistor. The equivalent resistance of the BA304B may be added to the terminating resistance because it is an infallible resistance which will increase under fault conditions. The resistance of other instruments and loads in the loop must be considered zero unless they have also been certified as infallible.

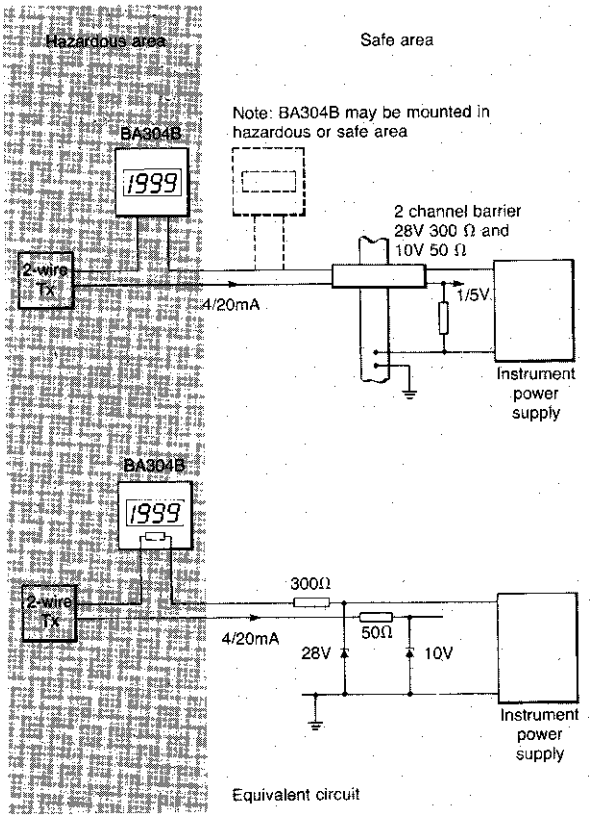
$I_{max:out}$ for each channel is therefore:

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

$W_{max:out}$ is the maximum power which can be transferred into the hazardous area by each Zener barrier or channel when perfectly matched, therefore:

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

Figure 4 shows how these calculations are applied for a two channel barrier, and Appendix 2, lists some of the popular barriers which may be used. Other intrinsically safe power sources should be assessed in the same way as a Zener barrier.



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

	Max Zener voltage	Min terminating resistor
28V channel	28.0V	300.0 ohms
10V channel	10.0V	50.0 ohms

Considering 28V channel

$$I_{max:\,out} = \frac{28.0}{300.0 + 15.4} = 88.78\text{mA}$$

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

Considering 10V channel

$$I_{max:\,out} = \frac{10.0}{50.0 + 15.4} = 152.91\text{mA}$$

$$W_{max:\,out} = \frac{10.0 \times 152.9}{4} = 0.38\text{W}$$

All calculated figures are below the maximum permitted output parameters specified on the BA304B apparatus certificate; the indicator can therefore be connected to the loop without the need for additional certification.

Figure 4 Example of calculations required to establish if a BA304B may safely be connected to an intrinsically safe loop.

The BA304B has been certified EEx ia IIC T4, which means that when connected to a suitable system, it 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 with above ground (group II) gases or vapour 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

This means that the BA304B may be installed in all Zones and used with most common industrial gases except carbon disulphide and ethyl nitrate.

NOTE: If the certification of the system to which the indicator is connected is more restrictive, then these limitations also apply to the indicator e.g. If the system is only certified for use with gases in Groups IIA & IIB, then the indicator may also only be used in these gases.

The BA304B BASEEFA certificate also specifies the maximum equivalent capacitance and inductance which can occur between the two terminals of the indicator.

These are:

Ceq = 15nF
Leq = 2μH

These figures should be subtracted from the maximum cable capacitance and inductance permitted by the system certificate of the loop into which the BA304B is installed. In practice, this is not restrictive as both reactances are small compared to most permitted cable parameters. Only when 'high voltage' barriers are used with IIC gases will the permitted cable capacitance, and hence the cable length, be reduced.

3.3 Electrical system design for hazardous area installations

The BA304B is connected in series with the 4/20mA current loop and introduces a voltage drop (or burden), of up to 1.1V at 20mA. When designing a loop it is therefore necessary to add this voltage to the other voltage drops caused by the Zener barrier and loads, and to ensure that the sum of these voltage drops is less than the minimum power supply voltage – see figure 5.

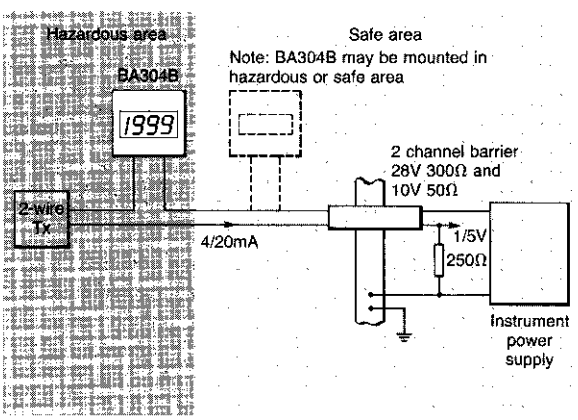


Figure 5 Hazardous area measurement loop

Total voltage drop around loop shown in figure 5:

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 × 20mA)	6.8V
Maximum voltage drop caused by 10V 50Ω barrier (85Ω end to end resistance × 20mA)	1.7V
Maximum voltage drop caused by cable resistance (10Ω × 20mA)	0.2V
Maximum voltage drop caused by BA304B 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 BA304B may be driven via an intrinisically safe interface from any instrument with a 4/20mA output to provide a remote indication in a hazardous area. The type of interface is not critical, providing it complies with the maximum output parameters specified on the BA304B certificate. Either a certified intrinsically safe isolator or a Zener barrier may be used.

If one side of the 4/20mA signal may be earthed, then a single channel Zener barrier provides the lowest cost solution. If the 4/20mA signal is not isolated, then two Zener barriers, a two channel Zener barrier or a certified intrinsically safe 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 voltage drops introduced by the intrinsically safe interface.

Figure 6 shows the two alternative barrier circuits which may be used.

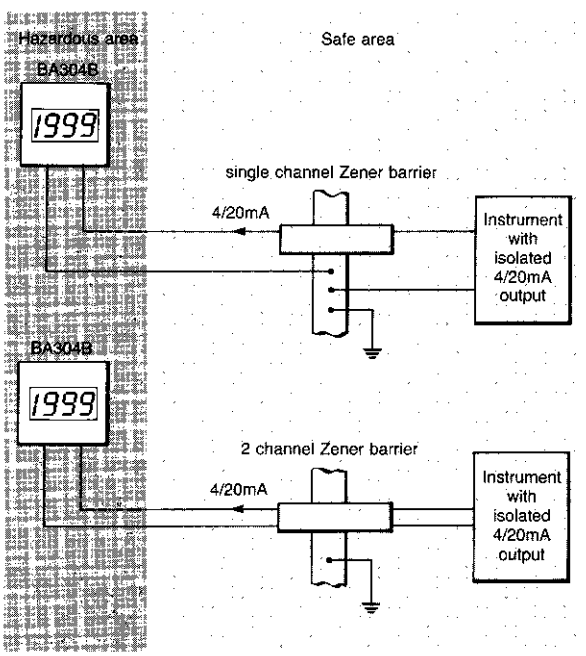


Figure 6 Alternative circuits for remote indication in hazardous area.

4 INSTALLATION

4.1 Location

The BA304B 4/20mA digital indicator is housed in either an epoxy painted die-cast aluminium enclosure or a glass reinforced plastic (GRP) enclosure. To simplify installation the field wiring terminals are located in the enclosure so that it can be installed and wired without the indicator in place. The enclosure also contains a 3.3V Zener diode to maintain the continuity of the 4/20mA loop when the indicator is not fitted. A simplified diagram of the indicator and enclosure is shown in figure 8.

The enclosure can be directly mounted onto any flat surface using the four corner 'D' holes, or can be clamped to pipework using the accessory pipe mounting kit. Whichever technique is used, it is important to choose a location which ensures that the indicator always remains within the environmental limits shown in the specification, and that the display window is not exposed to continuous direct sunlight.

When correctly installed, the enclosure will provide IP65 (hoseproof) protection. However, when the BA304B is mounted outside it is recommended that a hood or flexible transparent cover be provided to prevent standing water accumulating on the gasket.

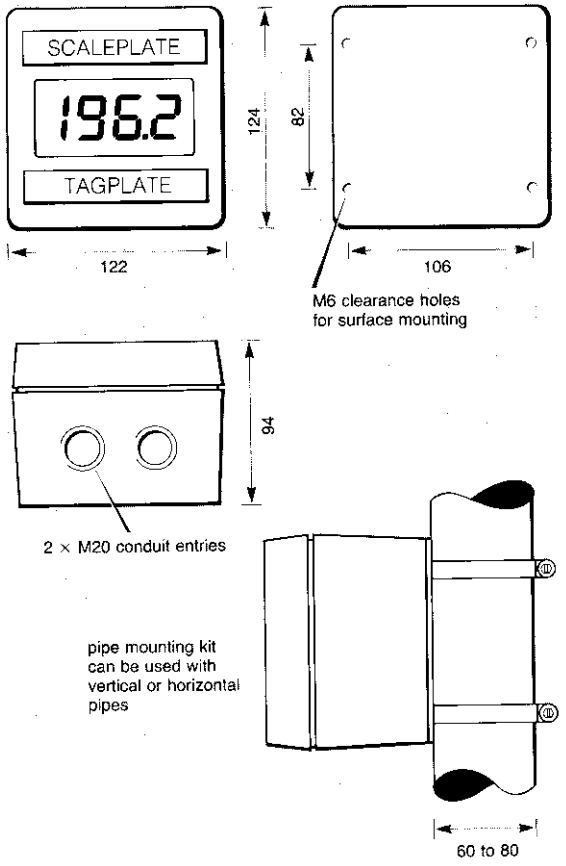


Figure 7 Dimension (mm)

4.2 Installation procedure

i Remove the enclosure cover by unscrewing the four captive 'A' screws.

ii Remove the indicator from the enclosure by unscrewing the three captive 'B' screws and carefully lifting the assembly from the enclosure.

iii Remove the terminal cover from the enclosure by unscrewing the two captive 'C' screws.

iv Mount the enclosure on a flat surface and secure with screws or bolts through the four corner 'D' holes. Alternatively, assemble the pipe mounting kit which is supplied with its own instruction sheet.

v Fit cable glands or conduit fitting into the two M20x1.5 holes at the bottom of the enclosure, ensure that the screw threads do not protrude too far into the terminal compartment.

vi Connect the field wiring to the terminals as shown in figure 9. The version in an aluminium enclosure is provided with an earth terminal which is internally connected to the enclosure die-casting. This terminal should be connected to a local earthing point to ensure personnel safety. This earth connection is not associated with the intrinsic safety of the indicator.
The glass reinforced plastic (GRP) version has a non-conductive enclosure and a local earth connection is therefore not required. In this version the terminal at the right hand side of the seven way terminal block is fitted with a blank identification tag and should not be used.

vii Replace terminal cover and tighten the two 'C' screws. **NOTE: When the indicator is installed in a hazardous area it is mandatory that this terminal cover be fitted.**

viii Replace the indicator in the enclosure and evenly tighten the three 'B' screws.

ix Replace the enclosure cover and evenly tighten the four 'A' screws.

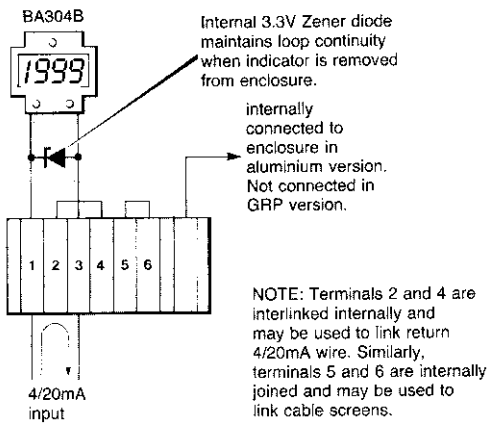
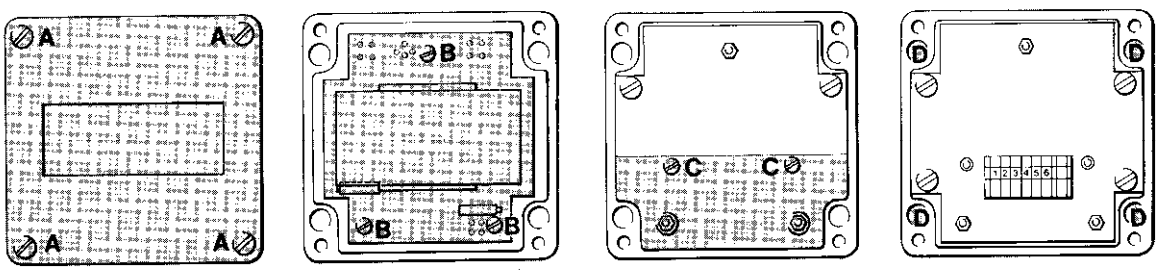


Figure 9 Terminal connections.



Step 1 – Remove the enclosure cover by unscrewing the four 'A' screws.

Step 2 – Remove the indicator from the enclosure by unscrewing the three captive 'B' screws.

Step 3 – Remove the terminal cover from the enclosure by unscrewing the two captive 'C' screws.

Step 4 – Mount the enclosure on a flat surface and secure with screws or bolts through the four corner 'D' holes. Alternatively, assemble the pipe mounting kit which is supplied with its own instruction sheet.

Figure 8 Simplified view of BA304B showing assembly sequence.

5 CALIBRATION

The BA304B digital indicator will be supplied calibrated as requested at time of ordering. If calibration is not requested, the indicator will be set to display 00.0 at 4mA and 100.0 at 20mA.

5.1 Calibration controls

The location of all calibration controls and links are shown in figure 10.

Zero Adjustment

Zero is defined as the figure displayed by the 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, and the zero potentiometer sets the exact figure displayed.

With the suppression/elevation links in the suppression position the unit 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 set to display any figure between 000 and 1000 with a 4mA input.

The zero potentiometer has two ranges. With the zero link in position 'A' the zero potentiometer will adjust the figure displayed by the indicator with a 4mA input current between 000 and ±500. With the zero link in position 'B' 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 100 and 1000. This range of adjustment can be increased – see section 5.4.

The span potentiometer has two ranges. With the span link in position 'C' the span potentiometer will adjust the span to any value between 100 and 550. With the span link in position 'D' the potentiometer will adjust the span to any value between 550 and 1000.

Decimal Point

The position, or absence, of the displayed decimal point is defined by the position of the decimal point selection link – see figure 10.

All the calibration links should be extracted and inserted with a pair of long nosed pliers, taking care not to damage any nearby components.

5.2 Calibration Example

The BA304B is required to display:

25.0 with a 4.000mA input
and 115.0 with a 20.000mA input

i.e. A zero of 250 positive } *ignoring decimal*
A span of 900 } *point*
A decimal point at position dp3

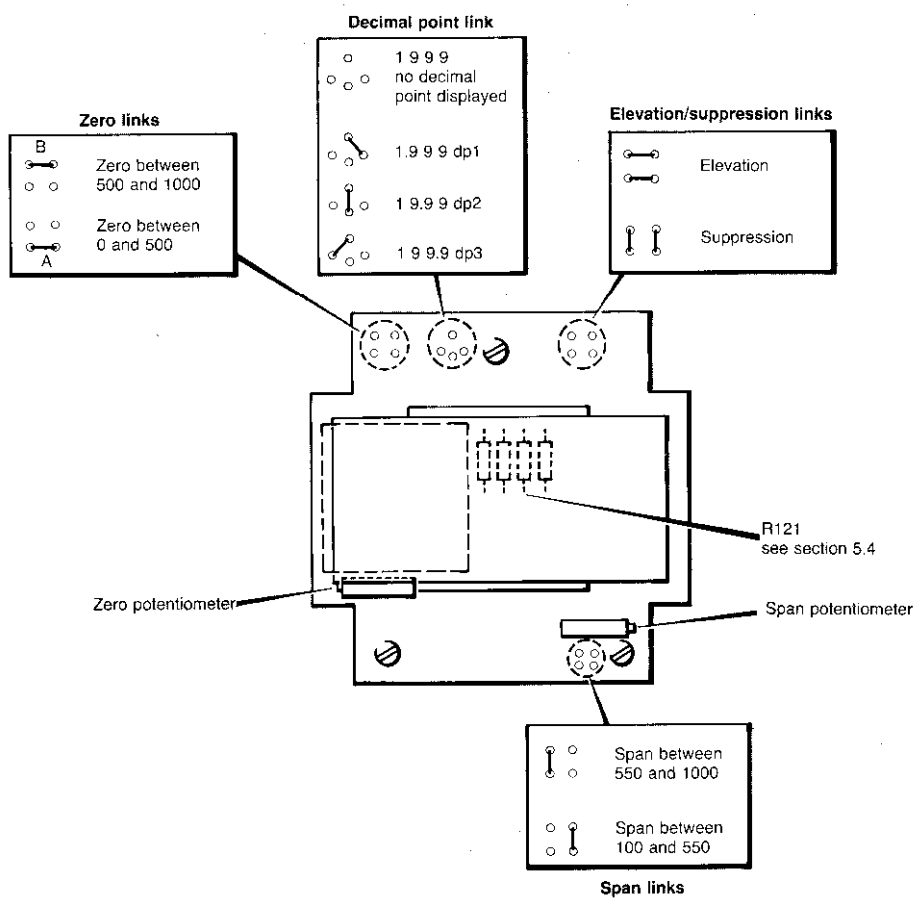


Figure 10 Location of calibration controls and links.

The following adjustments are required – see figure 10.

Step 1 The BA304B 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 'A' position.

Step 3 The required span is 900 therefore the span link should be put into the 'D' position.

Step 4 The decimal point is required between the least two significant digits, therefore the decimal point selection link should be put in position dp3.

Step 5 With 4.000mA input current adjust the zero potentiometer until the indicator displays 25.0

Step 6 With 20.000mA input current adjust the span potentiometer until the indicator displays 115.0.

Step 7 Repeat steps 5 and 6 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.

5.3 Over and Under-range

If the display range of the BA304B is exceeded i.e. below – 1999 or above 1999, the three least significant digits will be automatically blanked. Under-range is therefore indicated by a –1 display and over-range by a 1 display. If the display range is not exceeded, the BA304B will produce accurate results outside the normal 4/20mA input current range. Although not guaranteed, most BA304B indicators will operate from 3 to 25mA.

5.4 Extended range

The maximum span and zero may be doubled by fitting a resistor in position R121 – see figure 10. Standard range indicators are supplied with this position vacant.

Value of R121	Span adjustment	Zero adjustment
82K metal film 50ppm/°C	200 to 1999	± 1999

This modification does not invalidate the intrinsic safety certification, but it slightly increases the jitter on the least significant digit and will reduce the resolution of the span and zero potentiometers.

6 MAINTENANCE

6.1 Fault finding during commissioning

If a BA304B 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 not correctly installed in enclosure	Check that the three 'B' screws are tight, but do not overtighten. Ensure that connecting surfaces are clean
		Note: The voltage drop caused by the enclosure is about 3.3V without the indicator. This falls to 1V with the indicator correctly installed in the enclosure
Indicator displays 1	Positive over-range	The indicator has been incorrectly calibrated and is trying to display a number greater than 1999
Indicator displays –1	Negative over-range	The indicator has been incorrectly calibrated and is trying to display a number less than –1999
Unstable display. More than ±1 digit of jitter	4/20mA input current contains large ripple current	Reduce ripple content
	Insufficient voltage to operate indicator i.e. less than 1.1V	Check supply voltage and voltage drops caused by all components within the loop

6.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance is permitted on intrinsically safe equipment installed in a hazardous area, but only certified intrinsically safe electrical test equipment should be used unless a gas clearance certificate is available

If a BA304B 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
No display, between 3 and 4V across terminals	Indicator not correctly installed in enclosure	Remove indicator from enclosure, clean connecting surfaces on pillars and indicator. Replace indicator and tighten three 'B' screws. Do not overtighten
Unstable display More than ±1 digit of jitter	4/20mA current has developed large ripple component	Find source of ripple
	Insufficient voltage to operate indicator i.e. less than 1.1V	Check supply voltage and 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 enclosure and replaced with another unit. If the second unit functions correctly, the fault is within the original indicator. If the BA304B is still faulty, it is likely that the fault is within the enclosure assembly.

6.3 Servicing

The BA304B uses a high density construction technique and is partially potted, it is therefore difficult to service to component level in the field. For this reason the BA304B has been designed so that the indicator can easily be replaced without disturbing the field wiring. All standard BA304B indicators are interchangeable and 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 a spare unit on site.

BEKA Associates recommend that, except under exceptional circumstances, faulty BA304B indicators are returned to the factory or local agent for repair. However, if this is not possible BEKA Associates will provide a service sheet for the instrument.

If a repaired indicator is to be used in a hazardous area, it is essential that the servicing has not degraded the safety of the instrument. The current Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres, BS5345: Part 4: 1977, permits on-site maintenance providing the repairs are inspected by a second competent person and are recorded. BEKA Associates again strongly recommend that faulty units should be returned to the factory for repair to ensure that the certification requirements are complied with.

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 Engraved scale and tag plates

The BA304B can be supplied with engraved stainless steel scale and tag plates. The scaleplate is fitted above the display and is engraved to show the units of measurement; the tagplate is fitted below the display and shows the tag number or function of the indicator. Each plate can accommodate:

1 row of 9 alphanumeric characters	10mm high
or 1 row of 13 alphanumeric characters	7mm high
or 2 rows each of 18 alphanumeric characters	5mm high

If engraving is not requested two blank stainless steel plates are fitted to the BA304B, which can easily be removed for engraving on site.

7.2 Pipe mounting kits

The standard pipe mounting kit enables the BA304B to be clamped onto any vertical or horizontal pipe-stand or pipe having a diameter between 60 and 80mm. Kits for other diameter pipes are also available, together with stainless steel clamps for use in corrosive areas. Each pipe mounting kit is supplied with its own instruction sheet.

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.

APPENDIX 1: BASEEFA Certificate

The BA304B certificate is a variation of the certificate for the BA303B field mounting indicator. Reduced copies of these certificates are shown in this Appendix, full size copies are available from BEKA Associates and distributors.

Health & Safety Executive

BASEEFA

British Approvals Service for Electrical Equipment in Flammable Atmospheres

VARIATION

CERTIFICATE OF CONFORMITY

THIS IS TO CERTIFY THAT

CERTIFICATE OF CONFORMITY BAS NO Ex 832399

Issued to BEKA ASSOCIATES
of Hitchin, Herts

for the BA 303B 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 variations specified in the attached Schedule.

Code : EEx ia IIC T4 File : SFA 16/263/01

CERTIFICATE OF CONFORMITY BAS NO Ex 832399/4

Sheet 1/2
430/4

B HILL
DIRECTOR
Dated 15 May 1986

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

CERTIFICATE OF CONFORMITY Ex **SCHEDULE**

NUMBER Ex 832399/4
DATED 15 May 1986

VARIATION FOUR

To permit the following changes to form a BA 304B 4/20mA DIGITAL METER.

1. Re-arrangement of the electronic components onto two printed circuit boards which are mounted in an aluminium enclosure or optionally in a plastics enclosure.

2. The addition of diode D201.

The intrinsic safety parameters are not affected by these changes.

DRAWINGS

Number	Issue	Date	Description
CI304-001 Sheets 1-14	1	Dec 85	Certification Information

Sheet 2 of 2

BA304B apparatus certificate

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)

   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.

CERTIFICATE OF CONFORMITY 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

Original BA303B apparatus certificate

APPENDIX 2: List of common intrinsically safe interfaces which may be used with the BA304B

This Appendix lists the certified Zener barriers and isolators which may be used with the BA304B without the need for additional certification. The list is not intended to show all types which may be used, but merely to identify the industry standard devices which are suitable. The suitability of other certified intrinsically safe interfaces can be assessed using the technique shown in Section 3.2 of this manual. If in doubt, ask BEKA Associates or the distributor from whom you purchased the instrument for advice.

Products from:	Pepperl and Fuch (GB) Limited
Zener barriers:	Z111/Ex. Z119/Ex, Z125/Ex, Z428/Ex Z488/Ex, Z488/Ex-R
Isolators:	ZG31/Ex, ZG32/Ex, ZG30/Ex KH03-ICR/Ex130, KHD3-IST/Ex1 KHD3-ISV/Ex1 WE77/Ex-TR01
Products from:	R Stahl
Zener barriers:	8901/30-100/200/60, 8901/31-100/200/60 8901/30-150/150/60, 8901/31-150/150/60 8901/30-220/147/60, 8901/31-220/147/60 8901/30-280/093/60, 8901/31-280/093/60 8901/30-280/093/60 plus 8901/34-280/000/60 8901/31-280/093/60 plus 8901/33-280/000/60 8901/30-280/093/60 plus 8901/30-100/200/60 8901/31-280/093/60 plus 8901/31-100/200/60 8901/30-280/093/60 plus 8901/30-100/200/62 8901/31-280/093/60 plus 8901/31-100/200/62
Products from:	Safety Technology Limited
Zener barriers:	E82, E821, E83, E84, E841, E85, E851, E86, E82 plus E85, E921, E931, E941, E951, E965, E925(R)
Products from:	Measurement Technology Limited
Zener barriers:	MTL710, MTL715, MTL722, MTL728, MTL787, MTL788(R) MTL110, MTL115, MTL122, MTL128, MTL187, MTL188 (R) MTL322, MTL702, MTL705, MTL706
Isolators:	MTL2441, MTL2442, MTL3041, MTL3042, MTL3046

APPENDIX 3: Product Specification

Input	
current	4 to 20mA
voltage drop at 20mA	Less than 1V @ 20°C Less than 1.1V @ −20°C
overrange	±300mA will not cause damage
Display	
type	3½ digits (−1999 to 1999) liquid crystal 25mm high.
span	Adjustable between: 100 & 1000 for 4 to 20mA input
zero	Adjustable between: −1000 & 1000 with 4mA input.
polarity	Automatic minus sign.
decimal point	1 of 3 positions, selected by link
reading rate	2.5 per second.
overrange	3 least significant digits are blanked.
Accuracy	
@ 20°C	±0.1% ±1 digit
Temperature effect on:	
span	typ 50ppm, max 100ppm/°C
zero	typ 0.05 digit + 100ppm/°C max 0.1 digit + 200ppm/°C
series mode rejection	Typ 1 digit error for 1V pk to pk 50Hz signal.
Intrinsic Safety	
Europe (BASEEFA)	
standard	BS5501:Part 7:1977:EN50 020
code	EEx ia IIC T4
certificate number	BAS Ex832399
output parameters:	
Umax: out	1.2V] Complies with Clause
Imax: out	75mA] 1.3 of BS5501:
Wmax: out	20mW] Part 1:1977:EN50 014
Ceq	15nF] *'Non energy-storing*
Leq	2μH] *apparatus'.*
location	Zone 0, 1 or 2
installation	The BA304B may be connected to any certified intrinsically safe circuit whose output parameters do not exceed: Imax: out 215mA Wmax: out 1.1W See certificate and AG300 for full details
Australia (SA)	
standard	AS1829-1981
code	Ex ia IIC T4
certificate No.	Ex 1083
Environmental	
operating temperature	−20 to +60°C
humidity	to 95% @ 40°C
case	Hose-proof (IP65)
Mechanical	
terminals	Screw clamp for 0.5 to 2.5mm cables.
weight	1.2kg
Accessories	
engraved scale plate	removable blank stainless steel plate fitted to each indicator, can be supplied engraved with units of measurement
engraved tagging plate	removable blank stainless steel plate fitted to each indicator, can be supplied engraved with tagging information.
pipe-mounting kit	mounts indicator onto any vertical or horizontal pipe with diameter between 60 & 80mm. For larger or smaller pipes special kits are available.

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August 1990