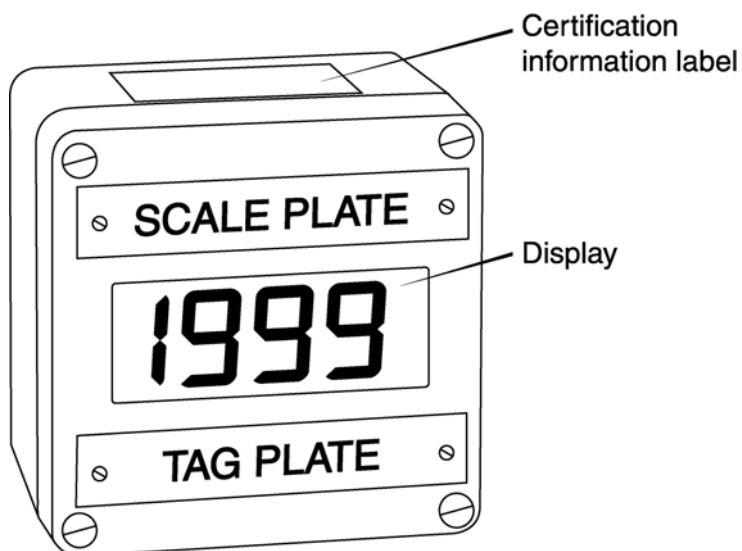


BA304C

Intrinsically safe loop- powered 3½ digit field mounting indicator

Issue 6



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Appendix 1 Installation in USA

1. DESCRIPTION

The BA304C is an intrinsically safe loop powered digital indicator which displays the current flowing in a 4/20mA loop in engineering units. The indicator introduces less than 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 BA304C is to display a measured variable or control signal in a hazardous process area. The zero and span of the display are independently adjustable so that the indicator may be calibrated to display any variable represented by the 4/20mA current, e.g. temperature, flow, pressure or level.

The BA304C has been certified intrinsically safe by ITS Testing and Certification Ltd to the European ATEX Directive 94/9/EC. The EC-Type Examination certificate specifies that under fault conditions the voltage, current and power at the two input terminals will not exceed those specified for simple apparatus.

Safety approvals from other authorities allowing installation outside Europe are described in appendices to this manual.

The indicator is available in a glass reinforced polyester (GRP), or an epoxy painted aluminium enclosure. Both provide IP66 protection.

2. OPERATION

Fig 1 shows a simplified block diagram of a BA304C. The 4/20mA input current flows through resistor R1 and forward biased diode D1. The voltage developed across D1, which is relatively constant, is multiplied by a switch mode power supply and used to power the analogue to digital converter and liquid crystal display. The voltage developed across R1, which is proportional to the 4/20mA input current, provides the input signal for the analogue to digital converter.

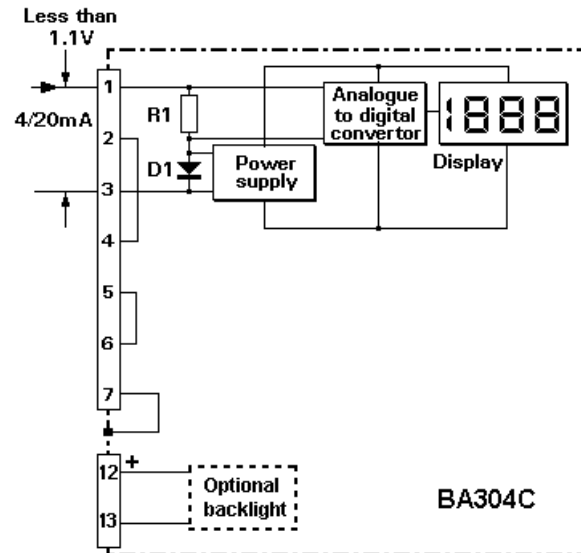


Fig 1 Simplified block diagram of BA304C

3. INTRINSIC SAFETY CERTIFICATION

3.1 ATEX certificate

The BA304C has been issued with an EC-Type Examination Certificate number ITS02ATEX2027 by Notified Body ITS Testing and Certification Ltd. This confirms compliance with the European ATEX Directive for Group II, Category 1G equipment, EEx ia IIC T5. The instrument bears the Community Mark and, subject to local codes of practice, may be installed in any of the European Economic Area (EEA) member countries. i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Norway, The Netherlands, Portugal, Spain, Sweden and the United Kingdom. ATEX certificates are also accepted in Iceland, Liechtenstein, Switzerland and the Czech Republic.

This manual describes installations which conform with BS EN60079:Part 14 Electrical Installation in Hazardous Areas. When designing systems for installation outside the UK the local Code of Practice should be consulted.

3.2 4/20mA input

In Europe, sources of energy which do not generate more than 1.5V; 100mA, 20μJ and 25mW are for intrinsic safety purposes considered to be simple apparatus.

Although the BA304C indicator does not itself comply with the requirements for simple apparatus, the EC-Type Examination Certificate specifies that under fault conditions the voltage, current and power at the 4/20mA input terminals 1 and 3 will not exceed those specified for simple apparatus. This allows the BA304C to be connected into any intrinsically safe circuit protected by a Zener barrier or galvanic isolator providing the output parameters of the circuit do not exceed:

$$\begin{aligned}U_o &= 30V \text{ dc} \\I_o &= 200mA \\P_o &= 0.85W\end{aligned}$$

The BA304C EC-Type Examination Certificate specifies that the maximum equivalent capacitance and inductance between the two 4/20mA input terminals 1 and 3 is:

$$\begin{aligned}C_i &= 20nF \\L_i &= 10\mu H\end{aligned}$$

To determine the maximum permitted cable parameters, these figures should be subtracted from the maximum cable capacitance and inductance permitted by the certificate for the loop into which the indicator is being installed.

3.3 Zones, gas groups and T rating

The BA304C has been certified Group II, Category 1G, EEx ia IIC T5, Tamb -40 to 60°C. When connected to a suitable system the indicator 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.

Be used with gases in groups:

Group	A	propane
Group	B	ethylene
Group	C	hydrogen

Having a temperature classification of:

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

This allows BA304C indicators to be installed in all Zones and to be used with most common industrial gases.

WARNING installation in Zone 0

When installed in a Zone 0 potentially explosive atmosphere requiring apparatus of Category 1G, the indicator shall be installed such that even in the event of rare incidents, an ignition source due to impact or friction between the aluminium enclosure and iron/steel is excluded.

3.4 Certification Label Information

The certification label is fitted on the top outer surface of the enclosure. It shows the ATEX certification information plus BEKA associates name and location. Non European certification information may also be included.



The instrument serial number and date of manufacture are shown on a separate label within the instrument enclosure.

4. SYSTEM DESIGN FOR HAZARDOUS AREAS

4.1 Transmitter loops

A BA304C indicator may be connected in series with almost any intrinsically safe 4/20mA current loop and calibrated to display the measured variable or control signal in engineering units.

There are two basic design requirements:

1. The intrinsic safety output parameters of the 4/20mA loop, which are defined by the Zener barrier or galvanic isolator, must be less than:

$$\begin{aligned}U_o &= 30V \text{ dc} \\I_o &= 200mA \\P_o &= 0.85W\end{aligned}$$

2. The loop must be able to tolerate the additional 1.1V required to operate the indicator.

Fig 2 illustrates a typical application in which a BA304C indicator is connected in series with a 2-wire transmitter protected by a Zener barrier.

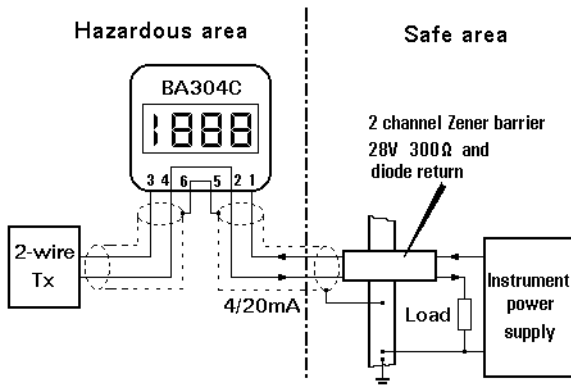


Fig 2 BA304C in a transmitter loop

4.2 Remote indication

A BA304C indicator may be driven from a 4/20mA safe area signal via an intrinsically safe interface to provide a remote indication within a hazardous area. The type of interface is not critical, either a Zener barrier or a galvanic isolator may be used, providing the output parameters of the interface are:

U_o	less than	30Vdc
I_o	less than	200mA
P_o	less than	0.85W

Note: when the hazard is a IIC gas and two single channel Zener barriers or a two channel Zener barrier are used, only one barrier or channel may be a 28V 300ohm device.

Again it is necessary to ensure that the voltage capability of the 4/20mA signal is sufficient to drive the indicator plus the voltage drop introduced by the intrinsically safe interface. Figs 3A, 3B and 3C show the alternative circuits which may be used.

If one side of the 4/20mA current loop may be earthed, a single channel Zener barrier provides the lowest cost protection. If the 4/20mA signal is not isolated, then two Zener barriers, a two channel Zener barrier or a galvanic isolator should 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 drop introduced by the intrinsically safe interface. Fig 3 shows the alternative circuits which may be used.

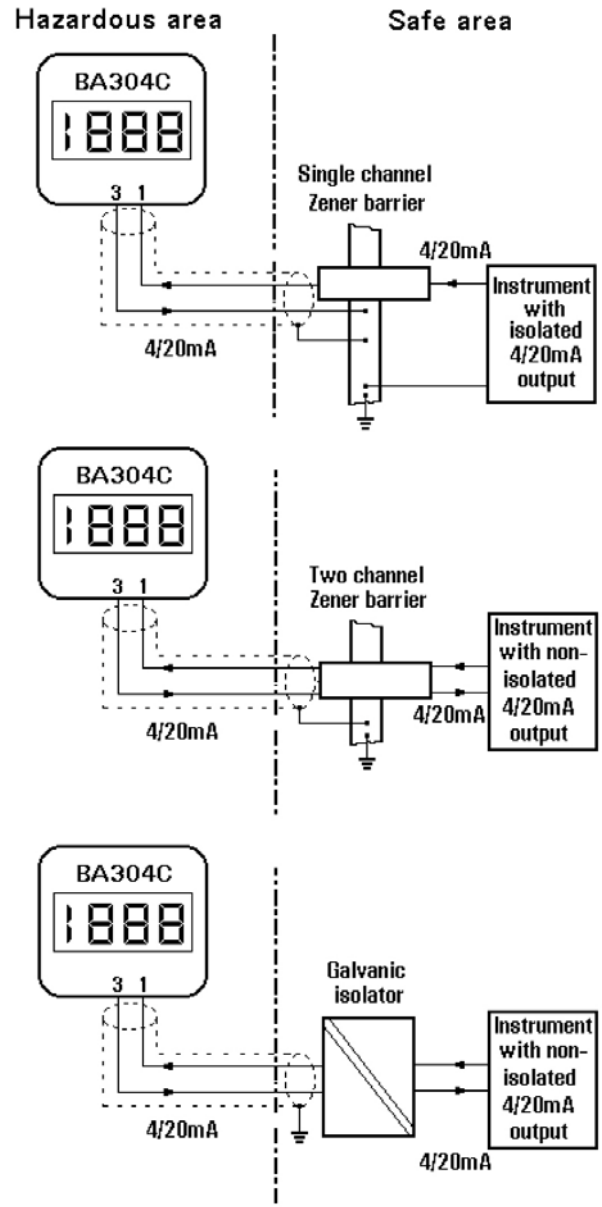


Fig 3 Alternative circuits for remote indication in a hazardous area

5. INSTALLATION

5.1 Location

The BA304C indicator can be supplied in either a glass reinforced polyester (GRP), or an epoxy painted aluminium enclosure. Both provide IP66 protection and have a toughened glass window and stainless steel fittings. The GRP enclosure is suitable for most industrial installations including off-shore and waste water treatment applications. For installations where solvents may be present, the aluminium enclosure provides maximum protection, but it is not recommended for offshore applications.

Both enclosures are surface mounting, but may be pipe or panel mounted using the accessory kits described in section 8 of this manual.

To simplify installation, the enclosure can be installed and the field wiring terminated prior to the indicator assembly being fitted. The enclosure contains diodes to maintain continuity of the 4/20mA loop when the indicator assembly is not present. Terminals 2 and 4 are internally joined and may be used for linking the return 4/20mA wire - see Fig 2. Similarly, terminals 5 and 6 are internally joined and may be used for linking the cable screens. Terminal 7 is internally connected to an insulated radio frequency screen in the GRP enclosure, and to the case in the aluminium enclosure.

5.2 Installation Procedure

Fig 4 illustrates the instrument installation procedure.

- Remove the enclosure cover by unscrewing the four captive 'A' screws.
- Remove the indicator assembly from the enclosure by unscrewing the three captive 'B' screws.
- Mount the enclosure on a flat surface and secure with screws or bolts through the four corner 'C' holes. Alternatively use one of the pipe or panel mounting kits described in sections 8.5 and 8.6
- Remove the temporary dust seals from the two cable entries and install glands, conduit fittings or blanking plugs with the required ingress protection.
- Connect the field wiring to the terminals as shown in Fig 5.
- Replace the indicator assembly and evenly tighten the three 'B' screws.

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

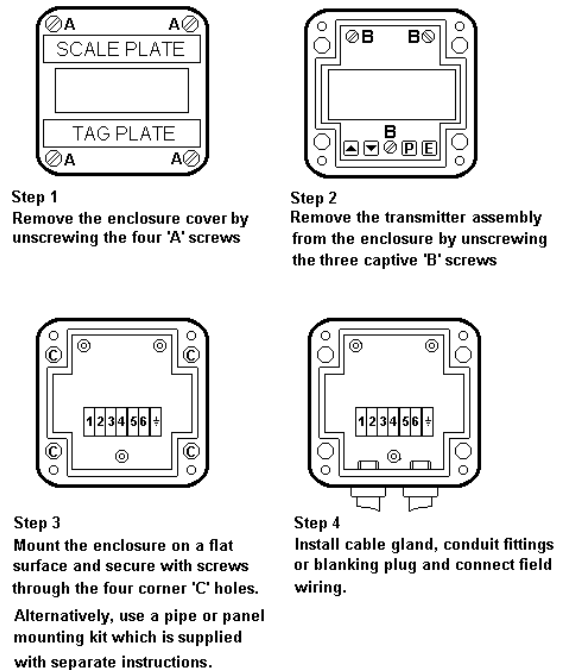


Fig 4 BA304C installation procedure

5.3 EMC

The BA304C complies with the requirements of the European EMC Directive 2004/108/EEC. For specified immunity all 4/20mA wiring should be in screened twisted pairs, with the screen earthed within the safe area. Terminal 7 should be connected to a local earth or to a cable screen which is earthed in the safe area.

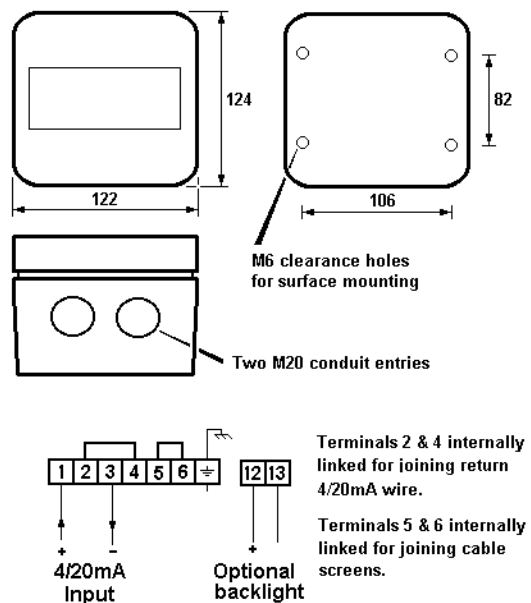


Fig 5 Dimensions and terminal connections

6. CALIBRATION

The BA304C will be supplied calibrated as requested at time of ordering. If calibration is not requested, the indicator will be set to display 00.0 with 4.000mA input, and 100.0 with 20.000mA input.

The BA304C is conditioned and calibrated by plug-in links and two multi-turn potentiometers. For maximum accuracy, the instrument should be calibrated using an external traceable current source with a resolution of at least 4µA. However, when verification is not required, the instrument may be fitted with an internal calibrator which allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current. See section 8.2 for details.

6.1 Zero adjustment

Zero is defined as the number displayed by the indicator with a 4.000mA input current and may be adjusted between -1000 and 1000. The zero potentiometer has two ranges, 0 to 500 and 500 to 1000. Zero polarity is defined by the position of the suppression / elevation links which are shown in Fig 6.

Suppression / elevation links

Position	Display with 4mA input adjustable between
Elevation	0 and 1000
Suppression	0 and -1000

Zero link

Position	Display with 4mA input adjustable between
0 to 500	0 and 500
500 to 1000	500 to 1000

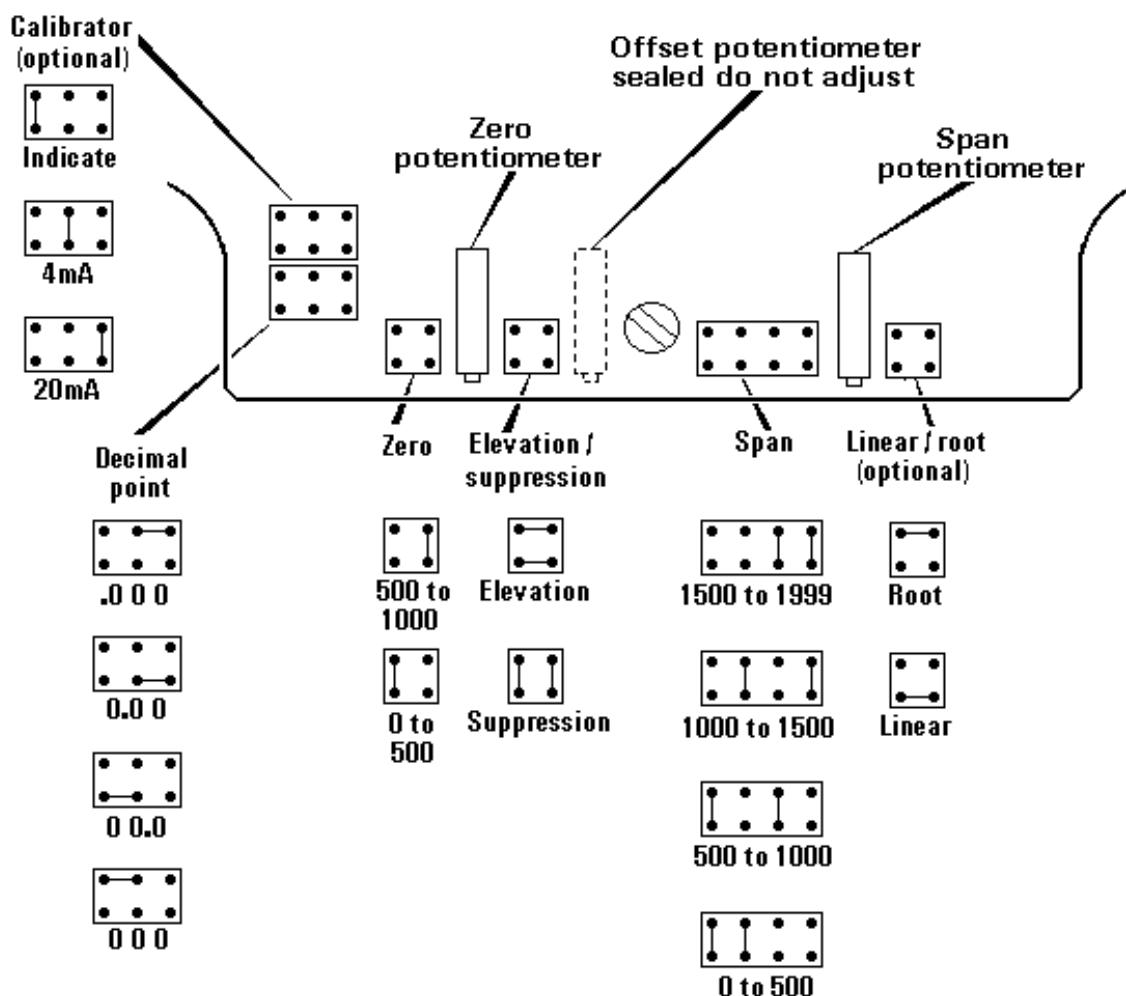


Fig 6 Position of plug-in links and potentiometers

6.2 Span adjustment

Span is defined as the difference between the number displayed with 4.000mA input, and the number displayed with 20.000mA input. It is adjustable between 0 and 1999 in four ranges. Fig 6 shows the position of the span links and the span potentiometer.

Span links

Position	Difference in display with 4 & 20mA input adjustable between
000 to 500	000 and 500
or 500 to 1000	500 and 1000
or 1000 to 1500	1000 and 1500
or 1500 to 1999	1500 and 1999

6.3 Decimal point

A decimal point may be displayed between any of the four digits. The position or absence of this dummy decimal point is determined by the position of the decimal point link shown in Fig 6. When calculating the required span and zero settings the decimal point should be ignored.

6.4 Reverse action

Normally the BA304C display increases as the input current increases, but this can be reversed. Please contact BEKA associates for details.

6.5 Calibration example

The BA304C is required to display:

25.0 with 4.000mA input
115.0 with 20.000mA input

- i.e. A zero of positive 250 (Ignoring decimal point)
A span of 900 (Ignoring decimal point)
A decimal point in position 00.0

The following adjustments are required:

- Step 1 The BA304C 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 in the 0 to 500 position.
- Step 3 The required span is 900, therefore the span links should be placed in the 500 to 1000 position.
- Step 4 The decimal point is required in front of the least significant digit, therefore the decimal point link should be placed in the 00.0 position.
- Step 5 With 4.000mA input adjust the zero potentiometer until the indicator displays 25.0
- Step 6 With 20.000mA input 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 so it should only be necessary to repeat each adjustment twice.

6.6 Over and under-range

If the indicator display range is exceeded, the three least significant digits will be blanked. Under-range is indicated by -1 and over-range by 1. If the display range is not exceeded, the BA304C will produce accurate readings outside the 4/20mA current range. Although not guaranteed, most BA304C indicators will operate between 3 and 25mA.

7. MAINTENANCE

7.1 Fault finding during commissioning

If the BA304C fails to function during commissioning the following procedure should be followed:

Symptom	Cause	Solution
No display	Incorrect wiring.	There should be 1V between terminals 1 & 3 with terminal 1 positive.
No display with 0V Between terminals 1 and 3.	Incorrect wiring or no power supply.	Check that a current is flowing in the loop.
	Insufficient loop voltage to operate BA304C.	Check supply voltage and voltage drops caused by all components in the loop.
No display with 4V between terminals 1 and 3.	Indicator assembly not correctly installed in enclosure.	Check that the three screws securing the indicator assembly are tightened.
BA304C displays 1	Positive over-range.	The BA304C has been incorrectly calibrated & is trying to display a number greater than 1999.
BA304C displays -1	Negative over-range.	The BA304C has been incorrectly calibrated & is trying to display a number less than -1999.
Unstable display.	4/20mA input has a large ripple	Check loop supply voltage.

7.2 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 test equipment should be used unless a gas clearance certificate is available.

If a BA304C fails after it has been functioning correctly, the following procedure should be followed:

Symptom	Cause	Solution
No display with 0V Between terminals 1 and 3.	No power supply.	Check that a current is flowing in the loop.
No display with 4V between terminals 1 and 3.	Indicator assembly not correctly installed in enclosure.	Check that the three screws securing the indicator assembly are tightened.
Unstable display.	4/20mA input has a large ripple.	Check loop supply voltage.

If this procedure does not reveal the cause of the fault, it is recommended that the indicator assembly is removed from the enclosure and replaced. This can be done without disconnecting power. If the replacement assembly functions, the fault is within the original indicator assembly. If the indicator is still faulty, it is likely that the fault is within the enclosure assembly or field wiring.

7.3 Servicing

To simplify servicing BA304C indicators use a common indicator assembly which may be replaced on site. All BA304C indicator assemblies without accessories are interchangeable.

To replace the indicator assembly remove the three 'B' screws shown in Fig 4 which will allow the assembly to be removed. If the instrument is fitted with a backlight the fly-lead connecting it to the terminals must be un-plugged. The replacement indicator assembly may then be installed and the enclosure reassembled.

Please note that an ATEX certified BA304C indicator assembly must not be replaced by a non ATEX certified BA304C assembly.

If after replacement of the indicator assembly the instrument still does not function, it is likely that the fault is within the protection components on the terminal assembly. Terminal assemblies may also be replaced on site providing that an instrument with a backlight is fitted with a replacement board including terminals 12 and 13.

We recommend that faulty instruments and instrument assemblies are returned to BEKA associates or your local BEKA agent for repair

7.4 Routine maintenance

The mechanical condition of the instrument and the electrical calibration should be regularly checked. The interval between inspections depends upon environmental conditions. We recommend that initially instrument calibration should be checked annually.

7.5 Guarantee

Indicators which fail within the guarantee period should be returned to BEKA associates or your local BEKA agent. It is helpful if a brief description of the fault symptoms is provided.

7.6 Customer comments

BEKA associates is always pleased to receive comments from customers about our products and services. All communications are acknowledged and whenever possible, suggestions are implemented.

8. ACCESSORIES

8.1 Engraved scale and tag plates

All BA304C indicators are fitted with blank stainless steel scale and tag plates above and below the display. These can easily be removed for engraving, or if requested they can be supplied etched with any units of measurement and tag information. Each plate can accommodate:

- 1 row of 9 alphanumeric characters 10mm high
- or 1 row of 11 alphanumeric characters 7mm high
- or 2 rows of 18 alphanumeric characters 5mm high

8.2 Internal Calibrator

The BA304C can be supplied with an optional internal calibrator which simulates 4 and 20mA input currents. This allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current, but it is not a substitute for calibration with a traceable external current source. Fig 6 shows the position of the calibrator link.

An internal calibrator can not be fitted to an instrument with a root extractor.

To recalibrate the BA304C using the internal calibrator, the following procedure should be followed. This may be done at any input current between 4 and 20mA.

- Step 1 Put the suppression / elevation, zero, span and decimal point links in the required position.
- Step 2 Put the calibrator link in the 4mA position and adjust the indicator zero potentiometer to give the required display at 4mA.
- Step 3 Put the calibrator link in the 20mA position and adjust the indicator span potentiometer to give the required display at 20mA.
- Step 4 Repeat steps 2 and 3 until both calibration points are correct. The span and zero controls are almost independent so it should only be necessary to repeat each adjustment twice.
- Step 5 Return the calibrator link to the 'indicate' position. The indicator will now respond to the 4/20mA input current with the revised calibration.

8.3 Root extractor

The BA304C can be supplied with a square root extractor which enables the indicator to accurately display the output from a differential flow meter in linear engineering units between 10 and 100% of full flow (4.16 to 20mA). The lineariser continues to operate with reduced accuracy down to 2.5% of maximum flow, or clip-off can be selected which will force the display to zero at flows below 5% (4.04mA). The location of the clip-off link is shown in Fig 7.

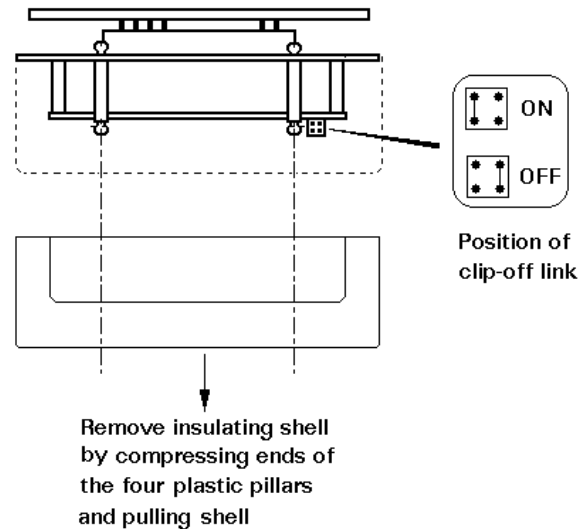


Fig 7 Location root extractor clip-off link

When calibrating a root extracting BA304C the indicator zero potentiometer should be adjusted to give the required display at 10% of flow (4.16mA). The indicator zero potentiometer should not be used to set the display to zero with a 4mA input. Zero suppression or elevation may not be used, i.e. 4mA must correspond to zero flow.

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

% of full flow	Current output mA
2.5	4.01
10.0	4.16
25.0	5.00
50.0	8.00
75.0	13.00
100.0	20.00

A root extractor can not be fitted to an instrument with an internal calibrator.

8.3.1 Calibration example with root extractor

The BA304C is required to display rate of flow in gallons per minute, with a resolution of 0.1 gallons. The differential flowmeter has an output of 20mA at a flow rate of 140.0 gallons per minute.

i.e. A span of 1400 ignoring the decimal point
A decimal point in position 00.0

The following adjustments are required:

- Step 1 Put the suppression / elevation links in the elevation position.
- Step 2 Put the zero link in the 0 to 500 position.
- Step 3 The required span is 1400, therefore the span links should be placed in the 1000 to 1500 position.
- Step 4 The decimal point is required between the least two significant digits, therefore the decimal point link should be placed in the 00.0 position.
- Step 5 With 4.160mA input current adjust the zero potentiometer until the indicator displays 14.0 (10% of flow). If there is insufficient adjustment to achieve this, put the elevation/suppression links in the suppression position and continue with the calibration procedure.
- Step 6 With 20.000mA input current adjust the span potentiometer until the indicator displays 140.0
- Step 7 Repeat steps 5 and 6 until both calibration points are correct.

8.4 Display backlight

The BA304C may be supplied with two different backlights. The loop powered backlight produces green background illumination enabling the display to be read at night and in poor lighting conditions. No additional power supply, IS interface or field wiring are required, but the indicator voltage drop is increased. Alternatively, the separately powered backlight has a bright orange output which enhances daylight viewing, but an additional IS interface and field wiring are required.

8.4.1 Separately powered backlight

The separately powered backlight is segregated from the measuring circuit and has been certified as a separate intrinsically safe circuit, but it does not comply with the requirements for simple apparatus.

This backlight must be powered from the safe area via a Zener barrier or a galvanic isolator as shown in Fig 8. Any certified device may be used, providing the output parameters do not exceed:

$$\begin{aligned} U_o &= 28V \text{ dc} \\ I_o &= 110mA \\ P_o &= 0.77W \end{aligned}$$

The EC-Type Examination Certificate specifies that the maximum equivalent capacitance and inductance between terminals 12 and 13 is:

$$\begin{aligned} C_i &= 0.045\mu F \\ L_i &= 0.02mH \end{aligned}$$

To determine the maximum permitted cable parameters, these figures should be subtracted from the maximum permitted cable capacitance and inductance specified by the certificate for the Zener barrier or galvanic isolator powering the backlight.

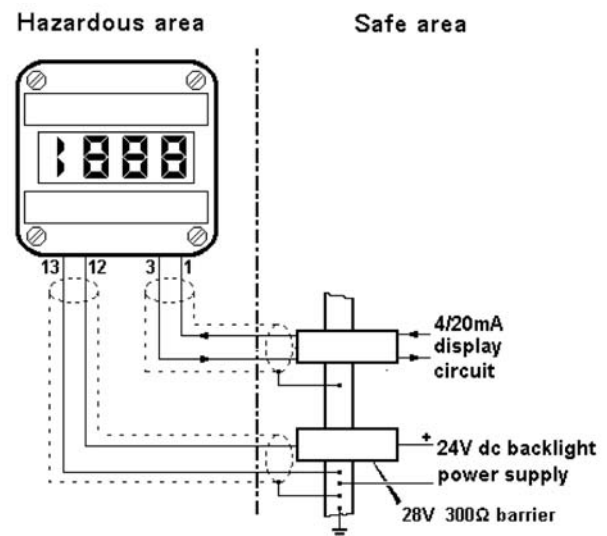


Fig 8 Separately powered backlight

The display brilliance depends upon the current flowing through the backlight which is determined by the supply voltage and the end-to-end resistance of the Zener barrier or output resistance of the galvanic isolator. Brilliance will not be significantly reduced until the current falls below 20mA.

$$\text{Backlight current} = \frac{V_{\text{supply}} - 18}{\text{End-to-end resistance of barrier\#}}$$

or output resistance of galvanic isolator

8.4.2 Loop powered backlight

This backlight may be connected in series with the 4/20mA measuring circuit so that like the BA304C indicator it is loop powered. This eliminates the need for a separate Zener barrier or galvanic isolator and associated wiring for the backlight, thus significantly reducing the installation costs.

As shown in Fig 9 the loop powered backlight may be connected in series with the BA304C indicator. Any Zener barrier or galvanic isolator certified EEx ia IIC by an EEC approved certification body may be used, providing the output parameters do not exceed:

U_o	=	30V dc
I_o	=	200mA
P_o	=	0.85W

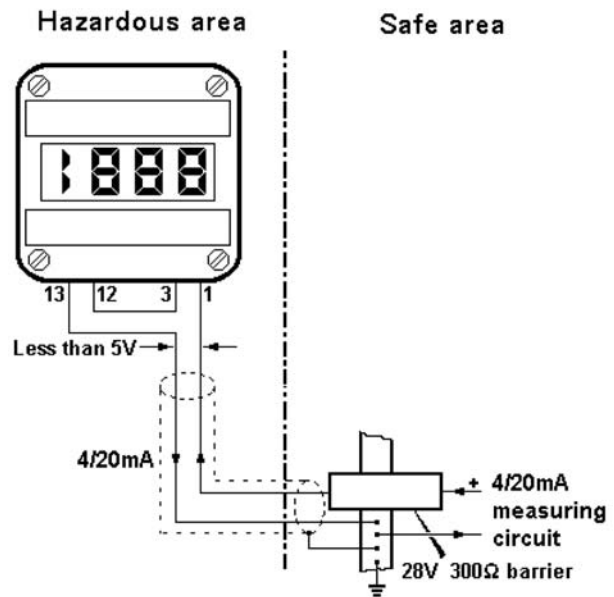


Fig 9 Loop-powered backlight

Connecting the backlight in series with the indicator will increase the total voltage drop in the 4/20mA loop from 1.1V to 5.0V

8.5 Pipe mounting kits

Two pipe mounting kits are available for securing the BA304C to a horizontal or vertical pipe.

BA392C Stainless steel bracket secured by two worm drive hose clips. For 60 to 80mm outside diameter pipes.

BA393 Heavy duty stainless steel bracket secured by a single 'V' bolt. Will clamp to any pipe with an outside diameter between 40 and 80mm.

8.6 Panel mounting kit

The BA394 stainless steel panel mounting kit will secure a BA304C indicator into a panel aperture, but it does not seal the joint between the indicator enclosure and the instrument panel

Appendix 1 Installation in USA

A1.0 Factory Mutual Approval

For installations in the USA the BA304C and all accessories have been approved by Factory Mutual as intrinsically safe for Class I, II and III, Divisions 1 and 2; and nonincendive for Class I, II and III, Division 2.

Installations must comply with the BEKA associates control drawing CI300-22, ANSI/ISA RP12.6 and the National Electrical Code ANSI/NFPA70. The supplied bonding plate must be fitted between the two conduit / cable entries.

All the intrinsically safe circuits shown in this instruction manual may be used for installations in the USA, providing the Zener barriers and galvanic isolators comply with the specified Factory Mutual entity parameters.

A1.1 4/20mA input in intrinsically safe circuit

The BA304C has been evaluated under the entity concept, and may be connected in series with any intrinsically safe circuit having output parameters equal to or less than:

$$\begin{aligned} V_{oc}, V_t &= 32V \\ I_{sc}, I_t &= 200mA \end{aligned}$$

The 4/20mA input terminals have a maximum equivalent capacitance and inductance of:

$$\begin{aligned} C_i &= 0.02\mu F \\ L_i &= 0.01mH \end{aligned}$$

These figures must be subtracted from the maximum permissible cable capacitance and inductance allowed for the Zener barrier or galvanic isolator powering the loop into which the indicator is installed.

See Figs 2 and 3.

A1.2 4/20mA input in nonincendive circuit

The BA304C is Factory Mutual approved as nonincendive for Class I, II and III Division 2 locations, which allows it to be installed in Division 2 without the need for Zener barriers or galvanic isolators. The maximum supply voltage must be less than 32V, and the wiring must be nonincendive or 'Division 2 suitable' as defined in the National Electrical Code ANSI/NFPA70.

A1.3 Classes, Divisions, Gas Groups and Temperature rating

The indicator has been approved by Factory Mutual for installation in all Classes, Divisions and Gas Groups as shown below.

Intrinsic Safety		Nonincendive	
Division 1 or 2		Division 2	
Class I	Group A & B Group C Group D	Class I	Group A & B Group C Group D
Class II	Group E Group F Group G	Class II	Group E Group F Group G
Class III		Class III	

A2.0 Backlight

Both the separately powered and the loop powered backlight may be used.

A2.1 Separately powered backlight

The backlight is segregated from the measuring circuit and has been approved as a separate intrinsically safe circuit under the entity concept. The backlight may be powered from any certified associated apparatus such as a Zener barrier or galvanic isolator having output parameters equal to or less than:

$$\begin{aligned} V_{oc}, V_t &= 32V \\ I_{sc}, I_t &= 159mA \end{aligned}$$

The backlight terminals have a maximum equivalent capacitance and inductance of:

$$\begin{aligned} C_i &= 0.03\mu F \\ L_i &= 0.01mH \end{aligned}$$

These figures must be subtracted from the maximum permissible cable capacitance and inductance allowed for the Zener barrier or galvanic isolator powering the backlight. Segregation between the backlight and the measuring circuits should be maintained by following the wiring methods recommended in ANSI/NFPA70 article 504.

See Fig 8

A2.2 Loop powered backlight

The backlight is segregated from the measuring circuit and has been approved as a separate intrinsically safe circuit under the entity concept. As shown in Fig 9 the backlight may be connected in series with the BA304C indicator and powered from any certified associated apparatus such as a Zener barrier or galvanic isolator having output parameters equal to or less than:

$$\begin{array}{lcl} V_{oc}, V_t & = & 32V \\ I_{sc}, I_t & = & 200mA \end{array}$$

The backlight & indicator terminals have a combined maximum equivalent capacitance and inductance of:

$$\begin{array}{lcl} C_i & = & 0.05\mu F \\ L_i & = & 0.02mH \end{array}$$

These figures must be subtracted from the maximum permissible cable capacitance and inductance allowed for the Zener barrier or galvanic isolator powering the backlight.

A2.3 Nonincendive applications

For nonincendive applications the separately powered backlight may be connected to a dc supply between 18 and 30V without the need for a Zener barrier or a galvanic isolator. The wiring must be nonincendive or "Division 2 suitable" as defined in the National Electrical Code ANSI/NFPA70.

Similarly the loop powered backlight may be connected in series with the 4/20mA measurement loop without the need for a Zener barrier or galvanic isolator - see A1.2

