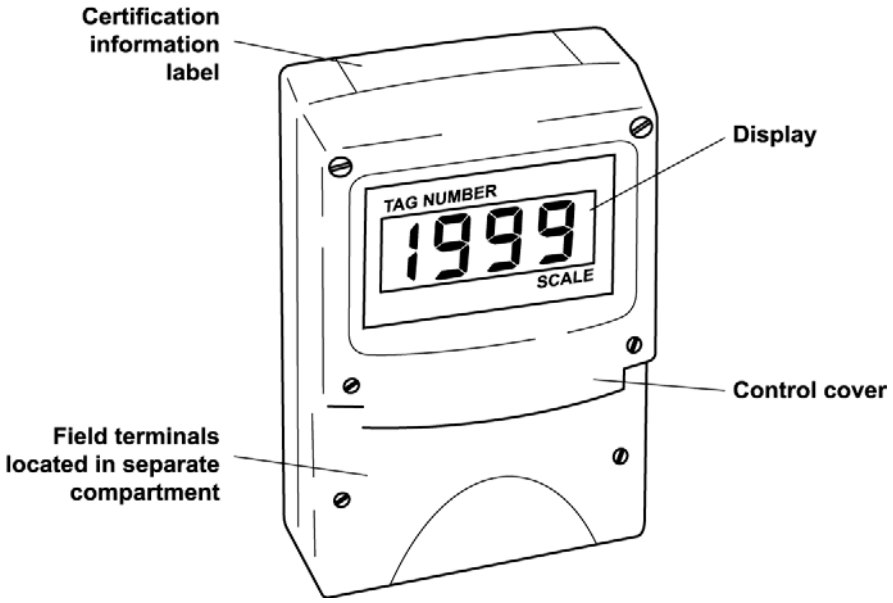
BA304D
Intrinsically safe loop-powered 3½ digit field mounting indicator

issue 13



Issue: 13
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The BA304D is CE marked to show compliance with the European Explosive Atmospheres Directive 94/9/EC and the European EMC Directive 2004/108/EC

1. DESCRIPTION

The BA304D 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 are required.

The BA304D is a third generation instrument incorporating a separate terminal enclosure. Complying with the European Explosive Atmospheres Directive ATEX, the instrument has been certified intrinsically safe for use in explosive gas and combustible dust atmospheres. ATEX dust certification is an option - See Appendix 2.

For installations in the USA and Canada, FM and cFM intrinsic safety and nonincendive certification are also available. See Appendix 1.

All versions have IECEx certification.

The main application of the BA304D 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 BA304D 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 input terminals 1 and 3 will not exceed those specified for *simple apparatus* in Clause 5.4 of EN50020:1994.

The indicator is housed in a robust IP66 glass reinforced polyester (GRP) enclosure with an armoured glass window.

2. OPERATION

Fig 1 shows a simplified block diagram of a BA304D. 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.

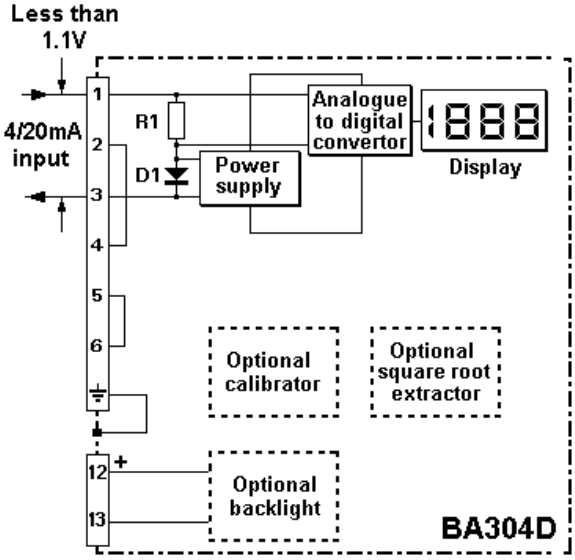


Fig 1 Simplified block diagram of BA304D

3. INTRINSIC SAFETY CERTIFICATION

3.1 ATEX certificate

The BA304D has been issued with an EC-Type Examination Certificate number ITS99ATEX2001 by ITS Testing and Certification Ltd (formerly ERA Technology Ltd) showing compliance with the European ATEX Directive 94/9/EC for Group II, Category 1, gas and dust atmospheres, EEx ia IIC. 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. ATEX certificates are also acceptable for installations in Switzerland.

This manual describes installations in gas atmospheres which conform with BS EN60079:Part 14:2003 Electrical Installation in Hazardous Areas. When designing systems for installation outside the UK, the local Code of Practice should be consulted.

For use in the presence of combustible dust, please refer to Appendix 2 which describes installations complying with EN 61242 -14. Dust certification is an option, which must be specified when the instrument is ordered.

3.2 4/20mA input

In Europe, sources of energy which do not generate more than 1.5V; 100mA, and 25mW are, for intrinsic safety purposes, considered to be *simple apparatus* (Clause 5.4 of EN50 020:1994).

Although the BA304D 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* in Clause 5.4 of EN50020:1994. This allows the BA304D 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:

Uo	=	30V dc
Io	=	200mA
Po	=	0.85W

For this reason the BA304D indicator has only 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. Note: The optional display backlight does have a system certificate.

The BA304D EC-Type Examination Certificate specifies the maximum equivalent capacitance and inductance between the two 4/20mA input terminals is:

Ci	=	20nF
Li	=	10µH

To determine the maximum permissible cable parameters these figures must be subtracted from the maximum cable capacitance and inductance permitted by the system certificate of the loop into which the BA304D is installed.

3.3 Zones, gas groups and T rating

The BA304D has been certified for Group II, Category 1, G, EEx ia IIC T5 Tamb -40 to 60^{o}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

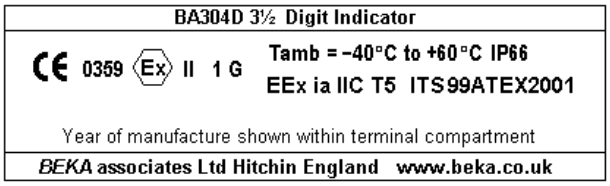
Having a temperature classification of:

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

This allows the BA304D indicators to be installed in all Zones and to be used with most common industrial gases.

3.4 Certification Label Information

The certification label is fitted in a recess 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 inside the terminal compartment.



4. SYSTEM DESIGN FOR HAZARDOUS AREAS

4.1 Transmitter loops

A BA304D 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:

Uo	=	30V dc
Io	=	200mA
Po	=	0.85W

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 BA304D indicator is connected in series with a 2-wire transmitter protected by a Zener barrier.

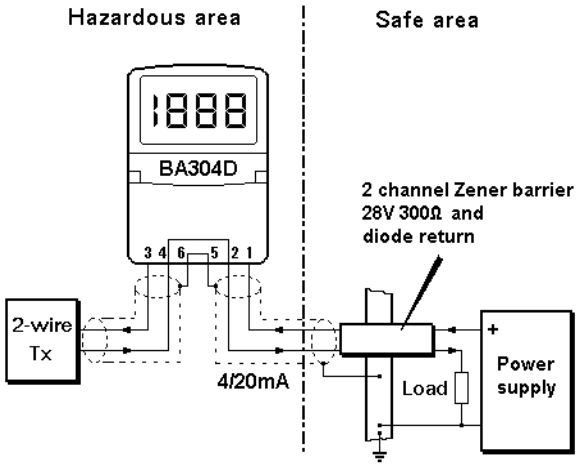


Fig 2 BA304D in a transmitter loop

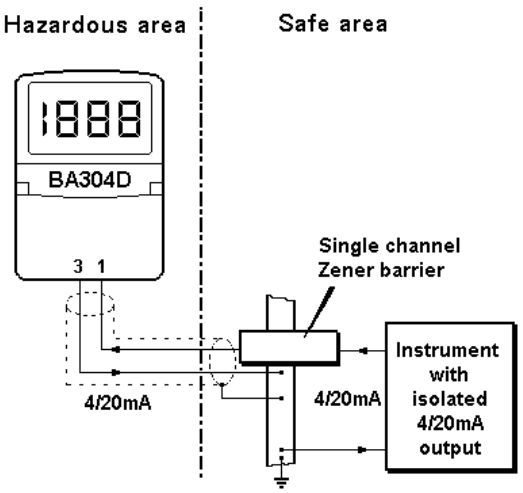


Fig 3A Simplest circuit with one side of 4/20mA current loop connected to earth

4.2 Remote indication

A BA304D 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:

Uo	less than	30Vdc
Io	less than	200mA
Po	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.

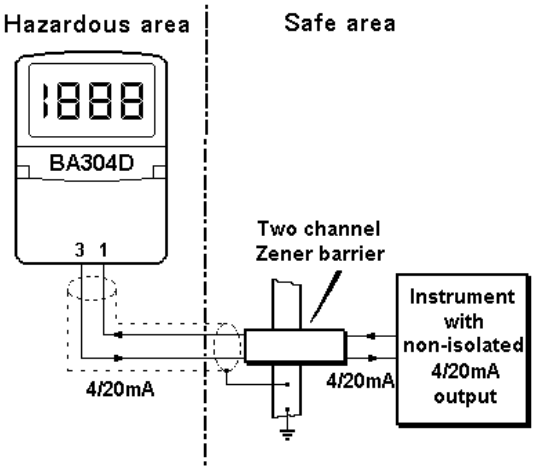


Fig 3B Two Zener barrier channels are required if the 4/20mA current loop can not be earthed at the barrier busbar.

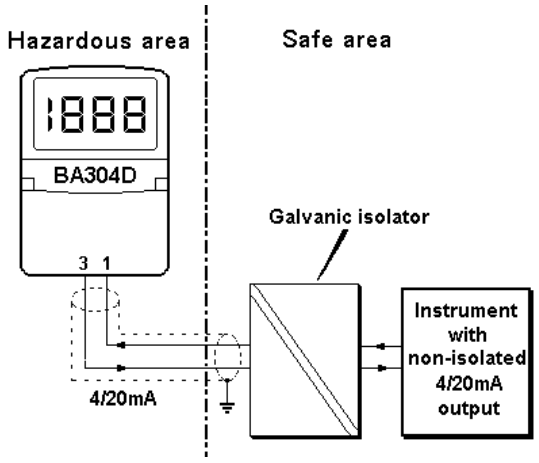


Fig 3C Galvanic isolator can be used with any 4/20mA current loop.

5. INSTALLATION

5.1 Location

The BA304D indicator is housed in a robust IP66 glass reinforced polyester (GRP) enclosure incorporating an armoured glass window and stainless steel fittings making it suitable for exterior mounting in most industrial applications, including offshore and waste water treatment. Please consult BEKA associates if high vibration is anticipated.

The BA304D is surface mounting, but may be pipe or stem mounted using the accessory kits described in section 8 of this manual.

The field terminals and the two mounting holes are located in a separate compartment with a sealed cover allowing the instrument to be installed without exposing the display assembly or controls. 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. The BA304D earth terminal is connected to the internal EMC filters. For maximum radio frequency interference rejection this terminal should be connected to a local earth, or to a cable screen which is earthed in the safe area. To prevent circulating currents, cable screens should only be earthed in the safe area.

The BA304D enclosure is fitted with a bonding plate to ensure electrical continuity between the three conduit / cable entries.

5.2 Installation Procedure

Fig 4 illustrates the instrument installation procedure.

a. Remove the instrument terminal cover by unscrewing the two captive 'A' screws.

b. Mount the instrument on a flat surface and secure with screws or bolts through the two 'B' holes. Alternatively use one of the pipe or stem mounting kits described in sections 8.5 and 8.6

c. Remove the temporary hole plug and install cable gland or conduit entry with required ingress protection. If more than one entry is required, replace one or both IP66 stopping plugs with a cable gland or conduit entry having the required ingress protection.

d. Connect the field wiring to the terminals as shown in Fig 5.

e. Replace the instrument terminal cover and tighten the two 'A' screws.

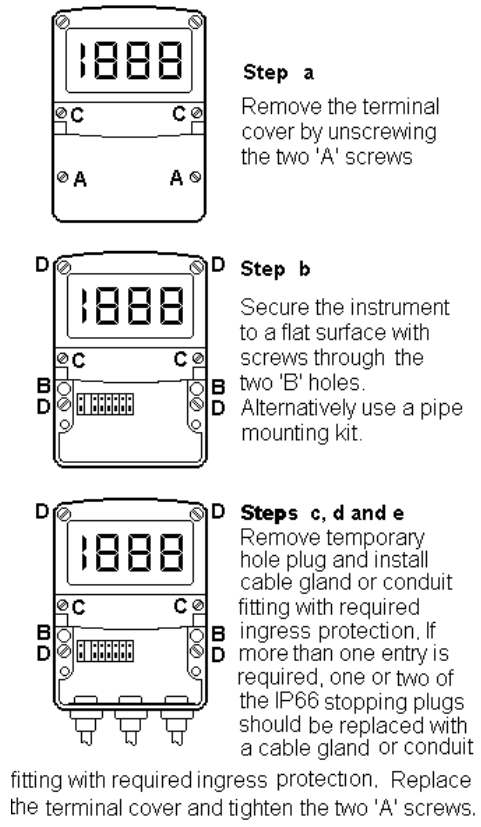


Fig 4 BA304D installation procedure

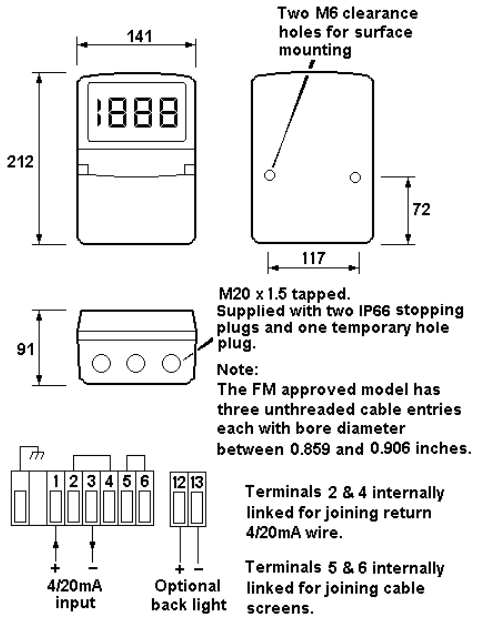


Fig 5 Dimensions and terminal connections

5.3 EMC

The BA304D complies with the requirements of the European EMC Directive 2004/108/EC. For specified immunity all 4/20mA wiring should be in screened twisted pairs, with the screen earthed within the safe area.

6. CALIBRATION

The BA304D 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 BA304D is conditioned and calibrated by plug-in links and two multi-turn potentiometers located behind the instrument control cover which is secured by two 'C' screws - see Fig 4. Removal of this cover does not expose the field terminals or the display assembly. 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 optional 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

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.

Position of span links	Instrument span 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 BA304D display increases as the input current increases, but this can be reversed. Please contact BEKA associates for details.

6.5 Calibration example

The BA304D 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 BA304D 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 between the two least significant digits, 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.

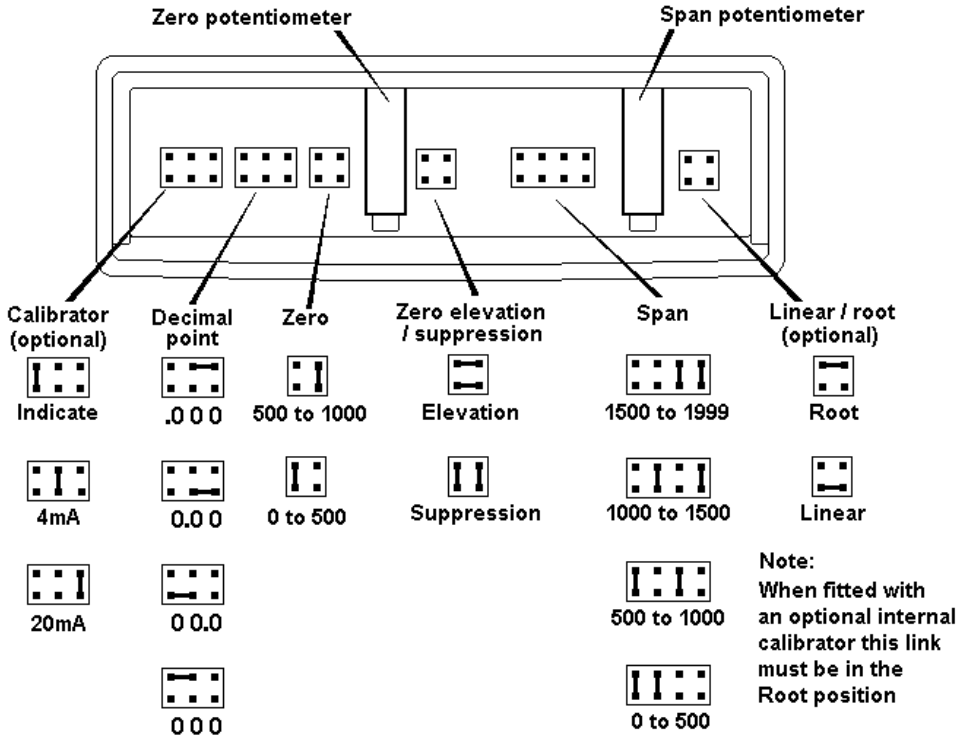


Fig 6 Position of plug-in links and potentiometers shown with the control cover removed

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 BA304D will produce accurate readings outside the 4/20mA current range. Although not guaranteed, most BA304D indicators will operate between 3 and 25mA.

7. MAINTENANCE

7.1 Fault finding during commissioning

If the BA304D 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 and no volts 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 BA304D.	Check supply voltage and voltage drops caused by all components in the loop.
BA304D displays 1	Positive over-range	The BA304D has been incorrectly calibrated & is trying to display a number greater than 1999.
BA304D displays -1	Negative over-range	The BA304D 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 BA304D fails after it has been functioning correctly, the following table may help to identify the cause of the failure.

Symptom	Cause	Solution
No display and no volts between terminals 1 and 3	No power supply	Check that a current is flowing in the loop.
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 instrument is replaced. Alternatively the electronic display assembly may be exchanged as described in section 7.3

7.3 Servicing

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

Electronic components must not be replaced or repaired on site.

To simplify servicing all BA304D indicators use a common display assembly. Depending upon the accessories fitted, one spare display assembly may be used to replace any BA304D which fails. The exchange may be made without disconnecting the 4/20mA loop which will continue to function, but the indicator voltage drop will increase from 1V to 4V without the display assembly.

To exchange the indicator assembly remove the terminal cover by unscrewing the two 'A' screws which will reveal two concealed 'D' screws - see Fig 4. Unscrew all four 'D' screws and carefully lift off the instrument front. The instrument assembly is secured by three Pozi headed screws which should be removed. If the instrument is fitted with a backlight the fly-lead connecting it to the terminals must be unplugged. The replacement display assembly may then be installed and the enclosure reassembled.

If after replacement of the display 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 be replaced on site providing instruments with a backlight are fitted with a replacement board including terminals 12 and 13.

7.4 Routine maintenance

The mechanical condition of the instrument and 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 our local 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 Units of measurement and instrument identification

All BA304D indicators are fitted with a blank label around the liquid crystal display. This label can be supplied printed with any units of measurement and tag information specified at the time of ordering. Alternatively the information may be added on-site via an embossed strip, dry transfer or even a permanent marker.

To gain access to the display label remove the terminal cover by unscrewing the two 'A' screws which will reveal two concealed 'D' screws. Unscrew the four 'D' screws and carefully lift off the front of the instrument enclosure - see Fig 4. Add the required legend to the display label, or replace with a new pre-printed label which is available from BEKA associates.

The BA304D can also be supplied with a blank or custom engraved stainless steel plate secured by two screws to the side of the instrument enclosure. This 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 BA304D 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 which is located behind the instrument control cover.

The plug-in root / linear link shown in Fig 6 must always be in the root position when an internal calibrator is fitted. An internal calibrator can not be fitted to an instrument with a root extractor.

When using an internal calibrator, the following procedure should be followed at any input current between 4 and 20mA.

Step 1 Put the suppression / elevation, zero, span and decimal point links in the required position. Ensure that the root / linear link is in the root 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 BA304D 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, alternatively 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.

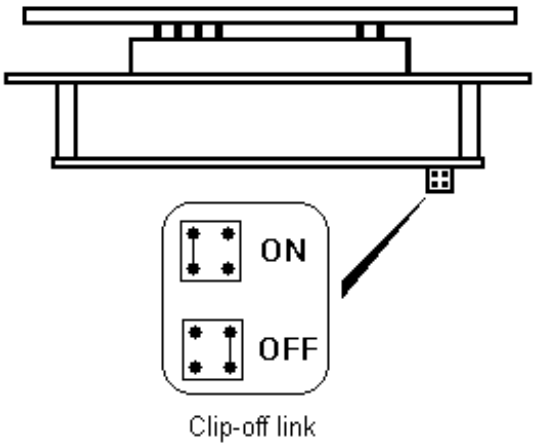


Fig 7 Location of root extractor clip-off link

When calibrating a BA304D fitted with a root extractor 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 BA304D 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 two least 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 repeat step 5.

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 BA304D 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:

Uo = 28V dc
Io = 159mA
Po = 0.8W

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

Ci = 40nF
Li = 20µH

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.

For guidance, System Certificates ITS No Ex99E2006 and 2007 have been issued which list some of the devices that may be used.

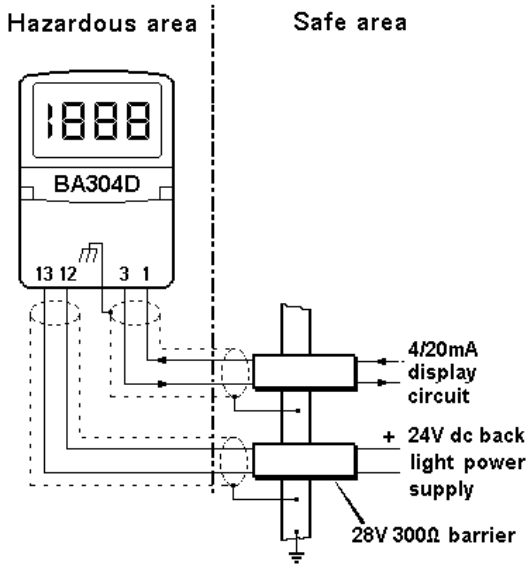


Fig 8 Separately powered backlight

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.

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

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 BA304D 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 BA304D 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:

Uo	=	30V dc
Io	=	200mA
Po	=	0.85W

For guidance, ITS System Certificates Ex02E2031 and 2032 have been issued which list some of the devices that may be used and define cable parameters.

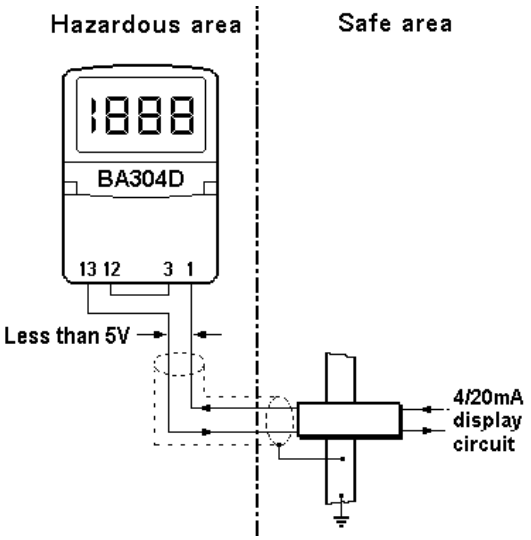


Fig 9 Loop-powered backlight

Connecting the backlight in series with the indicator increases 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 BA304D to a horizontal or vertical pipe. Detailed assembly instructions are supplied with each kit.

BA392D Stainless steel bracket secured by two worm drive hose clips. Will clamp to any pipe with outside diameter between 60 and 80mm.

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.

Appendix 1
FM approval for use in USA and cFM Approval for use in Canada

A1.0 Factory Mutual Approval

For installations in the USA and Canada, the BA304D and all accessories have FM and cFM intrinsic safety, Class I, II and III, Divisions 1 and 2; Class I, Zone 0 approval. They also have FM and cFM nonincendive approval for Class I, II and III, Division 2 and Class I, Zone 2 installations.

US installations must comply with the BEKA associates Control Drawing CI300-27, ANSI/ISA RP12.6 and the National Electrical Code ANSI/NFPA70.

Canadian installations must comply with the BEKA associates Control Drawing CI300-27 and the Canadian Electrical Code C22.2

All the intrinsically safe circuits shown in this instruction manual may be used for installations in the USA and Canada, providing the Zener barriers and galvanic isolators have the appropriate approval and specified entity parameters.

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

The BA304D 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:

Voc, Vt	=	32V
Isc, It	=	200mA
Po	=	1.2W

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

Ci	=	0.02µF
Li	=	0.01mH

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 BA304D is Factory Mutual approved as nonincendive for Class I, II and III Division 2 locations, which allows both indicators 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'.

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

The BA304D has a T4 temperature rating at a maximum ambient temperature of 60°C. It has been approved by FM for installation in the following Divisions and Gas Groups.

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, F & G	Class II Groups F & G
Class III	Class III
Zone 0, 1 or 2 Class 1 Group IIC Group IIB Group IIA	Zone 2 Class I Group IIC Group IIB Group IIA

A1.4 Nonincendive applications

For nonincendive applications a Zener barrier or galvanic isolator is not required. The wiring must be nonincendive or 'Division 2 suitable'.

A2.0 Display backlights

The FM approval allows the BA304D to 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 from 1 to 5V. Alternatively, the separately powered backlight has a bright orange output which enhances daylight viewing, but an additional IS interface and field wiring are required.

A2.1 Seperately powered backlight
The separately powered 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 FM certified associated apparatus such as a Zener barrier or galvanic isolator having output parameters equal to or less than:

Voc, Vt	=	32V
Isc, It	=	159mA
Po	=	1.2W

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

Ci	=	0.03µF
Li	=	0.01mH

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 Nonincendive applications
For nonincendive applications a Zener barrier or galvanic isolator is not required. The backlight may be powered directly from a dc supply providing the voltage does not exceed 32V. The wiring must be nonincendive or 'Division 2 suitable'.

A2.3 Loop powered backlight
This backlight is connected in series with the 4/20mA measuring circuit so that like the BA324D indicator it is powered by the 4/20mA signal. This eliminates the need for a separate Zener barrier or galvanic isolator and associated wiring for the backlight, thus significantly reducing the installation costs, but it increases the total voltage drop in the 4/20mA loop from 1.1V to 5.0V

See Fig 9.

Any FM certified Zener barrier or galvanic isolator may be used, providing the output parameters do not exceed:

Voc, Vt	=	32V dc
Isc, It	=	200mA
Po	=	1.2W

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

Ci	=	0.05µF
Li	=	0.02mH

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

A3.4 Nonincendive applications
For nonincendive installations no barrier or isolator is required, but the maximum supply voltage to the combined indicator and backlight must be less than 32V. Wiring must be nonincendive or 'Division 2 suitable'.

Appendix 2
ATEX dust certification

A2.0 ATEX dust certification

In addition to ATEX certification permitting installation in explosive gas atmospheres which is described in the main section of this instruction manual, the BA304D is available ATEX certified for use in the presence of combustible dusts. If ATEX dust certification is required it must be specified when the BA304D indicator is purchased.

WARNING

Before installing a BA304D indicator in the presence of a combustible dust, ensure that the certification information label which is located on the top of the instrument specifies dust certification - see section A2.2

A2.1 Zones and Maximum Surface Temperature

The BA304D has been ATEX certified as Group II, Category 1 GD apparatus Tamb = -20 to 60°C, with a Maximum Surface Temperature of 80°C. When installed as specified by EN 61241-14 'Selection, installation and maintenance of electrical apparatus protected by enclosures', the indicator may be installed in:

Zone 20 explosive atmosphere in the form of a cloud of combustible dust in air is continuously present, or for long periods or frequently.

Zone 21 explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur occasionally in normal operation.

Zone 22 explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation, but if it does occur, will only persist for a short period.

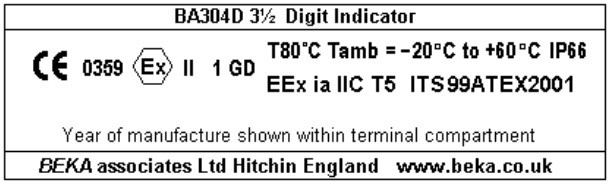
Be used with dusts having a Minimum Ignition Temperature of:

Dust cloud	120°C
Dust layer on BA304D up to 5mm thick	155°C
Dust layer on BA304D over 5mm thick.	Refer to EN 61241-14

At an ambient temperature between -20 and +60°C

A2.2 Certification Label Information

The certification label is fitted in a recess on the top outer surface of the enclosure. It shows the ATEX dust certification information including the maximum surface temperature and ingress protection, plus the ATEX gas certification information. Non European information may also be shown.



The instrument serial number and date of manufacture are recorded on a separate label inside the terminal compartment.

A2.3 Calibration & maintenance

The ATEX dust certification relies on the indicator enclosure being dust-tight. Therefore the control and terminal covers should only be removed when dust can not enter the instrument enclosure. Before replacing the control and terminal covers ensure that the sealing gaskets are undamaged and are free from foreign bodies.

Appendix 3
IECEx Certification

A3.0 The IECEx Certification Scheme

IECEx is a global certification scheme for explosion protected products which aims to harmonise international certification standards.

For additional information about the IECEx certification scheme and to view the BEKA associate certificates, please visit www.iecex.com

A3.1 IECEx Certificate of Conformity

The BA304D loop powered indicator has been issued with an IECEx Certificate of Conformity number IECEx ITS 05.0004 which specifies the following certification codes and marking:

For gas	Ex ia IIC T5 Ta = -40°C to 60°C
For gas & dust	Ex ia IIC T5 DIP A21 TA 80°C IP66 Ta = -20°C to 60°C

The specified intrinsic safety parameters are identical to the ATEX parameters.

The IECEx certificate may be downloaded from www.beka.co.uk, www.iecex.com or requested from the BEKA sales office.

A3.2 Versions of the BA304D

All versions of the BA304D Fieldbus Display have IECEx certification. This includes:

ATEX version for use in gas atmospheres.

IECEx code Ex ia IIC T5
Ta = -40°C to 60°C

ATEX version for use in gas and dust atmospheres.

IECEx code Ex ia IIC T5
DIP A21 TA 80°C IP66
Ta = -20°C to 60°C

Factory Mutual Approved version

IECEx code Ex ia IIC T5
Ta = -40°C to 60°C

A3.3 Installation

As the IECEx and ATEX certifications specify identical safety parameters and installation requirements for both are defined by IEC 60079-14, the ATEX installation requirements specified in this manual may also be used for IECEx installations in gas atmospheres. The local code of practice should also be consulted.