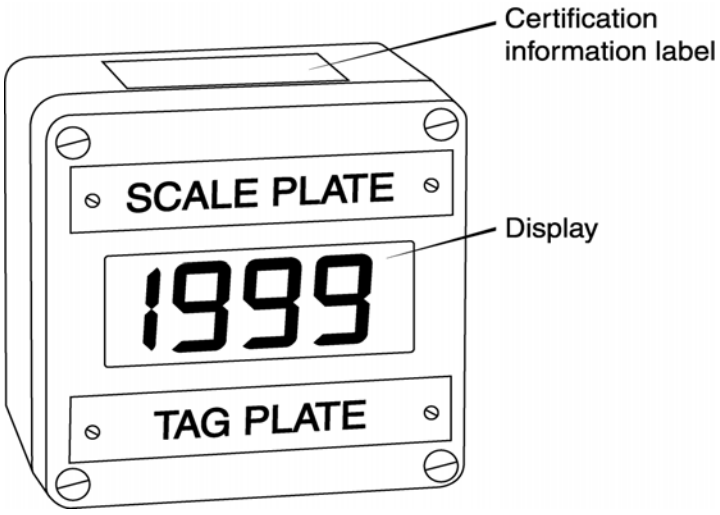
BA304NC
Type nL
Loop-powered
3½ digit field mounting indicator

issue 5



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The BA304NC 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 BA304NC is an Ex nL certified loop powered digital indicator which displays the current flowing in a 4/20mA loop in engineering units. The instrument 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 BA304NC is to display a measured variable or control signal in a Zone 2 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 BA304NC complies with the European ATEX Directive for Group II Category 3G equipment and has been issued with an EC Declaration of Conformity.

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 BA304NC. 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.

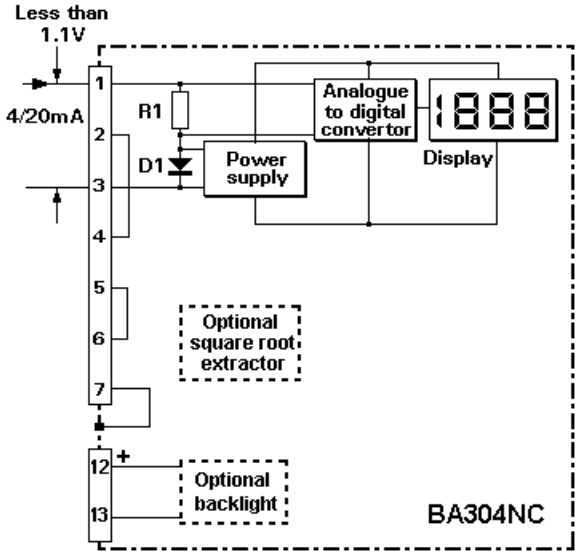

Fig 1 Simplified block diagram of BA304NC

3. TYPE 'nL' CERTIFICATION

3.1 ATEX certificate

The BA304NC complies with the European ATEX Directive 94/9/EC for Group II, Category 3G equipment. It has been assessed using the 'Internal Control of Production' procedure specified in Annex 8 of the Directive. A technical dossier has been prepared and an EC Declaration of Conformity BEKA03ATEX0015 has been issued.

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 instruction 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 Zones, Gas Groups and T rating

The BA304NC has been certified as Group II, Category 3G apparatus as defined in the ATEC Directive and as Ex nL IIC T5 Tamb -40 to 60°C.

'L' indicates that the BA304NC uses an energy-limiting technique to achieve compliance as defined in EN 60079-15. This technique is based on the philosophy of *intrinsic safety* which limits the current and voltage applied to components which may generate a spark in normal operation. e.g. switches and potentiometers

These approvals confirm that the BA304NC is safe in normal operation and may be:

Installed in a Zone 2 hazardous area

At ambient temperatures between -40 to 60°C.

Used in gase groups:

Group	A	propane
Group	B	ethylene
Group	C	hydrogen

Having a temperature classification of:

T1	450ºC
T2	300ºC
T3	200ºC
T4	135ºC
T5	100ºC

Although certified safe in normal operation at ambient temperatures between –40 and +60ºC, the guaranteed operating temperature range of the BA304NC is –20 to +60ºC.

This allows the BA304NC indicator to be installed in a Zone 2 low risk hazardous area and to be used with most common industrial gases.

3.3 Input parameters

Input terminals 1 and 3 may be safely connected in series with any 4/20mA loop providing that in normal operation the input current to the indicator does not exceed 40mA.

3.4 Certification Label Information

The certification information label is fitted on the top outer surface of the enclosure. It shows the ATEX certification information plus BEKA associates name and location.

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

4. SYSTEM DESIGN FOR ZONE 2

4.1 Transmitter loops

A BA304NC indicator may be connected in series with almost any 4/20mA current loop and calibrated to display the measured variable or control signal in engineering units.

Fig 2 illustrates a typical application in which a BA304NC indicator is connected in series with a 2-wire transmitter and controller.

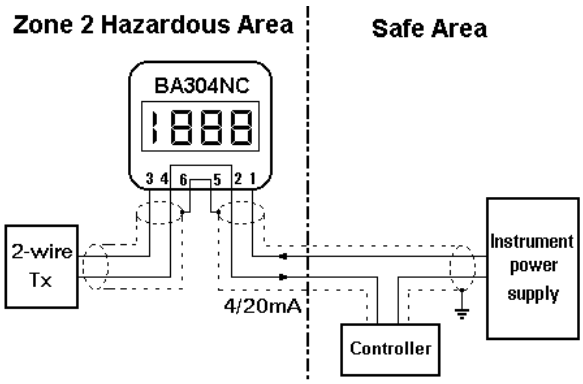

Fig 2 BA304NC in a transmitter loop

There are four basic design requirements:

1. In normal operation the voltage, current and power applied to the terminals 1 and 3 of the BA304NC must not exceed:

Ui	=	4V
Ii	=	40mA dc
Pi	=	0.2W

   Providing the maximum input current in normal operation is less than 40mA, the maximum voltage between the indicator terminals and the maximum input power to the indicator will be automatically limited to less than the above figures by the internal safety components.

2. Apparatus in safe area must not be supplied from nor contain under normal conditions a source of potential with respect to earth in excess of 250V rms or 250V dc.

3. Both M20 entries must be fitted with an Ex e or Ex n certified cable gland or blanking plug.

4. The 4/20mA loop must be able to tolerate the additional 1.1V required to operate the indicator.

CAUTION !

The enclosure cover should only be removed when the measuring loop is not energised, or when there is no risk of a flammable atmosphere being present and dust or water can not enter the enclosure. Before replacing the enclosure cover ensure that the sealing gasket is undamaged and that it is free from dirt and foreign bodies.

In practice it is only necessary to ensure that in normal operation the maximum current flowing in the 4/20mA loop is less than 40mA. Fig 2 shows a temperature measuring loop in which the maximum current in normal operation is defined by the maximum output from the Type n transmitter.

The sum of the maximum voltage drops of all the components in the loop must be less than the minimum power supply voltage. Considering the example shown in Fig 2.

Minimum operating voltage of 2-wire Tx	10.0
Maximum voltage drop caused by controller	5.0
Maximum voltage drop caused by BA304NC	1.1
Maximum voltage drop caused by cables	0.4
	16.5V

Therefore at 20mA the power supply in this example must have an output greater than 16.5V

4.2 Remote indication

A BA304NC indicator may be driven from a 4/20mA safe area signal to provide a remote indication within a Zone 2 hazardous area. Fig 3 shows a typical application in which the output from a gas analyser drives a BA304NC. Again it is necessary to ensure that the loop complies with the three design requirements listed in section 4.1.

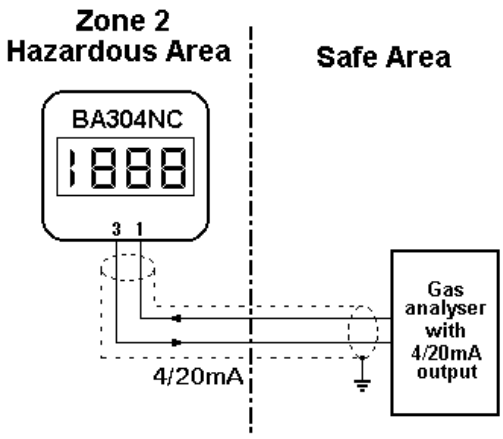

Fig 3 Remote indication

5. INSTALLATION

5.1 Location

The BA304NC indicator can be supplied in either a glass reinforced polyester (GRP), or an epoxy painted aluminium enclosure. Both provide IP66 protection and have a polycarbonate 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.

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

b. Remove the indicator assembly from the enclosure by unscrewing the three captive 'B' screws.

c. 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 8.4 and 8.5

d. Remove the temporary dust seals from the two cable entries and install Ex e or Ex n certified glands, conduit fittings or blanking plugs.

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

f. Replace the indicator assembly and evenly tighten the three 'B' screws.

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

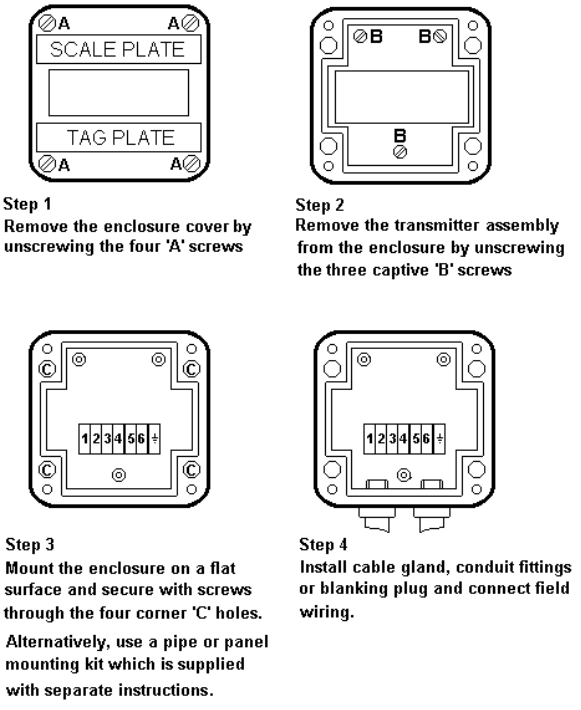

Fig 4 BA304NC installation procedure

5.3 EMC

The BA304NC complies with the requirements of the European EMC Directive 89/336/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.

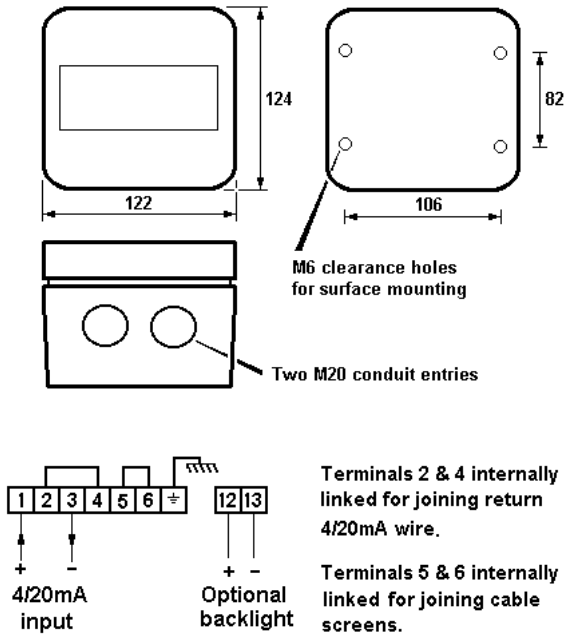

Fig 5 Dimensions and terminal connections

6. CALIBRATION

The BA304NC 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 BA304NC 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.

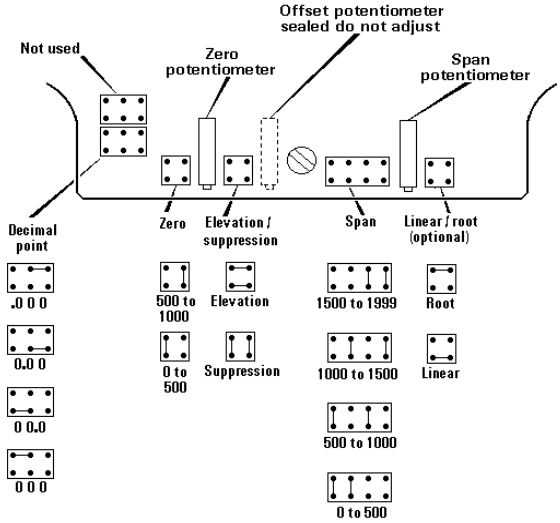

Fig 6 Location of calibration links and potentiometers

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	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 dummy 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 BA304NC display increases as the input current increases, but this can be reversed. Please contact BEKA associates for details.

6.5 Calibration example

The BA304NC 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 BA304NC 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 BA304NC will produce accurate readings outside the 4/20mA current range. Although not guaranteed, most BA304NC indicators will operate between 3 and 25mA.

7. MAINTENANCE

7.1 Fault finding during commissioning

If the BA304NC 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 BA304NC.	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.
BA304NC displays 1	Positive over-range	The BA304NC has been incorrectly calibrated & is trying to display a number greater than 1999.
BA304NC displays -1	Negative over-range	The BA304NC 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

CAUTION!

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance should only be performed when there is no risk of a flammable atmosphere being present, and dust or water can not enter the enclosure. Before replacing enclosure cover ensure that the sealing gasket is undamaged and free from dirt and foreign bodies.

If a BA304NC 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

CAUTION!

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance should only be performed when there is no risk of a flammable atmosphere being present, and dust or water can not enter the enclosure. Before replacing enclosure cover ensure that the sealing gasket is undamaged and free from dirt and foreign bodies.

To simplify servicing, all ATEX certified BA304NC indicators use a common indicator assembly which may be replaced on site. All ATEX certified BA304NC 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 BA304NC indicator assembly must not be replaced by a non ATEX certified BA304NC assembly. The product code label on all ATEX certified indicator assemblies carry the legend ‘ATEX’.

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 BA304NC 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 engraved 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 Root extractor

The BA304NC 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 root extractor 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.

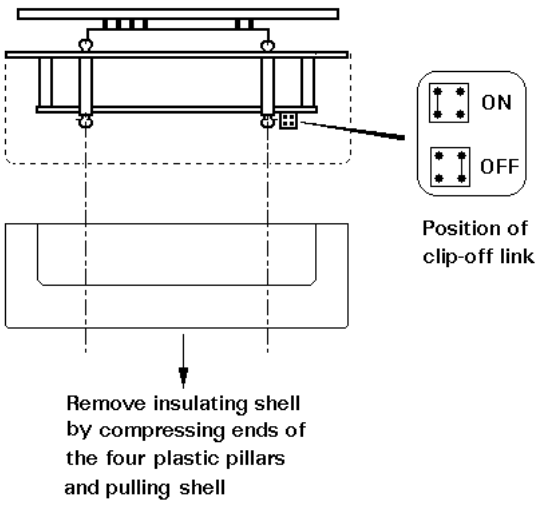

Fig 7 Location root extractor clip-off link

When calibrating a root extracting BA304NC 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

8.2.1 Calibration example with root extractor

The BA304NC 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.

8.3 Display backlight

The BA304NC can be supplied with LED backlighting to improve display contrast in poorly illuminated areas. This backlight is electrically segregated from the measuring circuit and has been certified as a separate Ex nL Group II, Category 3G circuit.

The Type n input safety parameters ae:

Ui	=	30V dc
Ii	=	100mA
Pi	=	1.3W

This allows the backlight to be powered from a safe area 18 to 30V dc supply as shown in Fig 8. Providing the supply voltage is less than 30V dc in normal operation the backlight safety components will ensure that the maximum input current and power are within the safety limits.

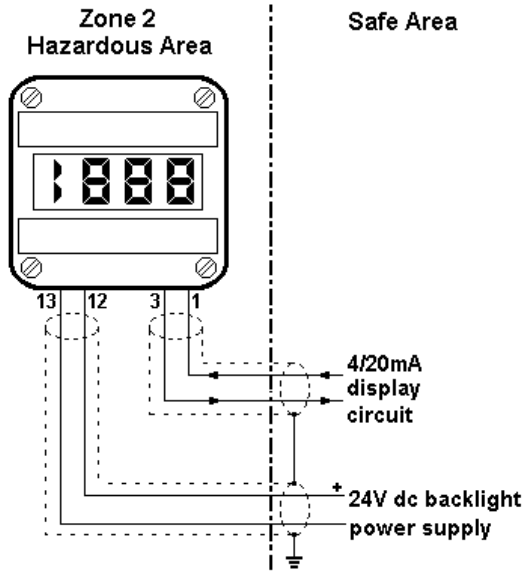

Fig 8 Separately powered backlight

Reducing the supply voltage below 18V will reduce the backlight brilliance.

8.4 Pipe mounting kits

Two pipe mounting kits are available for securing the BA304NC 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.

8.5 Panel mounting kit

The BA394 stainless steel panel mounting kit will secure a BA304NC indicator into a panel aperture, but it does not seal the joint between the indicator enclosure and the instrument panel.