

# Application Guide

**AG300** Issue 15

Hazardous Area  
Zones 0, 1 and 2

Safe Area

BA300G & E Series  
intrinsically safe 4/20mA  
loop powered indicators

**BEKA**  
**associates**

## Contents

- 1. Introduction**
- 2. Description**
- 3. Intrinsic safety certifications**
  - 3.1 IECEx certification
  - 3.2 ATEX certification
  - 3.3 US and Canadian certification
- 4. Description of ATEX & IECEx gas certification**
  - 4.1 Certification label
  - 4.2 Zones, gas groups and T rating
  - 4.3 4/20mA input
  - 4.4 Optional display backlighting
    - 4.4.1 Loop powering
    - 4.4.2 Separately powering
  - 4.5 Optional alarms
- 5. Description of ATEX & IECEx dust certification**
  - 5.1 Certification label
  - 5.2 Zones, dust groups and surface temperature
- 6. Description of North American certification**
  - 6.1 FM certification of BA304E and BA324E
  - 6.2 FM certification of BA307E, BA308E, BA327E and BA328E
  - 6.3 ETL and cETL certification of BA304G & BA324G
- 7. Hazardous areas applications**
  - 7.1 4/20mA loop design
  - 7.2 Remote indication
  - 7.3 Display backlight
    - 7.3.1 Loop powering the backlight
    - 7.3.2 Separately powering the backlight
  - 7.4 Optional Alarms
- 8. Special functions**
  - 8.1 Square root extractor
  - 8.2 Lineariser
  - 8.3 Tare
- 9. Rugged panel indicator application**
  - 9.1 BA307E-SS and BA327E-SS
    - 9.1.1 Installation in an Ex e panel enclosure
    - 9.1.2 Installation in an Ex p panel enclosure
    - 9.1.3 Ex pxb panel enclosure
    - 9.1.4 Ex pzc panel enclosure
    - 9.1.5 Ex pyb panel enclosure
    - 9.1.6 Ex t panel enclosure
    - 9.1.7 Installation in the USA and Canada
  - 9.2 BA304G-SS-PM & BA324G-SS-PM
    - 9.2.1 Installation in an Ex e panel enclosure
    - 9.2.2 Installation in an Ex p panel enclosure
    - 9.2.3 Ex pyb enclosure
    - 9.2.4 Ex pxb enclosure
    - 9.2.5 Ex pzc enclosure
  - 9.3 Installation in an Ex t panel enclosure

## 1. INTRODUCTION

The first BA300 series intrinsically safe loop powered 4/20mA indicator was introduced in 1984, since then the range has been continuously developed through the B, C and D models. This edition of Application Guide AG300 describes the use of the fourth generation intrinsically safe E & G instruments including the rugged stainless steel panel mounting models introduced in 2014 and extended in 2018.

For applications in Zone 2 hazardous areas without the need for an intrinsically safe interface such as a Zener barrier or galvanic isolator, Ex nA certified field and panel mounting models are available. See Application Guide AG310 for details.

The BA500 series duplicates the complete range of field and panel mounting models for safe area applications.

## 2. DESCRIPTION

The BA300G & E series indicators are loop powered by the 4/20mA current they are measuring and do not require an additional power supply. All the models can be calibrated to display the 4/20mA input current in engineering units, they may be used in new installations and are backwards compatible allowing them to replace earlier B, C and D suffix models.

Fig 1 shows a simplified block diagram of a BA300 series indicator. 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 and used to power the analogue to digital converter and the 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. This technique allows all models to drop less than 1.2V in the 4/20mA loop, and enables the two input terminals to comply with the requirements for *simple apparatus*.

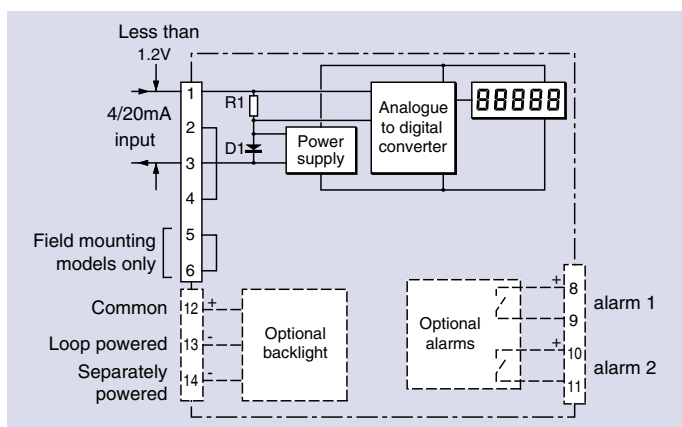


Fig 1 Simplified block diagram of a BA300G or E intrinsically safe indicator.

The features of all the intrinsically safe BA300G & E models are summarised in Tables 1 and 2. Detailed specifications for each model are contained in individual datasheets available from BEKA associates sales department or they may be downloaded from the BEKA web site at [www.beka.co.uk/datasheets.html](http://www.beka.co.uk/datasheets.html).

## 3. INTRINSIC SAFETY CERTIFICATIONS

The BA300G & E series indicators have international intrinsic safety certifications allowing them to be installed in gas and dust hazardous areas worldwide.

### 3.1 IECEx certification

All models have an IECEx Certificate of Conformity issued by Certification Body Intertek Testing and Certification Ltd. IECEx certificates, which are based on international IEC standards, are already acceptable directly or indirectly in large parts of the world.

### 3.2 ATEX certification

Notified Body Intertek Testing and Certification Ltd has issued all models with an EU or EC-Type Examination Certificate confirming compliance with harmonised BS EN standards which have been used to confirm compliance with the European Explosive Atmospheres Directive 2014/34/EU. The instruments carry 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 in Switzerland, Iceland, Liechtenstein, Norway and Turkey. The European Commission's Blue Guide lists the member states, overseas countries and territories that have adopted harmonisation legislation.

British BS EN standards are based on international IEC standards, therefore ATEX and IECEx certificates now use similar terminology and for these indicators are identical.

This guide describes ATEX and IECEx installations which conform with IEC/BS EN 60079-14 *Electrical installations design, selection and erection*. When designing systems for installation outside the UK, the local Code of Practice should always be consulted.

### 3.3 US and Canadian certification

All models except the BA304G-SS-PM & BA324G-SS-PM have certification allowing installation in the USA and Canada which have been issued by two Nationally Recognised Testing Laboratories NRTLs, FM and ETL. For the USA both the traditional NEC500 Class and Division classification, which is acceptable for installation on most North American sites, and the more recent NEC505 Zone classification are included. US NEC505 intrinsic safe equipment is coded AEx and the approval is similar to international IECEx and European ATEX certifications.

Canadian certification also includes both Division and Zone classifications. The Canadian Electrical Code mandates that new installations use Zones, but Class and Divisions are still frequently employed.





Model	BA304E	BA324E	BA304G	BA304G-SS
Shown with optional backlight				
Enclosure material & size	Field GRP 141 x 212mm		Field GRP 122 x 120mm	Field Stainless steel 316 122 x 120mm
Protection	IP66			
Separate terminal compartment	Yes		No	
Number of digits	4	5 and 31 segment bargraph	4	4
Height of digits	34mm	29mm	34mm	34mm
<b>Certification International &amp; Europe</b> IECEX gas	Ex ia IIC T5 Ga -40°C ≤ Ta ≤ +70°C			
dust	Ex ia IIIC T80°C Da IP66 -40°C ≤ Ta ≤ +70°C			
ATEX gas	⊕ II 1G, Ex ia IIC T5 Ga -40°C ≤ Ta ≤ +70°C			
dust	⊕ II 1D, Ex ia IIIC T80°C Da IP66 -40°C ≤ Ta ≤ +70°C			
Additional certification features				
<b>Certification USA &amp; Canada</b>	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G T5 Class III T5 Class I Zone 0 AEx ia IIC T5 -40°C ≤ Ta ≤ +70°C		Class I, Div 1, Gp A, B, C & D T5 Class I, Zone 0, AEx ia IIC T5 Ga (USA only) -40°C ≤ Ta ≤ 70°C  Class II, Div 1, Gp E, F & G. Class III, Div 1 Zone 20 AEx ia IIIC T80°C Da (USA only) -40°C ≤ Ta ≤ 60°C  Ex ia T5 Ga -40°C ≤ Ta ≤ 70°C Ex ia IIIC Da -40°C ≤ Ta ≤ 60°C (Canada only)	
Additional certification features				
Options	<i>Optional items must be specified when indicator is ordered</i>			
Certification IECEX & ATEX dust US and Canadian Backlight Alarms External keypad	Available Available Available Available Available	Available Available Available Available Available	Standard Standard Available Available Standard	Standard Standard Available Available Standard

Table 1 BA300G &amp; E intrinsically safe indicators







Model	BA307E-SS	BA327E-SS	BA304G-SS-PM	BA324G-SS-PM
Shown with optional backlight				
Enclosure material & size	Panel Stainless steel 316 105 x 60mm		Panel Stainless steel 316 122 x 120mm	
Protection	Front impact resistant & IP66 rear IP20			
Separate terminal compartment	No			
Number of digits	4	5 and 31 segment bargraph	4	5 and 31 segment bargraph
Height of digits	15mm	11mm	34mm	29mm
<b>Certification International &amp; Europe</b> IECEX gas	Ex ia IIC T5 Ga -40°C ≤ Ta ≤ +70°C			
dust	Ex ia IIIC T80°C Da IP66 -40°C ≤ Ta ≤ +70°C			
ATEX gas	⊕ II 1G, Ex ia IIC T5 Ga -40°C ≤ Ta ≤ +70°C			
dust	⊕ II 1D, Ex ia IIIC T80°C Da IP66 -40°C ≤ Ta ≤ +70°C			
Additional certification features	Certification permits installation in Ex e, Ex p or Ex t panel enclosure without invalidating the panel enclosure's certification.			
<b>Certification USA &amp; Canada</b>	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G T5 Class III T5 Class I Zone 0 AEx ia IIC T5 -40°C ≤ Ta ≤ +70°C			
Additional certification features	Certification permits installation in AEx e, AEx p or AEx t panel enclosure without invalidating enclosure's certification.			
Options	<i>Optional items must be specified when indicator is ordered</i>			
Certification IECEX & ATEX dust US and Canadian Backlight Alarms External keypad	Standard Standard Available Available Standard	Standard Standard Available Available Standard	Standard N/A Available Available Standard	Standard N/A Available Available Standard

Table 2 Rugged panel mounting indicators

## 4. DESCRIPTION OF ATEX & IECEX GAS CERTIFICATION.

All of the BA300G & E series indicators and accessories have ATEX and IECEx certification. This section describes certification for installation in a gas hazardous area, section 5 describes dust certification.

### 4.1 Certification label

All BA300G & E series indicators are fitted with an external label showing the ATEX and IECEx certification information and numbers. The gas certification information on a BA304E certification label is highlighted in Fig 2.

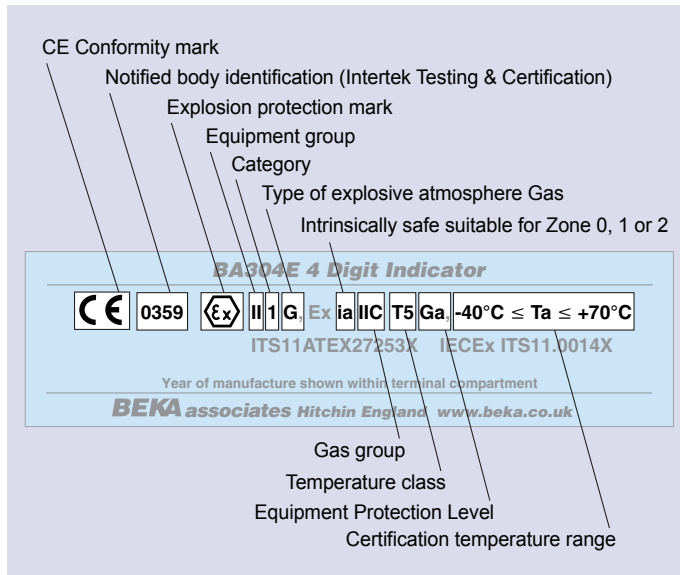


Fig 2 BA304E gas certification label

### 4.2 Zones, gas groups and T rating

All of the BA300G & E series indicators have the following gas certification code:

#### IECEX

Ex ia IIC T5 Ga  
 $-40^{\circ}\text{C} \leq \text{Ta} \leq 70^{\circ}\text{C}$

#### ATEX

Group II Category 1G, Ex ia IIC T5 Ga  
 $-40^{\circ}\text{C} \leq \text{Ta} \leq 70^{\circ}\text{C}$

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

In gases that may safely be used with equipment having a temperature classification of:

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

At an ambient temperature between

$-40^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$

This allows the BA300G & E series indicators to be installed in all Zones and to be used with most common industrial gases at an ambient temperature between  $-40^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$ . Known exceptions (listed in IEC 60079-20-1) being carbon disulphide and ethyl nitrate which have an ignition temperature of  $95^{\circ}\text{C}$ .

**Note 1:** BA300G & E intrinsically safe field mounting indicators in GRP enclosures may be fitted with a label containing aluminium and are therefore subject to the following conditions for safe use indicated by an 'X' suffix on the ATEX and IECEx certification numbers.

***When installed in a Zone 0 potentially explosive atmosphere requiring Equipment Protection Level Ga apparatus, the instrument shall be installed such that even in the event of rare incidents, an ignition source due to impact or friction between the aluminium label and iron/steel is avoided.***

These special conditions for safe use of field mounting BA304G and BA324G GRP indicators are not restrictive as it is very unlikely that an indicator would be installed in Zone 0 where a potentially explosive atmosphere is always present. The requirement does not apply when a GRP indicator is installed in Zone 1 or 2.

The requirement does not apply to BA304G-SS, BA324G-SS, BA304G-SS-PL and BA324G-SS-PM indicators which have stainless steel enclosures and labels.



### 4.3 4/20mA input

Sources of energy that do not generate more than 1.5V, 100mA and 25mW are, for intrinsic safety purposes, considered to be *simple apparatus* (Clause 5.7 of IEC 60079:11). *Simple apparatus* is easier to incorporate into intrinsically safe systems and requires less documentation than other certified intrinsically safe apparatus.

Although the BA300G & E series indicators do not themselves comply with the requirements for *simple apparatus*, the ATEX and IECEx certificates specify that under fault conditions the voltage, current and power output ( $U_o$ ;  $I_o$ ;  $P_o$ ) from the 4/20mA input terminals will not exceed those specified for *simple apparatus*. This allows the output safety parameters of the indicator to be ignored when calculating the intrinsic safety of a loop into which an indicator is inserted.

It is only necessary to establish that the output parameters of the loop are equal to or less than the input parameters of the indicator and that the internal inductance and capacitance of the indicator are acceptable.

The output parameters of the loop which are determined by the intrinsically safe interface powering the loop, be it a Zener barrier, galvanic isolator or associated apparatus should be equal to or less than:

$$\begin{aligned} U_o &\leq 30V \text{ dc} \\ I_o &\leq 200mA \\ P_o &\leq 0.84W \end{aligned}$$

The maximum equivalent capacitance and inductance between the two 4/20mA input terminals 1 and 3 of an indicator are:

		BA300E	BA300G
$C_i$	=	13nF	5.4nF
$L_i$	=	0.02mH	0.02mH

To determine the maximum permissible cable parameters of the loop, these figures, plus  $C_i$  and  $L_i$  for any other instruments in the loop, should be subtracted from the specified  $C_o$  and  $L_o$  for the Zener barrier, galvanic isolator or associated apparatus powering the loop.

Apparatus certificates for intrinsically safe interfaces usually specify  $C_o$  and  $L_o$  for IIC gases (hydrogen), the figures for IIB (ethylene) and IIA (propane) gases are considerably larger.

It is unlikely that the additional inductance of the indicator will be restrictive and can usually be ignored, but the additional indicator capacitance will reduce the maximum permissible cable length.

### 4.4 Optional display backlighting

All BA300G & E series indicators can be supplied with an optional factory fitted green backlight that has three terminals allowing it to be loop or separately powered.

When loop powered, the backlight produces background illumination allowing the indicator display to be read at night and in poor lighting conditions. Loop powering does not require an additional power supply, intrinsically safe interface or field wiring, but the maximum voltage drop in the 4/20mA loop caused by the indicator is increased from 1.2 to 5.0V. Backlight brilliance is constant between 6 and 20mA but slightly diminishes below 6mA.

When separately powered, the backlight produces a brighter background illumination which enhances daylight viewing of the indicator display, but an additional intrinsically safe interface and field wiring are required. The maximum voltage drop of the indicator in the 4/20mA loop remains at 1.2V.

#### 4.4.1 Loop powering

To power the display backlight from the 4/20mA loop, backlight terminals 12 & 13 are connected in series with the 4/20mA indicator input terminals as shown in Fig 6

Both the ATEX and IECEx certificates confirm that terminals 3 & 12 comply with the requirements of *simple apparatus* when the indicator's 4/20mA input terminals 1 & 3 are connected in series with the backlight, terminals 12 & 13. The input intrinsic safety parameters of the combined indicator and loop powered backlight are the same as those for the indicator alone. The indicator and loop powered backlight may therefore be connected in series with any certified intrinsically safe circuit providing the output parameters of the circuit do not exceed:

$$\begin{aligned} U_o &\leq 30V \text{ dc} \\ I_o &\leq 200mA \\ P_o &\leq 0.84W \end{aligned}$$

The maximum equivalent capacitance and inductance between input terminals 3 and 12 are:

		BA300E	BA300G
$C_i$	=	13nF	5.4nF
$L_i$	=	0.02mH	0.02mH

To determine the maximum permissible cable parameters of the loop, these figures, plus  $C_i$  and  $L_i$  of any other instrument in the loop, should be subtracted from the specified  $C_o$  and  $L_o$  for the Zener barrier, galvanic isolator or associated apparatus powering the loop.

The loop powered backlight increases the maximum voltage drop of the BA300G & E series indicators to 5V.



#### 4.4.2 Separately powering

The backlight is segregated from all other circuits within the indicator and has been certified as a separate intrinsically safe circuit. It is powered via terminals 12 and 14 which may be connected to any intrinsically safe power supply such as a certified Zener barrier or galvanic isolator having output parameters equal to or less than:

$$\begin{aligned} U_o &\leq 30\text{V dc} \\ I_o &\leq 200\text{mA} \\ P_o &\leq 0.84\text{W} \end{aligned}$$

The ATEX and IECEx certificates specify that the maximum equivalent capacitance and inductance between the backlight terminals is:

		BA300E	BA300G
C <sub>i</sub>	=	13nF	3.3nF
L <sub>i</sub>	=	0.01mH	0.01mH

To determine the maximum permissible cable parameters these figures should be subtracted from the specified C<sub>o</sub> and L<sub>o</sub> for the Zener barrier or galvanic isolator powering the backlight.

#### 4.5 Optional alarms

All indicators can be supplied with two factory fitted single pole solid state alarm outputs. Each output is galvanically isolated and has been certified as a separate intrinsically safe circuit which, complies with the requirements for *simple apparatus*.

This allows each alarm output to switch any intrinsically safe circuit with output parameters not exceeding:

$$\begin{aligned} U_o &\leq 30\text{V dc} \\ I_o &\leq 200\text{mA} \\ P_o &\leq 0.84\text{W} \end{aligned}$$

The ATEX and IECEx certificates specify that the maximum equivalent capacitance and inductance between the terminals of each alarm output is:

		BA300E	BA300G
C <sub>i</sub>	=	24nF	0
L <sub>i</sub>	=	0.01mH	0.01mH

To determine the maximum permissible cable parameters these figures, plus C<sub>i</sub> and L<sub>i</sub> for other apparatus in the circuit, should be subtracted from the specified C<sub>o</sub> and L<sub>o</sub> of the Zener barrier, galvanic isolator or associated apparatus powering the circuit.

## 5. DESCRIPTION OF ATEX & IECEX DUST CERTIFICATION

All BA300G & E intrinsically safe indicators can be supplied with ATEX and IECEx dust certification. BA300G field and the BA300E panel mounting models have dust certification as standard, but it must be requested for BA300E series field mounting models.

### 5.1 Certification label

All BA300G & E series indicators are fitted with an external label showing the ATEX and IECEx certification information and numbers. The dust certification information on a BA304E certification label is highlighted in Fig 3.

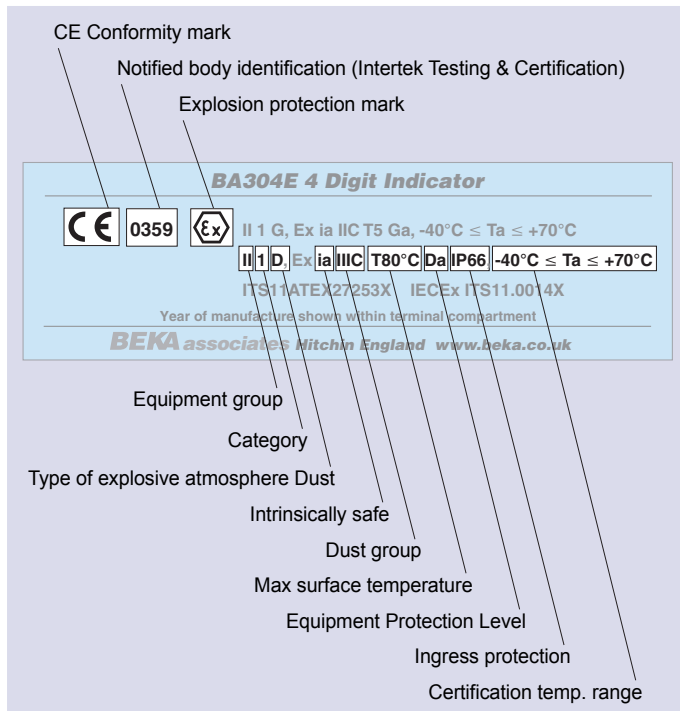


Fig 3 BA304E dust certification label

### 5.2 Zones, dust groups and surface temperature

All of the BA300G & E series indicators have the following dust code:

Group II Category 1D Ex ia IIC T80°C Da IP66  
-40°C ≤ Ta ≤ 70°C

When connected to a suitable system the indicators 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 dust in subdivisions:

IIIA	combustible flyings
IIIB	non-conductive dust
IIIC	conductive dust. <i>See note</i>

Having a Minimum Ignition Temperature of:

Dust cloud	120°C
Dust layer on indicator up to 5mm thick	155°C
Dust layer on indicator over 5mm thick.	Refer to IEC 60079-14

At an ambient temperature between -40 and +70°C.

**Note:** BA300E series panel mounting indicators have IP20 rear protection and are subject to the following special conditions for safe use indicated by an 'X' suffix on the ATEX and IECEx certification numbers.

***'When installed in a IIIC conductive dust atmosphere, the indicator shall be mounted such that the instrument terminals have at least IP6X protection.'***

These special conditions do not affect installations in IIIA, IIIB dust or gas atmospheres.

IP6X indicates that the rear of the panel mounting indicator should be totally protected from dust, by for example mounting the indicator in a sealed IP6X panel enclosure or cubicle so that conductive dust can not accumulate on the indicator terminals. For 96 x 48mm and rugged indicators, this can be achieved with a BA495 rear cover sealing kit.

## 6. DESCRIPTION OF NORTH AMERICAN CERTIFICATION

BEKA loop powered indicators have been certified intrinsically safe for use in the USA and Canada by two Nationally Recognised Testing Laboratories, FM Global and ETL. Class / Division and Zone approval is included for all models.

All installations in the USA should comply with the associated BEKA Control Drawing *Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations ANSI/ISA RP12.6* and the *National Electrical Code ANSI/NFPA70*. Any local code of Practice should also be consulted.

Installations in Canada should comply with the associated BEKA Control Drawing, the Canadian Electrical Code C22.1, plus any relevant local code of practice.

### 6.1 FM certification of BA304E & BA324E

The BA304E and the BA324E field mounting indicators incorporating a separate terminal compartment have the following FM and cFM intrinsic safety codes:

Class I	Division 1	Groups A, B, C & D T5
Class II	Division 1	Groups E, F & G T5
Class III	T5	
Class I	Zone 0	AEx ia IIC T5
-40°C ≤ Ta ≤ +70°C		

When connected to a suitable system the BA304E and BA324E field mounting indicators may be installed in:

Division 1	Explosive gas air mixture likely to occur in normal operation
Division 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	Acetylene
Group B	Hydrogen
Group C	Ethylene
Group D	Propane

In gases that may safely be used with equipment having a temperature classification of:

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

Be used with dusts in groups:

Group E	Metal
Group F	Carbonaceous
Group G	Non-carbonaceous

At an ambient temperature between -40°C and +70°C

**Note:** AEx ia IIC T5 Zone coding allows installation in atmospheres similar to those specified for IECEx and ATEX certification in section 4.

### 6.2 FM certification of BA307E, BA308E, BA327E & BA328E

The BA307E, BA308E, BA327E and the BA328E panel mounting indicators have the following FM and cFM intrinsic safety codes:

Class I	Division 1	Groups A, B, C & D T5
Class I	Zone 0	AEx ia IIC T5
-40°C ≤ Ta ≤ +70°C		

When connected to a suitable system these panel mounting indicators may be installed in:

Division 1	Explosive gas air mixture likely to occur in normal operation
Division 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	Acetylene
Group B	Hydrogen
Group C	Ethylene
Group D	Propane

In gasses that may safely be used with equipment having a temperature classification of:

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

At an ambient temperature between -40°C and +70°C

**Note:** AEx ia IIC T5 Zone coding allows installation in atmospheres similar to those specified for IECEx and ATEX certification in section 4.

FM & cFM certification of the rugged BA307E-SS & BA327E-SS is described in section 9.1.7

### 6.3 ETL and cETL certification of BA304G & BA324G

The BA304G and the BA324G field mounting indicators have the following ETL and cETL intrinsic safety code:

Class I Div 1 Gp A, B, C, D T5 (USA & Canada)  
 Class I Zone 0 AEx ia IIC T5 Ga (USA)  
 $-40^{\circ}\text{C} \leq \text{Ta} \leq 70^{\circ}\text{C}$

Class II Div 1 Gp E, F, G Class III, Div 1 (USA & Canada)  
 Class II Zone 20 Ex ia IIIC T80°C Da (USA)  
 $-40^{\circ}\text{C} \leq \text{Ta} \leq 60^{\circ}\text{C}$

Ex ia T5 Ga  $-40^{\circ}\text{C} \leq \text{Ta} \leq 70^{\circ}\text{C}$  ] (Canada)  
 Ex ia IIIC Da  $-40^{\circ}\text{C} \leq \text{Ta} \leq 60^{\circ}\text{C}$  ]

When connected to a suitable system the BA304G and BA324G field mounting indicators may be installed in:

- Division 1 Explosive gas air mixture likely to occur in normal operation
- Division 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 Acetylene
- Group B Hydrogen
- Group C Ethylene
- Group D Propane

In gasses that may safely be used with equipment having a temperature classification of:

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

At an ambient temperature between  $-40^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$

Be used in dusts in groups:

- Group E Metal
- Group F Carbonaceous
- Group G Non-carbonaceous

At an ambient temperature between  $-40^{\circ}\text{C}$  and  $+60^{\circ}\text{C}$

**Note:** AEx ia IIC T5 Ga and AEx ia IIIC T80°C Zone codings allow installation in atmospheres similar to those specified for IECEx and ATEX certification in sections 4 and 5.

## 7. HAZARDOUS AREAS APPLICATIONS

BA300G and E series ATEX, IECEx, US and Canadian certifications specify common indicator safety parameters. The circuits shown in this section may be used with all indicators and with any of the intrinsic safety certifications providing that the installation complies with the local code of practice.

The four rugged stainless steel panel mounting indicators have the same IECEx and ATEX gas and dust certification as the other models, although only the BA307E-SS & BA327E-SS have US certification. Whilst they may be used in any of the examples shown in this section, their certification also permits them to be mounted in an aperture in a certified Ex e, Ex p or Ex t panel enclosure without invalidating the panel enclosure's certification which further extends their applications. The use of these rugged instruments in certified panel enclosures is explained in section 9 of this guide.

### 7.1 4/20mA loop design

A BA300G or E series 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 four design steps:

- From tables 1 or 2 select the model with the required display, mounting and accessories.

4 digit models can display  
-9999 to 9999

5 digit models can display  
-99999 to 99999 with a bargraph

- The output safety parameters of the 4/20mA loop, which are usually defined by the Zener barrier, galvanic isolator or associated apparatus powering the loop, must be equal to or less than the maximum input safety parameters of the indicator, which are:

$$\begin{aligned} U_o &\leq 30V \text{ dc} \\ I_o &\leq 200mA \\ P_o &\leq 0.84W \end{aligned}$$

- The equivalent internal capacitance  $C_i$  and internal inductance  $L_i$  of the indicator with or without a loop powered backlight is:

	BA300E	BA300G
$C_i$	13nF	5.4nF
$L_i$	0.02mH	0.02mH

When added to the  $C_i$  and  $L_i$  of other instruments in the loop, the totals should not exceed the specified  $C_o$  and  $L_o$  of the Zener barrier, galvanic isolator or associated apparatus powering the loop.

- The loop must be able to supply the additional 1.2V required to operate the indicator. If the optional backlight is loop powered the loop must be able to supply an additional 5V.

A BA300G or E series indicator may be connected in series with a 2-wire intrinsically safe transmitter to display the current and hence the process variable in engineering units. Fig 4A illustrates the use of a 2-channel Zener barrier, or two separate barriers as the intrinsically safe interface. Zener barriers are usually less expensive than galvanic isolators but do not provide isolation and require a high integrity earth which if not available may be expensive to install.

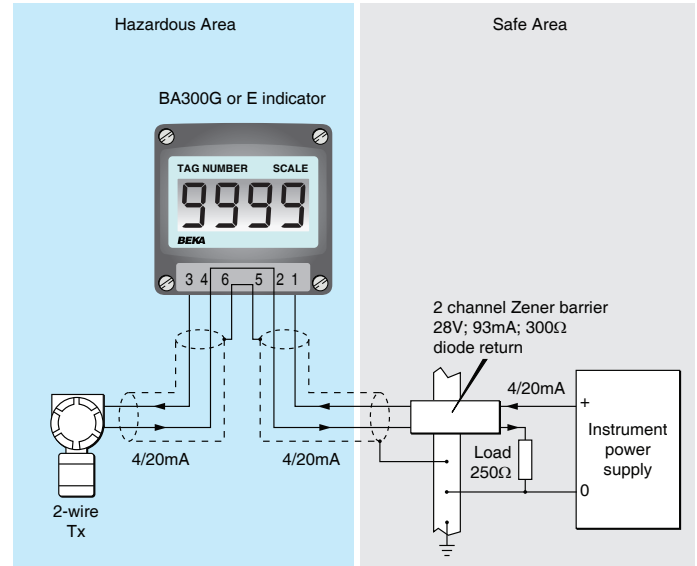


Fig 4A Transmitter loop powered via Zener barriers

Considering the voltage drop around the loop in Fig 4A.

2-wire transmitter	8.0V
Maximum voltage drop caused by BA300G or E series indicator.	1.2V
Max voltage drop caused by 28V 93mA barrier. (340Ω end-to-end resistance x 20mA)	6.8V
Max voltage drop caused by diode return barrier (21Ω x 20mA + 0.9V)	1.4V
Max voltage drop caused by 250Ω load. (250Ω x 20mA)	5.0V
Max voltage drop caused by cables. (10Ω x 20mA)	0.2V
<b>Total voltage drop around loop</b>	<b>22.6V</b>

The instrument power supply must therefore have an output above 22.6V but below 25.5V which is the maximum working voltage of the 28V 93mA Zener barrier.

Fig 4B illustrates the same loop using a galvanic isolator as the intrinsically safe interface. Galvanic isolators although more expensive than Zener barriers allow a non-floating power supply to be used, do not require a high integrity earth connection and in general are easier to apply. It is usually only necessary to read the manufacturers specification to determine the voltage available to power the hazardous area loop.

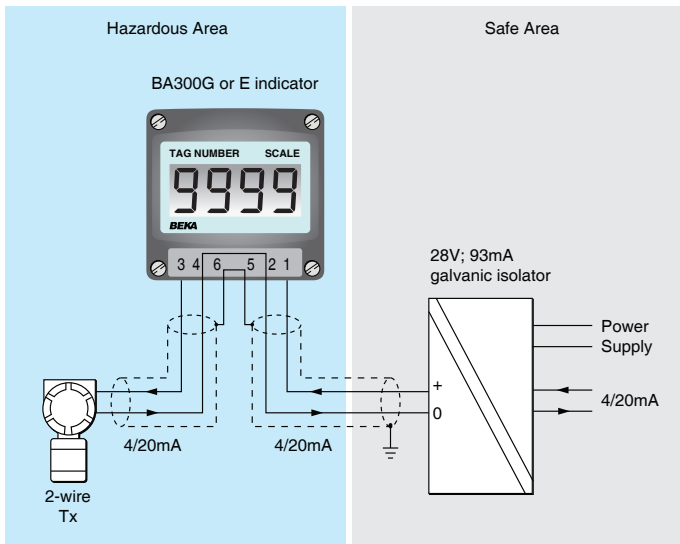


Fig 4B Transmitter loop powered via galvanic isolator

## 7.2 Remote indication

BA300G & E series indicators may also be driven via an intrinsically safe interface from a 4/20mA safe area signal to provide a remote indication within a hazardous area. The type of interface is not critical, a Zener barrier, galvanic isolator or associated apparatus may be used, but again output parameters of the interface must not exceed the indicator's maximum input parameters. Zener barriers are the least expensive interface particularly if a high integrity earth is already available. 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, two Zener barriers, a two channel Zener barrier or a galvanic isolator must be used. Again it is necessary to ensure that the voltage capability of the 4/20mA signal is sufficient to drive the indicator plus the voltage drop introduced by the intrinsically safe interface. Fig 5 shows the three alternative circuits which may be used.

## 7.3 Display backlight

All BA300G & E series indicators can be supplied with an optional factory fitted display backlight that has three terminals allowing it to be loop or separately powered.

### 7.3.1 Loop powering the backlight

When loop powered, the backlight produces green background illumination enabling the indicator display to be read at night and in poor lighting conditions. Loop powering does not require an additional power supply, intrinsically safe interface or field wiring, but the maximum indicator voltage drop in the 4/20mA loop is increased from 1.2 to 5.0V. Backlight brilliance is constant between 6 and 20mA but slightly diminishes below 6mA.

The indicators backlight terminals 12(+) and 13(-) should be connected in series with the indicator's 4/20mA input terminals as shown in Fig 6.

Any of the circuits shown in sections 7.1 and 7.2 may be used providing that 5V is available to power the indicator and the backlight.

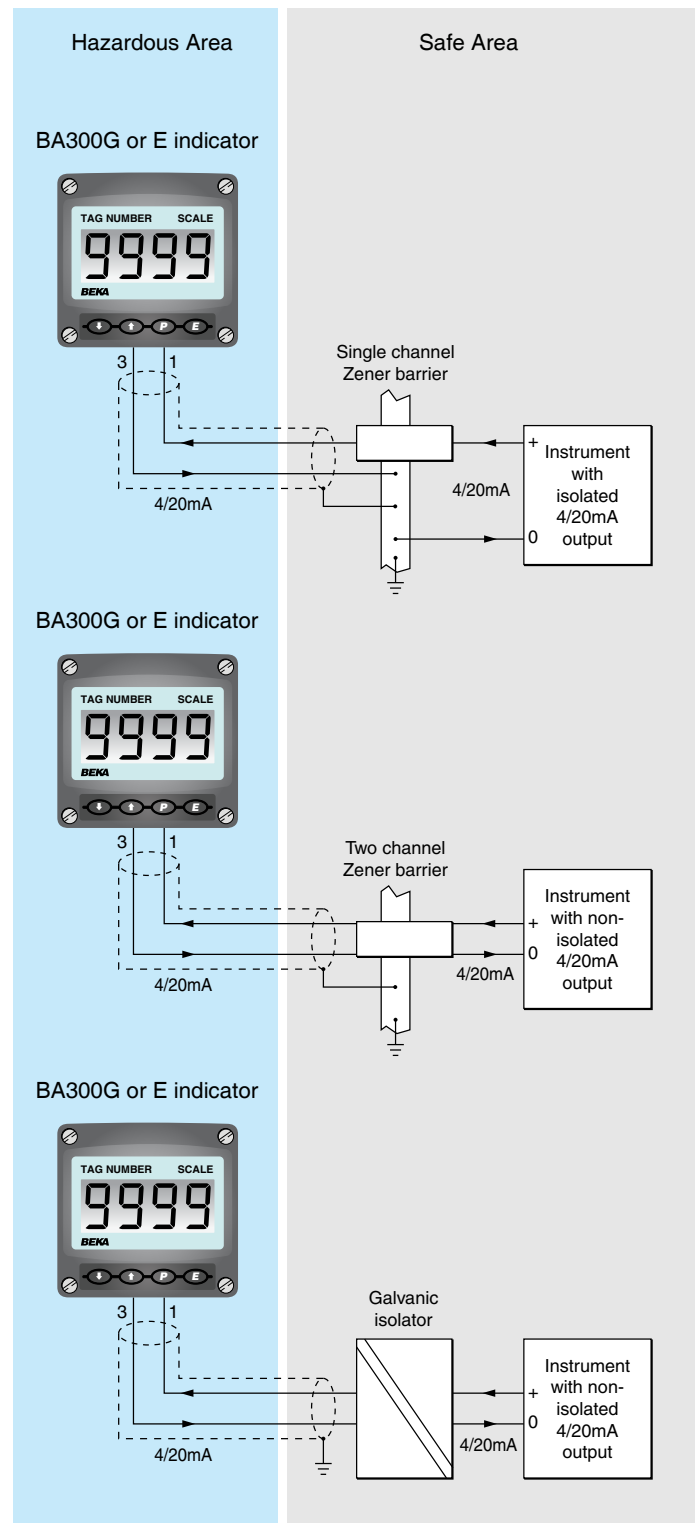


Fig 5 Alternative circuits for remote indication in a hazardous areas



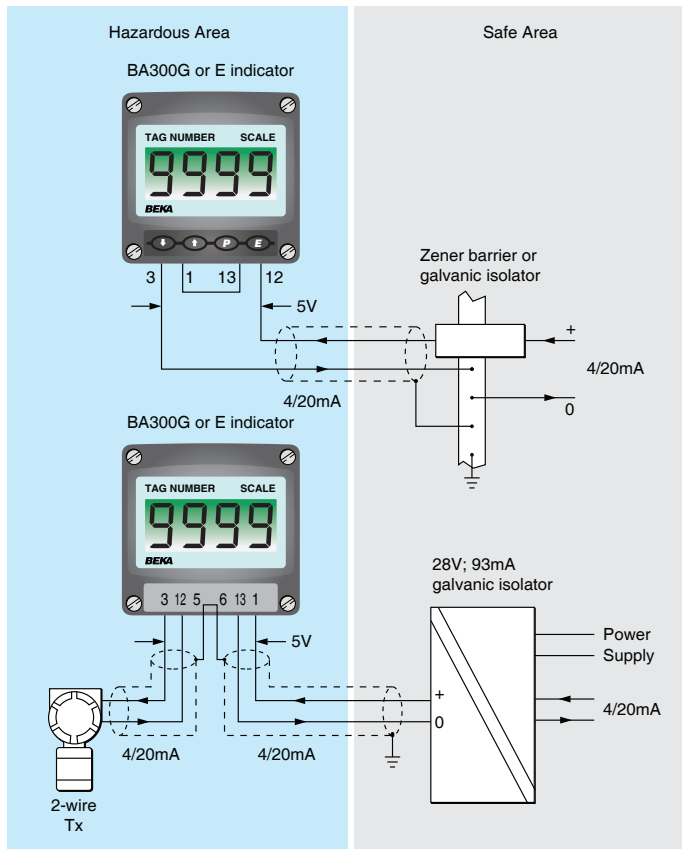


Fig 6 Alternative circuits for BA300G or E series indicator with loop powered backlight

### 7.3.2 Separately powering the backlight

Separately powering the backlight produces brighter green background illumination than loop powering. It enhances daylight viewing of the indicator display but an additional intrinsically safe interface and field wiring are required, the maximum voltage drop of the indicator in the 4/20mA loop remains at 1.2V.

The separately powered backlight is a current sink drawing a constant current when the supply between terminals 12(+) and 14(-) is above the minimum supply voltage.

Model	Current	Minimum supply voltage terminals 12 & 14
BA304E BA304G BA304G-SS BA304G-SS-PM BA324E BA324G BA324G-SS BA324G-SS-PM BA308E BA328E	35mA	11V
BA307E BA327E BA307E-SS BA327E-SS	23mA	9V

Table 3 Separately powered backlight voltage & current for each model

Below the minimum supply voltage the backlight continues to function but the brilliance is diminished. For applications where operator's night vision has to be preserved, adjusting the backlight supply voltage is a simple method of dimming the display backlight.

The backlight is segregated from all other circuits within the indicator and is separately powered via terminals 12(+) and 14(-) which may be connected to any intrinsically safe interface such as a certified Zener barrier, galvanic isolator or associated apparatus having output parameters equal to or less than:

$$\begin{aligned}
 U_o &\leq 30V \text{ dc} \\
 I_o &\leq 200mA \\
 P_o &\leq 0.84W
 \end{aligned}$$

The maximum equivalent capacitance and inductance between the backlight terminals is:

	BA300E	BA300G
$C_i$	= 13nF	3.3nF
$L_i$	= 0.01mH	0.01mH

To determine the maximum permissible backlight cable parameters these figures should be subtracted from the specified  $C_o$  and  $L_o$  of the Zener barrier, galvanic isolator or associated apparatus powering the backlight. Fig 7 shows an example of a Zener barrier separately powering the backlight.

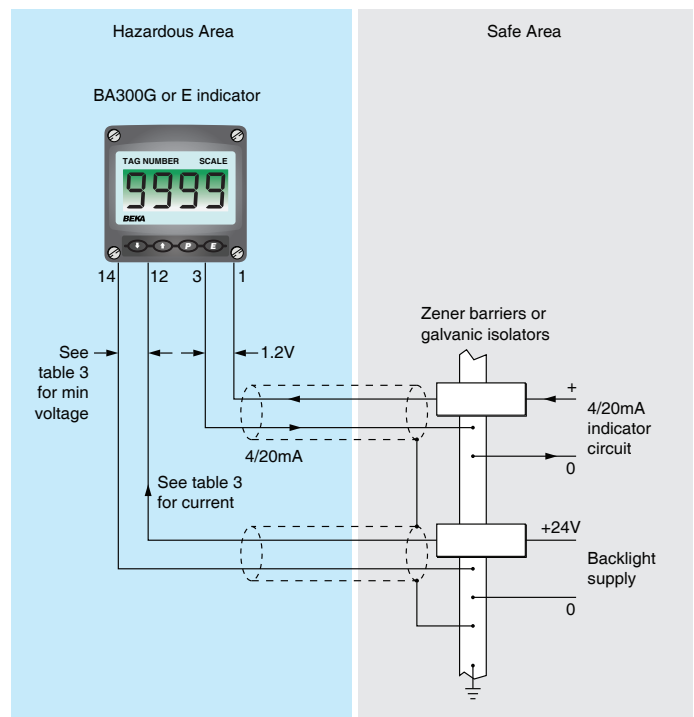


Fig 7 BA300G or E series indicator with separately powered backlight

Two separately powered BA307E or BA327E indicator backlights may be connected in parallel to a single channel 28V, 93mA Zener barrier or galvanic isolator with no noticeable reduction in brilliance on a 24V dc supply.



### 7.4 Optional Alarms

All BA300G or E series indicators can be supplied with two factory fitted single pole solid state alarm outputs. Each output is galvanically isolated and has been certified as a separate intrinsically safe circuit complying with the requirements for *simple apparatus* making it easier to use in intrinsically safe circuits.

Each output may be individually configured as a high or a low alarm with a normally open or a normally closed 'contact'. Fig 8 illustrates the conditions available and shows which are 'fail safe'. i.e. output is in alarm condition ('contact' open) when the 4/20mA input current is zero.

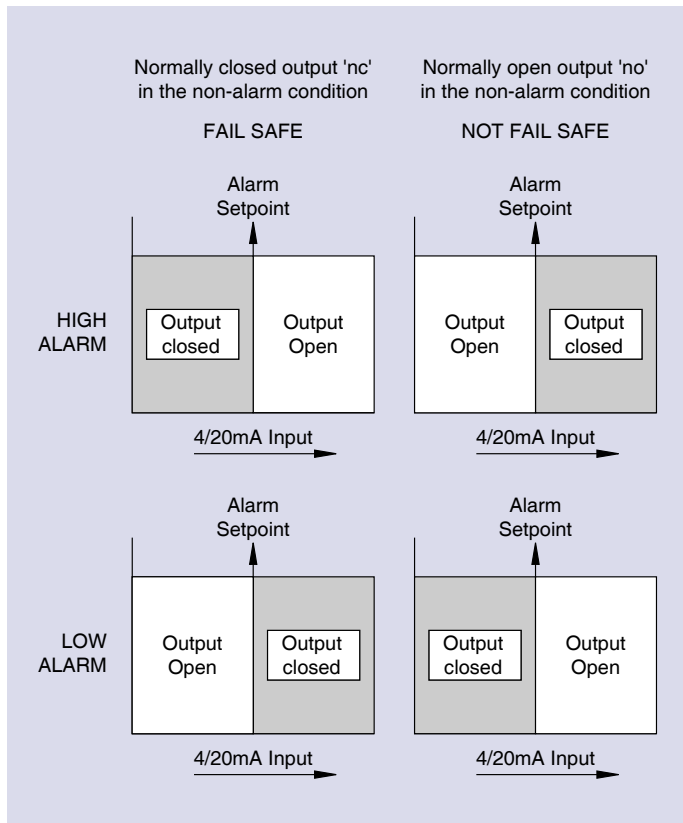


Fig 8 Alarm outputs

These alarm outputs are not suitable for use in critical safety applications such as a shut down system.

The equivalent electrical circuit of each alarm output is shown in Fig 9. Both outputs are polarised and will only pass current in one direction.

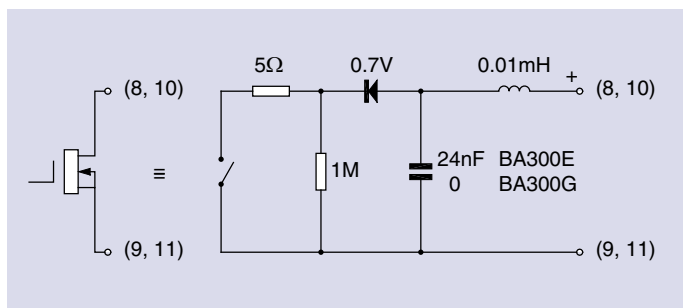


Fig 9 Equivalent circuit of each alarm output

Each alarm output is segregated and is a separate intrinsically safe circuit. It may switch any intrinsically safe circuit with output parameters equal to or less than:

$U_o$	$\leq$	30V dc
$I_o$	$\leq$	200mA
$P_o$	$\leq$	0.84W

The maximum equivalent capacitance and inductance between the terminals of each alarm output is:

		BA300E	BA300G
$C_i$	=	24nF	0
$L_i$	=	0.01mH	0.01mH

To determine the maximum permitted circuit cable parameters, these  $C_i$  and  $L_i$  parameters, plus those of any other device in the circuit, should be subtracted from the  $C_o$  and  $L_o$  of the certified Zener barrier, galvanic isolator or associated apparatus powering the alarm circuit.

The alarm outputs may be used to switch intrinsically safe loads within the hazardous area or to switch safe area loads via a Zener barrier or a galvanic isolator. Fig 10 illustrates how one alarm output of a BA300 series indicator can switch a certified intrinsically safe solenoid valve located in the hazardous area and the other alarm output can control a pump in the safe area via a switch transfer galvanic isolator.

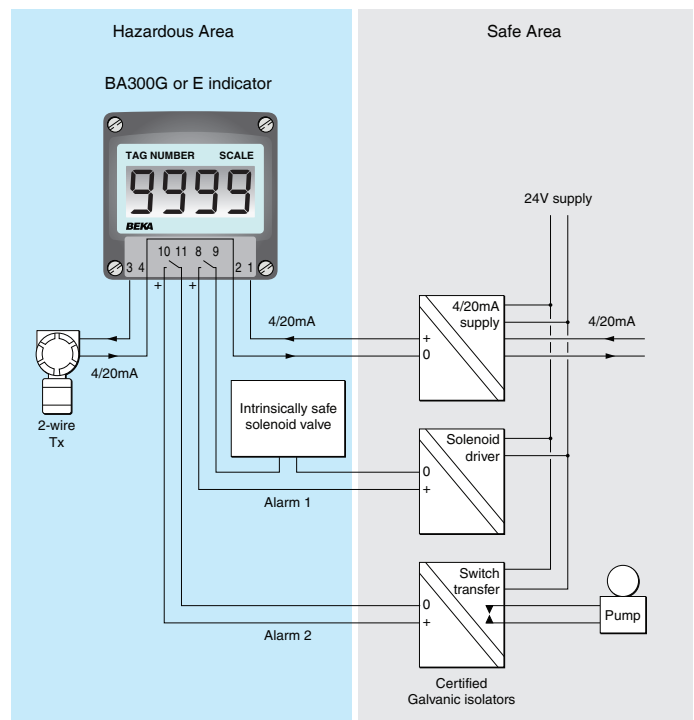


Fig 10 Typical alarm application

When an indicator alarm output is used to activate an annunciator such as a flashing beacon or a sounder one of the indicator push buttons may be configured to operate as an alarm 'accept' button. This allows the operator to silence the alarm for a configurable time up to 3,600 seconds in 1 second increments. If the alarm condition is not corrected during the silence time, the alarm will be reactivated.

## 8. SPECIAL FUNCTIONS

All BA300G & E series indicators include special functions that extend their applications.

### 8.1 Square root extractor

All the BA300G & E series indicators contain a square root extractor that allows the output from non-linearised differential flow transmitters to be displayed in linear units. The root extractor is selectable from within the indicator's configuration menu using the instrument's push buttons.

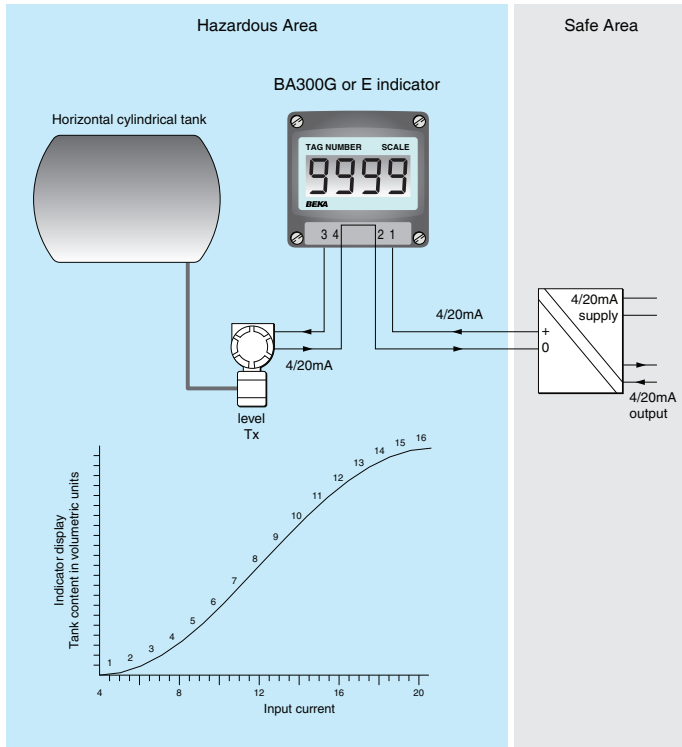


Fig 11 Lineariser enables tank contents to be displayed in linear units of volume

### 8.2 Lineariser

The integral lineariser enables BA300G & E series indicators to display non-linear variables in linear engineering units. The function provides a sixteen point fully adjustable straight line lineariser which may be conditioned on-site to compensate for most non-linearities. Fig 11 shows an example in which a BA300 series indicator displays the contents of a horizontal cylindrical tank in linear volumetric units from the 4/20mA output of a level transmitter. The internal indicator lineariser converts the tank level 4/20mA signal into a linear display of the volume being stored in the tank.

The lineariser can be adjusted on-site via the instruments push buttons, or if the curve parameters are specified when the indicator is ordered, it can be supplied calibrated.

### 8.3 Tare

Primarily intended for use with weighing systems, the tare function replaces the percentage function on the indicator. When the tare push button is operated for more than three seconds the indicator display is set to zero and the tare annunciator activated, thus subtracting the current display from subsequent displays. When used with a weighing system, this function subtracts the displayed weight of an empty container from the weight of the container plus contents, so that the net weight of the contents is displayed. Subsequent operation of the tare push button for less than 3 seconds will return the indicator to the gross display and deactivate the tare annunciator.

## 9. RUGGED PANEL INDICATOR APPLICATIONS

These rugged panel mounting indicators have the same IECEx and ATEX certification as the other models and may be used in any of the applications shown in section 7 of this guide. They have impact and IP66 ingress resistant front panels and are ideal for use in harsh environments or where the front of the instrument is likely to be impacted.

In addition these rugged indicators may be installed into an aperture in a certified Ex e, Ex p or Ex t panel enclosure located in Zone 1, 2, 21 or 22 without invalidating the panel enclosure's certification. This enables a rugged indicator to display a process variable in a hazardous area panel providing protection for equipment such as Ex e motor controls for a compressor.

The small rugged indicators BA307E-SS and BA327E-SS and the larger BA304G-SS-PM and BA324G-SS-PM have different certifications and installation requirements. Therefore each type is described separately.

### 9.1 BA307E-SS and BA327E-SS

Both instruments are housed in rugged cast 316 stainless steel cases with a 10mm thick toughened glass window. The joint between the instrument case and the panel enclosure in which it is mounted is sealed with a captive silicone gasket. After high and low temperature thermal endurance ageing, followed by impact testing at low and high temperatures, notified body Intertek Testing and Certification issued the stainless steel case with component certificates IECEx ITS14.0007U and ITS14ATEX17967U confirming that the front of the case provides IP66 ingress protection and complies with Ex e, Ex p and Ex t impact and ingress requirements. These ATEX and IECEx component certificates supplement the Ex ia intrinsic safety certificates ITS14ATEX28077X and IECEx ITS14.0048X for the BA307E-SS and BA327E-SS indicators which specify special conditions for safe use when installed in an Ex e, Ex p or Ex t panel enclosure.

#### 9.1.1 Installation in an Ex e panel enclosure

Installation of a BA307E-SS or BA327E-SS indicator in an Ex e IIC Gb increased safety panel enclosure does not invalidate the Ex e panel's certification, but the indicator remains Group II Category 1G Ex ia IIC T5 Ga intrinsically safe apparatus, therefore it must be powered via a Zener barrier or galvanic isolator as described in section 7 of this guide.

The Zener barrier or galvanic isolator is usually installed in the safe area but some intrinsically safe interfaces are certified for mounting within a protective enclosure located in Zone 2 which may permit them to be mounted in the same Ex e enclosure as the rugged indicator. Where the Zener barrier or galvanic isolator may be located is defined by its ATEX EU-Type Examination certificate or IECEx Certificate of Conformity. Zener barriers and galvanic isolators are not permitted in Ex e enclosures located in Zone 1.

For personnel safety and prevention of an electrostatic charge, rugged indicators should be electrically connected to the panel enclosure in which they are mounted, or to a local bonding point if the panel enclosure is non-conductive. The indicator terminals, the wiring to the indicator and the intrinsically safe interface, if mounted within the enclosure, should be segregated from all other non-intrinsically safe wiring and equipment within the panel enclosure.

Required segregation distances are defined in standards EN 60079-11 *Equipment protected by intrinsic safety* and EN 60079-14 *Electrical installations design, selection and erection*. Terminals for intrinsically safe circuits should be segregated by at least 50mm from terminals for non-intrinsically safe circuits and from bare electrical conductors.

The intrinsically safe terminals and wiring should be identified and, if live maintenance is to be performed, any bare live non-intrinsically safe parts within the panel enclosure should be covered and labelled 'Non-intrinsically safe circuit' to prevent accidental contact.

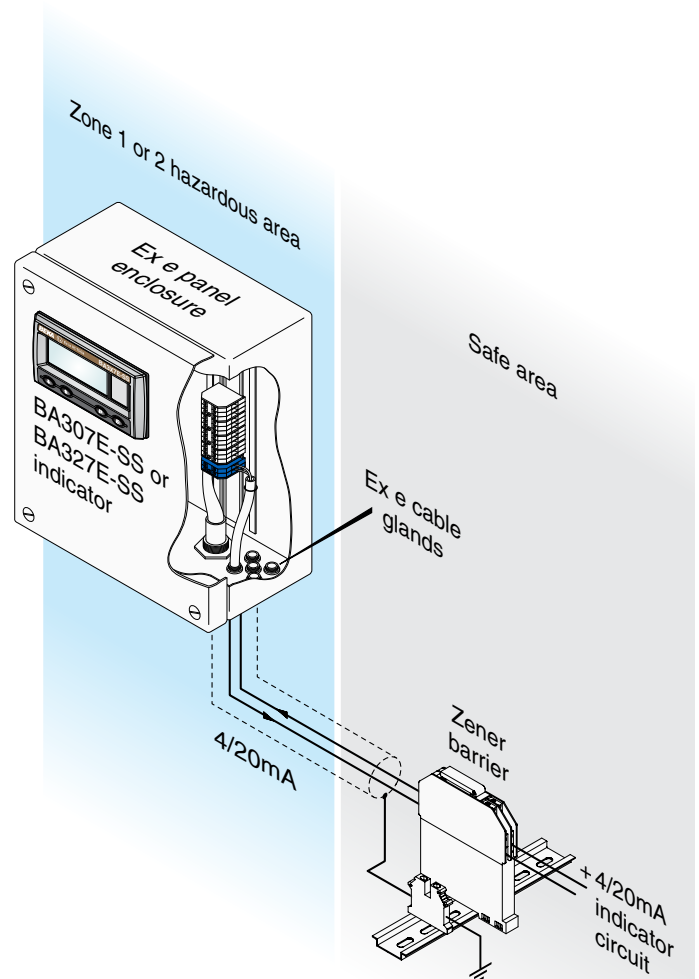


Fig 12 Typical installation in an Ex e panel enclosure

Fig 12 shows a BA307E-SS or BA327E-SS rugged indicator installed in an Ex e panel enclosure located in Zone 1 or 2. The 4/20mA cable should be sealed with an Ex e certified gland where it enters the Ex e panel enclosure and the cable screen should be earthed to a common point in the safe area such as the plant's equipotential conductor, or to the Zener barrier busbar when barriers are used. To prevent fault currents from other equipment installed in the Ex e enclosure flowing to earth via this cable screen, it should be insulated in the hazardous area and should not be connected to the Ex e enclosure.

The power dissipation within an indicator fitted with alarms and a backlight which is separately powered is normally about 350mW, in the very unlikely event that all four circuits fail to the worst case condition at the same time, the total power dissipation rises to 3.4W which could raise the internal temperature of a small thermally well insulated panel enclosure.

### 9.1.2 Installation in an Ex p panel enclosure

Installation of a BA307E-SS or BA327E-SS rugged indicator in an Ex p panel enclosure does not invalidate the Ex p panel enclosure's ingress or impact protection as the front of the rugged indicators comply with the Ex p ingress and impact requirements.

Because the BA307E-SS and BA327E-SS front panel push button contacts are outside of the pressurised panel enclosure, these two indicators remain Group II Category 1G Ex ia IIC T5 Ga intrinsically safe apparatus and may only be connected to an appropriate intrinsically safe circuit, even when mounted in an Ex pxb or Ex pzc panel enclosure which reduce the equipment protection level (EPL) inside the enclosure from Gb (Zone 1) to non-hazardous.

Both indicators have four rear panel vents to ensure that a potentially explosive gas is not trapped within the instrument case, when installed in an Ex p panel enclosure these vents, which are shown in Fig 13, should not be obstructed.

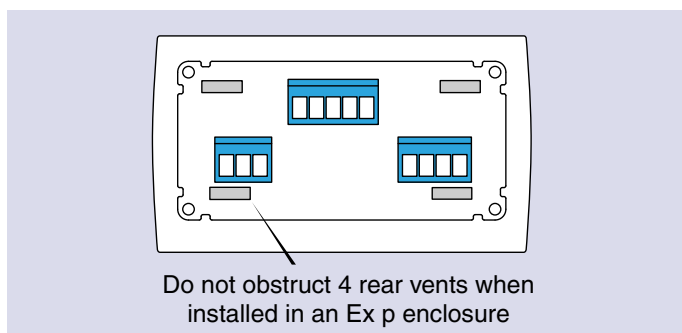


Fig 13 Position of vents in BA307E-SS & BA327E-SS

For personnel safety and prevention of an electrostatic charge, BA307E-SS & BA327E-SS rugged indicators should be electrically connected to the panel enclosure in which the indicator is mounted, or to a local bonding point if the panel enclosure is non-conductive. The indicator terminals, the wiring to the indicator and the intrinsically safe interface, if mounted within the enclosure, should be segregated from all other non-intrinsically safe wiring and equipment within the panel enclosure. Required segregation distances are defined in standards EN 60079-11 *Equipment protected by intrinsic safety* and EN 60079-14 *Electrical installations design, selection and erection*. Terminals for intrinsically safe circuits should be segregated by at least 50mm from terminals for non-intrinsically safe circuits and from bare electrical conductors.

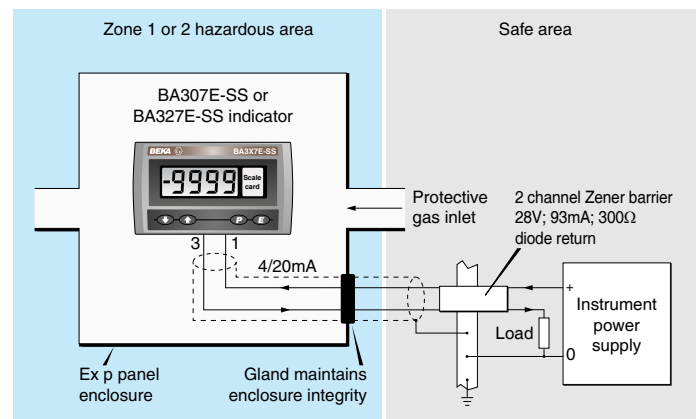


Fig 14 Typical installation in Ex p panel enclosure

BA307E-SS and BA327E-SS rugged indicators may be installed in all three types of pressurised panel enclosure, Ex pxb, Ex pyb and Ex pzc as shown in Fig 14. The 4/20mA cable should be sealed by a gland which maintains enclosure integrity where it enters the Ex p enclosure and the cable screen should be earthed in the safe area to a common point such as the plant's equipotential conductor, or to the Zener barrier busbar when barriers are used.

To prevent fault currents from other equipment installed within the Ex p enclosure flowing to earth via this cable screen, it should be insulated in the hazardous area and should not be connected to the Ex p enclosure.

### 9.1.3 Ex pxb panel enclosure

When pressurised an Ex pxb enclosure reduces the equipment protection level (EPL) inside the enclosure from Gb (Zone 1) to non-hazardous. When the Ex pxb panel enclosure is located in Zone 1, a BA307E-SS or BA327E-SS rugged indicator installed in the enclosure may only be connected to an Ex ia or Ex ib intrinsically safe circuit which will usually have its intrinsically safe interface located in the safe area. Alternatively, a suitably certified intrinsically safe interface such as a Zener barrier, galvanic isolator or associated apparatus may be mounted within the Ex pxb enclosure with the indicator. Where the certified intrinsically safe interface may be installed is defined by its EU-Type Examination Certificate or IECEx Certificate of Conformity.

### 9.1.4 Ex pzc panel enclosure

When pressurised an Ex pzc enclosure reduces the equipment protection level (EPL) inside the enclosure from Gc (Zone 2) to non-hazardous. When the Ex pzc panel enclosure is located in Zone 2 a BA307E-SS or BA327E-SS rugged indicator installed in the enclosure may only be connected to an Ex ia, Ex ib or Ex ic intrinsically safe circuit which will usually have its intrinsically safe interface located in the safe area. Alternatively, a suitably certified intrinsically safe interface such as a Zener barrier, galvanic isolator or associated apparatus may be mounted within the Ex pzc enclosure with the indicator. Where the certified intrinsically safe interface may be installed is defined by its EU-Type Examination Certificate or IECEx Certificate of Conformity.

### 9.1.5 Ex pyb panel enclosure

When pressurised an Ex pyb enclosure reduces the equipment protection level (EPL) inside the enclosure from Gb (Zone 1) to Gc (Zone 2). When the Ex pyb panel enclosure is located in Zone 1 a BA307E-SS or BA327E-SS rugged indicator installed in the enclosure may only be connected to an Ex ia or Ex ib intrinsically safe circuit which will usually have its intrinsically safe interface located in the safe area. Alternatively, a suitably certified intrinsically safe interface such as a Zener barrier, galvanic isolator or associated apparatus may be mounted within the Ex pyb enclosure. Where the certified intrinsically safe interface may be installed is defined by its EU-Type Examination Certificate or IECEx Certificate of Conformity.

### 9.1.6 Ex t panel enclosure

Installation of a BA307E-SS or BA327E-SS rugged indicator in a certified Ex t (dust ignition protection by enclosure) panel enclosure does not invalidate the Ex t panel's impact and ingress protection as the front of both indicators comply with Ex t impact and ingress requirements. However, because the indicator's front panel push button contacts are outside of the enclosure the rugged BA307E-SS or BA327E-SS may only be connected to an appropriate intrinsically safe circuit, Ex ia or ib for Zone 21 installations and Ex ia, ib or ic for Zone 22 installations. Any of the circuits shown in section 7 of this Application Guide may be used.

The Zener barrier, galvanic isolator or associated apparatus is usually installed in the safe area. Alternatively, a suitably certified intrinsically safe interface such as a Zener barrier, galvanic isolator or associated apparatus may be mounted within the Ex t enclosure. Where the certified intrinsically safe interface may be installed is defined by its EU-Type Examination Certificate or IECEx Certificate of Conformity.

The 4/20mA cable should be sealed by a gland where it enters the Ex t enclosure and the cable screen should be earthed in the safe area to a common point such as the plants equipotential conductor, or to the Zener barrier busbar when barriers are used. To prevent fault currents from other equipment installed within the Ex t enclosure flowing to earth via this cable screen, the screen should be insulated in the hazardous area and should not be connected to the Ex t enclosure.

Both indicators have an earth stud adjacent to the terminals on the rear panel. For personnel safety and prevention of an electrostatic charge this should be electrically connected to the panel enclosure in which the indicator is mounted, or to a local bonding point if the panel enclosure is non-conductive.

The indicator terminals, the wiring to the indicator and the intrinsically safe interface, if mounted within the enclosure, should be segregated from all other non-intrinsically safe wiring and equipment within the panel enclosure. Required segregation distances are defined in standards IEC 60079-11 *Equipment protected by intrinsic safety* and IEC 60079-14 *Electrical installations design, selection and erection*. Terminals for intrinsically safe circuits should be segregated by at least 50mm from terminals for non-intrinsically safe circuits and from bare electrical conductors.

The intrinsically safe terminals and wiring should be identified and if live maintenance is to be performed any bare live non-intrinsically safe parts within the panel enclosure should be covered and labelled 'Non-intrinsically safe circuit' to prevent accidental contact.

The power dissipation within an indicator fitted with operational alarms and a backlight which is separately powered is normally about 350mW, in the very unlikely event that all four circuits fail to the worst case condition at the same time, the total power dissipation rises to 3.4W which could raise the internal temperature of a small thermally well insulated panel enclosure.



### 9.1.7 Installation in the USA and Canada

The BA307E-SS and BA327E-SS rugged indicators have the following FM and cFM intrinsic safety certification permitting installation in both Divisions and Zones in the USA and Canada.

Class I Division 1	Groups A, B, C & D T5
Class I Zone 0	AEx ia IIC T5
-40°C = Ta = +70°C	

When connected to a suitable system these rugged panel mounting indicators may be installed in:

Division 1	Explosive gas air mixture likely to occur in normal operation.
Division 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	Acetylene
Group B	Hydrogen
Group C	Ethylene
Group D	Propane

In gases that may safely be used with equipment having a temperature classification of:

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

At an ambient temperature between -40°C and +70°C.

For installations of these rugged indicators in the USA and Canada the intrinsically safe circuits shown in this Application Guide may be used providing the Zener barriers and galvanic isolators have local approval and the installation complies with the BEKA Control Drawing CI300-72. A copy of this Control Drawing is included in the BA307E-SS and BA327E-SS instruction manual which may be downloaded from the BEKA website.

Section 14 of the FM and cFM intrinsic safety Control Drawing CI300-72 states that when correctly installed in an AEx e, AEx n, AEx p or AEx t panel enclosure, the rugged BA307E-SS and BA327E-SS indicators will not invalidate the enclosure certification.

Installation recommendations for these rugged indicators in Ex e, Ex p and Ex t enclosures described in sections 9.1.1 to 9.1.6 of this guide may therefore also be used for similar installations in the US and Canada, but the installation must comply with the local code of practice.

**Note:** Certified AEx e, AEx n, AEx p and AEx t enclosures may only be installed in areas with zoned classification, not in areas with division classification.

### 9.2 BA304G-SS-PM and BA324G-SS-PM

These rugged 4 and 5 digit indicators are similar to the rugged BA307E-SS and BA327E-SS, but have larger displays. They have a cast 316 stainless steel front panel with a toughened glass window, the joint between the instrument case and the panel enclosure in which the indicator is mounted is sealed with a silicone gasket. After high and low temperature thermal endurance ageing followed by impact testing at below the minimum and above the maximum service temperature, notified body Certification Management Ltd issued component certificates 18ATEX3128U and 29U and IECExCML18.0071U confirming that the front of the enclosure provides IP66 ingress protection and complies with Ex e, Ex p and Ex t impact and ingress requirements. These ATEX and IECEx component certificates supplement the Ex ia intrinsic safety certificates for the indicators ITS11ATEX27253X and IECEx ITS11.0014X.

#### 9.2.1 Installation in an Ex e panel enclosure

Installation of a BA304G-SS-PM or BA324G-SS-PM indicator in an Ex e IIC Gb increased safety panel enclosure does not invalidate the Ex e panel's certification, but the indicator remains Group II Category 1G Ex ia IIC T5 Ga intrinsically safe apparatus, therefore it must be powered via a Zener barrier or galvanic isolator as described in section 7 of this guide.

The Zener barrier or galvanic isolator is usually installed in the safe area but some intrinsically safe interfaces are certified for mounting within a protective enclosure located in Zone 2 which may permit them to be mounted in the same Ex e enclosure as the rugged indicator. Where the Zener barrier or galvanic isolator may be located is defined by its ATEX EU-Type Examination certificate or IECEx Certificate of Conformity. Zener barriers and galvanic isolators are not permitted in Ex e enclosures located in Zone 1.

For personnel safety and prevention of an electrostatic charge, rugged indicators should be electrically connected to the panel enclosure in which they are mounted, or to a local bonding point if the panel enclosure is non-conductive. The indicator terminals, the wiring to the indicator and the intrinsically safe interface, if mounted within the enclosure, should be segregated from all other non-intrinsically safe wiring and equipment within the panel enclosure. Required segregation distances are defined in standards EN 60079-11 *Equipment protected by intrinsic safety* and EN 60079-14 *Electrical installations design, selection and erection*. Terminals for intrinsically safe circuits should be segregated by at least 50mm from terminals for non-intrinsically safe circuits and from bare electrical conductors.

The intrinsically safe terminals and wiring should be identified and if live maintenance is to be performed any bare live non-intrinsically safe parts within the panel enclosure should be covered and labelled 'Non-intrinsically safe circuit' to prevent accidental contact.

Installation of a BA304G-SS-PM or BA324G-SS-PM rugged indicator in an Ex e panel enclosure located in Zone 1 or 2 is shown in Fig 15. The 4/20mA cable should be sealed with an Ex e certified gland where it enters the Ex e panel enclosure and the cable screen should be earthed to a common point in the safe area such as the plant's equipotential conductor, or to the Zener barrier busbar when barriers are used. To prevent fault currents from other equipment installed in the Ex e enclosure flowing to earth via this cable screen, it should be insulated in the hazardous area and should not be connected to the Ex e enclosure.

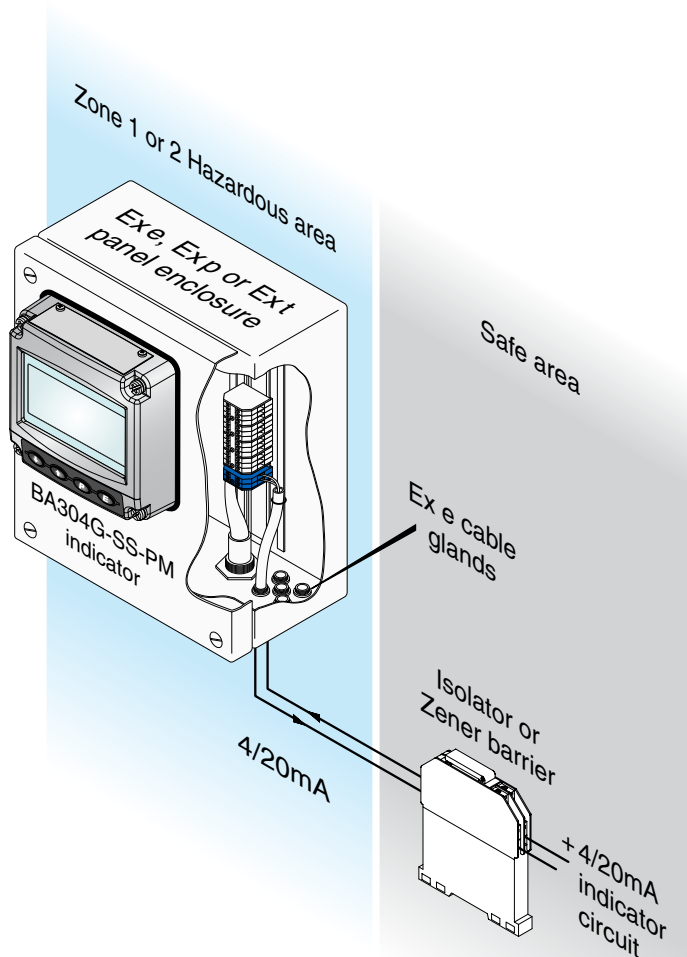


Fig 15 Typical installation in an Ex e, Ex p or Ex t panel enclosure

The power dissipation within an indicator fitted with operational alarms and a backlight which is separately powered is normally about 350mW, in the very unlikely event that all four circuits fail to the worst case condition at the same time, the total power dissipation rises to 3.4W which could raise the internal temperature of a small thermally well insulated panel enclosure.

For personnel safety and to prevent the accumulation of an electrostatic charge, the stainless steel front panel should be electrically connected to the panel enclosure in which the indicator is mounted by fitting a ring tag under one of the four rear of panel fixing screws.

### 9.2.2 Installation in an Ex p panel enclosure

Installation of a rugged BA304G-SS-PM or BA324G-SS-PM indicator in an Ex p panel enclosure does not invalidate the Ex p panel enclosure's ingress or impact protection as the front of the rugged indicators comply with the Ex p ingress and impact requirements.

Unlike the smaller BA307E-SS and BA327E-SS rugged indicators, the front panel push button contacts of the BA304G-SS-PM and BA324G-SS-PM are within the rugged indicator, and hence inside of the pressurised panel enclosure. Therefore, when installed in a Ex pxb or Ex pyz pressurised enclosure which reduces the equipment protection level EPL inside the enclosure to non-hazardous, a rugged BA304G-SS-PM or BA324G-SS-PM indicator does not require protection by a Zener barrier, galvanic isolator or intrinsically safe output from associated apparatus. The installation should comply with requirements of IEC 60079-2 *Equipment protection by pressurised enclosure*.

For personnel safety and to prevent the accumulation of an electrostatic charge, the stainless steel front panel should be electrically connected to the panel enclosure in which the indicator is mounted by fitting a ring tag under one of the four rear of panel fixing screws.



### 9.2.3 Ex pyb enclosure

When pressurised, an Ex pyb enclosure reduces the equipment protection level (EPL) inside the enclosure from Gb (Zone 1) to Gc (Zone 2). When correctly installed in an Ex pyb enclosure the indicator should be powered by an appropriately rated Zener barrier or galvanic isolator located in a safe area

### 9.2.4 Ex pxb enclosure

When pressurised, an Ex pxb enclosure reduces the equipment protection level (EPL) inside the enclosure from Gb (Zone 1) to non-hazardous. When correctly installed in an Ex pxb enclosure the indicator may therefore be used without a Zener barrier or galvanic isolator.

### 9.2.5 Ex pzc enclosure

When pressurised, an Ex pzc enclosure reduces the equipment protection level (EPL) inside the enclosure from Gc (Zone 2) to non-hazardous. When correctly installed in an Ex pzc enclosure the indicator may therefore be used without a Zener barrier or galvanic isolator.

## 9.3 Installation in an Ex t panel enclosure

Installation of a BA304G-SS-PM or a BA324G-SS-PM rugged indicator in a certified Ex t (dust ignition protection by enclosure) panel enclosure does not invalidate the Ex t panel's impact and ingress protection as the front of both indicators comply with Ex t impact and ingress requirements.

Unlike the BA307E-SS and BA327E-SS indicators, the front panel push button contacts of the BA304G-SS-PM and BA324G-SS-PM are within the rugged indicator, and hence inside the Ex t panel enclosure. Therefore when installed in an Ex t enclosure a rugged BA304G-SS-PM or BA324G-SS-PM indicator does not require protection by a Zener barrier, galvanic isolator or intrinsically safe output from associated apparatus but should comply with requirements of IEC 60079-31 Equipment dust ignition protection by enclosure.

The 4/20mA cable should be sealed by a gland where it enters the Ex t enclosure and the cable screen should be earthed in the safe area to a common point such as the plant's equipotential conductor. To prevent fault currents from other equipment installed within the Ex t enclosure flowing to earth via this cable screen the screen should be insulated in the hazardous area and should not be connected to the Ex t enclosure.

For personnel safety and to prevent the accumulation of an electrostatic charge, the stainless steel front panel should be electrically connected to the panel enclosure in which the indicator is mounted by fitting a ring tag under one of the four rear of panel fixing screws.