APPLICATION GUIDE AG334

BA334D and BA338C intrinsically safe Externally powered rate totalisers

1. Introduction

This application guide describes the BA334D and BA338C intrinsically safe externally powered rate totalisers that have ATEX and FM certification. They may be installed in all hazardous areas and be used with almost any pulse output flowmeter to provide an accurate display of the flow rate and the total flow. They are just two of the instruments in this range of five externally powered instruments – see Table 1.

The other models have identical functions but are intended for use in Zone 2 without barriers or isolators, or for use in non hazardous areas.

For applications where a power supply is not available, the BA344D is a battery powered field mounting intrinsically safe rate totaliser which has similar features as the externally powered model described in this application guide. The BA344D datasheet may be downloaded from the BEKA web site at www.beka.co.uk

For use with flowmeters having a 4/20mA analogue output, a complementary range of loop powered rate totalisers are described in Application Guide AG354.

2. Description

The BA334D and BA338C are functionally identical, differing only in their enclosures. The BA334D is housed in a rugged IP66 GRP field mounting enclosure with a separate terminal compartment. The BA338C is housed in a 144 x 72mm DIN panel mounting enclosure with an IP65 front.

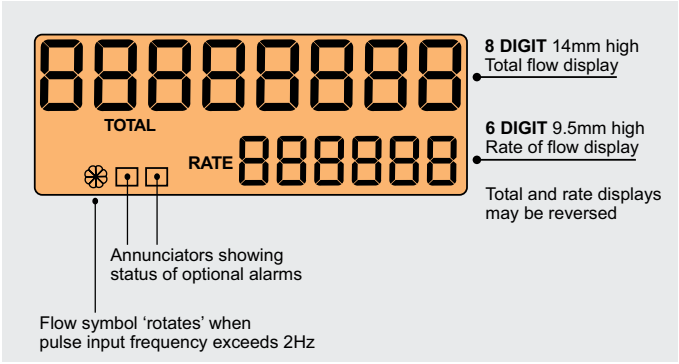


Fig 1 instrument display

These instruments simultaneously display rate and total flow on the high contrast liquid crystal display shown in Fig 1. Rate and total may be in the same or different engineering units and the total display can be reset to zero locally, or by closure of a remote switch.

The BA334D and BA338C comply with the European ATEX Directive and have been certified as intrinsically safe Group II Category 1G equipment EEx ia IIC T5 allowing installation in all Zones and use with all gas groups.

Subject to a few simple rules, pulses from almost any hazardous area source may be counted. These include transducers with voltage outputs, magnetic pick-offs, switch contacts, proximity detectors and open collector transistors.

Model	BA334D	BA338C	BA334ND	BA534D	BA538C
					
Mounting & enclosure	Field GRP	Panel 144 x 72	Field GRP	Field GRP	Panel 144 x 72
Protection	IP66 & NEMA 4X	IP65 front IP20 rear	IP66	IP66	IP65 front IP20 rear
Separate terminal compartment	Yes	No	Yes	Yes	No
Displays	Rate 6 digits 9.5mm high Total 8 digits 14mm high } can be reversed				
Certification Europe	ATEX Group II Category 1GD EEx ia IIC T5	ATEX Group II Category 1G EEx ia IIC T5	ATEX Group II Category 3GD EEx nL IIC T5	Not Certified	
USA	FM 3610 Intrinsic safety FM 3611 Nonincendive		Not Certified		
Options					
ATEX dust certification	Yes	No	Yes	N/A	N/A
Backlight	Yes	Yes	Yes	Yes	Yes
Pulse output	Yes	Yes	Yes	Yes	Yes
4/20mA output	Yes	Yes	Yes	Yes	Yes
Alarms	Yes	Yes	Yes	Yes	Yes
External keypad	Yes	Standard	Yes	Yes	Standard

Table 1: All the models in this range of instruments

A wide range of options are available including alarms, a pulse output proportional to total flow and an analogue 4/20mA output proportional to flow rate. All the optional outputs are isolated. To improve display contrast when installed in poorly illuminated areas, all models can be supplied with an optional separately powered backlight.

3. Intrinsic Safety Certification

All the instruments in this range have been designed for easy installation and programming. This includes easy system design for the two intrinsically safe models, where the use of terminals complying with the requirements for simple apparatus allows direct connection to a wide range of barriers, isolators and flowmeters. Although this Application Guide explains the simple interconnection rules, experienced BEKA engineers are always available to provide system design assistance by 'phone, fax or e-mail.

3.1 ATEX certification

The BA334D and BA338C comply with the European ATEX Directive 94/9/EC and have been issued with Group II, Category 1G EEx ia IIC T5, EC-Type Examination certificates. Subject to local codes of practice, both instruments may be installed in any of the European Economic Area (EEA) member countries. ATEX certificates are also acceptable for installations in Switzerland.

This guide describes installations which comply with BS EN60079: Part14:2003 Electrical Installation in Hazardous Areas. When designing systems for installation outside the UK, the local Code of Practice should be consulted.

3.1.1 Zones, gas groups and T rating

The BA334D and BA338C have been issued with EC-Type Examination Certificates confirming that they comply with the requirements for Group II Category 1 G EEx ia IIC T5 (Tamb -40 to 60°C) equipment specified in the ATEX Directive.

When connected to a suitable system these rate totalisers 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

At an ambient temperature between -40 and +60°C.

Note: Although certified as intrinsically safe between -40 and +60°C, the guaranteed operating temperature range of the BA334D and BA338C is -20 to +60°C

3.1.2 Power supply

When installed in a hazardous area the BA334D and BA338C must be powered via a Zener barrier or a galvanic isolator from a dc supply located in the safe area. Any Zener barrier or galvanic isolator certified EEx ia by an EC Notified Body, having output safety parameters equal to or less than:

Uo	=	28V dc
Io	=	100mA dc
Po	=	0.7W

may be used to power the instrument.

The maximum equivalent internal capacitance and inductance between terminals 1 and 2 is:

Ci	=	20nF
Li	=	20µH

To determine the maximum permissible cable parameters the above figures should be subtracted from the maximum permitted cable parameters specified for the Zener barrier or galvanic isolator powering the rate totaliser.

3.1.3 Pulse input terminals

The BA334D and BA338C rate totalisers have two pairs of input terminals enabling the instruments to count pulses from a wide variety of sources, but only one pair of input terminals may be used at one time.

3.1.4 Voltage pulse input

Terminals 3 and 4 are intended for connection to a voltage pulse source. 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 020:2002).

Although the BA334D and BA338C do not themselves comply with the requirements for simple apparatus, the EC-Type Examination Certificate specifies that under fault conditions the voltage, current and power at terminals 3 & 4 will not exceed those specified for simple apparatus.

This allows these input terminals to be connected to any certified intrinsically safe apparatus or circuit providing that the output parameters of the apparatus or circuit do not exceed:

Uo	=	28V dc
Io	=	100mA dc
Po	=	0.7W

The certified intrinsically safe voltage pulse output of a flowmeter mounted in a hazardous area, or the output of a certified magnetic pick-off mounted in a hazardous area may be connected directly to these terminals providing:

The output parameters of the device do not exceed the figures shown above.

The device and associated wiring can withstand a 500V rms insulation test to earth for one minute.

The EC-Type Examination Certificates for the BA334D and BA338C specify that the maximum equivalent capacitance and inductance between the two pulse input terminals 3 and 4 is:

Ci	=	20nF
Li	=	20µH

Again to determine the maximum permissible cable parameters these figures must be subtracted from the maximum permitted cable parameters specified for the device connected to terminals 3 and 4.

3.1.5 Contact, 2-wire proximity detector or open collector inputs

Terminals 5 and 6 are intended for connection to a switch contact, a certified open collector output or a certified intrinsically safe 2-wire NAMUR proximity detector. The output safety parameters of these rate totalisers terminals are:

Uo	=	10.5V dc
Io	=	9.2mA dc
Po	=	24mW

and the maximum permitted external capacitance and inductance is:

Co	=	2.41µF
Lo	=	250mH

Switch contacts which are mechanically operated and together with associated wiring can withstand a 500V rms insulation test to earth for one minute comply with the requirements for simple apparatus. Providing the switch and the rate totaliser are both located in the same hazardous area, the switch may be connected directly to input terminals 5 and 6. This also applies to most magnetically operated reed switches used in turbine flowmeters.

Similarly, certified intrinsically safe open collector outputs and optical isolators may be directly connected to input terminals 5 and 6.

Most certified intrinsically safe 2-wire proximity detectors may also be connected directly to terminals 5 & 6 of the rate totaliser, providing that the input safety parameters of the detector are greater than the output parameters of the rate totaliser input terminals 5 & 6.

If the transducer is in the safe area and the rate totaliser is in a hazardous area, a barrier or isolator is required between the input terminals and the transducer.

The maximum input safety parameters for the rate totaliser input terminals 5 & 6 are:

Ui	=	28V dc
Ii	=	100mA dc
Pi	=	0.7W

and the internal capacitance and inductance is:

Ci	=	20nF
Li	=	20µH

The Zener barrier or galvanic must have output parameters equal to or less than the rate totaliser input parameters shown above. Ci and Li should be subtracted from cable parameters permitted by the barrier or isolator certificate.

3.1.6 Remote reset terminals

The instrument total display may be reset to zero by momentarily connecting the reset terminals 7 and 8 together. These two terminals have the following input and output safety parameters:

Uo	=	3.8V dc
Io	=	1.6mA dc
Po	=	2.0mW

Ui	=	28V dc
Ii	=	100mA dc
Pi	=	0.7W

The maximum equivalent internal capacitance and inductance C_1 and L_1 are effectively zero.

The total display may be reset to zero from within the hazardous area by mechanically operated switch connected directly to terminals 7 and 8. This switch and associated wiring must be able to withstand a 500V rms insulation test to earth for one minute.

To reset the total display from the safe area a Zener barrier or intrinsically safe relay is required to transfer the contact closure into the hazardous area. Almost any intrinsically safe relay with certification permitting the contacts to be connected to equipment in the hazardous area may be used.

A positive diode return Zener barrier may also be used as shown in Fig 2. Any certified diode return barrier may be used providing it introduces a voltage drop of less than 0.9V

For guidance the system certificates list suitable devices and define the maximum cable parameters.

Note: The BA334D and BA338C may be programmed so that the total display can be reset to zero when the Up and Down push-buttons are operated simultaneously.

3.6 Optional combustible dust certification

The BA334D field mounting rate totaliser is available with optional ATEX Group II Category 1D EEx ia IIC T5 approval, permitting use in the presence of combustible dusts. The permitted ambient temperature range is -20 to +60°C which is slightly less than for flammable gas certification, and the maximum instrument surface temperature is 80°C.

When installed as specified by Part 14 of EN 61241-14:2004 'Selection and installation of electrical apparatus for use in presence of combustible dust' the BA334D may be used 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 indicator up to 5mm thick	155°C
Dust layer on indicator over 5mm thick	Refer to EN61241-14:2004 Part 14

At ambient temperatures between –20 and +60°C

3.2 FM Approval

The BA334D and BA338C rate totalisers and accessories have been approved intrinsically safe and nonincendive by Factory Mutual. Users should refer to the FM listing, Certificate of Conformity and the BEKA Control Drawing which can be downloaded from the BEKA web site at www.beka.co.uk.

3.2.1 Intrinsic safety

All FM intrinsic safety installations must comply with the appropriate BEKA associates Control Drawing, ANSI/ISA RP 12.06.01 'Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations' and the National Electrical Code ANSI/NFPA 70.

Most of the FM intrinsic safety parameters are identical to, or virtually identical to the ATEX parameters shown in section 3.1 of this Application Guide. This allows all the recommended circuits shown in this guide to also be used for FM installations providing the Zener barriers or the galvanic isolators are FM approved and comply with the FM specified safety parameters for the rate

totaliser. However, when documenting an FM installation reference should be made to the FM Certificate of Conformity for the exact parameters.

3.2.2 Classes, Divisions, Gas Groups and T Rating

The field mounting rate totaliser may be used with Class I, II & III hazards, but the panel mounting model may only the used with Class I hazards i.e. gases and vapours.

BA334D field mounting rate totaliser

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

BA338C panel mounting rate totaliser

Intrinsic Safety	Nonincendive
Division 1 and 2	Division 2
Class I Group A, B, C & D	Class I Group A, B, C & D

The FM temperature rating of the BA334D and BA338C is T4 at ambient temperatures between -40 and +60°C.

Note: Although certified intrinsically safe between -40 and +60°C the guaranteed operating temperature range of the BA334D and BA338C is -20 to +60°C.

Before installation reference should be made to the BEKA Control Drawing and the instrument FM Certificate of Compliance.

3.2.3 Nonincendive approval

Both the BA334D and BA338C have also been FM approved as Nonincendive Field Wiring Apparatus permitting installation in Division 2 without Zener barriers or galvanic isolators. The BA334D field mounting model has Class I, II & III approval and may be used with all hazards, the panel mounting BA338C is only approved for use with Class I hazards i.e. gases and vapours.

Detailed installation requirements are defined by the BEKA Control Drawing CI330-34 that is appended to the FM Approval Certificate of Compliance, which may be downloaded from www.beka.co.uk.

The installation must be in accordance with the National Electrical Code ANSI/NFPA 70.

The BA334D or BA338C may be connected to other FM certified Nonincendive Field Wiring Apparatus and Simple Apparatus in Division 2 subject to entity concept requirements.

The BA334D or BA338C may be connected to FM certified Associated Nonincendive Field Wiring Apparatus located in an unclassified location subject to entity concept requirements.

Any wiring method permitted for unclassified locations may be used.

4. Hazardous Area System Design

Designing rate totaliser systems for use in hazardous areas is not difficult. This Application Guide explains the simple interconnection rules, but if help is required experienced BEKA engineers are always available to provide system design assistance by 'phone, fax or e-mail.

The circuits recommended in this section apply to both ATEX and FM installations providing Zener barriers or galvanic isolators are approved by the appropriate authority and the installation complies with the local code of practice.

4.1 System Certificates of Conformity

In addition to the ATEX EC-Type Examination Certificate, Notified Body ITS have issued two system Certificates of Conformity. One defines how the BA334D and BA338C may be used with Zener barriers and the other with galvanic isolators. Both are divided into two sections to cover input signal sources in the hazardous and in the safe area.

Interface	Certificate No
Zener barriers	Ex01E2005
Galvanic isolators	Ex01E2006

These system Certificates of Conformity are not part of the ATEX certification, but they do provide a useful guide to acceptable systems as they identify specific barriers and isolators which may be used. Copies of these certificates are available from BEKA.

4.2 Use with Zener barriers

Zener barriers are the least expensive intrinsically safe interface between a safe and hazardous area. However they do not provide isolation and require a high integrity earth connection that may be expensive to install. For a single rate totaliser installation, it is probably less expensive and complicated to use galvanic isolators when a high integrity earth connection is not already available.

Any Zener barriers certified EEx ia by a EU Notified Body may be used with the BA334D and BA338C, providing that the output parameters of the barrier do not exceed the input parameters of the rate totaliser terminals to which it is connected. Only one polarity of Zener barrier i.e. positive or negative, may be connected to each rate totaliser. All wiring and transducers, unless earthed, must be able to withstand a 500V rms insulation test for one minute.

Fig 2 illustrates the basic circuit that is used for all BA334D and BA338C installations protected by Zener barriers. The pulse source may also be located in the safe area. Fig 3 shows how an additional Zener barrier may be used to transfer the signal to the rate totaliser in the hazardous area.

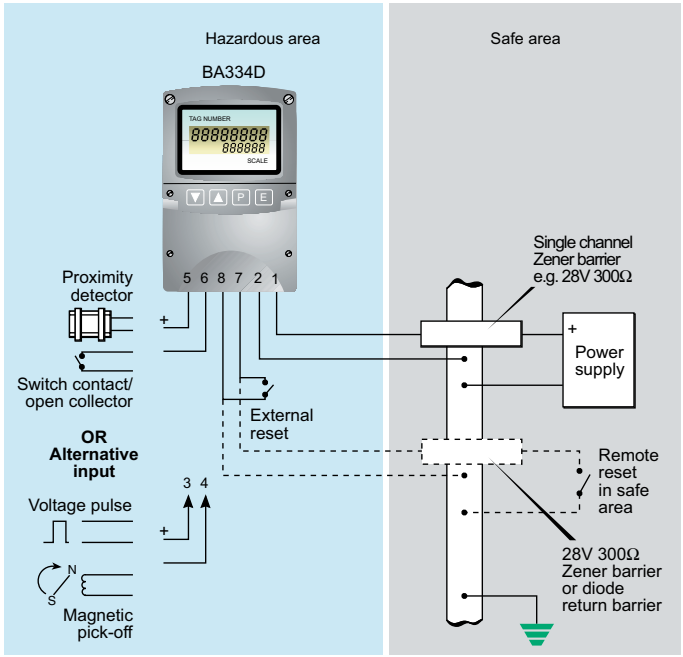


Fig 2 BA334D used with zener barriers

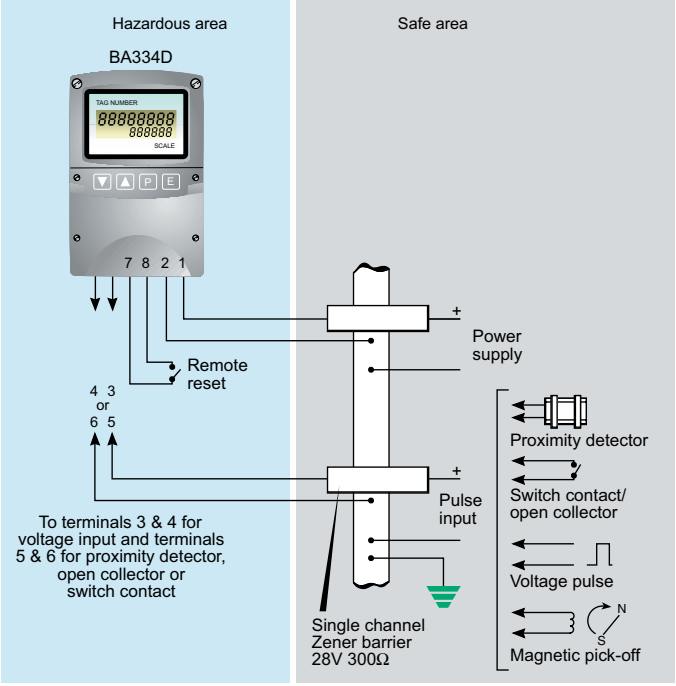


Fig 3 Pulse source in safe area

When designing a system it is important to remember that terminals 2, 4, 6 and 8 are interconnected within the rate totaliser.

For simplicity, connections for the optional pulse output, 4/20mA output and backlight are shown in separate sections at the end of the guide.

4.2.1 Power supply

Rate totalisers are usually powered from the safe area via a positive polarity 28V 300Ω Zener barrier that will have an end-to-end resistance of about 340Ω. When used with a proximity detector the BA334D or BA338C consume approximately 25mA and require a minimum voltage of 10V between terminals 1 and 2. The supply voltage in the safe area must therefore be between 18.5V and the maximum working voltage of the Zener barrier - usually about 26V.

4.2.2 Pulse inputs

As shown in Fig 2 externally powered rate totalisers will count pulses from a wide variety of sources in the hazardous area, or from the safe area as shown in Fig 3. Terminals 3 and 4 are for voltage pulse inputs. Terminals 5 and 6 are for pulse sources that need powering such as a switch, an open collector transistor or a 2-wire NAMUR proximity detector.

Note: For reliable counting only one input may be used at a time. i.e pulses can not be counted at terminals 3 & 4 and at 5 & 6 at the same time.

No Zener barrier is required in series with the input if the intrinsically safe pulse source is located within the hazardous area. e.g. a certified magnetic pick-off or proximity detector.

4.2.3 Switch contact input

Any mechanically activated switch contact located in the hazardous area may be directly connected to terminals 5 & 6, providing the switch and associated wiring can withstand a 500V rms insulation test to earth. This includes most magnetically activated reed relays used in turbine flowmeters. The BA334D and BA338C contain filtering to prevent contact bounce being counted, this limits the maximum operating frequency of a rate totaliser to 100Hz when programmed to operate with a switch contact.

4.2.4 2-wire proximity detector input

Any certified intrinsically safe 2-wire proximity detector complying with NAMUR switching thresholds may be used, providing its input safety parameters are greater than the rate totaliser's output safety parameters at terminals 5 & 6. The system certificates list some of the acceptable detectors, but any compliant device may be used.

When programmed to operate with a proximity detector, the rate totaliser's maximum counting frequency is 5kHz.

4.2.5 Voltage pulse input

Voltage pulse sources should be connected to terminals 3 and 4. These terminals comply with the requirements for simple apparatus and may be directly connected to any certified intrinsically safe voltage source within the hazardous area which can withstand a 500V rms insulation test to earth for one minute and has output parameters equal to or less than:

Uo	=	28V dc
Io	=	100mA dc
Po	=	0.7W

This enables the BA334D and BA338C to be connected directly to most flowmeters incorporating a certified intrinsically safe magnetic pick-off, or a certified intrinsically safe amplifier producing a high level pulse output.

The maximum voltage pulse counting frequency is 5kHz.

4.2.6 Remote reset

The rate totaliser's total display may be reset to zero by temporarily connecting terminals 7 & 8 together. Permanent interconnection will inhibit totalisation. Remote resetting may be accomplished by any mechanically operated switch located in the hazardous area providing it can withstand a 500V rms insulation test to earth. No Zener barrier is required.

The total display may also be reset to zero from the safe area. Any switch may be used, but a Zener barrier is required to transfer the contact closure into the hazardous area. A positive diode return barrier having a voltage drop of less than 0.9V is ideal and may be combined with the supply barrier so that only one package is required. The system certificate identifies some suitable devices. Fig 2 illustrates how the BA334D and BA338C may be reset from both the safe and the hazardous area.

Note: Both rate totalisers may be programmed to reset the total display to zero when the up and down push-buttons are operated simultaneously for more than 2 seconds.

4.3 Use with Galvanic Isolators

Galvanic isolators are probably the most convenient intrinsically safe interface as they provide isolation and do not require a high integrity earth connection. However they are more expensive than Zener barriers.

Any galvanic isolator certified EEx ia by a EU Notified Body may be used with the BA334D and BA338C rate totalisers, providing that the output parameters of the isolator do not exceed the input parameters of the rate totaliser terminals to which it is connected. For guidance the BA334D and BA338C system certificates list some suitable devices together with the maximum permitted cable parameters.

Fig 4 illustrates the basic circuit that is used for all rate totaliser installations protected by galvanic isolators. For simplicity, connections for the optional pulse output, 4/20mA output and backlight are shown separate sections at the end of this guide.

The pulse source may also be located in the safe area. Fig 5 shows how an additional galvanic isolator is used to transfer the signal to the rate totaliser in the hazardous area.

4.3.1 Power supply

Any galvanic isolator certified EEx ia by an EU Notified Body may be used to power the rate totaliser, providing its output parameters are less than the input parameters of terminals 1 & 2. The isolator

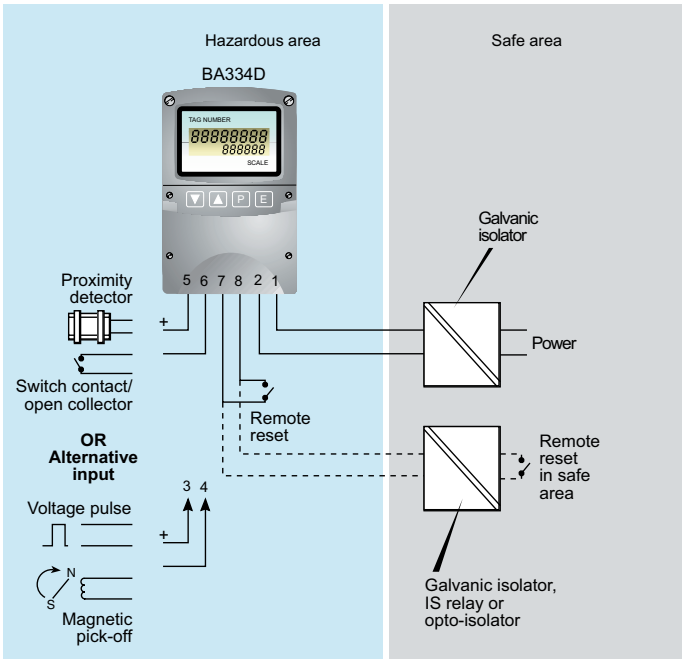


Fig 4 BA334D used with galvanic isolators

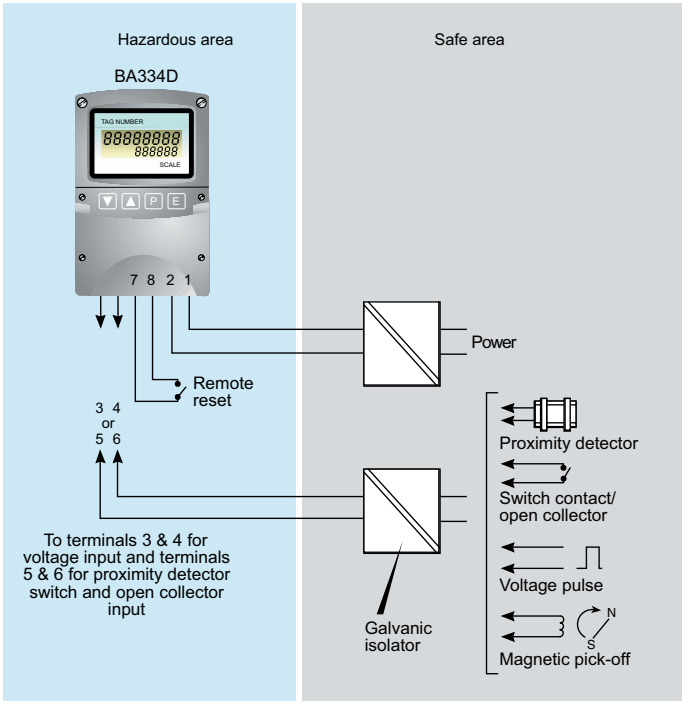
must be capable of supplying at least 25mA at 10Vdc to the rate totaliser, as shown in Fig 4.

4.3.2 Pulse inputs

As shown in Fig 4 rate totalisers will count pulses from a wide variety of sources in the hazardous area, or from the safe area as shown in Fig 5. Terminals 3 and 4 are for voltage pulse inputs. Terminals 5 and 6 are for pulse sources that need powering such as a switch, an open collector transistor or a 2-wire NAMUR proximity detector.

4.3.3 Switch contact input

Any mechanically activated switch contact located in the hazardous area may be directly connected to terminals 5 & 6 providing the switch and associated wiring can withstand a 500V rms insulation test to earth for one minute. This includes most magnetically activated reed relays used in turbine flowmeters. The BA334D and BA338C rate totalisers contain filtering to prevent contact bounce being counted. This limits the maximum operating frequency for a switch contact input to 100Hz.



4.3.4 2-wire proximity detector input

Any certified intrinsically safe 2-wire proximity detector complying with NAMUR switching thresholds may be used, providing the input safety parameters are greater than the rate totaliser's output safety parameters of terminals 5 & 6. Again the system certificates list some of the acceptable detectors, but any compliant device may be used.

When programmed to operate with a proximity detector, the rate totaliser's maximum counting frequency is 5kHz.

4.3.5 Voltage pulse input

Voltage pulse sources should be connected to terminals 3 and 4. These terminals comply with the requirements for simple apparatus and may be directly connected to any certified intrinsically safe voltage source within the hazardous area which can withstand a 500V rms insulation test to earth for one minute and has output parameters equal to or less than:

Uo	=	28V dc
Io	=	100mA dc
Po	=	0.7W

This enables the BA334D and BA338C to be connected directly to most flowmeters incorporating a certified intrinsically safe magnetic pick-off, or a certified intrinsically safe amplifier producing a high level pulse output.

The maximum voltage pulse counting frequency is 5kHz.

4.3.6 Remote reset

The total display is reset to zero when terminals 7 & 8 are momentarily connected together. Permanent interconnection inhibits totalisation. Remote resetting may be accomplished by any mechanically operated switch located in the hazardous area providing it can withstand a 500Vrms insulation test to earth for one minute. No galvanic isolator is required.

The rate totaliser may also be reset to zero from the safe area. Any switch may be used but a galvanic isolator or intrinsically safe relay is required to transfer the contact closure into the hazardous area. Fig 4 illustrates how the BA334D or a BA338C may be reset from both the safe and the hazardous area.

Note: Both rate totalisers may be programmed to reset the total display to zero when the up and down push-buttons are operated simultaneously for more than two seconds.

5. Location

5.1 BA334D field mounting rate totaliser

The BA334D field mounting rate totaliser is housed in a glass reinforced polyester enclosure (GRP) with silicone gaskets and a separate terminal compartment. This enclosure has been independently tested in the UK and the USA and reports are available confirming that it provides IP66 and NEMA 4X protection. Copies may be downloaded from the BEKA web site at www.beka.co.uk. The enclosure has a toughened glass window and stainless steel fitting making it suitable for use in marine and corrosive environments. Sealing will not be degraded by a 3.5 Joule impact (1kg dropped through 35cm) even after the enclosure has been operated at 90°C for 14 days. Enclosures with optional combustible dust approval will withstand a 7 Joule impact after 28 days at 90°C.

The BA334D field mounting rate totaliser is very robust and provided it is correctly installed will provide satisfactory performance in most industrial environments. Three entries are provided in the base of the enclosure. The ATEX version has M20 x 1.5 tapped holes to accept glands or treaded conduit. FM approved instruments have plain 22.25 diameter holes. Unused entries should be fitted with an appropriate sealing plug.

5.2 BA338C panel mounting rate totaliser

The panel mounting instrument has an IP65 sealed front and is supplied with a gasket to seal the joint between the instrument and the panel into which it is mounted. The rear of instrument has IP20 protection so it should be located where liquids and condensates are not present.

When correctly installed in an instrument panel, cubicle on box, the front of the BA338C will have IP65 protection and may be cleaned with a low pressure hose. It is not recommended that the rate totaliser front panel is permanently exposed to severe exterior environments unless additional protection is provided.

6. Programming

Both the BA334D and BA338C are easy to programme on-site via the four control push-buttons. No test equipment or programmer is required. To further simplify installation, BEKA will supply rate totalisers programmed to customers requirement for no additional charge. The rate and total display calibration functions are totally independent allowing the displays to have different engineering units.

6.1 Summary of programmable functions

The following instrument parameters may by adjusted via the programme menu, which may be protected by a security code to prevent accidental adjustment.

Display update time
Allows the interval between display updates to be selected.

Type of input
Enables one of five types of input to be selected:
- Voltage pulse
- Magnetic pick-off
- NAMUR proximity detector
- Switch contact
- Open collector

Decimal points
Defines the position of the decimal point in both the rate and total displays and enables the rate and total displays to be interchanged.

Rate Scale Factor
Defines the arithmetic relationship between the pulse input frequency and the rate display.

Timebase
Selectable multiplier to display flow rate in units per second, per minute or per hour.

Rate filter
Adjustable digital filter to reduce noise on the rate display.

Total Scale Factor
Defines the arithmetic relationship between the number of input pulses and the total display.

Clip-off
To prevent the totalisation of very low flow rates, clip-off enables the user to select a flow rate below which totalisation is inhibited.

Local reset of total display
When turned 'On' the total display may be reset to zero from the display mode by simultaneously operating the Up and Down push-buttons for more than two seconds.

Clear grand total
This function resets the grand total to zero.

Security code
Defines a four digit numeric code which must be entered to gain access to the programmable functions. Default code 0000 disables the security function and allows unrestricted access to all programmable functions.

7. Accessories

This section explains how to use the optional factory fitted accessories which extend the application of these instruments.

7.1. Alarms

The BA334D and BA338C can be supplied with two single pole solid state alarm outputs. Each may be programmed as a high or a low rate or total alarm with a normally open or closed "contact".

Each alarm output is galvanically isolated and complies with the requirements of simple apparatus - see Fig 6. It may be used to switch any dc intrinsically safe circuit protected by a Zener barrier or galvanic isolator with output parameters not exceeding:

Uo	=	28V dc
Io	=	200mA dc
Po	=	0.85W

Alarm annunciators on the instrument display show the status of both alarms.

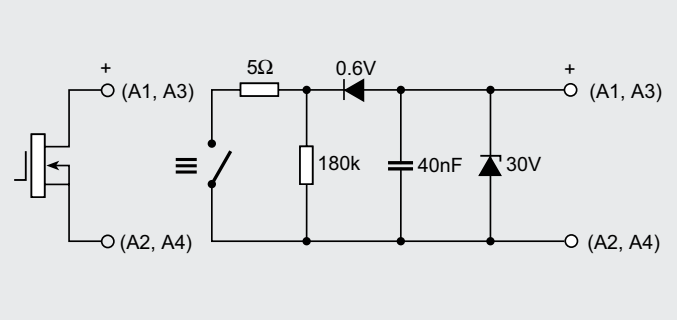


Fig 6 Equivalent circuit of each alarm output

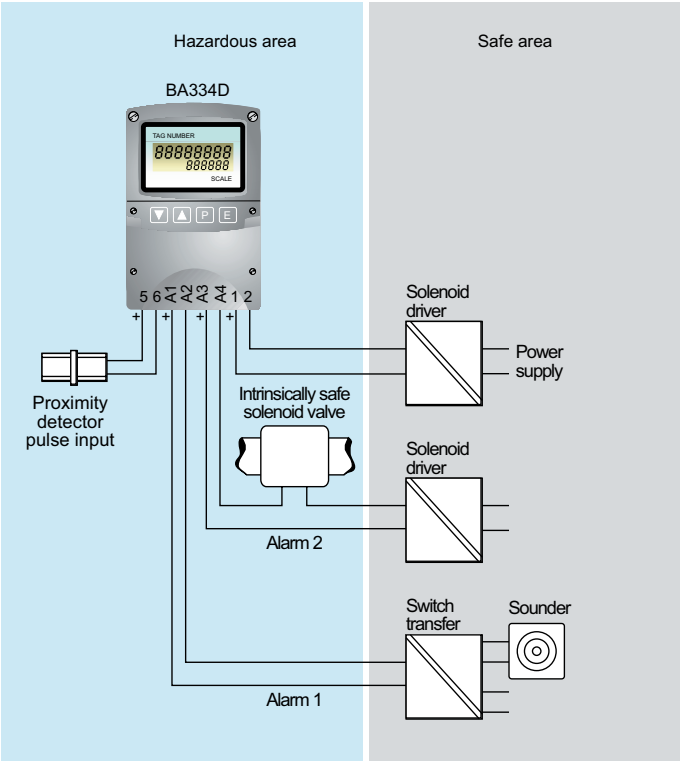


Fig 7 Typical alarm application

The equivalent capacitance and inductance of each alarm output is:

Ci	=	40nF
Li	=	30µH

To determine the maximum permissible cable parameters, these figures should be subtracted from the maximum cable capacitance and inductance permitted by the certificate for the circuit connected to each alarm.

Note: These alarms are not suitable for critical safety applications such as an emergency shut down system.

When the rate totaliser is not powered both alarm outputs will be open irrespective of programming.

7.2 Pulse Output

The BA334D and BA338C can be supplied with an optically isolated solid state pulse output which can be used to transmit the total flow to a remote instrument - see Fig 8. This output is a polarised current sink that closes for a programmable duration each time the least significant digit of the total display changes. A programmable divider enables the pulse output frequency to be reduced by 10, 100, 1,000 or 10,000.
The output complies with the requirements for simple apparatus and may be connected to any intrinsically safe circuit protected by a Zener barrier or galvanic isolator providing the output parameters do not exceed:

Uo	=	28V dc
Io	=	100mA
Po	=	0.7W

The maximum equivalent capacitance and inductance of the pulse output is:

Ci	=	20nF
Li	=	20µH

To determine the maximum permissible cable parameters, these figures should be subtracted from the maximum cable capacitance and inductance specified for the barrier or galvanic isolator connected to the pulse output terminals.

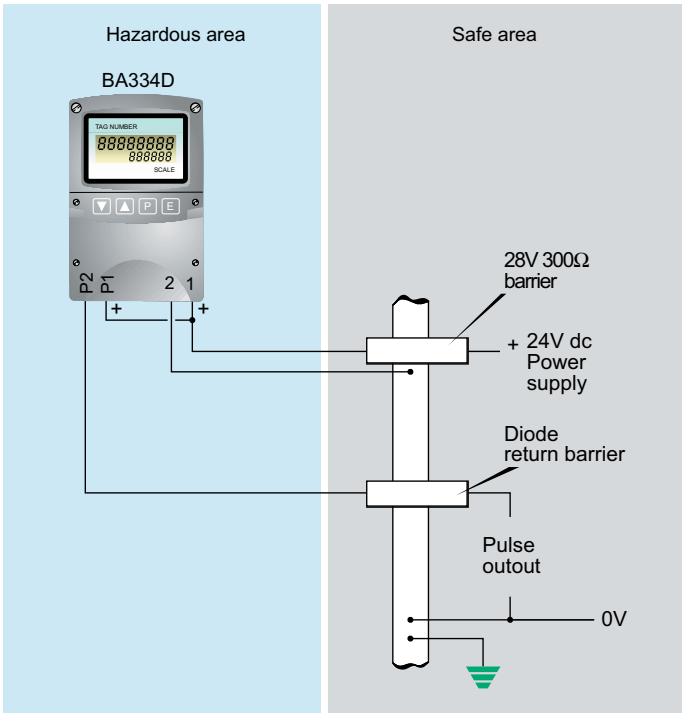


Fig 8 Application of pulse output

7.3. 4/20mA Output

The BA334D and BA338C can be supplied with an optically isolated 4/20mA current sink which may be programmed to produce

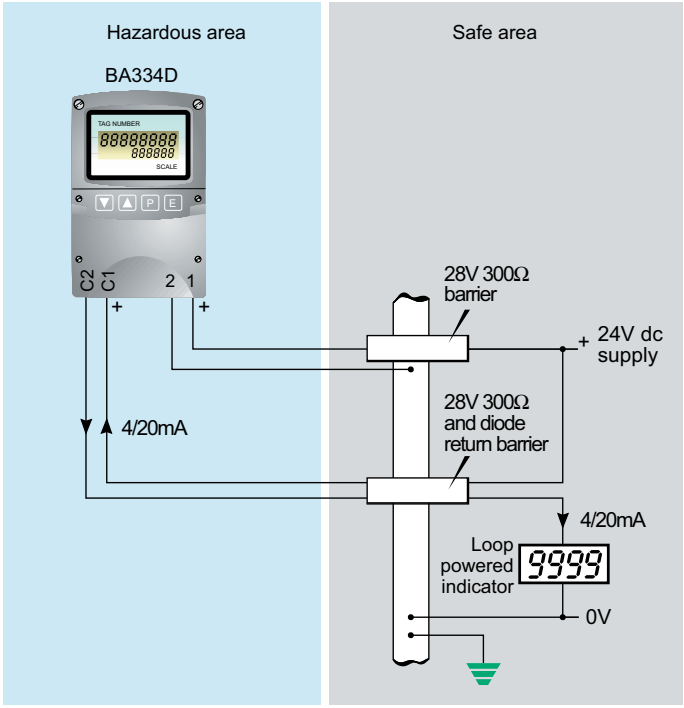


Fig 9 Driving remote 4/20mA indicators

an analogue output proportional to the whole or part of the rate display. The output may be connected to any intrinsically safe circuit protected by a certified Zener barrier or galvanic isolator providing the output parameters do not exceed:

Uo	=	28V dc
Io	=	100mA
Po	=	0.7W

As shown in Fig 9 this 4/20mA output can be used to transmit the rate of flow to remote instruments in the safe or hazardous areas.

7.4. Display Backlight

To improve display contrast when a rate totaliser is installed in a poorly illuminated area, the BA334D and BA338C can be supplied with an optional seperately powered backlight.

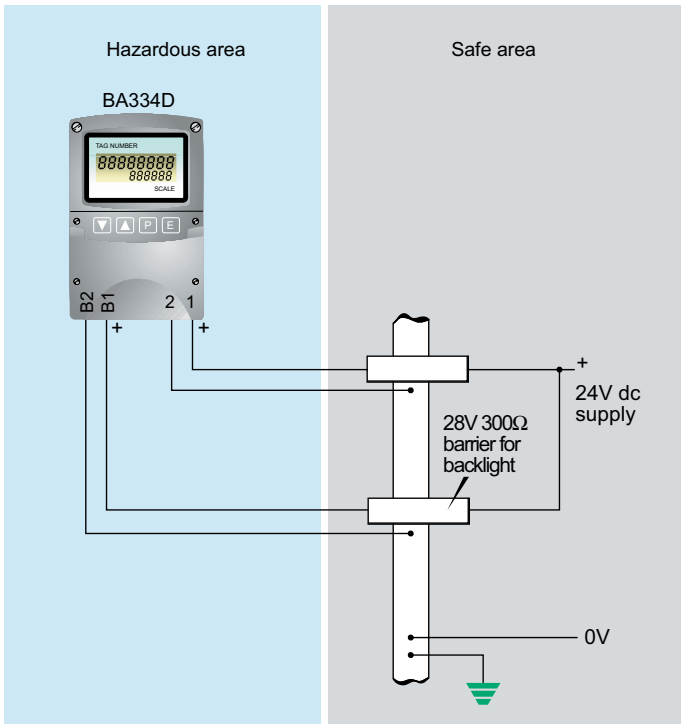


Fig 10 Backlight powered by Zener barrier

The backlight is powered from the safe area via a Zener barrier or a galvanic isolator as shown in Fig 10. Any certified Zener barrier or galvanic isolator may be used, providing the output parameters do not exceed:

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

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