BA377E
Single input
Intrinsically safe
Timer or Clock
Issue 2

Certification information label

Status output
annunciator

BEKA ⟨Ex⟩   **BA377E**

Elapsed or
remaining time

88:88:88
HRS   MINS   SECS

Scale card

RESET

RTx
1 2

88:88:88

Reset
annunciator

Lower
display

⟱   ⟰   P   E

Push buttons

Annunciators for
optional control outputs

CONTENTS

The BA377E is CE marked to show compliance with the European Explosive Atmospheres Directive 2014/34/EU and the European EMC Directive 2014/30/EU

1.   DESCRIPTION

The BA377E is an intrinsically safe, panel mounting instrument with a single input that can be configured as a Timer or as a Clock. As a Timer the BA377E is able to measure and display the elapsed time between external events, or control external events via two optional factory fitted control outputs.

When configured as a Clock, the instrument can display time in a variety of formats and the two optional control outputs may be configured to switch loads *on* and *off* at pre-set times.

This instruction manual is divided into sections.

The common features sections of this instruction manual describe ATEX certification for use in gas atmospheres.

For international applications the BA377E has IECEx gas certification which is described in Appendix 1.

For applications in the USA and Canada the BA377E has ETL and cETL certification which is described in Appendix 2.

This instruction manual supplements the abbreviated instruction sheet supplied with each instrument.

2.   INTRINSIC SAFETY CERTIFICATION

The BA377E has IECEx and ATEX gas certification. This section of the instruction manual describes ATEX gas certification. IECEx and other approvals are each described in separate appendixes to this manual.   The intrinsic safety of the instrument is unaffected by whether it is configured as a Timer or as a Clock.

2.1   ATEX gas certification

Notified Body Intertek Testing and Certification Ltd have issued the BA377E with an EC-Type Examination Certificate number ITS16ATEX28408X. This confirms compliance with harmonised European standards and this certificate has been used to confirm compliance with the European ATEX Directive for Group II, Category 1G equipment. The instrument carries the community mark and subject to local codes of practice may be installed in any of the European Economic Area (EEA) member countries. ATEX certificates are also acceptable for installations in other countries such as Switzerland.

This instruction manual describes ATEX installations in explosive gas atmospheres conforming with EN60079-14 *Electrical Installations design, selection and erection*.   When designing systems for installation outside of the UK the local Code of Practice should be consulted.

2.2   Zones, gas groups and T rating

The BA377E has been certified Ex ia IIC T5 Ga -40°C ≤ Ta ≤ 70°C.   When connected to a suitable system it 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 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 ambient temperatures between -40 and +70°C.

The specified operating temperature for the BA377E is -40 to +70°C. At temperatures below -20°C the instrument will continue to function, but the display digits will change more slowly and the contrast will be reduced.

This allows the BA377E to be installed in all gas Zones and to be used with most common industrial gases except carbon disulphide and ethyl nitrite which have an ignition temperature of 95°C.

2.3   Special conditions for safe use
The ATEX certificate has an 'X' suffix indicating that special conditions apply to prevent an electrostatic charge developing on the outside of the instrument enclosure.

WARNING
To avoid an electrostatic charge being generated instrument enclosure should only be cleaned with a damp cloth.

2.4   Power supply
When installed in a hazardous area the BA377E must be powered via a certified Zener barrier or galvanic isolator from a dc supply located in the safe area, or from certified associated apparatus with an intrinsically safe output.

The input safety parameters of the BA377E power supply terminals 1 and 2 are:

$$U_i \quad = \quad 28V\,dc$$
$$I_i \quad = \quad 200mA\,dc$$
$$P_i \quad = \quad 0.84W$$

Any certified Zener barrier or galvanic isolator with output safety parameters equal to or less than these limits may be used to power the BA377E.

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

$$C_i \quad = \quad 2nF$$
$$L_i \quad = \quad 4\mu H$$

To determine the maximum permissible power supply cable parameters the above figures, which are small and may be ignored for many applications, should be subtracted from the maximum permitted parameters, Co and Lo, specified for the Zener barrier or galvanic isolator powering the BA377E.

2.5   Input terminals
When configured as a Timer the BA377E is controlled via a single input that may be configured for use with different types of sensor. The input is a separate intrinsically safe circuit, although the negative side is internally connected to the negative side of the power supply and the reset terminal RS2. See Fig 9.

Some types of sensor that may be connected to the BA377E input, such as a switch contact or a 2-wire proximity detector, require energising to determine their state. For sensors requiring energising fitting an external link between terminals 3 & 4 connects an internal 7V, 6mA supply to the input. Energising is not required when the BA377E input is connected to a voltage source.

Fitting an energising link changes the output safety parameters of the BA377E input as shown in the following table which also shows the types of sensor requiring energising (link fitting).

Type of input	Link*	Output safety parameters of input terminals 5 & 6.		
		Uo	Io	Po
Switch contact	Yes	10.5V	9.2mA	24mW
Proximity detector	Yes	10.5V	9.2mA	24mW
Open collector	Yes	10.5V	9.2mA	24mW
Magnetic pick-off	No	1.1V	0.5mA	0.2mW
Voltage input (low)	No	1.1V	0.5mA	0.2mW
Voltage input (high)	No	1.1V	0.5mA	0.2mW

*Link terminals 3 and 4

2.5.1   Sensors that do not require energising
Sensors with a voltage output do not require energising, therefore terminals 3 & 4 should not be linked. When not energised i.e. without a link the BA377E pulse input complies with the requirements for *simple apparatus*. For intrinsic safety purposes, sources of energy with output parameters less than 1.5V; 100mA and 25mW are considered to be *simple apparatus* (Clause 5.7 of EN60079-11), which allows them not to be considered or documented when assessing the safety of an intrinsically safe system, thus simplifying loop assessment.

This allows almost any voltage output sensor to be directly connected to the BA377E pulse input in a hazardous area providing that:

a. The sensor is a certified intrinsically safe device having output parameters equal to or less than:

$$U_o \quad \leq \quad 28V\,dc$$
$$I_o \quad \leq \quad 200mA\,dc$$
$$P_o \quad \leq \quad 0.84W$$

   or   complies with requirements for *simple apparatus.*

b. The sensor and associated wiring can withstand a 500V rms insulation test to earth.

c. The sensor is located in the same hazardous area as the BA377E.

The BA377E EC-Type Examination Certificate specifies that the equivalent capacitance and inductance of the BA377E sensor input is:

$$C_i = 2nF$$
$$L_i = 4\mu H$$

To determine the maximum permissible cable parameters these figures should be subtracted from the maximum permitted output parameters L_o and C_o specified by the certificate for the sensor connected to the BA377E input terminals. The BA377E input parameters are small and therefore unlikely to make a significant difference to the allowable cable parameters.

2.5.2 Sensors that require energising

Switch contacts, proximity detectors and open collector sensors require energising which is achieved by linking two BA377E terminals together as described in section 2.5. When energised, the output parameters of the BA377E input are:

$$U_o = 10.5V\ dc$$
$$I_o = 9.2mA\ dc$$
$$P_o = 24mW$$

These parameters do not comply with the requirements for *simple apparatus* and should be considered when assessing the safety of the sensor connected to a BA377E input.

Any certified intrinsically safe sensor may be connected to the BA377E energised input providing that the sensor's input safety parameters are equal to, or greater than, the output safety parameters of the BA377E input shown above. This is not restrictive and most intrinsically safe sensors will comply. A sensor complying with the requirements for *simple apparatus*, such as a mechanically operated switch contact, may also be connected.

This allows most mechanically operated switches, open collector transistors and certified intrinsically safe NAMUR proximity detectors to be directly connected to the BA377E energised input. The sensor and wiring should be able to withstand a 500V rms insulation test to earth and the sensor should be located in the same hazardous area as the BA377E.

The maximum capacitance and inductance that may be safely connected to the energised input (link connected) is:

$$C_o = 2.4\mu F$$
$$L_o = 200mH$$

Again this is not restrictive as the combined capacitance and inductance of most sensors and connecting cable will be less than this.

2.6 Remote reset terminals

Connecting the external reset terminals RS1 and RS2 together will reset the BA377E when configured as a Timer and synchronise the displayed time when configured as a Clock. The two reset terminals have the following input and output safety parameters:

$$U_o = 3.8V\ dc$$
$$I_o = 1.6mA\ dc$$
$$P_o = 2.0mW$$

$$U_i = 28V\ dc$$
$$I_i = 200mA\ dc$$
$$P_i = 0.84W$$

The equivalent capacitance and inductance between them is:
$$C_i = 0nF$$
$$L_i = 0\mu H$$

The maximum cable capacitance and inductance that may be safely connected between the reset terminals RS1 and RS2 is:

$$C_o = 40\mu F$$
$$L_o = 1H$$

The reset terminals may be directly connected to any mechanically operated switch located within the same hazardous area as the BA377E. The switch and associated wiring should be able to withstand a 500V insulation test to earth.

If the reset switch is required in 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 1.

When used as a Timer the BA377E may also be reset from the display mode by operating the ▾ and ▴ push buttons simultaneously for more than two seconds. See 6.5.19

2.7   Control outputs - optional

Each of the two factory fitted optional control outputs is a separate galvanically isolated intrinsically safe circuit with output safety parameters complying with the requirements for *simple apparatus*. This allows the control output terminals A1 & A2 and A3 & A4 to be connected to almost any intrinsically safe circuit protected by a Zener barrier or galvanic isolator providing the output safety parameters of the circuit do not exceed:

$$U_o \quad \leq \quad 28V\ dc$$
$$I_o \quad \leq \quad 200mA\ dc$$
$$P_o \quad \leq \quad 0.84W$$

The maximum equivalent capacitance and inductance between each set of control output terminals is:

$$C_i \quad = \quad 24nF$$
$$L_i \quad = \quad 8\mu H$$

To determine the maximum permissible cable capacitance C_i should be subtracted from the maximum permitted external capacitance C_o specified by the certificate for the intrinsically safe interface powering the circuit being switched by the control output. See figs 4 & 5.

2.8   Certification label information

The BA377E product certification label is fitted in a recess on the top outer surface of the enclosure. It shows the ATEX and IECEx certification information plus BEKA associates name and location and the instrument serial number.   Certification information from other authorities may also be included.

BEKA *associates* Hitchin, England.   www.beka.co.uk

$C \epsilon$ 0359 ⟨Ex⟩ II 1 G

II 1 G, Ex ia IIC T5 Ga,-40°C ≤ Ta ≤ +70°C
ITS16ATEX28408X IECEx ITS16.0004X

WARNING:POTENTIAL ELECTROSTATIC CHARGING HAZARD.CLEAN ONLY WITH A DAMP CLOTH.

[OTHER APPROVALS SHOWN HERE]

S/No: 054321 / 01 / 001   Manufactured: 2016

BA377E 1 INPUT TIMER OR CLOCK
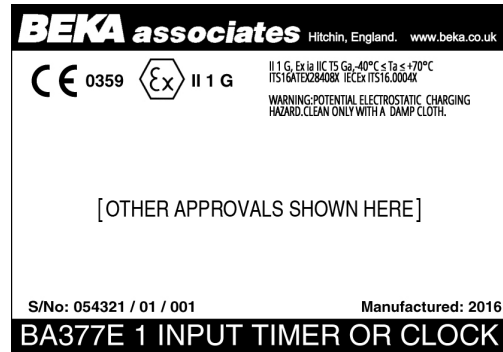
BA377E Certification information label

3. SYSTEM DESIGN FOR HAZARDOUS AREAS

3.1 Use with Zener barriers

Zener barriers are the least expensive intrinsically safe interface between a safe and hazardous area. However, they require a high integrity earth connection that may be expensive to install and they do not provide isolation. When a high integrity earth connection is not already available, it may be less expensive and complicated to use galvanic isolators for the installation of a single BA377E.

Terminals 2, 6 and RS2 of the BA377E are internally connected together as shown in Fig 9. If any of these terminals are earthed, as shown in Figs 1 & 2, the other common terminals should only be connected to the same earth, i.e. the barrier busbar, or to circuits that have at least 500V insulation to earth.

Any Zener barrier certified for the gas group and Zone in which the BA377E is installed may be used, providing the output parameters do not exceed the input parameters of the BA377E terminals to which it is connected. Only one polarity of Zener barrier i.e. positive or negative may be used in each system.

Fig 1 illustrates the basic circuit that is used for all BA377E Timer installations protected by Zener barriers. BA377E Clock installations are the same, except that the input terminals 5 & 6 are not used. For simplicity the optional control outputs are described separately in section 3.1.9 of this manual.
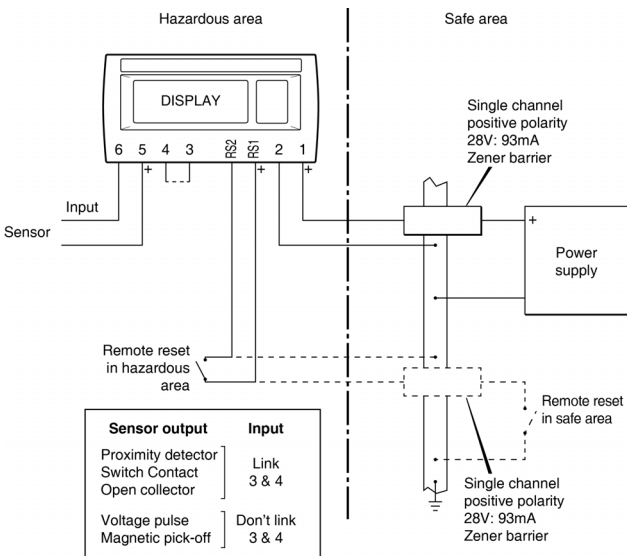
Fig 1 BA377E Timer used with Zener barriers

Alternatively the sensor may be located in the safe area. Fig 2 shows how an additional Zener barrier is used to transfer signals to the Timer in the hazardous area.

When more than one Zener barrier is used in a system all must have the same polarity. i.e. all positive or all negative barriers. When designing a Timer system it is important to remember that terminals 2, 6 and RS2 of the BA377E are connected together within the instrument. Similarly, terminals 2 and RS2 are internally connected together when the BA377E is configured as Clock. See Fig 18.
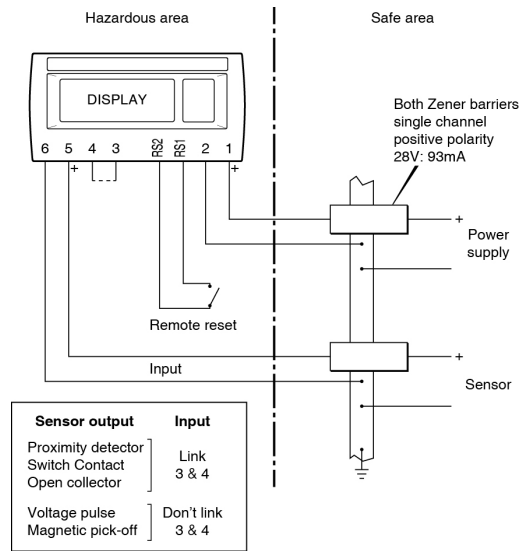
Fig 2 BA377E Timer used with Zener barriers with input sensor in the safe area.

3.1.1 Power supply

The BA377E requires a minimum of 10V between terminal 1 & 2 and consumes:

	10mA	without optional backlight
plus	22mA	with optional backlight
plus	6mA	when terminals 3 & 4 are linked

Any Zener barrier certified for the gas group and Zone in which the BA377E is installed may be used to power the instrument, providing the output safety parameters of the barrier are equal to or less than the input safety parameters of terminals 1 & 2.

Although this allows a wide variety of barriers to be used, a positive polarity 28V; 93mA; 300Ω Zener barrier, which has an end-to-end resistance of about 340Ω, is an industry standard device which is frequently used. With this barrier the supply voltage in the safe area must be between the minimum value shown below and the maximum working voltage of the Zener barrier which, depending upon manufacturer, will be approximately 26V.

	13.5V min	without optional backlight
	20.9V min	with optional backlight
plus	2.1V	when terminals 3 & 4 are linked

3.1.2   Sensor input

When configured as a Timer the sensor input may be connected to a wide variety of hazardous area devices as shown in Fig 1, or to safe area sensor as shown in Fig 2. The BA377E input is not used when the instrument is configured as a Clock.

No Zener barrier is required in series with the input if the intrinsically safe sensor is located within the same hazardous area as the BA377E. The following table shows the instrument's input switching thresholds when configured to operate with various sensors. For reliable operation the BA377E input must fall below the lower threshold and rise above the upper threshold.

Sensor	Switching thresholds	
	Lower	Upper
Voltage pulse low	1.0V	3.0V
Voltage pulse high	3.0V	10.0V
Magnetic pick-off	0mV	40mV peak
Proximity detector	1.2mA	2.1mA
Switch	100Ω	1000Ω
Open collector	2kΩ	10kΩ

Switch contacts, proximity detectors and open collector sensors require energising which is achieved by linking terminals 3 and 4 together as described in section 2.5.

3.1.3   Switch contact input

Any mechanically activated switch contact may be directly connected to input terminals 5 & 6 providing the switch is located in the same hazardous area as the BA377E, and the switch and associated wiring can withstand a 500V rms insulation test to earth. Most industrial push buttons and magnetically activated reed relays comply with these requirements. The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6.

3.1.4   Open collector input

Any sensor with an open collector output located in the same hazardous area as the BA377E, such as a mechanically activated opto-isolator may be directly connected to input terminals 5 & 6. The sensor and the associated wiring must be able to withstand a 500V rms insulation test to earth. The BA377E contains a configurable debounce circuit to prevent false triggering. Three levels of debounce protection are available. See section 6.4.6.

3.1.5   2-wire proximity detector input

Most intrinsically safe NAMUR 2-wire proximity detectors may be connected to the BA377E sensor input, providing the input safety parameters of the proximity detector are equal to or greater than the output safety parameters of a BA377E input. i.e.

U_i	≥	10.5V dc
I_i	≥	8.2mA dc
P_i	≥	25mW

and the minimum operating voltage of the proximity detector is less than 7.5V. The proximity detector must be located in the same hazardous area as the BA377E.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6.

3.1.6   Magnetic pick-off input

$Co.L$ in the input configuration menu is a low level voltage pulse input intended for use with an intrinsically safe magnetic pick-off sensor. When configured for $Co.L$ input, the BA377E input complies with the requirements for *simple apparatus* allowing connection to any certified intrinsically safe magnetic sensor having output parameters equal to or less than:

U_o	≤	28V dc
I_o	≤	200mA dc
P_o	≤	0.84W

The maximum permitted cable parameters will be the sensor's Co and Lo specified on it's intrinsic safety certificate, less the BA377E input parameters Ci and Li which are small and can often be ignored.

The magnetic pick-off must be located within the same hazardous area as the BA377E and be able, together with the associated wiring, to withstand a 500V rms insulation test to earth.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6.

3.1.7 Voltage pulse input

Two voltage pulse input ranges are independently selectable in the BA377E Timer configuration menu, ⊔o⌐Ł⌐5 ⌐ and ⊔o⌐Ł⌐5 H. When configured for either of the voltage pulse ranges, the input terminals 5 & 6 comply with the requirements for *simple apparatus*. This allows the input to be connected to any certified intrinsically safe voltage source located within the same hazardous area as the BA377E having output parameters equal to or less than:

$$Uo \leq 28V \text{ dc}$$
$$Io \leq 200mA \text{ dc}$$
$$Po \leq 0.84W$$

The BA377E Timer may therefore be directly connected to and controlled by most certified intrinsically safe high level voltage signals.

The maximum permitted cable parameters will be defined by the intrinsic safety certification of the voltage source less the BA377E input parameters which are small and can often be ignored.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6.

3.1.8 Remote reset

Connecting the external reset terminals RS1 and RS2 together will reset the BA377E when configured as a Timer and synchronise the displayed time when configured as a Clock. Remote resetting may be accomplished by any mechanically operated switch located in the same hazardous area as the instrument providing the switch and the associated wiring can withstand a 500V rms insulation test to earth. No Zener barrier is required.

A BA377E may also be remotely reset from the safe area. Any switch may be used but a Zener barrier is required to transfer the contact closure into the hazardous area which may be combined with the supply barrier so that only one package is required. A diode return barrier is not suitable for this application. Fig 1 illustrates how a BA377E may be reset from both the safe and the hazardous area.

Note: When used as a Timer the BA377E may also be reset from the display mode by operating the ▼ and ▲ push buttons simultaneously for more than two seconds. See 6.5.19

3.1.9 Control outputs (optional)

Each of the two factory fitted optional control outputs is a galvanically isolated single pole solid state switch as shown in Fig 3. The outputs are polarised and current will only flow in one direction. Terminals A1 and A3 should be connected to the positive side of the supply.

$$Ron < 5\Omega + 0.7V$$
$$Roff > 1M\Omega$$

Note: Because of the series protection diode some test meters may not detect a closed alarm output
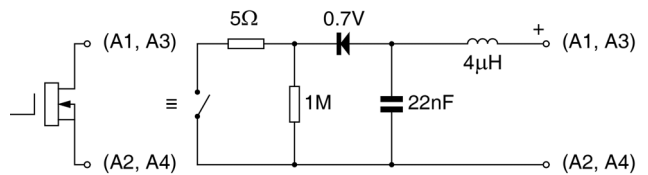
Fig 3 Equivalent circuit of each control output

Each control output is a separate galvanically isolated intrinsically safe circuit with output safety parameters complying with the requirements for *simple apparatus*. This allows the control output terminals A1 & A2 and A3 & A4 to be connected to almost any intrinsically safe circuit protected by a Zener barrier having output parameters equal to or less than:

$$Uo \leq 28V$$
$$Io \leq 200mA$$
$$Po \leq 0.84W$$

The maximum equivalent capacitance and inductance between each set of control output terminals is:

$$Ci = 22nF$$
$$Li = 8\mu H$$

To determine the maximum permissible cable parameters Ci and Li of the BA377E should be subtracted from the maximum permitted external capacitance Co and inductance Lo specified by the certificate for the Zener barrier powering the circuit as shown in Fig 4. The internal capacitance and inductance of other devices in the loop, such as the solenoid valve in Fig 4, should also be subtracted from Co & Lo.
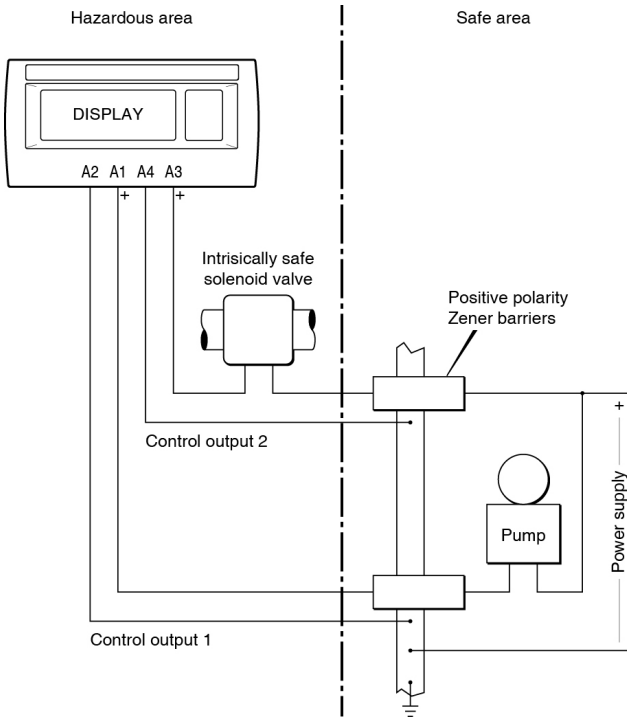
Fig 4 Typical control output application

3.2   Use with Galvanic Isolators

Galvanic isolators are probably the simplest intrinsically safe interface to install as they provide isolation and do not require a high integrity earth connection.

Any galvanic isolator certified for the gas group in which the BA377E is installed, with output parameters less than the input parameters of the BA377E having the correct function may be used.
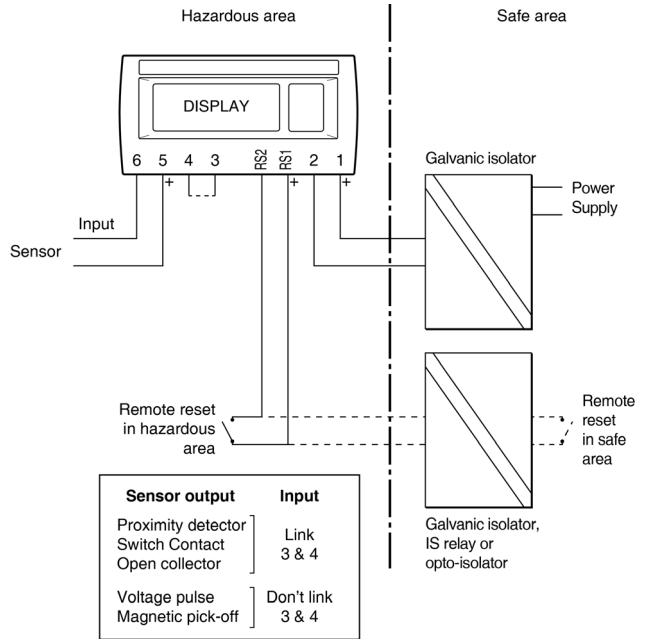
Fig 5 BA377E used with galvanic isolators

Fig 5 illustrates the basic circuit that is used for all BA377E installations protected by galvanic isolators.

Alternatively sensors may be located in the safe area. Fig 6 shows how an additional galvanic isolator is used to transfer the sensor output to the BA377E in the hazardous area, although it may be difficult to find isolators for some types of sensor. The BA377E external input conditioning link should be positioned to suite the output of the galvanic isolator not the sensor.
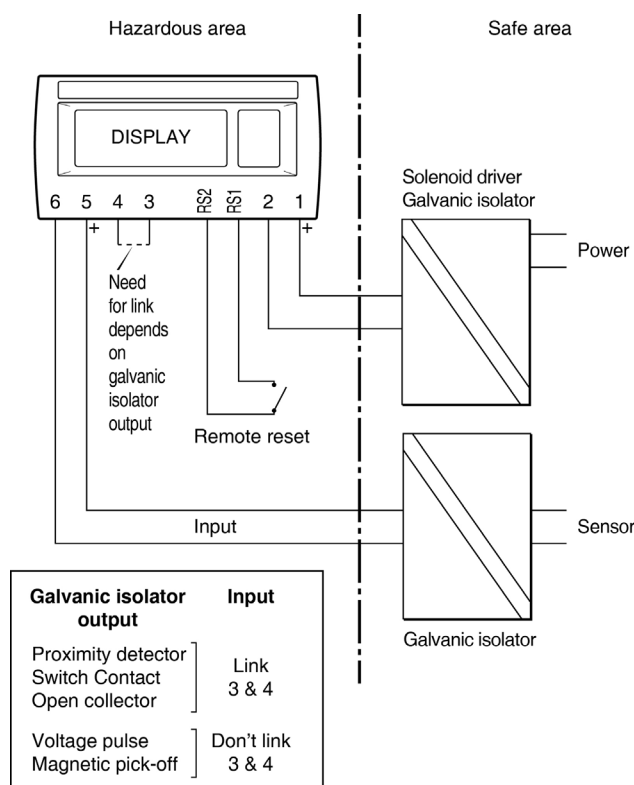
Fig 6   BA377E Timer used with galvanic isolators with input sensor in safe area.

3.2.1   Power supply

The BA377E requires a minimum of 10V between terminal 1 & 2 and consumes:

	10mA	without optional backlight
plus	22mA	with optional backlight
plus	6mA	when terminals 3 & 4 are linked

Any galvanic isolator certified for the gas group and Zone in which the BA377E is installed may be used to power the instrument.   The output safety parameters of the isolator must be equal to or less than the input safety parameters of terminals 1 & 2 and the voltage at terminals 1 & 2 must be greater than 10V.   These requirements are not restrictive and allow a wide range of galvanic isolators, such as solenoid drivers, to be used.

3.2.2   Sensor inputs

As shown in Fig 5 the BA377E input can be directly connected to hazardous area sensor, or to safe area sensors via isolators as shown in Fig 6.   Galvanic isolators are not required in series with the inputs if the intrinsically safe sensor is located within the same hazardous area as the BA377E.

The BA377E may be used with a wide variety of sensors, the following table shows the switching thresholds for each type.   For reliable operation the input signal must fall below the lower threshold and rise above the upper threshold.

Sensor	Switching thresholds	
	Lower	Upper
Voltage pulse low	1.0V	3.0V
Voltage pulse high	3.0V	10.0V
Magnetic pick-off	0mV	40mV peak
Proximity detector	1.2mA	2.1mA
Switch	100Ω	1000Ω
Open collector	2kΩ	10kΩ

Switch contacts, proximity detectors and open collector sensors require energising which is achieved by linking two BA377E terminals together as described in section 2.5.

3.2.3   Switch contact input

Any mechanically activated switch contact may be directly connected to input terminals 5 & 6 providing the switch is located in the same hazardous area as the BA377E, and the switch and associated wiring can withstand a 500V rms insulation test to earth. Most magnetically activated industrial push buttons and reed relays comply with these requirements. The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6

3.2.4   Open collector input

Any open collector sensor located in the same hazardous area as the BA377E, such as a mechanically activated opto-isolator, may be directly connected to input terminals 5 & 6. The sensor and the associated wiring must be able to withstand a 500V rms insulation test to earth.

The BA377E contains a configurable debounce circuit to prevent false triggering. Three levels of debounce protection are available See section 6.5.6

3.2.5   2-wire proximity detector input

Most intrinsically safe NAMUR 2-wire proximity detectors may be connected to the BA377E input, providing the input safety parameters of the proximity detector are equal to or greater than the output safety parameters of a BA377E input. i.e.

$$U_i \quad \geq \quad 10.5V \ dc$$
$$I_i \quad \geq \quad 8.2mA \ dc$$
$$P_i \quad \geq \quad 25mW$$

and the minimum operating voltage of the proximity detector is less than 7.5V. The proximity detector must be located in the same hazardous area as the BA377E.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6

3.2.6   Magnetic pick-off input

ᶜₒᵢᴸ in the input configuration menu is a low level voltage pulse input intended for use with an intrinsically safe magnetic pick-off sensor. When configured for ᶜₒᵢᴸ input, the BA377E input complies with the requirements for *simple apparatus* allowing connection to any certified intrinsically safe magnetic sensor having output parameters equal to or less than:

$$U_o \quad \leq \quad 28V \ dc$$
$$I_o \quad \leq \quad 200mA \ dc$$
$$P_o \quad \leq \quad 0.84W$$

The maximum permitted cable parameters will be the sensor's Co and Lo specified on it's intrinsic safety certificate, less the BA377E input parameters Ci and Li which are small and can often be ignored.

The magnetic pick-off must be located within the same hazardous area as the BA377E and with the associated wiring be able to withstand a 500V rms insulation test to earth.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6.

3.2.7   Voltage input

Two voltage input ranges are independently selectable in the BA377E configuration menu, ᵁₒᴸᵗˢ ᴸ and ᵁₒᴸᵗˢ ᴴ. When configured for either of the voltage pulse ranges, the input terminals 5 & 6 comply with the requirements for *simple apparatus*. This allows the inputs to be connected to any certified intrinsically safe voltage source within the same hazardous area as the BA377E having output parameters equal to or less than:

$$U_o \quad \leq \quad 28V \ dc$$
$$I_o \quad \leq \quad 200mA \ dc$$
$$P_o \quad \leq \quad 0.84W$$

The BA377E Timer may therefore be directly connected to and controlled by most certified intrinsically safe high level outputs.

The maximum permitted cable parameters will be defined by the intrinsic safety certification of the voltage source less the BA377E input parameters which are small and can often be ignored.

The BA377E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are available. See section 6.5.6

3.2.8   Remote reset

Connecting the external reset terminals RS1 and RS2 together will reset the BA377E when configured as a Timer and synchronise the displayed time when configured as a Clock. Remote resetting may be accomplished by any mechanically operated switch located in the same hazardous area as the instrument providing the switch and the associated wiring can withstand a 500V rms insulation test to earth. No galvanic isolator is required.

A BA377E may also be remotely reset or synchronised from the safe area. Any switch may be used but a galvanic isolator or IS relay is required to transfer the contact closure into the hazardous area. Fig 5 illustrates how a BA377E Timer may be reset from both the safe and the hazardous area.

Note: The BA377E can also be configured to reset when the ▼ and ▲ push buttons are operated simultaneously in the display mode for more than three seconds - see 6.5.19

3.2.9   Control outputs - optional

Each of the two factory fitted optional control outputs is a galvanically isolated single pole solid state switch as shown in Fig 7. The outputs are polarised and current will only flow in one direction.   Terminals A1 and A3 should be connected to the positive side of the supply.

$$Ron = \text{less than } 5\Omega + 0.7V$$
$$Roff = \text{greater than } 1M\Omega$$

Note: Because of the series protection diode some test meters may not detect a closed alarm output
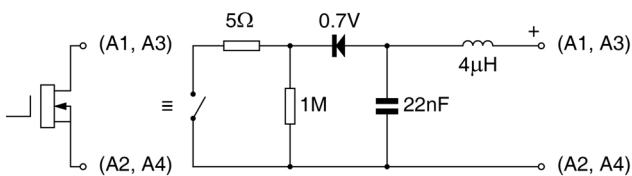
Fig 7 Equivalent circuit of each control output

Each control output is a separate galvanically isolated intrinsically safe circuit with output safety parameters complying with the requirements for *simple apparatus*.   This allows the control output terminals A1 & A2 and A3 & A4 to be connected to almost any certified intrinsically safe circuit protected by a galvanic isolator providing the isolator has the correct function and the output parameters do not exceed:

$$Uo \leq 28V$$
$$Io \leq 200mA$$
$$Po \leq 0.84W$$

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

$$Ci = 22nF$$
$$Li = 8\mu H \text{ (Effectively 0)}$$

To determine the maximum permissible cable parameters Ci and Li, plus those for any other intrinsically safe instruments in the loop, should be subtracted from the maximum permitted external capacitance Co and inductance Lo specified by the certificate for the galvanic isolator powering the circuit as shown in Fig 8.
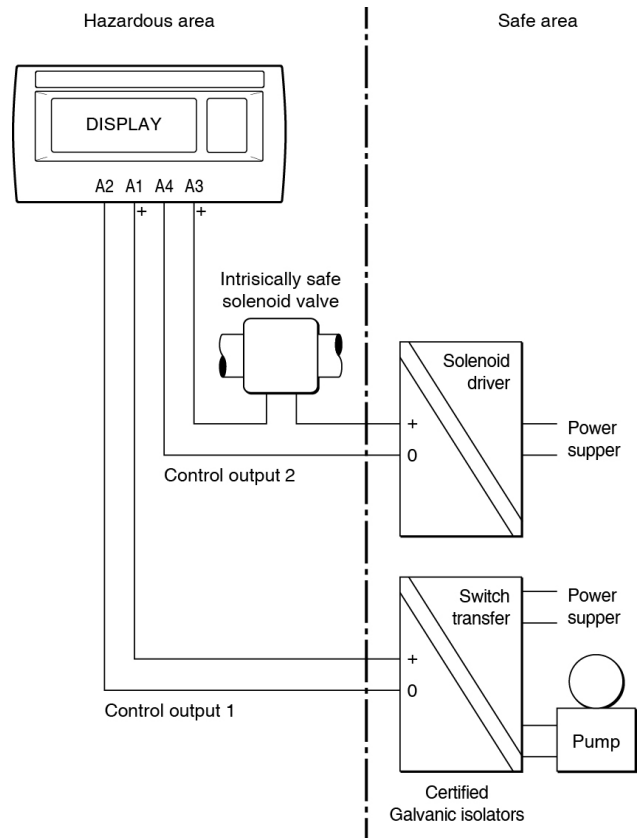
Fig 8 Typical control output application

4. INSTALLATION

4.1 Location

The BA377E has a robust glass reinforced Noryl enclosure with a toughened glass window. The front has IP66 ingress protection and a gasket seals the joint between the instrument enclosure and the panel, the rear of the instrument has IP20 ingress protection.

The BA377E may be installed in any panel providing that the operating temperature is between -40°C and +70°C and the intrinsic safety requirements are complied with. At temperatures below -20°C the display will become increasingly slow with reduced contrast but the instrument will continue to function normally.

Fig 9 shows the overall dimensions of the instrument together with the recommended panel cut-out dimensions. To achieve an IP66 seal between the instrument enclosure and the instrument panel the smaller tolerance aperture must be used.

Although the front of the BA377E has IP66 protection it should be shielded from continuous direct sunlight and severe weather conditions.

4.2 EMC

The BA377E complies with the requirements of the European EMC Directive 2014/30/EU. For specified immunity all wiring should be in screened twisted pairs, with the screens earthed at one point within the safe area.

Recommended panel cut-out dimensions for all installations

Mandatory to achieve an IP66 seal between instrument and panel

90 +0.5/-0.0 x 43.5 +0.5/-0.0

DIN 43700
92.0 +0.8/ -0.0 x 45 +0.6 -0.0

Panel cut-out

65

7.5

96

DISPLAY

48

Optional

| A1 | A2 | | A3 | A4 |
+ +
Control Control
output 1 output 2

| 1 | 2 | | RS1 | RS2 | | 3 | 4 | 5 | 6 |
+ +
Power Reset Add link Sensor
supply to energise input
sensor
input
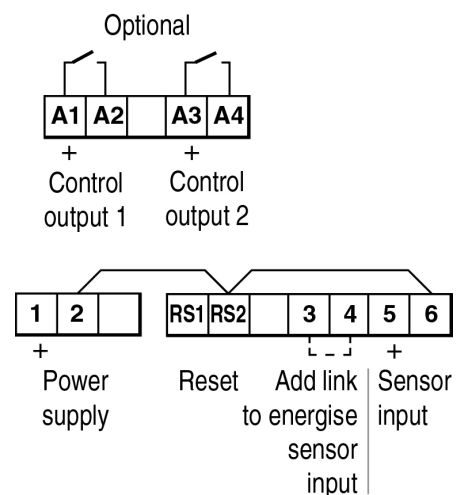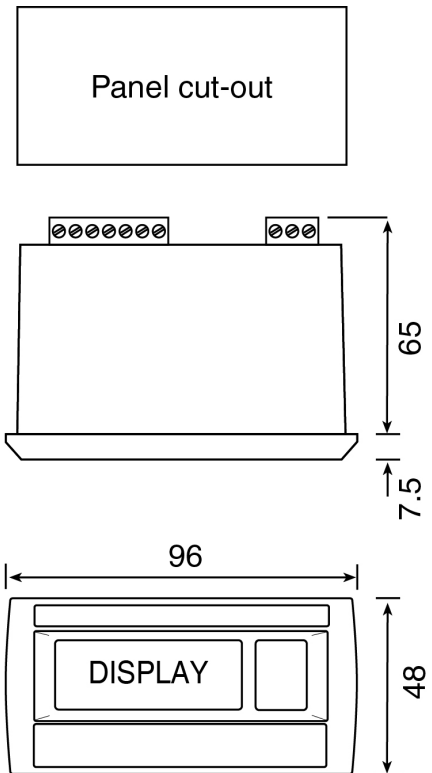
Support panel wiring to prevent vibration damage

Note: Optional backlight is internally powered

Fig 9   BA377E dimensions & terminals

4.3   Installation Procedure

a. Cut the specified aperture in the panel. To achieve an IP66 seal between the instrument enclosure and the instrument panel the aperture must have the tighter tolerances specified in Fig 9.

b. Slide the gasket over the body of the BA377E before inserting the instrument into the panel aperture.

c. Firstly ensure that both the panel mounting clamps are closed by turning the knurled screws fully anti clockwise until the two pips in the clamp foot align with holes in the clamp body.

d. Place a clamp in the recess on each side of the instrument, pulling gently to slide it onto the dovetail as shown in Fig 10.   Push the knurled screw slightly forward to engage the thread and tighten by turning clockwise until it is just finger tight. When the clamps are fitted ensure that the gasket behind the front panel bezel is correctly positioned before fully tightening the clamps to secure the instrument. The maximum recommended clamp tightening torque is 22cNm (1.95 lbf in) which is approximately equivalent to finger-tight plus one half turn. **Do not over tighten**.

e. Connect the panel wiring to the rear terminal block(s) as shown in Fig 9.   To simplify installation, the terminals are removable so that the panel wiring can be completed before the instrument is installed.   In areas subject to vibration wiring should be secured to prevent damage to the connectors.

Align foot and body by turning screw anticlockwise

Position gasket behind instrument bezel

Insert panel clamp into recess and gently pull it onto the dovetail. Engage screw & turn clockwise to tighten clamp

Insert instrument into the panel from the front
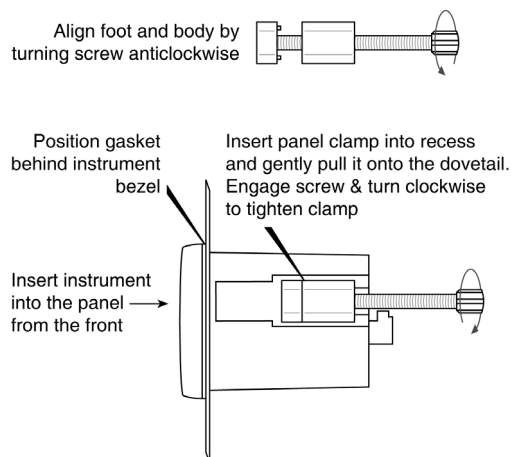
Fig 10 Fitting panel mounting clamps

4.4   Scale card

The BA377E's units of measurement are shown on a printed scale card in a window at the right hand side of the display.   The scale card is mounted on a flexible strip that is inserted into a slot at the rear of the instrument as shown in Fig 11. Thus the scale card can easily be changed without removing the BA377E from the panel or opening the instrument enclosure.

New instruments are supplied with a printed scale card showing the requested units of measurement, if this information is not supplied when the instrument is ordered a blank card will be fitted.

A pack of self-adhesive scale cards printed with common units of flow measurement is available as an accessory from BEKA associates.   Custom printed scale cards can also be supplied - see 5.3

To change a scale card, unclip the tapered end of the flexible strip at the rear of the instrument by gently pushing it upwards and pulling it out of the enclosure.   Peel the existing scale card from the flexible strip and replace it with a new printed card, which should be aligned as shown below.   Do not fit a new scale card on top of an existing card.

Install the new scale card by gently pushing the flexible strip into the slot at the rear of the instrument, when it reaches the internal end-stop secure it by pushing the end of the flexible strip downwards so that the tapered section is held by the rear panel.

Align on these edges

Scale card

Align the self-adhesive printed scale card onto the flexible strip and insert the strip into the instrument as shown below.

Unlock

Insert

Lock

Fig 11   Inserting the flexible strip carrying the scale card into slot at the rear of the instrument.

5. ACCESSORIES

5.1 Display backlight

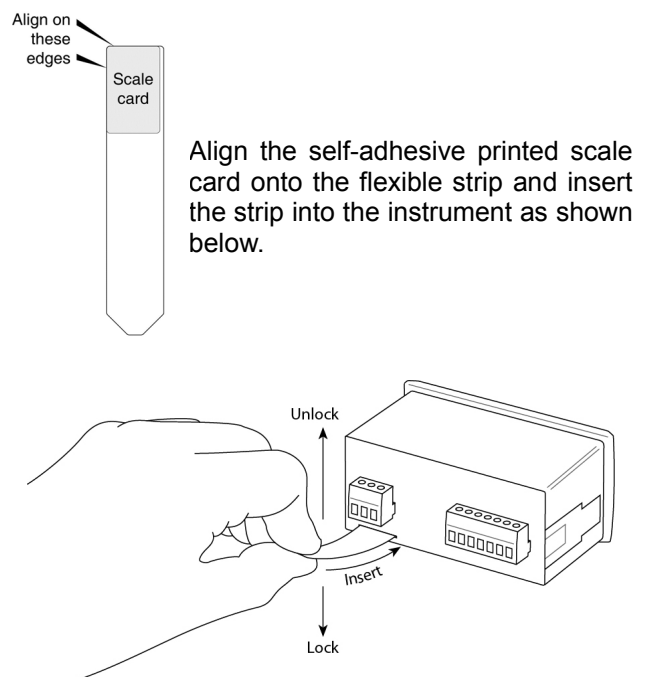The BA377E Timer and Clock can be supplied with a factory fitted backlight that produce green illumination enhancing display contrast and enabling it to be read at night or in poor lighting conditions. The backlight is internally powered from the instrument power supply so no additional wiring or intrinsically safe interface is required, but the supply current increases as shown below.

	BA377E Timer current consumption
Without backlight	10mA
Additional for backlight	22mA
Addition with terminals 3 & 4 linked	6mA

Total current	38mA max

	BA377E Clock current consumption
Without backlight	10mA
Additional for backlight	22mA

Total current	32mA max

5.2 Control outputs

Although the dual isolated control outputs are factory fitted options, they are described in the main body of this instruction manual as they will be used for the majority of applications. If control outputs are required they should be specified when the instrument is ordered.

5.3 Scale card

The BA377E has a window on the right hand side of the display through which a scale card showing the units of measurement such as hours can be seen. New instruments are fitted with a scale card showing the units of measurement specified when the instrument was ordered, if the units are not specified a blank scale card will be fitted. A pack of scale cards pre-printed with common units of measurement is available as an accessory. These can easily be fitted on-site without opening the instrument enclosure or removing it from the panel. See section 4.4 of this instruction manual.

Custom scale cards for applications requiring less common units of measurement are also available.

5.4 Tag information

New instruments can be supplied with a tag number or application information printed onto the rear panel adjacent to the terminals. This information is not visible from the front of the instrument after installation.

6. OPERATION AS A TIMER

When configured as a Timer the BA377E can measure and display the elapsed time between external events such as measuring and displaying how long machinery is operating. The Timer can be started and stopped by a remote sensor, or from the front panel push buttons.

The addition of two optional factory fitted isolated control outputs allows the Timer to control external events such as opening a valve for a predetermined time. Again the Timer can be started and stopped by a remote sensor, or from the front panel push buttons.

When controlling external events the CYCLE function enables the BA377E Timer to be configured to repeat the timing period up to 99 times with a configurable delay between timed periods up to 100 hours or to repeat continuously.

The BA377E may be configured to *time-up* from zero to the set time SEt t, or to *time-down* from the set time to zero. The set time may be entered and displayed in hours, minutes or seconds, or a combination of units. Elapsed or remaining time is continuously displayed and a separate display may be activated to show the Timer set time SEt t. Resetting the timer cycle can be accomplished via the front panel push buttons or by a remote contact.

A grand total time is maintained which can be viewed by operating the front panel push buttons. It may be reset to zero from within the configuration menu, or the instrument may be configured to allow resetting from the front panel push buttons.

Fig 12 shows a simplified block diagram of the BA377E when configured as a Timer. The input can be configured to accept inputs from a wide variety of sensors. When the sensor requires energising, such as a switch contact, open collector or a two wire proximity detector, a link connected between terminals 3 & 4 supplies power to the sensor input.

The instrument can be supplied with the following factory fitted accessories:

Internally powered Backlight

Dual isolated Control Outputs

The two factory fitted solid state isolated control outputs may be independently configured to close and open at specified parts of the timer cycle, such as when the timer starts or finishes.

6.1 Initialisation

Each time power is applied to a BA377E initialisation is performed. After a short delay the following display sequence occurs:

All segments of the display are activated

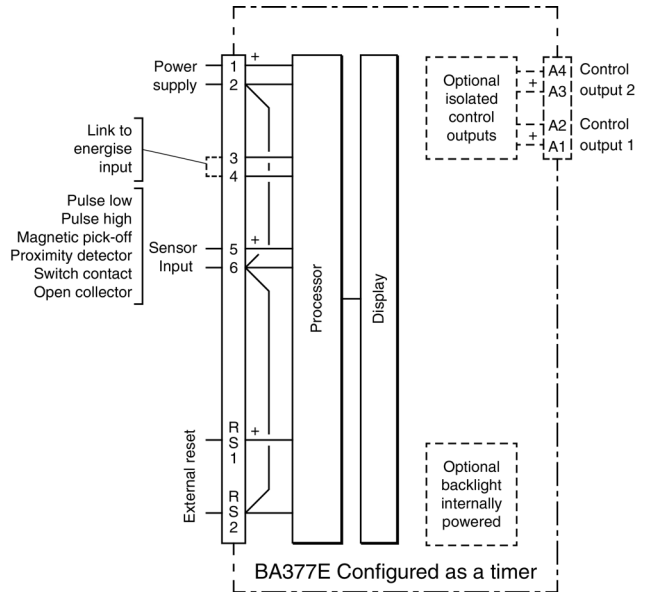BA377E is ready to start functioning using the configuration information stored in the instrument's permanent memory.

Fig 12 BA377E block diagram with Timer configuration.

6.2 Controls when configured as a Timer

The BA377E is controlled and configured via four front panel push buttons. In the display mode i.e. when the instrument is displaying time the push button functions are:

Push Button Functions

▼   When local control is enabled starts the Timer. See 6.5.8

▲   When local control is enabled stops the Timer. See 6.5.8

E + ▲   Shows the grand total (run time) in hours and tenths of an hour irrespective of Timer configuration. If buttons are held for longer than ten seconds the grand total may be reset to zero if the grand total reset sub-function CLr Gtot is enabled in the LoC rSEt configuration function. See 6.5.20

     To reset the grand total to zero from the display mode press the E + ▲ buttons for ten seconds until CLr. no is displayed, using the ▼ or ▲ button change the display to CLr.YES and press E.

▼ + ▲   Resets the Timer to zero or to the set time SEt t depending on whether the Timer is configured to *time-up* or *time-down* when the two buttons are operated simultaneously for more than three seconds. This is a configurable function. See 6.5.19

P + ▲   When enabled in the configuration menu, operating these two buttons simultaneously provides direct access to the set time SEt t and allows adjustment when the timer is in the display mode. See 6.5.15

P + ▼   Shows in succession, firmware version number, instrument function ELAPSE and any output accessories that are fitted:

         -A   Dual Control Outputs

P + E   Access to configuration menu

6.3 Displays when configured as a Timer

The BA377E has two digital displays and associated annunciators as shown on page 1.

Elapsed time   The upper display shows the elapsed time since the Timer was started when *timing-up* from zero and the remaining time when *timing-down* from the set time. The display may be formatted as hh:mm:ss; hh:mm; mm:ss or ss.

Lower display   The display options available on the lower display depend on whether the Timer repeat cycle function CYCLES, which can repeat the timing period up to 99 times, or continuously with a configurable delay between periods, is enabled.

CYCLES disabled
The lower display shows the set time SEt t, or the lower display may be disabled if not required. See 6.5.7

CYCLES enabled
The lower display shows the total number of repeat cycles requested together with the number of the current cycle. Each operation may be briefly named at it's start or periodically throughout the cycle.
The lower display may also be disabled if not required.
See 6.5.7

Reset annunciator   Activated while elapsed time is being reset to zero or to the set time SEt t.

Grand total annunciator   Activated when the grand total time is being shown on the upper display.

Control output annunciators   Show status of both optional control outputs.

6.4 Timer structure

Fig 13 illustrates the Timer structure and function. It applies when the instrument is measuring the time between events or is controlling external events.

The circles in Fig 13 represent the five Timer states, *Reset*, *Running, Restart-delay, Paused* and *Complete*. The lines between the circles represent the event required to move the Timer between states. e.g. to initiate timing the Timer is moved from the *Reset* state to the *Running* state by a start event. This could be an input signal or operation of the ⬇ button. Similarly, to pause the Timer while it is timing, the Timer must be moved from the *Running* state to the *Pause* state by a stop event which could be an input or operation of the ⬆ button.

Reset

In this state the Timer is readied for operation. The Timer is stopped and loaded with zero for timing-up or 5Et t for timing-down.

Running

Entered by a start event from the *Reset* or *Paused* states. The Timer times-up to 5Et t or times-down to zero depending upon it's configuration.

Pause

Entered by a stop event from *Running* or *Restart-delay*. Timer is stopped, a start event returns the timer to it's previous state.

Restart-delay

Entered automatically from *Running.* At the end of the delay time automatically returns to *Running*.

Complete

Entered automatically from *Running* when there are no more timing cycles to perform.

When the EYELE5 function is enabled the timing cycle can be repeated a specified number of times, or continuously.

6.5   Configuration as a Timer

The BA377E is configured via the four front panel push buttons.   All the configuration functions are contained in an easy to use intuitive menu that is shown diagrammatically in Fig 14.

Each menu function is summarised in section 6.5.2 of this manual and each summary includes a reference to more detailed information.

All new BA377E instruments are supplied configured as requested at the time of ordering. If configuration is not requested, the BA377E will be supplied with default Timer configuration as shown below, but the instrument can easily be re-configured on-site.

Function	Display	Default
Access code	CodE	0000
Function	FunCtion	ELAPSE
Input	inPut	oP.CoL
Debounce	dEbounCE	dEFAuLt
Display 2	diSP-2	Std
Start stop	StArStoP	LoCAL
Units	uni t5	12:00:00
Set time	5Et t	00:00:00
Enable repeat cycle	EYELE5	oFF
Access set time from display mode.	RE5Et t	oFF
Direction of count	uP or dn	dn
Recovery from power supply failure.	P-FAiL	idLE
Local total reset	t-rE5Et	on
Local grand total reset	Gt-rE5Et	oFF
External reset	E-r5Et	5td
Enable control output 1	EnbL	oFF
Enable control output 2	EnbL	oFF

TIMER STATE

EVENT
Moves Timer between states.

INSTRUMENT
INITIALISATION

COMPLETE
donE

* (Only when CYCLES
not enabled)

RESET

RESET
rESEt

RESET

* SET TIME
COMPLETE

RUNNING
run

START

NO MORE CYCLES

(Only when CYCLES enabled)

STOP

START

DELAY

DONE

TIME COMPLETE +
DELAY SET

RESET

PAUSED
PAuSEd

STOP

START

RESTART
DELAY
dELAY

RESET
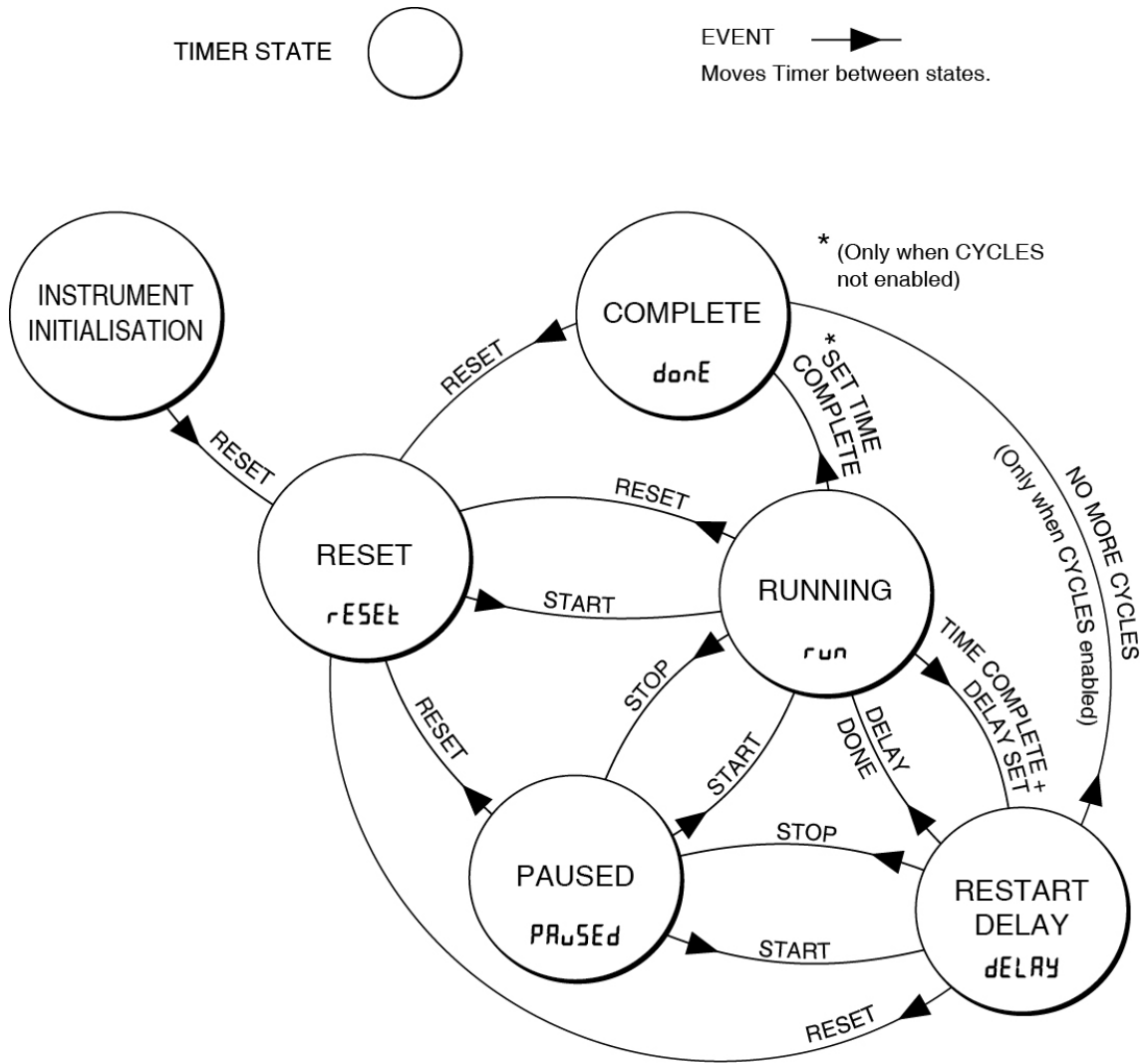
Fig 13 Timer structure showing states and events

6.5.1 Accessing configuration functions

Throughout this manual front panel push buttons are shown as ▼, ▲, Ⓟ and Ⓔ and legends displayed by the instrument are shown in a seven segment font just as they appear on the instrument e.g. ınPuŁ and ſLr ſŁoŁ.

Access to the configuration menu is obtained by operating the Ⓟ and Ⓔ push buttons simultaneously. If the instrument is not protected by an access security code the first parameter FunſŁıon will be displayed. If a security code other than the default code 0000 has already been entered, the instrument will display ſodE. Press Ⓟ to clear this prompt and enter the security code for the instrument using the ▼ or ▲ push button to adjust the flashing digit and the Ⓟ push button to transfer control to the next digit. If the correct code has been entered pressing Ⓔ will cause the first parameter FunſŁıon to be displayed. If an incorrect code is entered, or a push button is not operated within ten seconds, the instrument will automatically return to the display mode.

All configuration functions and prompts are shown on the upper eight digit display.

Once within the main configuration menu the required function can be selected by scrolling through the menu using the ▼ and ▲ push buttons. The Timer configuration menu is shown diagrammatically in Fig 14.

When returning to the display mode following reconfiguration, the Timer will display dAŁA followed by SAUE while the new information is stored in permanent memory.

6.5.2 Summary of Timer configuration functions

This section summarises all the Timer configuration functions. When read in conjunction with Fig 14 it provides a quick aid for configuring the Timer. If more detail is required, each section of this summary contains a reference to a full description of the function.

Display	Summary of function

FunſŁıon **Instrument function**
Defines the function of the instrument. May be set to:

ELAPSE Timer configuration
ſLoſ Clock configuration

All the entries in this Timer summary assume that the BA377E is configured as a Timer by selecting ELAPSE.
See section 6.5.3

ınPuŁ **Configuration of Input**
Contains a sub-menu with two sub-functions:

ınP.ŁYPE Selects input sensor type
dEbounſE Defines input debounce
See section 6.5.4

ınP.ŁYPE
Configures the Timer sensor input to accept one of six types of input:
oPſoL Open collector ●
UoLŁS L Voltage pulse <1 >3V
UoLŁS H Voltage pulse <3 >10V
ſoıL Magnetic pick-off
PrdEŁ Proximity detector ●
ſonŁAſŁ Switch contact ●

● Energise input by linking terminals 3 & 4.
See section 6.5.5

dEbounſE
Defines the level of debounce applied to the input to prevent false functioning:
dEFAuLŁ
HEAUY
LıGHŁ
See section 6.5.6

Display	Summary of function

di5P-2 **Lower display**
Configures the lower display to show set time 5Et t or, when the CYCLES repeat function is activated, the restart delay count-down plus the cycle count number.

With CYCLES not enabled:

Select	Lower display shows
5td	Set time 5Et t
oFF	Disables lower display.

See section 6.5.7

With CYCLES enabled:

Select	Lower display shows
5td	Cycles requested and cycles performed with time-down shown during requested delay period. Brief notification of timer status i.e. CYCLE or dELAY at start of each period.
LAbEL	Exactly as 5td but with periodic notification of timer status i.e. CYCLE or dELAY.
oFF	Disables lower display.

See section 6.5.7

5tArStoP **Starting and stopping the timer**
Defines how the Timer is started and stopped.

	Start	Stop
LoCAL	▼ button	▲ button
Control 1	Input high	Input low
Control 2	Input low	Input high

High and low inputs are specified for a voltage input. For other types of sensor input.
See section 6.5.8

uni t5 **Units of display**
Selects displayed units.
12:00:00	Hours, minutes & seconds
12:00	Hours & minutes *
30:00	Minutes & seconds
30	Seconds

Excludes delay of optional control outputs which is always shown in seconds and the grand total which is always shown in hours.
*Only available if 5Et t and r5t dELA , if already entered, specify zero seconds or seconds which are exactly divisible by sixty.
See section 6.5.9

5Et t **Set time**
When controlling an external event via the optional control outputs the BA377E will *time-down* from the set time to zero or *time-up* from zero to the set time.
Note: Timer will only start if a non zero value is entered for set time 5Et t.
See section 6.5.10

CYCLES **Repeat timing cycle**
Contains a sub-menu with three sub-functions, EnbL, CYCL Cnt and r5t dELA.
See section 6.5.11

Cycle function enable EnbL
Enables or disables the CYCLES function without changing the parameters.
See section 6.5.12

Cycle count CYCL Cnt
Defines the number of times that the timer cycle is repeated.
See section 6.5.13

Restart delay r5t dELA
Defines the time delay between timer cycles.
See section 6.5.14

ACSEt t **Access 5Et t and r5t dELA from display mode.**
Enables 5Et t and r5t dELA to be adjusted from the display mode. Also contains a sub-function ACCd which defines a separate code to protect access from the display mode to 5Et t and r5t dELA .
See section 6.5.15

Display	Summary of function
uP or dn	**Direction of count** Defines whether the Timer *times-down* from SEt t to zero or *times-up* from zero to the set time SEt t. **See section 6.5.16**
P-FAiL	**Power Failure** Defines how the Timer functions when power is restored after a power failure. Contains three sub-functions idLE, PAuSE and ContinuE.

    idLE   Timer returns in stopped state as if having completed a single timing cycle displaying Timer value when power was lost. Timing resumes when reset followed by start instructions are received.

    PAuSE   Timer returns in paused state displaying Timer value when power was lost. Timing resumes when start instruction is received.

    ContinuE   Timer will continue without any manual intervention.
See section 6.5.17

Display	Summary of function
LoC rSEt	**Local reset** Contains two sub-functions which when enabled allow the Timer and the grand total, which represents total Timer run-time, to be reset to zero via the front panel push buttons while the Timer is in the display mode. **See section 6.5.18**

Local total reset rSEtEnbL
When on is selected, Timer is reset to zero, or SEt t if *timing-down*, when the ▼ and ▲ buttons are operated simultaneously for more than 3 seconds in the display mode.
See section 6.5.19

Local grand total reset CLr Gtot
When on is selected the grand total, which represents total run-time, may be reset to zero by operating the Ⓔ + ▲ buttons simultaneously for more than 10 seconds in the display mode.
Note: Once reset, the grand total can not be recovered.
See section 6.5.20

Display	Summary of function
oP1	**Control output 1 (Optional)** Contains sub-menu with four sub-functions, EnbL, oP1 on, oP1 oFF and oP1 dELA. **See section 6.5.21**

Control output enable EnbL
Enables or disables control output 1 without changing the parameters.
See section 6.5.22

Control output 1 on at oP1 on
Defines when the control output turns on (closes).
See section 6.5.23

Control output 1 off at oP1 oFF
Defines when the control output turns off (opens).
See section 6.5.24

Control output 1 delay oP1 dELA
Introduces a configurable delay between the oP1 on condition occurring and the control output turning on (closing).
See section 6.5.25

Display	Summary of function
oP2	**Control output 2 (Optional)** Functions as control output 1. **See section 6.5.26**

Display	Summary of function

ᴄᴌʀ ɢtot   **Resets grand total to zero**
This function resets the grand total, which represents the total Timer run-time, from within the configuration menu when ᴄᴌʀ ᵧES is selected and Sᴜʀᴇ is entered to confirm the instruction.
Note: Once reset, the grand total can not be recovered.
See section 6.5.27

ᴄodᴇ   **Security code**
Defines a four digit alphanumeric code that must be entered to gain access to the instrument's configuration menu. Default code 0000 disables the security function and allows unrestricted access to all configuration functions when the ⒫ and ⒠ buttons are operated simultaneously in the display mode.
See section 6.5.28

ʀSᴇt dᴇF   **Reset to factory defaults**
Resets the BA377E to the factory default configuration shown in section 6.5 when Sᴜʀᴇ is entered to confirm instruction.
See section 6.5.29

6.5.3 Instrument function: FunEbı on

The BA377E may be configured as a Timer or as a Clock. This section of the instruction manual describes the Timer, for details of Clock configuration see section 9.

To reveal the existing function of the instrument select FunEbı on from the configuration menu and press Ⓟ. If ELAPSE is displayed, the instrument is already configured as a Timer therefore press Ⓔ to return to the FunEbı on prompt in the configuration menu. If ELoE is displayed, press the ▲ or ▼ button to change the setting to ELAPSE followed by the Ⓟ button which will result in a 0000 prompt being displayed with the first digit flashing. This is a request for the instruction to be confirmed by entering SurE using the ▼ and ▲ buttons to adjust the flashing digit and the Ⓟ button to move control to the next digit. When SurE has been entered, pressing Ⓔ will reconfigure the instrument to a Timer and return the display to FunEbı on in the configuration menu.

6.5.4 Input: ı nPub

The ı nPub function contains two sub-functions ı nP.bYPE which defines the type of sensor that may be connected to the input and dEbounEE which adjust the amount of input noise rejection.

6.5.5 Input type: ı nP.bYPE

ı nP.bYPE is a sub-menu in the ı nPub function which defines the type of input sensor that may be connected to the input. To check or change the type of input, select ı nPub in the configuration menu and press Ⓟ which will reveal the ı nP.bYPE prompt, pressing Ⓟ again will show the existing input type. If set as required press Ⓔ twice to return to the configuration menu, or repeatedly press the ▲ or ▼ button until the required type of input is displayed and then press Ⓔ twice to return to the configuration menu.

One of following six types of input may be selected:

Display	Input type	Switching thresholds	
		Low	High
oPEoL	Open collector[2]	2	10kΩ
UoLbS L	Voltage pulse low[1]	1	3V
UoLbS H	Voltage pulse high[1]	3	10V
Eoı L	Magnetic pick-off	0	40mV
Pr.dEb	Proximity detector[2]	1.2	2.1mA
EonbAEb	Switch contact[2]	100	1000Ω

Notes:

1. Maximum voltage input +28V.

2. For sensors that require energising i.e. proximity detectors, switch contacts and those with open collector outputs, terminals 3 & 4 of the BA377E Timer should be linked together.

3. For the Timer to function correctly, the input signal must fall below the lower switching threshold and rise above the higher switching threshold for the times shown in the debounce section 6.5.6 below.

6.5.6 debounce: dEbounEE

dEbounEE is an adjustable sub-menu in the ı nPub function which prevents the Timer mis-functioning when the input has noisy edges, such as those resulting from a mechanical contact closing and bouncing. Three levels of protection may be selected and the amount of debounce applied depends upon the type of Timer input that has been selected in the ı nP.bYPE function.

The following table shows the minimum time that the input signal must be continuously above the upper input switching threshold and continuously below the lower switching threshold to ensure that the Timer processes the input signal. Input switching thresholds are shown in section 6.5.5.

Debounce level	Min input pulse width	
	Type of Input	
	Contact	All others
Default	1600μs	40μs
Heavy	3200μs	350μs
Light	400μs	5μs

6.5.7 Lower display: dıSP-2

The configuration of the lower display which has six 12mm high digits, depend upon whether the repeat timer function CYCLES, which can repeat the timing period up to 99 times or continuously with a configurable delay between periods, is enabled. The configuration options are:

> **CYCLES disabled**
> The lower display shows the set time SEt t or the lower display may be disabled.

> **CYCLES enabled**
> The lower display shows the total number of repeat cycles requested together with the current cycle number. During the configurable delay between cycles the display times-down from the requested delay time to zero. Each operation may be briefly named at it's start or periodically throughout the cycle.
> The lower display may also be disabled if not required.

To check or change the configuration of the lower display select dıSP-2 from the configuration menu and press Ⓟ which will reveal the existing setting which can be changed by pressing the ⬆ or ⬇ button followed by the Ⓔ button to enter the selection and return to the configuration menu.

If the CYCLES function is not enabled the following two options are available:

> Std   Lower display shows the Timer's set time SEt t, from which the BA377E will time-up or time-down depending upon the direction of count selected in the uP or dn function.

> oFF   Lower display disabled.

If the CYCLES function is enabled the following three options are available:

> Std   Lower display shows the number of cycles requested together with the current cycle number. During the configurable delay period the display times-down from the requested delay to zero. A brief notification of timer status i.e. CYCLE or dELAY is shown at start of each period.

> ## 02 - 11
> | Current cycle number | Number of cycles requested, not shown when cycle is continuously repeated. |
> |---|---|

> LAbEL   Exactly the same as Std, but timer status i.e. CYCLE or dELAY is shown periodically.

> oFF   Lower display disabled.

6.5.8 Starting & stopping the Timer: StArStoP

The Timer may be started and stopped by a sensor input signal or by operation of the front panel ⬆ or ⬇ push buttons.

To check or change the control of the Timer, select StArStoP from the configuration menu and press Ⓟ which will reveal the existing setting which can be changed by pressing the ⬆ or ⬇ button followed by the Ⓔ button to enter the selection and return to the configuration menu. Options available are:

Voltage inputs or control from front panel

Display	Start	Stop
Control 1	Input high	Input low
Control 2	Input low	Input high
LoCAL	⬇ button	⬆ button

Contact and open collector inputs

Display	Start	Stop
Control 1	Open	Closed
Control 2	Closed	Open

Proximity detector input

Display	Start	Stop
Control 1	Low current	High current
Control 2	High current	Low current

6.5.9 Units of display: unıtS

Defines the format of all displayed times, except the delay time of the optional control outputs which is shown in seconds and the grand total which is shown in hours and tenths of an hour.

To check or change the units of display, select unıtS from the configuration menu and press Ⓟ which will reveal the existing setting. The required units can be selected by pressing the ⬆ or ⬇ button followed by the Ⓔ button to enter the selection and return to the configuration menu. The options available are shown below:

Display	
12:00:00	Hours, minutes & seconds
12:00	Hours & minutes*
30:00	Minutes & seconds
30	Seconds

* Only available when time in seconds specified in any Timer function is zero or divisible by 60.

The Timer's maximum elapsed time in any format is equivalent to 99 hours, 59 minutes & 59 seconds.

Display mode — DISPLAY

Security Code

Enter code by pressing
▲ or ▼ & P
to move to next digit. Code 0000 allows direct access to the menu

CodE

0000

FunCtion — inPut — diSP-2 — StArtStoP — unitS — SEt t — CYCLES — ACSEt t

ELAPSE

inPtYPE — dEbounCE

Std

LoCAL

12:00:00

00:00:00

EnbL — ACCd

0000

oPCoL

dEFAuLt

oFF

0000

Function	Input	Debounce	Lower Display	Start & stop timer	Units of display	Set time	Enable access to Set Time from display mode	Security code for direct access to Set Time
▲ or ▼ to select	▲ or ▼ to select	▲ or ▼ to select	CYCLES not enabled	▲ or ▼ to select how timer is controlled	▲ or ▼ to select	▲ or ▼ to adjust value and P to move control to next digit	▲ or ▼ to select on or oFF	Enter code by pressing ▲ or ▼ and P to move to next digit
Function of instrument	Input type	level of debounce.	▲ or ▼ to select display		hours minutes seconds			
ELAPSE Interval measurement	oPCoL Open Collector	dEFAuLt LiGHt HEAVY	Std Set time SEt t	LoCAL Start ▼ button Stop ▲ button	12:00:00 12:00 30:00 30			Code 0000 allows direct access
CLoC Time display	UoLtS L Pulse <1V >3V		oFF lower display disabled	Control 1 Start Input high (open) Stop Input low (closed)				
Confirm selection by entering SurE by pressing ▲ or ▼ and P to move to next digit	UoLtS H Pulse <3V >10V		CYCLES enabled	Control 2 Start Input low (closed) Stop Input high (open)				
	Coi L Magnetic pick-off		▲ or ▼ to select display					
	PrdEt Proximity detector		Std Cycle No. & total cycle with status shown at start of each operation					
	ContACt Switch contact		LAbEL Cycle No. & total cycle with status shown periodically					
			oFF lower display disabled					

EnbL — CYCL Cnt — rSt dELA

oFF

00

00:00:00:00

Enable cycle function	Cycle count	Restart delay
▲ and ▼ to toggle between on and oFF	▲ and ▼ to adjust flashing digit and P to move to next digit.	▲ and ▼ to adjust flashing digit and P to move to next digit.
	Sets number of cycles between 1 and 99 to be performed.	Sets delay between cycles in the same units as SEt t
	00 for continuous cycling	

Timer repeat cycle function

Fig 14 Timer Configuration menu

Only included when optional
Control Outputs are fitted

uP or dn   P-FAiL   LoC rSEt   oP1   oP2   CLr Gtot   CodE   rSEt dEF

dn   idLE   rSEtEnbl   CLr Gtot   As oP1   CLr.no   0000   0000

oFF   oFF   0000

Direction of count

▲ or ▼ to select uP or dn

Power fail

▲ or ▼ to select how timer functions when power is restored after failure

idLE Stopped, requires reset & start input

PAuSE Paused, requires start input

ContinuE Resumes timing

Local total reset

▲ or ▼ to turn the local total reset function on or oFF

When on is selected pressing ▲ and ▼ simultaneously for more than 3 seconds in the display mode resets the total display

Local grand total clear

▲ or ▼ to turn the local grand total reset function on or oFF

When on is selected pressing ▲ and ▼ simultaneously for more than 10 seconds in the display mode resets the grand total

Clear grand total

press ▲ or ▼ to select YES to reset grand total to zero.

Confirm instruction by entering SurE. Press ▼ or ▲ to adjust each digit and P to move to next digit

Define Security Code

Enter by pressing ▼ or ▲ and P to move to next digit

Reset configuration to Timer factory defaults

Confirm instruction by entering SurE. Press ▼ or ▲ to adjust each digit and P to move to next digit

EnbL   oP1 on   oP1 oFF   oP1 dELA

oFF   StArt   StoP   00000

Enable output 1

▲ and ▼ to toggle between on and oFF

Output on at

▲ and ▼ to select required function

rESEt
run
PAuSE
dELAY
donE
n rESEt
n run
n PAuSE
n dELAY
n donE

Select action that energises output 1

Output off at

▲ and ▼ to select required function

rESEt
run
PAuSE
dELAY
donE
n rESEt
n run
n PAuSE
n dELAY
n donE

Select action that de-energises output 1

Output on delay

▲ and ▼ to adjust flashing digit and P to move to next digit

Set delay in seconds before output 1 is energised.

Output 1 configuration

6.5.10 Set time: 5Et t

This is the Timer's setpoint. When controlling an external event via the optional control outputs the BA377E will time-down from the set time to zero or time-up from zero to the set time.

To check or change the set time, select 5Et t from the configuration menu and press Ⓟ which will reveal the existing setting with the most significant digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button followed by the Ⓟ button to transfer control to the next digit. When set as required, enter the selection and return to the 5Et t prompt in the configuration menu by operating the Ⓔ button.

Note: If 5Et t is zero the Timer will not function when an external start input is received or the ▼ button is operated.

6.5.11 Repeat timing cycle: CYCLE5

This powerful function which allows the BA377E timing cycle to be repeated up to 99 times or continuously with a configurable delay between cycles of up to 99 hours, 59 minutes & 59 seconds.

To check or adjust the repeat timing cycle, select CYCLE5 from the configuration menu and press Ⓟ which will enter a sub-menu containing three sub-functions, EnbL, CYCL Cnt and r5t dELA which are described in the following sections.

6.5.12 Cycle function enable: EnbL

This sub-function allows the repeat timing cycle to be enabled or disabled without altering any of the repeat timing cycle parameters. To check or change the function select EnbL from the repeat timing cycle sub-menu and press Ⓟ which will reveal if the repeat cycle function is on or oFF. The setting can be changed by pressing the ▼ or ▲ button followed by the Ⓔ button to return to the repeat timing cycle sub-menu.

6.5.13 Cycle count: CYCL Cnt

This sub-function defines the number of times that the timer cycle is repeated. It may be set to any number between 1 and 99, or to 00 for continuous repetition.

To check or change the function select CYCL Cnt from the repeat timing cycle sub-menu and press Ⓟ which will reveal two digits with the most significant flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button followed by the Ⓟ button to transfer control to the next digit. When set as required, enter the selection and return to the CYCL Cnt prompt in the sub-menu by operating the Ⓔ button.

6.5.14 Restart delay: r5t dELA

This sub-function defines the time delay between repeat timing periods. It is shown in the format selected in the units function and may be set to any time between zero and the maximum time allowed in the selected format.

Time format selected in uni t5	Maximum delay
12:00:00	99:59:59
12:00	99:59
30:00	5999:59
30	359999

To check or change the reset delay time select r5t dELA from the repeat timing cycle sub-menu and press Ⓟ which will reveal the delay time in the selected format with the most significant digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button followed by the Ⓟ button to transfer control to the next digit. When set as required, enter the selection and return to the r5t dELA prompt in the sub-menu by operating the Ⓔ button.

Can also be adjusted from the Timer display mode, see 6.5.15

6.5.15 Adjusting the set time 5Et t and restart delay r5t dELA from the display mode: ACSEt t

When this function is enabled the Timer's set time 5Et t and restart delay r5t dELA can be adjusted from the display mode by simultaneously operating the Ⓟ and ▲ push buttons. Thus allowing an operator to adjust these parameters without having access to the instrument's configuration menu. The function contains two sub-functions, EnbL which activates the function and ACCd which defines a separate code for access to 5Et t with the Timer in the display mode.

To check or change the function, select ACSEt t in the configuration menu and press Ⓟ which will reveal the EnbL prompt, pressing Ⓟ again will show if the function is on or oFF. If adjustment of the set time from the display mode is not required press the ▲ or ▼ button to select oFF and then press Ⓔ twice to return to the configuration menu. If the function is required, select on and press Ⓔ to return to the EnbL prompt from which ACCd, which allows a separate access code to be entered, can be selected by pressing the ▲ or ▼ button.

Access to 5Et t and r5t dELA from the display mode may be protected by a four digit alphanumeric security code which must be entered to gain access. Default security code 0000 allows unrestricted access. With ACCd displayed, press Ⓟ to enter a

new access code. The Timer will display ☐☐☐☐ with one digit flashing. The flashing digit may be adjusted using the ▲ or ▼ push button, when set as required operating the Ⓟ button will transfer control to the next digit. When all the digits have been entered press Ⓔ twice to return to the RESEt t prompt in the configuration menu. The revised access code will be activated when the BA377E is returned to the display mode.

Please contact BEKA associates sales department if the access code is lost.

6.5.16 Direction of count: uP or dn
The Timer may be configured to *time-up* from zero to the set time SEt t while displaying elapsed time, or to *time-down* from the set time SEt t to zero while displaying the remaining time.

When the repeat timing cycle function CYCLES is enabled, it is recommended that a down count is selected so that the progress of the timer can be observed with a known completion time i.e zero. If set as an up counter, elapsed will be displayed, but SEt t at which the Timer will stop is not shown.

To check the direction of count, select uP or dn from the configuration menu and press Ⓟ which will reveal the existing setting which can be changed by pressing the ▲ or ▼ button followed by the Ⓔ button to enter the selection and return to the configuration menu.

6.5.17 Power Fail: P-FAiL
Defines how the Timer powers-up and functions when power is restored after a power supply interruption. Three options are available, idLE, PAuSE and Continue.

idLE | The Timer is stopped in the state it achieves when it has timed-up to SEt t or timed-down to ☐☐☐☐, with the elapsed or remaining time when power was lost shown on the upper display. The Timer must be reset before it can be restarted. If the repeat timing cycle is in use the number of cycles completed will be lost when the Timer is reset.

PAuSE | The Timer is stopped in the state it achieves following receipt of a stop input to pause timing. The elapsed or remaining time when power was lost is shown on the upper display. Timing resumes when a start instruction is received. If a start input exists when power is restored timing will start immediately.

Continue | When power is restored the Timer will continue from where it stopped without any manual intervention. To check or change the function, select P-FAiL from the configuration menu and press Ⓟ which will reveal the existing setting which can be changed by pressing the ▲ or ▼ button followed by the Ⓔ button to enter the selection and return to the configuration menu.

6.5.18 Local reset: LoC rSEt
The Local reset function contains two separate sub-functions rESEt.EnbL and CLr Gtot which when enabled allow the Timer and the grand total to be reset via the instrument's front panel push buttons while the Timer is in the display mode.

6.5.19 Local total reset: rSEt.EnbL
rESEtEnbL is a sub-function in the LoC rSEt function which when activated allows an operator to reset the Timer from the display mode by operating the ▲ and ▼ push buttons simultaneously for more than three seconds.

To check or change the local total reset select LoC rSEt in the configuration menu and press Ⓟ which will reveal the rSEtEnbL prompt, press Ⓟ again to show if the local total reset is on or oFF. If set as required operate the Ⓔ button twice to return to the configuration menu, or the ▲ or ▼ button to change the setting followed by the Ⓔ button twice to enter the change and return to the LoC.rSEt prompt in the configuration menu.

Note:
> The Timer may also be reset remotely by connecting terminals RS1 and RS2 together for more than one second. See section 3.2.8

6.5.20 Local grand total reset: CLr Gtot
The grand total is the total run-time of the Timer that may be viewed by operating the Ⓔ and ▲ push buttons simultaneously in the display mode. When activated CLr Gtot allows an operator to reset the grand total display to zero from the display mode by operating the Ⓔ and ▲ push buttons simultaneously for more than ten seconds.

CLr Gtot is a sub-function in the LoC rSEt menu. To check or change the setting select LoC rSEt in the configuration menu and press Ⓟ which will reveal rESEt.EnbL. Using the ▼ or ▲ button select CLr Gtot and press Ⓟ which will show if local grand total reset is on or oFF. If set as required operate the Ⓔ button twice to return to the configuration menu, or the ▼ or ▲ button to change the setting followed by the Ⓔ button twice to enter the change and return to the LoC rSEt prompt in the configuration menu.

6.5.21 Control output 1 (optional): oP1

Control output 1 is an optional factory fitted, galvanically isolated solid state switch contact which can be configured to turn *on* and *off* when the Timer is in any of it's five states.   The control output status is shown by the 1 control output display annunciator.

The function contains four sub-functions, EnbL, oP1 on, oP1 oFF and oP1 dELA. To gain access to the sub-menu select oP1 in the configuration menu and press Ⓟ which will show the EnbL prompt from which the other sub-functions can be accessed using the ▼ or ▲ button.

There are ten independent Control Output 1 *on* and *off* conditions.   If Control Output 1 is only required to be active in one Timer state configure as follows:

oP1 on	state required	e.g. run
oP1 oFF	n state required	e.g. n run

If Control Output 1 is required to be active in all Timer states except one configure as follows:

StAt on	n state required	e.g. n run
StAt oFF	state required	e.g. run

Control Output 1 can also be configured to be active in three Timer states.   e.g. when configured as shown below Control Output 1 is *on* in the PAuSEd, dELAY and donE states, but *off* in the other two Timer states.

StAt on	n run
StAt oFF	rESEt

6.5.22 Control output 1 enable: EnbL

This function allows control output 1 to be enabled or disabled without altering any other control output parameters. To check or change the function select EnbL from the control output 1 sub-menu and press Ⓟ to reveal if control output 1 is on or oFF. The setting can be changed by pressing the ▼ or ▲ button followed by the Ⓔ button to return to the control output 1 sub-menu.

6.5.23 Control output 1 *on* at : oP1 on

Control output 1 is very versatile and may be configured to turn *on* (output closed) in any one of the five Timer states, or to turn on when the Timer is not in one of the Timer states.   Timer states are shown in   Fig 13.

To define when output 1 is on select oP1 on from the control output 1 sub-menu and press Ⓟ to show the existing setting. Pressing the ▼ or ▲ button will scroll through the options:

Display	Output 1 *on* when Timer is in
rESEt	*Reset* state
run	*Run* state
PAuSE	*Pause* state
dELAY	*Delay* state
donE	Com*plete* state

	Output 1 *on* when Timer is NOT in
n rESEt	*Reset* state
n run	*Run* state
n PAuSE	*Pause* state
n dELAY	*Delay* state
n donE	Com*plete* state

When the required setting has been selected press Ⓔ to enter the selection and return to the control output 1 sub-menu.

6.5.24 Control output 1 *off* at: oP1 oFF

Control output 1 may be configured to turn *off* (output open) in any one of the five Timer states, or to turn *off* when the timer is not in one of the five Timer states.   Timer states are shown in Fig 13.

To define when the output 1 is *off* select oP1 oFF from the sub-menu and press Ⓟ to show the existing setting. Pressing the ▼ or ▲ button will scroll through the options:

Display	Output 1 *off* when Timer is in
rESEt	*Reset* state
run	*Run* state
PAuSE	*Pause* state
dELAY	*Delay* state
donE	Com*plete* state

	Output 1 *off* when Timer is NOT in
n rESEt	*Reset* state
n run	*Run* state
n PAuSE	*Pause* state
n dELAY	*Delay* state
n donE	Com*plete* state

When the required setting has been selected press Ⓔ to enter the selection and return to the control output 1 sub-menu.

6.5.25 Control output 1 *on* delay time: oP1 dELA

Control output 1 may be delayed from turning on (output closed) for a fixed time following the selected condition occurring. e.g. when the Timer enters the *Run* state. This delay can be adjusted in 1 second increments up to 32,400 seconds, which is 9 hours. If a delay is not required zero should be entered. To adjust the delay select oP1 dELA from the control output 1 sub-menu and press Ⓟ which will reveal the existing delay time with one digit flashing. The flashing digit can be adjusted using the ▼ or ▲ button and the Ⓟ button to move to the next digit. When the required delay has been entered, press Ⓔ to return to the control output 1 sub-menu.

Timer configuration examples in section 7.2. and 7.3 of this manual illustrate how to configure the optional control outputs.

6.5.26 Control output 2 (optional): oP2

Control output 2 is an optional, galvanically isolated solid state switch contact which can be independently configured to turn *on* and *off* when the Timer is any of it's five states. It's functions and configuration are identical to control output 1 described in sections 6.5.21 to 6.5.25

The control output status is shown by the 2 control output display annunciator.

6.5.27 Reset grand total from within the configuration menu: CLr GtoE

The grand total is the total run-time of the Timer that may be viewed by operating the Ⓔ and ▲ push buttons simultaneously in the display mode.

The grand total can be reset to zero from within the configuration menu using this CLr GtoE function, or from the display mode if CLr GtoE is activated in the local grand total clear function - see 6.5.20

To zero the Timer grand total from within the configuration menu select CLr GtoE and press Ⓟ which will cause the instrument to display CLr.no with no flashing. Press the ▼ or ▲ push button until CLr.YES is displayed and then press Ⓟ which will result in a 0000 prompt being displayed with the first digit flashing. This is a request for the instruction to be confirmed by entering SurE using the ▼ and ▲ buttons to adjust the flashing digit and the Ⓟ button to move control to the next digit. Pressing Ⓔ will then reset the grand total to zero and return the Timer to the configuration menu.

Note: Once reset, the grand total can not be recovered.

6.5.28 Security code: CodE

Access to the instrument configuration menu may be protected by a four digit alphanumeric security code which must be entered to gain access. New instruments are configured with the default security code 0000 which allows unrestricted access to all configuration functions.

To enter a new security code select CodE from the configuration menu and press Ⓟ which will cause the Timer to display 0000 with one digit flashing. The flashing digit may be adjusted using the ▲ and ▼ push button, when set as required operating the Ⓟ button will transfer control to the next digit. When the new security code has been entered press Ⓔ to return to the CodE prompt. The revised security code will be activated when the Timer is returned to the display mode.

Please contact BEKA associates sales department if the security code is lost.

6.5.29 Reset configuration to Timer factory defaults: rSEt dEF

When the BA377E is configured as a Timer this function resets the instrument to the Timer factory defaults shown in sections 6.5

To reset the configuration select rSEt dEF from the configuration menu and press Ⓟ. The BA377E will display 0000 with the first digit flashing which is a request to confirm the instruction by entering SurE. Using the ▲ or ▼ button set the first flashing digit to 5 and press Ⓟ to transfer control to the second digit which should be set to u. When SurE has been entered pressing the Ⓔ button will reset all the configuration functions and return the instrument to the display mode.

Note:

rSEt dEF does not reset the grand total to zero.

7. TIMER APPLICATION EXAMPLES

This section illustrates two common applications for the BA377E when configured as a Timer.

7.1 Measuring the time that a contact is closed.

In this example a BA377E is required to display the time that a hazardous area contact is closed. The display is required in hours and minutes within the hazardous area and is to be reset to zero by a push button located in the same hazardous area, not by the instrument front panel push buttons. The operator is required to zero the grand total by operating the ⒠ + ⏶ buttons simultaneously. No security codes are required to protect access to the configuration menu or to the grand total reset. When power is restored after a supply interruption the Timer is to resume normal operation without manual intervention.

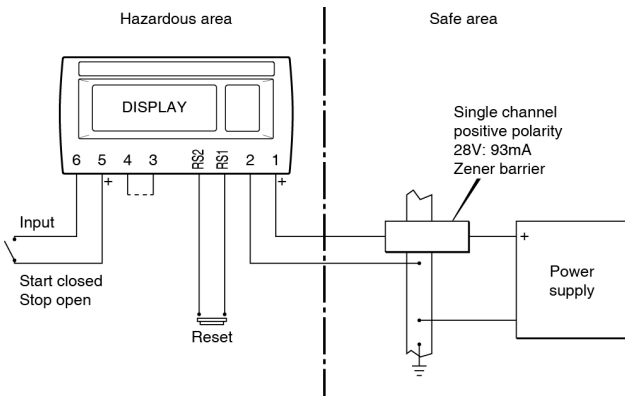Figure 15 shows the wiring for the BA377E when powered by a single channel Zener barrier.

Fig 15 Wiring for displaying time a contact is closed

The required instrument configurations for this example are shown below.

Function	Display	Setting
Access code	CodE	0000
Function	FunCtion	ELAPSE
Input	inPut	ContACt
Terminals 3 & 4 linked to energise input		
debounce	dEbounCE	dEFAuLt
Display 2	diSP-2	oFF
Start stop	StArStoP	ControL 2
Units	uni tS	12:00
Set time	SEt t	9999:99:99
Direction of count	uP or dn	uP
Power fail	P-FAiL	ContinuE
Local total reset	rSEt.EnbL	oFF
Local grand total reset	CLr Gtot	on

7.2 Controlling an IS solenoid valve

The BA377E Timer is required to open an intrinsically safe solenoid valve for 5 minutes when an external contact is closed. 55 minutes after the valve is closed it is to be opened again for another 5 minute period. This process is to be repeated 10 times after which the Timer is to automatically reset so that is ready to start the next 10 cycles when the external contact is closed.

In this example control output 2 has been wired to the timer reset terminals and configured with a five seconds control output delay after the solenoid valve has closed for the tenth time. Therefore five seconds after the tenth cycle has been completed the system automatically resets and is ready for the next timing cycle to be initiated.

The lower display is required to show timer status at the start of each period.

After a power interuption the timer is required to resume operation from the point at which it stopped when the start button is operated.
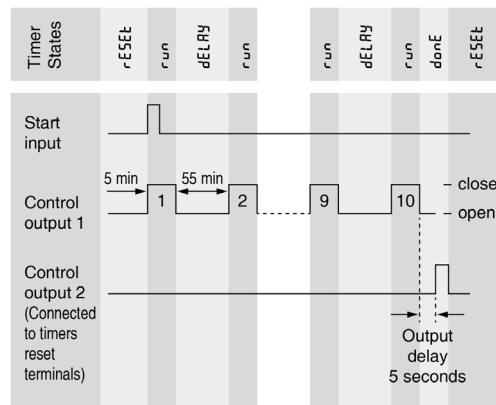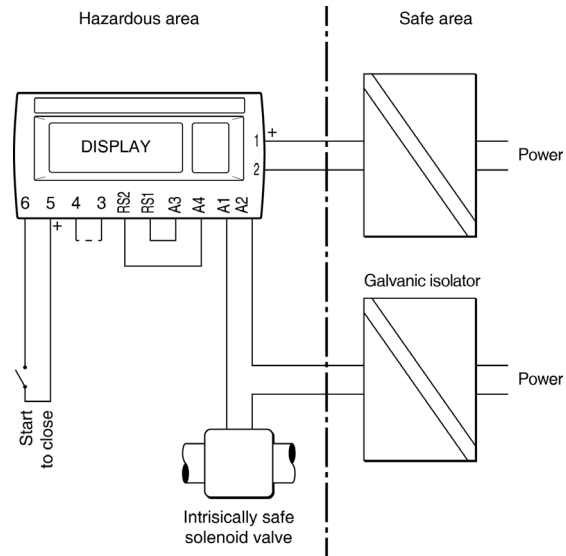

Fig 16 Control of valve in a hazardous area

The required instrument configuration for this example are shown below.

Function	Display	Setting
Access code	CodE	0000
Function	FunCtion	ELAPSE
Input	inP.tYPE	ContACt
debounce	dEbounCE	dEFAuLt
Display 2	diSP-2	Std
Start stop	StArStoP	Control 2
Units	uni tS	12:00
Set time	SEt t	00:05
Timer repeat cycle	CYCLES	
Cycle function enable	EnbL	on
Cycle count	CYCL Cnt	10
Reset delay	rSt dELA	00:55
Access set time from display mode.	RESEt - t	oFF
Direction of count	uP or dn	uP
Power failure	P-FAiL	PAuSE
Local total reset	rESEt.EnbL	oFF
Local grand total reset	CLr Gtot	oFF
Enable control output 1	EnbL	on
Control output 1 on at	oP1 on	run
Control output 1 off at	oP1 oFF	n run
Control output 1 delay	oP1 dELA	00000
Enable control output 2	EnbL	on
Control output 2 on at	oP2 on	donE
Control output 2 off at	oP2 oFF	rESEt
Control output 2 delay	oP2 dELA	00005

7.3 Cycling an IS solenoid valve

In this example a BA377E is required to cycle an intrinsically safe solenoid valve such that it opens 4 times for 10 minutes at 15 minutes intervals. Once all 4 solenoid valve cycles have been completed a remote "Sequence Complete" lamp is illuminated in the safe area until the reset push button is operated.

If, during the sequence, power is lost the control outputs are to remain de-energised when power is restored. The timer is to recommence operating from the last known point when the start push button is pressed.

For this application the BA377E Timer requires dual control outputs which are a factory fitted option and should be specified when the instrument is ordered.

When the start button is closed output 1 closes which opens the solenoid valve and the counter times-down 10 minutes. When the elapsed time equals zero, output 1 opens thus closing the solenoid valve. The timer then counts down the 15 minute delay which is shown on the lower display (display 2). When the delay equals zero, output 1 closes again for a second 10 minutes, the whole cycle being repeated such that the solenoid valve opens and closes 4 times. After the solenoid valve has closed for a fourth time output 2 closes which illuminates a "Sequence Complete" lamp indicating that the whole operation is finished.

The lamp remains illuminated until the reset push button is closed for 2 seconds (Reset is shown on the display) at which point control output 2 is de-energised which turns the lamp off.

Note:
Both the timer (display 1) and delay (display 2) will count down - but the cycle display counts *up* towards its target.

Fig 17 Control of valve in a hazardous area.
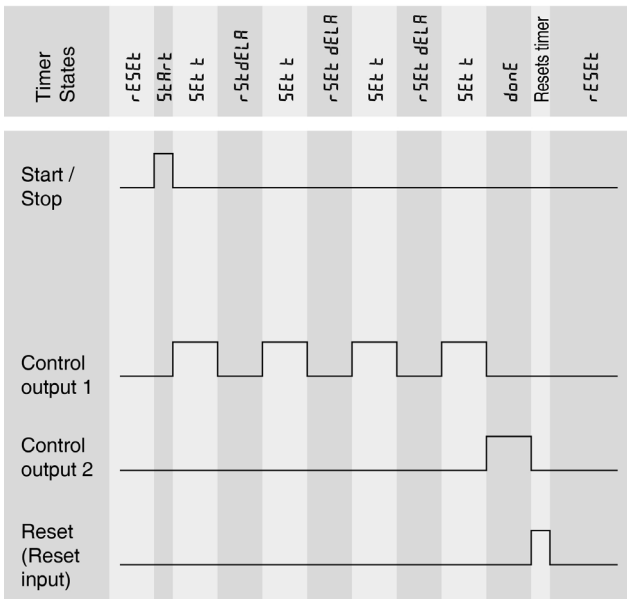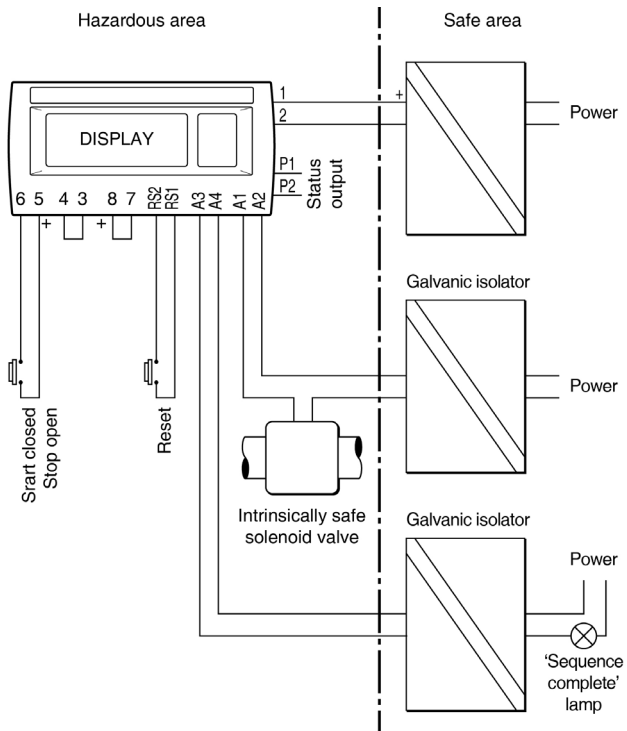
The required instrument configuration for this example is shown below:

Function	Display	Setting
Function	FunCti on	ELAPSE
Input A	i nPut -A	ContACt
Debounce (both inputs)	dEbounCE	dEFAuLt
Display 2	di SP-2	Std
Start stop	StArStoP	Control 2
Units	uni t	12:00:00
Set time	SEt t	00:10:00
Timer repeat cycle	CYCLES	
Enable Repeat Cycle	EnbL	on
Cycle Count	CYCL Cnt	04
Reset delay	rSt dELA	00:15:00
Access set time from display mode.	ACSEt -t	oFF
Direction of count	uP or dn	dn
Control output after power restoration	P-FAi L	PAuSE
Local total reset	LoC rSEt	oFF
External Reset Contact Closure Time	E rSEt	Std
Status Output	StAt oP	dEFAuLt
Output 1	oP I	
Enable control output 1	EnbL	on
Control output 1 on at	oP I on	run
Control output 1 off at	oP I oFF	n run
Control output 1 delay	oP I dELA	00000
Output 2	oP2	
Enable control output 2	EnbL	on
Control output 2 on at	oP2 on	donE
Control output 2 off at	oP2 oFF	rESEt
Control output 2 delay	oP2 dELA	00000
Local grand total reset	CLr Gtot	oFF
Access code	CodE	dEFAuLt

Note: Functions in **bold** are first level menu items.

8. MAINTENANCE when configured as a Timer

8.1 Fault finding during commissioning

If a BA377E fails to function as a Timer during commissioning the following procedure should be followed:

Symptom	Cause	Check:
No display	No power supply, or incorrect wiring. Note: Terminals 2, 6 & RS2 are interconnected within the instrument.	That there is between 10 and 28V on terminals 1 & 2 with terminal 1 positive.
Instrument configuration menu does not correspond with Timer section of this manual.	BA377E may be configured as a clock.	That FunEti on in configuration menu is set to ELAPSE not to ELoE.
Timer will not start.	Timer not reset	Reset timer via external contact or by operating ▲ and ▼ buttons simultaneously if the local total reset rSEt EnbL has been activated.
	Set time SEt t has not been entered.	Enter a value for SEt t other than zero.
Timer will not respond to external input.	Input incorrectly configured, or sensor incorrectly connected.	Input configuration and input energising link is correctly fitted for selected sensor.
Control output(s) do not function.	Control outputs have not been enabled.	Enable Control Output(s) in the configuration menu.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used. Contact BEKA if code is lost.

8.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance is permitted on intrinsically safe equipment installed in a hazardous area, but only certified test equipment should be used unless a gas clearance certificate is available.

If a BA377E fails after it has been functioning correctly, the following table may help to identify the cause of the failure.

Symptom	Cause	Check:
No display	No power supply	That there is between 10 and 28V on terminals 1 & 2 with terminal 1 positive.
Timer will not start.	Timer not reset	Reset timer via external contact or by operating ▲ and ▼ buttons simultaneously if local total reset rESEt.EnbL has been activated.
	Reset terminals RS1 & RS2 are linked which will inhibit Timer.	Remove link.
Control output(s) do not function.	Control Outputs have not been enabled.	Enable Control Output(s) in the configuration menu.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used. Contact BEKA if code is lost.

If this procedure does not reveal the cause of the fault, it is recommended that the instrument is replaced.

Note:

If configuration changes are made to i nPut, StArtStoP, EYELES, uP or dn, oP1 or oP2 functions the Timer will be forced into a fail safe i dLE condition. This stops the Timer in the state it achieves when it has timed-up to SEt t or timed-down to 0000. The Timer must be reset before it can be restarted.

8.3   Servicing

We recommend that faulty BA377E Timers are returned to BEKA associates or to our local agent for repair. It is helpful if a brief description of the fault symptoms is provided.

8.4   Routine maintenance

The mechanical and electrical condition of the instrument should be regularly checked. Inspection frequency should be chosen to suit the environmental conditions.

8.5   Guarantee

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

8.6   Customer comments

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

9.   OPERATION AS A CLOCK

When configured as a clock the BA377E can display local time in a variety of twelve or twenty four hour formats.   The displayed time can be adjusted via the front panel push buttons which may be protected by a user definable four digit security code to prevent unauthorised or accidental adjustment.

The clock may be synchronised to an external time standard via the instrument's reset terminals.   When these two terminals are connected together by an external switch contact, the clock display will be reset to a preconfigured time and will resume running from this time when the contacts are opened.

When fitted with the optional galvanically isolated control outputs the clock can be configured to turn each solid state output on and off twice during each twenty four hour period.

Fig 18 shows a simplified block diagram of the BA377E configured as a clock.

The instrument can be supplied with the following factory fitted accessories:

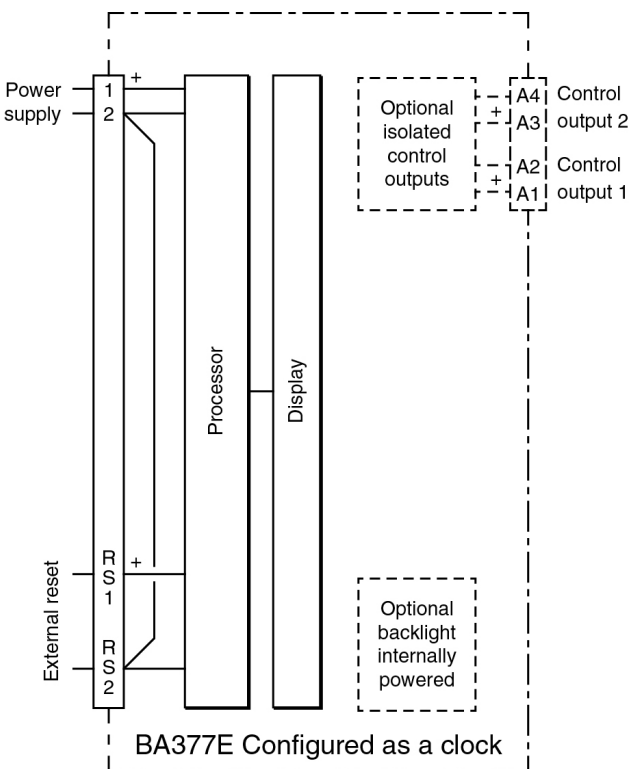Backlight Internally powered

Dual isolated control outputs

Fig 18   BA377E block diagram with clock configuration.

9.1   Initialisation and loss of power

Each time power is applied to a BA377E initialisation is performed.   After a short delay the following display sequence occurs:

All segments of the display are activated

Instrument starts functioning using the configuration stored in the instrument's permanent memory.

Following initialisation, the instrument will display a flashing display which is a request for the local time to be entered.   The clock will not start to function until a display time has been entered, or the remote reset contacts are closed and opened to synchronise the clock to a preconfigured time.

If during normal operation the power supply is interrupted for more than 30ms, the display will return to the flashing condition and the display time will have to be re-entered.   Longer interruptions may be tolerated by powering the Clock from a lightly loaded galvanic isolator or via a Zener barrier from an instrument supply with large output capacitance.

9.2   Controls when configured as a clock

The BA377E clock is configured and adjusted via four front panel push buttons.   In the display mode i.e. when the instrument is displaying time, the push button functions are:

P + **▼**   Shows in succession, firmware version number, instrument function ‾ɔŁoɔ and output accessories that are fitted:

-ʁ   Dual Control Outputs

P + **E**   Access to configuration menu

Note: When optional control outputs are fitted, the BA377E clock may be configured to provide direct access to the control output *on* and *off* times from the display mode when the **P** + **▲** push buttons are operated. - see section 9.4.13

9.3   Displays when configured as a clock

The BA377E clock has a single digital display plus annunciators.

Time display	Shows time in selected 12 or 24 hour format.
Reset annunciator	Activated while clock is being synchronised and external reset contacts are closed.
Control output annunciators	Show status of both optional control output.

9.4 Configuration as a clock

The BA377E is configured and calibrated via four front panel push buttons. All the configuration functions are contained in an easy to use intuitive menu that is shown diagrammatically in Fig 19.

Each menu function is summarised in section 9.4.2 of this manual and each includes a reference to more detailed information.

All new BA377E instruments are supplied configured as requested at the time of ordering. If configuration is not requested, the BA377E will be supplied with default Timer configuration as shown in section 6.5.

If a BA377E Clock is requested without detailed configuration information, the instrument will supplied with default Clock configuration as shown below, but can easily be re-configured on-site.

Default Clock Configuration

Function	Display	Default
Access code	CodE	0000
Function	FunCtion	CLoC
Display	di SPLAY	12:00
Syncronise time	SYnC t	A 12:00:00
Enable control output 1*	EnbL	oFF
Enable control output 2*	EnbL	oFF
Enable access alarm times from display mode.	ACSP	oFF
Access code for alarm times from display mode.	ACCd	0000

Note: * Control outputs are an option

9.4.1 Accessing configuration functions

Throughout this manual push buttons are shown as ▼, ▲, P and E and legends displayed by the Clock are shown in a seven segment font as they appear on the instrument e.g. di SPLAY and CodE.

Access to the configuration menu is obtained by operating the P and E push buttons simultaneously. If the instrument is not protected by an access security code the first parameter FunCtion will be displayed. If a security code other than the default code 0000 has already been entered, the instrument will display CodE. Press P to clear this prompt and enter the security code for the instrument using the ▼ or ▲ push button to adjust the flashing digit, and the P push button to transfer control to the next digit. If the correct code has been entered pressing E will cause the first parameter FunCtion to be displayed. If an incorrect code is entered, or a push button is not operated within ten seconds, the instrument will automatically return to the display mode.

All configuration functions and prompts are shown on the upper eight digit display.

Once within the main configuration menu the required function can be selected by scrolling through the menu using the ▼ and ▲ push buttons. The Clock configuration menu is shown diagrammatically in Fig 19.

When returning to the display mode following reconfiguration, the Clock will display dAtA followed by SAUE while the new information is stored in permanent memory.

Display mode

DISPLAY

Security Code

Enter code by pressing ▲ or ▼ & P to move to next digit. Code 0000 allows direct access to the menu

CodE

0000

Only included when optional Control Outputs are fitted

FunCtion di SPLAY SEt SYnC t oP 1 oP2 ACSP CodE rSEt dEF

CLoC 12:00:00 12:00:00 00:00:00 As oP 1 EnbL ACCd 0000 0000

0000 oFF 0000

Function

▲ or ▼ to select

Function of instrument

ELAPSE
Timer

CLoC
Clock

Confirm selection by entering SurE by pressing ▲ or ▼ and P to move to next digit

Format of display

▲ or ▼ to select

12:00:00
12:00
24:00:00
24:00

Set display time

▲ or ▼ to adjust each digit and P to move to the next digit

Clock starts from new time when instrument is returned to the display mode.

Set synchronisation time

▲ or ▼ to adjust each digit and P to move to the next digit. Clock is set to synchronisation time when reset terminals RS1 & RS2 are connected together, the clock restarts when the terminals are disconnected.

Access Enable

▲ or ▼ to select on or oFF

Access Code for adjustment of Output on and oFF Times from Display Mode

Enter code by pressing ▲ or ▼ and P to move to next digit

Code 0000 allows direct access.

Define Security Code

Enter code by pressing ▲ or ▼ and P to move to next digit.

Reset configuration to clock factory defaults

Confirm request by entering SurE by pressing ▼ or ▲ and P to move to next digit.

EnbL oP 1:on 1 oP 1:oFF 1 oP 1:on2 oP 1:oFF2

oFF 12:00:00 12:00:00 12:00:00 12:00:00

Enable output 1

▲ or ▼ to select

oFF
output disabled

on:1
on and off once per 24 hours

on:2
on and off twice per 24 hours

Set first on time

▲ or ▼ to adjust flashing digit and P to move to next digit.

Set first off time

▲ or ▼ to adjust flashing digit and P to move to next digit.

Set second on time

▲ or ▼ to adjust flashing digit and P to move to next digit.

Set second off time

▲ or ▼ to adjust flashing digit and P to move to next digit.
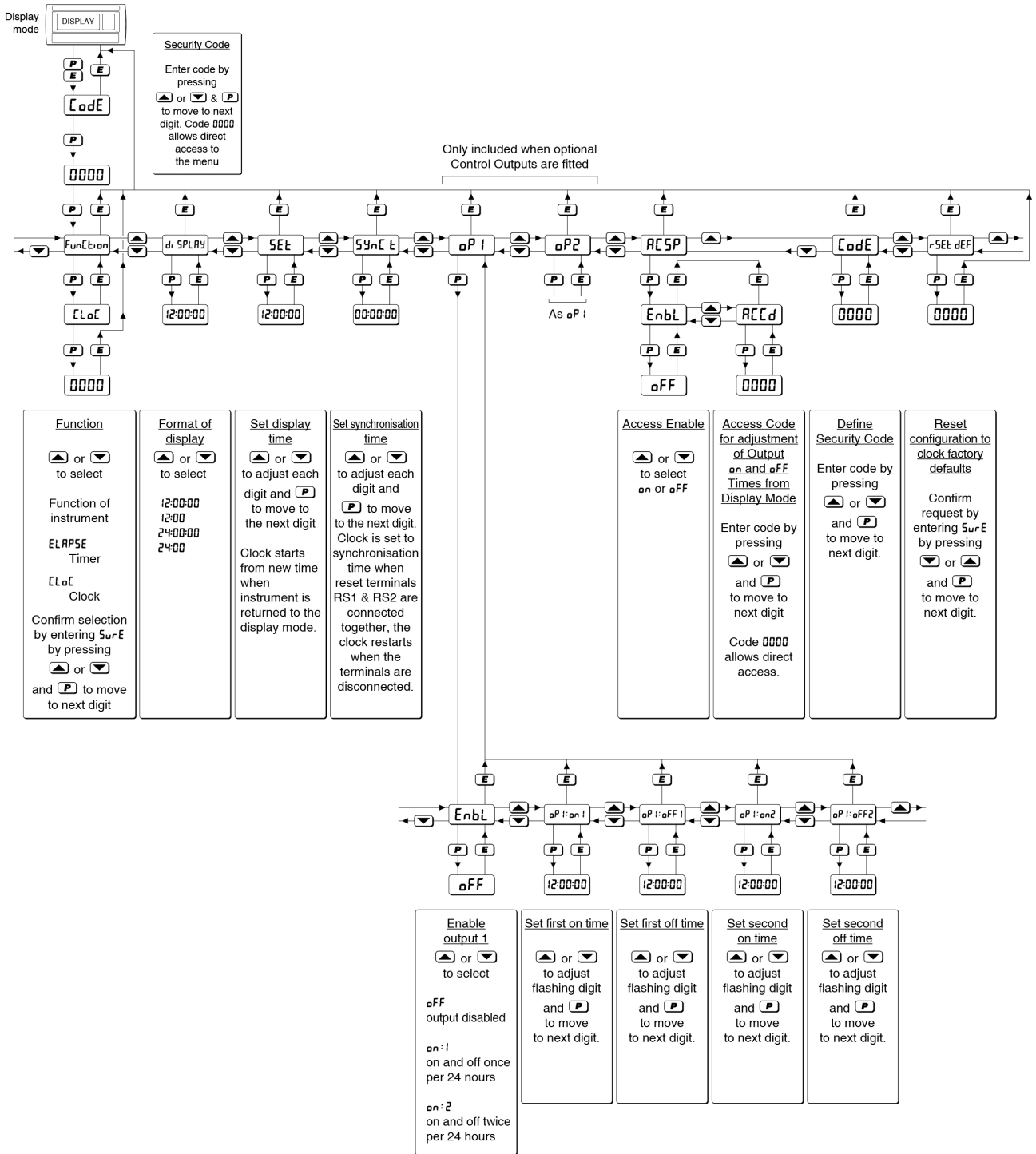
Fig 19 Clock Configuration menu

9.4.2 Summary of Clock configuration functions.

This section summarises all the Clock configuration functions. When read in conjunction with Fig 19 it provides a quick aid for configuring the Clock. If more detail is required, each section of this summary contains a reference to a full description of the function.

Display	Summary of function

FunCti on **Instrument function**
Defines the function of the instrument. May be set to:

  ELAPSE Timer
  CLoC Clock

All the entries in this Clock configuration summary assume that the BA377E is configured as a Clock by selecting CLoC.
See section 9.4.3

di SPLAY **Display format**
Defines the clock display format, four alternatives are available.
Select:

  12:00:00 Twelve hours with seconds
  12:00 Twelve hours without seconds
  24:00:00 Twenty four hours with seconds
  24:00 Twenty four hours without seconds
See section 9.4.4

SEt **Set clock display time**
Enables the clock displayed time to be adjusted, the clock resumes operation when the instrument is returned to the display mode.
See section 9.4.5

SYnC t **Synchronising time**
Defines the time to which the clock display is set when the reset terminals RS1 and RS2 are connected together. The Clock restarts from the synchronising time when terminals RS1 and RS2 are disconnected.
See section 9.4.6

Display	Summary of function

oP 1 **Control output 1 (Optional)**
Control output 1 can turn *on* (output closed) and *off* (output open) twice in each twenty-four hour period. This function contains five sub-function:

EnbL	Enables output 1 and defines if it turns on and off once or twice in each 24 hours.
oP 1:on 1	Time when oP 1 turns *on* 1st time
oP 1:oFF 1	Time when oP 1 turns *off* 1st time
oP 1:on 2	Time when oP 1 turns *on* 2nd time
oP 1:oFF 2	Time when oP 1 turns *off* 2nd time

See section 9.4.7 to 9.4.9

oP2 **Control output 2 (Optional)**
As control output 1 described above.
See section 9.4.10 to 9.4.12

ACSP **Access control output alarm-times from display mode.**
Contains two sub-functions, EnbL which when activated allows the control output times to be adjusted from the display mode (displaying time). The second sub-function ACCd defines a four digit alphanumeric access code which may be used to protect access to the alarm-times from the display mode. Default code 0000 disables this security feature and allows unrestricted access.
See section 9.4.13

CodE **Security code**
Defines a four digit alphanumeric code that may be used to protect access to the Clock configuration menu. Default code 0000 disables this security function and allows unrestricted access to all configuration functions when the P and E buttons are operated simultaneously in the display mode.
See section 9.4.14

rSEt dEF **Reset to factory defaults**
Resets the BA377E to the factory default configuration shown in section 9.4 when YES is selected and confirmed by entering SurE.
See section 9.4.15

9.4.3 Instrument function: FunCti on

The BA377E may be configured as a Timer or as a Clock. This section of the instruction manual describes the Clock configuration, for details of Timer configuration see section 6.5.

To reveal the existing function of the instrument select FunCti on from the configuration menu and press P. If CLoC is displayed, the instrument is already configured as a Clock therefore press E to return to the FunCti on prompt in the configuration menu. If ELRPSE is displayed, press the ▲ or ▼ button to change the setting to CLoC followed by the P button which will result in a 0000 prompt being displayed with the first digit flashing. This is a request for the instruction to be confirmed by entering SurE using the ▲ or ▼ button to adjust the flashing digit and the P button to move control to the next digit. When SurE has been entered, pressing E will change the instrument to a Clock and return the instrument to the display mode. To configure the Clock enter the configuration menu by pressing the P and E buttons simultaneously until FunCti on is displayed.

9.4.4 Display format: di SPLRY

The BA377E Clock may be configured to display time in a 12 or 24 hour format with or without seconds. When a 12 hour format is selected, AM is denoted by an R prefix at the left hand side of the display, similarly a P is displayed to denote PM.

To check or change the display format of the clock, select di SPLRY from the configuration menu and press P which will reveal the existing setting which can be changed by pressing the ▲ or ▼ button followed by the E button to enter the selection and return to the configuration menu. The options available are shown below:

12:00:00	Twelve hour format with seconds
12:00	Twelve hour format without seconds
24:00:00	Twenty four hour format with seconds
24:00	Twenty four hour format without seconds

9.4.5 Set clock display time: SEt

This function sets the time displayed by the Clock which must be entered each time the BA377E Clock is powered. Until a set time is entered the Clock will display a flashing 00:00:00 or 00:00 for 24 hour formats, or R 12:00:00 or R 12:00 for 12 hour formats.

To adjust the clock set time, select SEt from the configuration menu and press P that will show 00:00:00 or the existing set time with the hours flashing. When setting the clock display time seconds are always shown.

Using the ▲ or ▼ button adjust the flashing hours and then press P to transfer control to the minutes display, pressing P again will transfer control to the seconds display. When the clock display time has been adjusted press E to start the Clock and return to the SEt prompt in the configuration menu.

9.4.6 Enter synchronising time: SYnC t

When the external reset terminals RS1 and RS2 are connected together the clock is stopped and the displayed time is set to the synchronising time. When the connection between the reset terminals is removed, the clock restarts from the synchronising time. This function enables the BA377E clock to be synchronised with a master clock.

To enter the synchronising time, select SYnC t from the configuration menu and press P which will reveal the existing synchronising time with the hours flashing. Using the ▲ or ▼ button adjust the hours and then press P to transfer control to the minutes display, pressing P again will transfer control to the seconds display. When the synchronising time has been set as required, press E to return to the configuration menu.

9.4.7 Control output 1 (Optional): oP 1

Control output 1 is an optional factory fitted galvanically isolated solid state switch contact output which can be configured to turn *on* (output closed) and *off* (output open) twice in each twenty-four hour period. The control output status is shown by the 1 control output display annunciator.

Function oP 1 contains a sub-menu with five sub-functions:

EnbL	Number of times output 1 turns *on* & *off* in 24 hours.
oP 1:on 1	First time oP 1 turns *on* (closes)
oP 1:oFF 1	First time oP 1 turns *off* (opens)
oP 1:on 2	Second time oP 1 turns *on* (closes)
oP 1:oFF 2	Second time oP 1 turns *off* (opens)

To check or change the function of Control output 1 select oP 1 from the configuration menu and press P which will reveal the first sub-function EnbL.

9.4.8 Enable Control output 1: EnbL

This is a sub-function in the Control output 1 function oP1 which allows output 1 to be enabled or disabled without changing any of the *on* or *off* times and also determines whether output 1 turns *on* and *off* once or twice in each twenty four hour period.

Select oP1 in the configuration menu and press ⓟ which will result in the EnbL prompt being displayed. Pressing ⓟ again will enter the sub-function from which one of the three options may be selected using the ⏶ or ⏷ button:

Display	Control output 1
oFF	Control output 1 disabled
on:1	Turns *on* & *off* once per 24 hours
on:2	Turns *on* & *off* twice per 24 hours

When the required option is displayed operating ⓔ will enter the selection and return to the EnbL prompt from which another sub-function may be selected if control output 1 has not been disabled.

9.4.9 *On* and *off* times: oP1:on 1; oP1:oFF 1 oP1:on 2; oP1:oFF 2

The control output will have one or two *on* and *off* times depending upon whether control output 1 has been configured to turn *on* and *off* once or twice in each 24 hour period. - see 9.4.8.

All of the times are adjusted in the same way. To adjust any of them select oP1 from the configuration menu and press ⓟ which will result in the EnbL prompt being displayed. The ⏶ or ⏷ button will scroll through the sub-functions. Only oP1:on 1 and oP1:oFF 1 will be present if control output 1 has been configured to switch *on* and *off* once in a 24 hour period in the EnbL sub-function.

Select the required sub-function

oP1:on 1	Time oP1 turns *on* first time
oP1:oFF 1	Time oP1 turns *off* first time
oP1:on2	Time oP1 turns *on* second time
oP1:oFF2	Time oP1 turns *off* second time

When selected, pressing ⓟ will show the existing time with the hours flashing. Using the ⏶ or ⏷ button adjust the hours and then press ⓟ to transfer control to the minutes display, pressing ⓟ again will transfer control to the seconds display. When the time has been set as required press ⓔ to return to the sub-menu from which another *on* / *off* time may be selected for adjustment. When all the *on* / *off* times have been entered, return to the configuration menu by pressing the ⓔ button twice.

9.4.10 Control output 2 (Optional): oP2

Control output 2 is an optional factory fitted output which can be configured to turn *on* (output closed) and *off* (output open) twice in each twenty-four hour period. The control output status is shown by the 2 control output display annunciator.

Function oP2 contains a sub-menu with five sub-functions:

EnbL	Number of times output 2 turns *on* & *off* in 24 hours.
oP 2:on 1	First time when oP 2 turns *on* (closes)
oP 2:oFF 1	First time when oP 2 turns *off* (opens)
oP 2:on 2	Second time when oP 2 turns *on* (closes)
oP 2:oFF 2	Second time when oP 2 turns *off* (opens)

To check or change the function of Control output 2 select oP2 from the configuration menu and press ⓟ which will reveal the first sub-funtion EnbL.

9.4.11 Enable control output 2: EnbL

This is a sub-function in the Control output 2 function oP2 which allows output 2 to be enabled or disabled without changing any of the *on* or *off* times and also determines whether output 2 turns *on* and *off* once or twice in each twenty four hour period. Select oP2 in the configuration menu and press ⓟ which will result in the EnbL prompt being displayed. Pressing ⓟ again will enter the sub-function from which one of the three options may be selected using the ⏶ or ⏷ button:

Display	Control output 2
oFF	Control output 2 disabled
on:1	Turns *on* & *off* once per 24 hours
on:2	Turns *on* & *off* twice per 24 hours

When the required option is displayed operating ⓔ will enter the selection and return to the EnbL prompt from which another sub-function may be selected if control output 2 has not been disabled.

9.4.12 *On* and *off* times: oP2:on 1; oP2:oFF 1 oP2:on 2; oP2:oFF 2

The control output will have one or two *on* and *off* times depending upon whether control output 2 has been configured to turn *on* and *off* once or twice in each 24 hour period. - see 9.4.11.

All of the times are adjusted in the same way. To adjust any of them select oP2 from the configuration menu and press ⓟ which will result in the EnbL prompt being displayed. The ⏶ or ⏷ button will scroll through the sub-functions. Only oP2:on 1 and oP2:oFF 1 will be present if control output 2 has been configured to switch *on* and *off* once in a 24 hour period in the EnbL sub-function.

Select the required sub-function

oP2:on 1	Time oP2 turns *on* first time
oP2:oFF 1	Time oP2 turns *off* first time
oP2:on2	Time oP2 turns *on* second time
oP2:oFF2	Time oP2 turns *off* second time

When selected pressing Ⓟ will show the existing time with the hours flashing. Using the ⬆ or ⬇ button adjust the hours and then press Ⓟ to transfer control to the minutes display, pressing Ⓟ again will transfer control to the seconds display. When the time has been set as required press Ⓔ to return to the sub-menu from which another *on / off* time may be selected for adjustment. When all the *on / off* times have been entered, return to the configuration menu by pressing the Ⓔ button twice.

9.4.13 Access control output *on* & *off* times from display mode: ACSP

This function activates a separate menu that provides direct access to the control output's *on* and *off* times when the Clock is the display mode (displaying time). An operator may therefore adjust the *on* and *off* times without having access to the instrument configuration menu. Further protection is provided by a separate security code. When this function is enabled the *on* and *off* times of the two control outputs may be adjusted from the display mode by simultaneously operating the Ⓟ and ⬆ push buttons. The function contains two sub-functions, EnbL which activates the function and ACCd which defines a separate access code that may be used to prevent the *on* and *off* times being accidentally adjusted from the display mode.

To check or change the function, select ACSP in the configuration menu and press Ⓟ which will reveal the EnbL prompt, pressing Ⓟ again will show if the function is on or oFF. If adjustment of the control output times from the display mode is not required press the ⬆ or ⬇ button to select oFF and then press Ⓔ twice to return to the configuration menu. If the function is required, select on and press Ⓔ to return to the EnbL prompt from which ACCd, which allows a separate access code to be entered, can be selected by pressing the ⬆ or ⬇ button.

Access to the control output times from the display mode may be protected by a four digit alphanumeric security code which must be entered to gain access. Default security code 0000 allows unrestricted access. With ACCd displayed, press Ⓟ to enter a new access code. The BA377E Clock will display 0000 with one digit flashing. The flashing digit may be adjusted using the ⬆ or ⬇ push button, when set as required operating the Ⓟ button will transfer control to the next digit. When all the digits have been adjusted press Ⓔ twice to return to the ACSP prompt in the configuration menu. The revised security code will be activated when the BA377E is returned to the display mode.

9.4.14 Security code: CodE

Access to the instrument's configuration menu may be protected by a four digit alphanumeric security code which must be entered to gain access. New instruments are configured with the default security code 0000 which allows unrestricted access to all configuration functions.

To enter a new security code select CodE from the configuration menu and press Ⓟ which will cause the Clock to display 0000 with one digit flashing. The flashing digit may be adjusted using the ⬆ and ⬇ push button, when set as required operating the Ⓟ button will transfer control to the next digit. When all the digits have been adjusted press Ⓔ to return to the CodE prompt. The revised security code will be activated when the Clock is returned to the display mode.

Please contact BEKA associates sales department if the security code is lost.

9.4.15 Reset configuration to Clock factory defaults:. rSEt dEF

When the BA377E is configured as a Clock, this function resets the configuration to the Clock factory defaults shown in sections 9.4 of this manual.

To reset the instrument configuration select rSEt dEF from the configuration menu and press Ⓟ. The Clock will display 0000 with the first digit flashing which is a request to confirm the instruction by entering SurE. Using the ⬆ or ⬇ button set the first flashing digit to 5 and press Ⓟ to transfer control to the second digit which should be set to u. When SurE has been entered pressing the Ⓔ button will reset all the configuration functions to the factory defaults and return the instrument to the display mode as a Clock with default configuration.

10. CLOCK CONFIGURATION EXAMPLE

In this example a BA377E is required to function as a Clock. Time is to be displayed in a 24 hour format including seconds. For external synchronisation the displayed time is required to change to 12:00:00 when the external reset terminals are connected together.

Both control outputs are required to close and open once in each 24 hour period. Control output 1 (oP1) is to turn *on* (close) at 07:30:00 and *off* (open) at 09:30:00, control output 2 (oP2) is to turn *on* (close) at 18:00:00 and *off* (open) at 22:30:00.

For this application the operator needs to adjust the control output *on* and *off* times from the display mode via an access code of 1111. To prevent tampering the instrument configuration menu is to be protected by security code of 1209

10.1 Configuration procedure

The BA377E may be configured as a Clock on-site without disconnection from external wiring.

Step 1 Enter the configuration menu

Enter the configuration menu by simultaneously pressing P and E. Assuming a security code has not already been entered the instrument will respond by displaying FunCtion which is the first item in the configuration menu.
See Fig 19.

Step 2 Configure instrument as a Clock

With FunCtion displayed press P to reveal the existing function of the instrument. If CLoC is displayed no change is required, therefore return to the FunCtion prompt by pressing the E button.
If ELAPSE is displayed, press the ▲ or ▼ button to change the setting to CLoC followed by the P button which will result in a 0000 prompt being displayed with the first digit flashing. This is a request for the instruction to be confirmed by entering SurE using the ▼ and ▲ buttons to adjust the flashing digit and the P button to move control to the next digit. Pressing E will then change the instrument to a Clock and return the display to FunCtion in the configuration menu.

Step 3 Select display format

Using the ▲ or ▼ button select diSPLAY in the configuration menu and press P which will reveal the current display format. Using the ▲ or ▼ button select 24:00:00 which is the required 24 hour format with seconds and press E to enter the selection and return to the configuration menu.
See 9.4.4

Step 4 Enter the synchronisation time

Using the ▲ or ▼ button select SYnC t in the configuration menu and press P to reveal the current synchronisation time with the hours flashing. Using the ▲ or ▼ push button adjust the hours to 12 and press P to transfer control to the minutes. Using the ▲ or ▼ push button adjust the minutes to 00 and press P to transfer control to the seconds which should be adjusted to 00, in the same way. When the seconds are set enter the selection and return to the SYnC t prompt in the configuration menu by pressing the E button.
See 9.4.6

Step 5 Enable control output 1 and enter the *on* and *off* times.

Using the ▲ or ▼ button select oP1 in the configuration menu and press P to reveal the EnbL prompt in the control output 1 sub-menu.

In this application control output 1 is required to turn *on* and *off* once every 24 hours. With EnbL displayed press P and using the ▲ or ▼ button select on 1 followed by the E button to return to the EnbL prompt.

The control output *on* time should now be entered by selecting oP1:on1 in the control output 1 sub-menu using the ▲ or ▼ button. Pressing P will reveal the existing *on* time which should be adjusted to 07:30:00 using the ▲ or ▼ button and the P button to transfer control to the following digits. When entered return to the oP1:on1 prompt by pressing the E button.

The *off* time should now be entered by selecting oP1:oFF1 from the sub-menu and adjusting the time to 09:30:00. Finally press E to return to the oP1:oFF1 prompt in the sub-menu and press E again to return to oP1 in the configuration menu.

Step 6 Enable control output 2 and enter the *on* and *off* times.

Using the ⬆ or ⬇ button select oP2 in the configuration menu and press P to reveal the EnbL prompt in the control output 2 sub-menu. Follow the procedure described in step 5 above, but set control output 2 to turn *on* at 18:00:00 and *off* at 22:30:00.

Step 7 Allow control output times to be adjusted from the display mode & enter separate security code.

Using the ⬆ or ⬇ button select ACSP in the configuration menu and press P to reveal the EnbL prompt, pressing P again will show if this function is on or oFF. Using the ⬆ or ⬇ button select on followed by E to return to the EnbL prompt. A separate security code which must be entered to gain access to the alarm times in the operating mode, is entered in the ACCd function which may be selected by operating the ⬆ or ⬇ button once. Pressing E will reveal the existing access code with one digit flashing. This should be changed to the required code of 1111 by adjusting the flashing digit using using the ⬆ or ⬇ button and the P button to transfer control to the next digit. When 1111 has been entered press E twice to return to the configuration menu.

Step 8 Define the configuration menu security code.

Defining a security code prevents unauthorised access to the configuration menu. Using the ⬇ and ⬆ buttons select CodE from the configuration menu and press P which will reveal 0000 with the first digit flashing. This example requires the security code to be 1209, using the ⬇ and ⬆ buttons set the flashing digit to 1 and press P to transfer control to the second digit. When all have been entered press E to return to the main configuration menu.
See 9.4.14.

Step 9 Return to the display mode

The BA377E is now configured as required for this example. Pressing the E button will save the configuration and return the BA377E to the display mode with all the digits flashing indicating that the set time has to be entered.

Step 10 Enter the set time

Finally the current time to be displayed by the Clock should be entered. Re-enter the configuration menu by pressing the P and E buttons simultaneously which will result in CodE being displayed. Pressing P will allow the access code 1209 to be entered using the ⬇ or ⬆ button to adjust the flashing digit and the P button to transfer control to the next digit. When all four digits have been adjusted press P to enter the configuration menu and using the ⬇ or ⬆ button select SEt and press E to reveal 00:00:00 with the hours flashing. Using the ⬇ or ⬆ button adjust the flashing hours digit and press P to transfer control to the minutes and then to the seconds. When all have been set as required, press E to start the clock from the entered time and return to the display mode.

11. MAINTENANCE when configured as a Clock

11.1 Fault finding during commissioning

If a BA377E fails to function as a Clock during commissioning the following procedure should be followed:

Symptom	Cause	Check:
No display	No power supply, or incorrect wiring. Note: Terminals 2 & RS2 are interconnected within the instrument.	That there is between 10 and 28V on terminals 1 & 2 with terminal 1 positive. That there are no connections to terminals 3, 4, 5 & 6.
Configuration menu does not correspond with the Clock section of this manual.	BA377E is configured as a Timer.	That FunEti on in configuration menu is set to ELoE not to ELAPSE.
Clock display flashes 00:00:00	Local time has not been entered.	Enter the local time in the SEt function of the instrument configuration menu.
Control output(s) do not function.	Control outputs have not been enabled.	Enable Control Output(s) in the configuration menu.
Clock will not start	Reset terminals RS1 and RS2 are connected together and the clock is resetting.	If reset annunciator on display is activated, disconnect link between RS1 and RS2.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used. Contact BEKA if code is lost.

11.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance is permitted on intrinsically safe equipment installed in a hazardous area, but only certified test equipment should be used unless a gas clearance certificate is available.

If a BA377E fails after it has been functioning correctly as a Clock, the following table may help to identify the cause of the failure.

Symptom	Cause	Check:
No display	No power supply	That there is between 10 and 28V on terminals 1 & 2 with terminal 1 positive.
Clock display flashes 00:00:00	Instrument power supply has been interrupted and local time has been lost.	Enter the local time in the SEt function of the instrument configuration menu.
Control output(s) do not function.	Control outputs have not been enabled.	Enable Control Output(s) in the configuration menu.
Clock will not start	Reset terminals RS1 and RS2 are connected together and the clock is resetting.	If reset annunciator on display is activated, disconnect connection between RS1 and RS2.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used. Contact BEKA if code is lost.

If this procedure does not reveal the cause of the fault, it is recommended that the instrument is replaced.

11.3 Servicing

We recommend that faulty BA377E Clocks are returned to BEKA associates or to our local agent for repair.

11.4 Routine maintenance

The mechanical and electrical condition of the instrument should be regularly checked. Inspection frequency should be chosen to suit the environmental conditions.

11.5 Guarantee

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

11.6   Customer comments

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

Appendix 1   IECEx certification

A1.0   The IECEx Certification Scheme
IECEx is a global certification scheme for explosion protected products which aims to harmonise international certification standards. For additional information about the IECEx certification scheme and to view the BEKA associate certificates, please visit www.iecex.com

A1.1 IECEx Certificate of Conformity
The BA377E Timer or Clock has been issued with an IECEx Certificate of Conformity number IECEx ITS 16.0004X which specifies the following certification code:

Ex ia IIC T5 Ga -40ºC ≤ Ta ≤ +70ºC.

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

A1.2 Installation
The IECEx intrinsic safety parameters are identical to the ATEX safety parameters described in the main section of this manual and both refer to the same standards.   Therefore   the   ATEX   installation requirements specified in section 2 and 3 of this manual may be used for IECEx installations, but the local code of practice should also be consulted.

A1.3   Special conditions for safe use
The IECEx certificate has an 'X' suffix indicating that special conditions apply to prevent an electrostatic charge developing on the outside of the instrument enclosure.

WARNING
To avoid an electrostatic charge being generated instrument enclosure should only be cleaned with a damp cloth.

Appendix 2   ETL & cETL certification for installations in USA and Canada

A2.0 cETL Mark
For installations in the USA and Canada, the BA377E Timer or Clock has ETL and cETL intrinsic safety and nonincendive approval, Control Number 4008610.   Copies of the Authorisation to Mark are available from the BEKA associates sales office and www.beka.co.uk

A2.1 Intrinsic safety approval
The US and Canadian standards used for assessment and certification of the BA377E are listed on the cETL Authorisation to Mark.

Installations must comply with BEKA associates Control Drawing CI330-52, which is attached to this appendix.

The ETL safety parameters are the same as the ATEX and IECEx parameters, the systems shown in sections 2 and 3 of this manual may therefore also be used for US and Canadian installations subject to compliance with the local codes of practice.

ETL and cETL intrinsic safety codes

CL I Div 1 Groups A, B, C, D T5 (US IS gas, Div cert)
CL II Div 1 Groups E, F, G. CL III (US IS dust, Div cert)

CL I Zone 0 AEx ia IIC T5 Ga (US IS gas, Zone cert)
Ex ia IIC T5 Ga (Canadian IS gas, Zone cert)

-40ºC ≤ Ta ≤ +70ºC

A2.2 Nonincendive approval
The BA377E Timer or Clock also has ETL nonincendive approval allowing installation in Division 2 hazardous (classified) locations without the need for Zener barriers or galvanic isolators.

Installations must comply with BEKA associates Control Drawing CI330-53, which is attached to this appendix, and with the local codes of practice.

ETL and cETL nonincendive codes US & Canada

CL I Div 2 Groups A, B, C, D T5
CL II Div 2 Groups F, G CL III Div 2
-40ºC ≤ Ta ≤ +70ºC

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS

HAZARDOUS LOCATION

UNCLASSIFIED LOCATION
See note 4

INPUTS IN HAZARDOUS LOCATION

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1, 2 & 8

See notes 6 & 8

Hazardous Location Equipment

See note 6

See note 3

See note 5

Non Hazardous Location Equipment

See note 7

INPUTS IN UNCLASSIFIED LOCATION

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1, 2 & 8

See notes 6 & 8

Hazardous Location Equipment

See note 6

See note 3

See note 5

Non Hazardous Location Equipment

See note 7

	Iss.	Date	Modification	Ckd.	Appd.
	1	05.05 2016	New drawing	OL	CB
	2	05.08 2016	Field mounted rate totalisers added	OL	BB

Title	ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers	Drawn SQ	Checked OL	Scale —
		Drawing No. Sheet 1 of 6	Cl330−52	

File No 330−52s01.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS

HAZARDOUS LOCATION

UNCLASSIFIED LOCATION
See note 4

INPUTS IN HAZARDOUS AND UNCLASSIFIED LOCATIONS

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 6 & 8

See notes 6 & 8

See notes 1, 2 & 8

Terminals: 1, 2, P1, P2, A1, A2, A3, A4, RS1, RS2, C1, C3, C4, C2

See note 5 (repeated)

Non Hazardous Location Equipment

Hazardous Location Equipment

See note 6

See note 7

INPUTS IN HAZARDOUS AND UNCLASSIFIED LOCATIONS

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 6 & 8

See notes 6 & 8

See notes 1, 2 & 8

Terminals: 1, 2, P1, P2, A1, A2, A3, A4, RS1, RS2, C1, C3, C4, C2

See note 5 (repeated)

Non Hazardous Location Equipment

Hazardous Location Equipment

See note 6

See note 7

Iss.	Date	Modification	Ckd.	Appd.
1	05.05 2016	New drawing	QL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	OL

Title	ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale —

Drawing No. CI330-52
Sheet 2 of 6

File No 330-52s02.dwg 05.08.16

Notes

1. 1 and 2 input externally powered rate totalisers with model numbers and coding as shown in the following tables.

E PANEL MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 2 input rate totaliser 1 input counter 2 input counter 1 input timer 2 input timer	BA317E BA318E BA337E BA338E BA388E BA367E BA368E BA377E BA378E	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G Class III Division 1	Zone 0 AEx ia IIC T5 Ga	−40°C to +70°C

E-SS PANEL MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp. (see note 9)
1 input tachometer 1 input rate totaliser 1 input counter 1 input timer	BA317E-SS BA337E-SS BA367E-SS BA377E-SS	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G Class III Division 1	Zone 0 AEx ia IIC T5 Ga Zone 20 AEx ia IIIC T80°C Da	−40°C to +60°C

G FIELD MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp. (see note 9)
1 input tachometer 1 input rate totaliser 2 input rate totaliser 2 input counter 2 input timer	BA314G BA334G BA384G BA364G BA374G	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G Class III Division 1	Zone 0 AEx ia IIC T5 Ga Zone 20 AEx ia IIIC T80°C Da	−40°C to +60°C

E FIELD MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 2 input rate totaliser 2 input counter 2 input timer	BA314E BA334E BA384E BA364E BA374E	Class I Division 1 Groups A, B, C & D T5 Class II Division 1 Groups E, F & G Class III Division 1	Zone 0 AEx ia IIC T5 Ga	−40°C to +70°C

2. Terminals 7, 8, 9 and 10 only exist on 2 input instruments.

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	Appd.	CB	B·B
	Ckd.	QL	QL
	Modification	New drawing	Field mounted rate totalisers added
	Date	05.05 2016	05.08 2016
	Iss.	1	2

Title	ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale −
		Drawing No. Sheet 3 of 6	CI330−52	

File No 330−52s03.dwg 05.08.16

3. Installations shall be in accordance with ANSI/ISA RP 12.06.01 'Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations' and the National Electrical Code ANSI/NFPA 70. Installations in Canada shall be in accordance with the Canadian Electrical Code C22.2.

4. The associated protective barriers and galvanic isolators shall be NRTL approved and the manufacturers instructions shall be followed when installing this equipment.
For installations in Canada the associated protective barriers and galvanic isolators shall be NRTL or CSA approved and the manufacturers installation drawings shall be followed when installing this equipment.

5. One single channel or one two channel associated protective barrier or galvanic isolator with entity parameters complying with the following requirements:

U_o equal or less than   the lowest U_i of the NRTL or CSA approved apparatus installed in the loop.

I_o equal or less than   the lowest I_i of the NRTL or CSA approved apparatus installed in the loop.

P_o equal or less than   the lowest P_i of the NRTL or CSA approved apparatus installed in the loop.

L_o equal or greater than   the sum of the cable inductances and the internal inductances L_i of each NRTL or CSA approved apparatus in the loop.

C_o equal or greater than   the sum of the cable capacitance and the internal capacitance C_i of each NRTL or CSA approved apparatus in the loop.

6. Simple Apparatus as defined in the National Electrical Code ANSI/NFPA 70, or for installations in Canada by the Canadian Electrical Code C22.2   OR:

U_i equal or greater than   the highest U_o of the NTRL or CSA approved apparatus powering the loop.

I_i equal or greater than   the highest I_o of the NTRL or CSA approved apparatus powering the loop.

P_i equal or greater than   the highest P_o of the NTRL or CSA approved apparatus powering the loop.

L_o of the NTRL or CSA approved apparatus powering the loop equal or greater than   the sum of the cable inductances and the internal inductances L_i of each NTRL or CSA approved apparatus in the loop.

C_o of the NTRL or CSA approved apparatus powering the loop equal or greater than   the sum of the cable capacitances and the internal capacitances C_i of each NTRL or CSA approved apparatus in the loop.

	Iss.	Date	Modification	Ckd.	Appd.
	1	05.05 2016	New drawing	OL	CB
	2	05.08 2016	Field mounted rate totalisers added	OL	OL

Title	Drawn	Checked	Scale
ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.	SQ	OL	—

Drawing No. CI330-52
Sheet 4 of 6

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7. The unclassified location equipment shall not use or generate more than 250V rms or 250V dc.

8. Safety parameters

DC Power terminals 1 & 2

Ui	=	28V	Uo = 0
Ii	=	200mA	Io = 0
Pi	=	0.84W
Ci	=	2nF
Li	=	4µH

Terminals RS1-RS2, (optional reset input)

Ui	=	28V	Uo = 3.8V
Ii	=	200mA	Io = 1mA
Pi	=	0.84W	Po = 1mW
Ci	=	0
Li	=	0

Terminals 4,5,6 (input A for models in notes 6 and 7), terminals 8,9,10 (input b for models in note 7).

Ui	=	28V	Uo = 1.1V
Ii	=	200mA	Io = 0.5mA
Pi	=	0.84W	Po = 0.2mW
Ci	=	2nF
Li	=	4µH

Terminal 3,4,5,6 (input A for models in notes 6 and 7), terminals 7,8,9,10 (input b for models in note 7).

Ui	=	14V	Uo = 10.5V
Ii	=	200mA	Io = 9.2mA
Pi	=	0.7W	Po = 24mW
Ci	=	2nF
Li	=	4µH

Optional pulse output terminals P1 & P2

Ui	=	28V	Uo = 0
Ii	=	200mA	Io = 0
Pi	=	0.84W
Ci	=	0
Li	=	0

Optional 4-20mA output terminals C1, C2, C3 and C4

Ui	=	28V	Uo = 0
Ii	=	200mA	Io = 0
Pi	=	0.84W
Ci	=	2.2nF
Li	=	4µH

Optional alarm output terminals A1, A2, A3 and A4

Ui	=	28V	Uo = 1.47V
Ii	=	200mA	Io = 1µA
Pi	=	0.84W	Po = 2µW
Ci	=	22nF
Li	=	4µH

9. When installed purely as intrinsically safe equipment in division 1, division 2, zone 0, zone 1 or zone 2, the ambient temperature range of the BA317E-SS, BA337E-SS, BA367E-SS, BA377E-SS, BA314G, BA334G, BA364G, BA374G and BA384G is: -40°C ≤ Ta ≤ +70°C.

	Appd.		
Ckd.			
Modification			
Date			
Iss.			

	Appd.	CB	3.3
Ckd.	OL	OL	
Modification	New drawing	Field mounted rate totalisers added	
Date	05.05 2016	05.08 2016	
Iss.	1	2	

Title	ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale —
		Drawing No. Sheet 5 of 6	CI330-52	

File No 330-52s08.dwg 05.08.16

10. **CAUTION** Aluminium and stainless steel certification labels that are mounted on the BA317E, BA318E, BA337E, BA338E, BA367E, BA368E, BA377E, BA378E and BA388E externally powered rate totaliser enclosures may be marked with their maximum capacitance (8pF). The BA317E, BA318E, BA337E, BA338E, BA367E, BA368E, BA377E, BA378E and BA388E enclosures may also carry the following potential electrostatic warning:

WARNING
Potential electrostatic charging hazard clean only with a damp cloth

AVERTISSEMENT
Risque potentiel de charge électrostatique Nettoyer uniquement avec un chiffon humide

Alternatively, the enclosures may be manufactured from a conducting plastic per Article 250 of the National Electrical Code.

11. When mounting the BA317E, BA318E, BA337E, BA338E, BA367E, BA368E, BA377E, BA378E and the BA388E panel mounting externally powered rate totalisers in an enclosure to maintain Type 4 front panel rating:

Minimum panel thickness should be   2mm (0.08inches) Steel
3mm (0.12inches) Aluminium

Outside panel finish should be smooth, free from particles, inclusions, runs or build-ups around cut-out.

Panel cut-out for BA317E, BA327E, BS367E and BA377E shall be:
90.0 x 43.5mm -0.0 +0.5mm (3.54 x 1.71 inches −0.00 +0.02)

Two panel mounting clips are required and each shall be tightened to between: 20 & 22cNm (1.77 to 1.95inLb)

Panel cut-out for BA318E, BA338E, BA368E, BA378E and BA388E shall be:
66.2 x 136.0mm-0.0 +0.5mm (2.60 x 5.35 inches −0.00 +0.02)

Four panel mounting clips are required and each shall be tightened to between: 20 & 22cNm (1.77 to 1.95inLb)

12. When mounting the BA317E-SS, BA337E-SS, BA367E-SS, and BA377E-SS panel mounting externally powered rate totalisers in an AEx e, AEx n, AEx p or AEx t certified enclosure, or an enclosure to maintain IP66 front panel rating, the panel cut-out shall be:

92.0 +0.8/-0.0 x 45.0 +0.6/-0.0mm (3.62 +0.03/-0.0 x 1.77 +0.02/-0.0 inches)

4 panel mounting clamps are required and each shall be tightened to a minimum of 22cNm (1.95inLb).

When correctly installed, the BA317E-SS, BA337E-SS, BA367E-SS and BA377E-SS **will** not invalidate the certification of an AEx e, AEx n, AEx p or AEx t panel enclosure.

Title	ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale −
		Drawing No. Sheet 6 of 6	CI330−52	

File No 330−52s06.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS

HAZARDOUS LOCATION

UNCLASSIFIED LOCATION
See note 4

INPUTS IN HAZARDOUS LOCATION

See note 7

See note 7

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1,2 & 7

See note 3

Non Hazardous Location Equipment

Hazardous Location Equipment

See note 5

See note 6

INPUTS IN UNCLASSIFIED LOCATION

See note 7

See note 7

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1, 2 & 7

See note 3

Non Hazardous Location Equipment

Hazardous Location Equipment

See note 5

See note 6

	Iss.	Date	Modification	Ckd.	Appd.

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Modification	Date	Iss.		Appd.	Ckd.
New drawing	15.06 2016	1			
Field mounted rate totalisers added	05.08 2016	2		CB	QL OL

Title	ETL Nonincendive Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale —
		Drawing No. Sheet 1 of 6	CI330–53	

File No 330–53s01.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS

HAZARDOUS LOCATION

UNCLASSIFIED LOCATION
See note 4

INPUTS IN HAZARDOUS AND UNCLASSIFIED LOCATIONS

See note 7

See note 7

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1, 2 & 7

1
2   See note 3
P1
P2
A1
A2
A3
A4
RS1
RS2
C1
C3
C4
C2

3
4
5
6

7
8
9
10

Hazardous Location Equipment

See note 5

Non Hazardous Location Equipment

See note 6

INPUTS IN HAZARDOUS AND UNCLASSIFIED LOCATIONS

See note 7

See note 7

DC Power is connected across terminals 1 & 2.

Other connections are optional.

Terminals P1-P2, A1-A4, C1-C4, RS1-RS2 may not be fitted.

See notes 1, 2 & 7

1
2   See note 3
P1
P2
A1
A2
A3
A4
RS1
RS2
C1
C3
C4
C2

3
4
5
6

7
8
9
10

Hazardous Location Equipment

See note 5

Non Hazardous Location Equipment

See note 6

Iss.	Date	Modification	Ckd.	Appd.

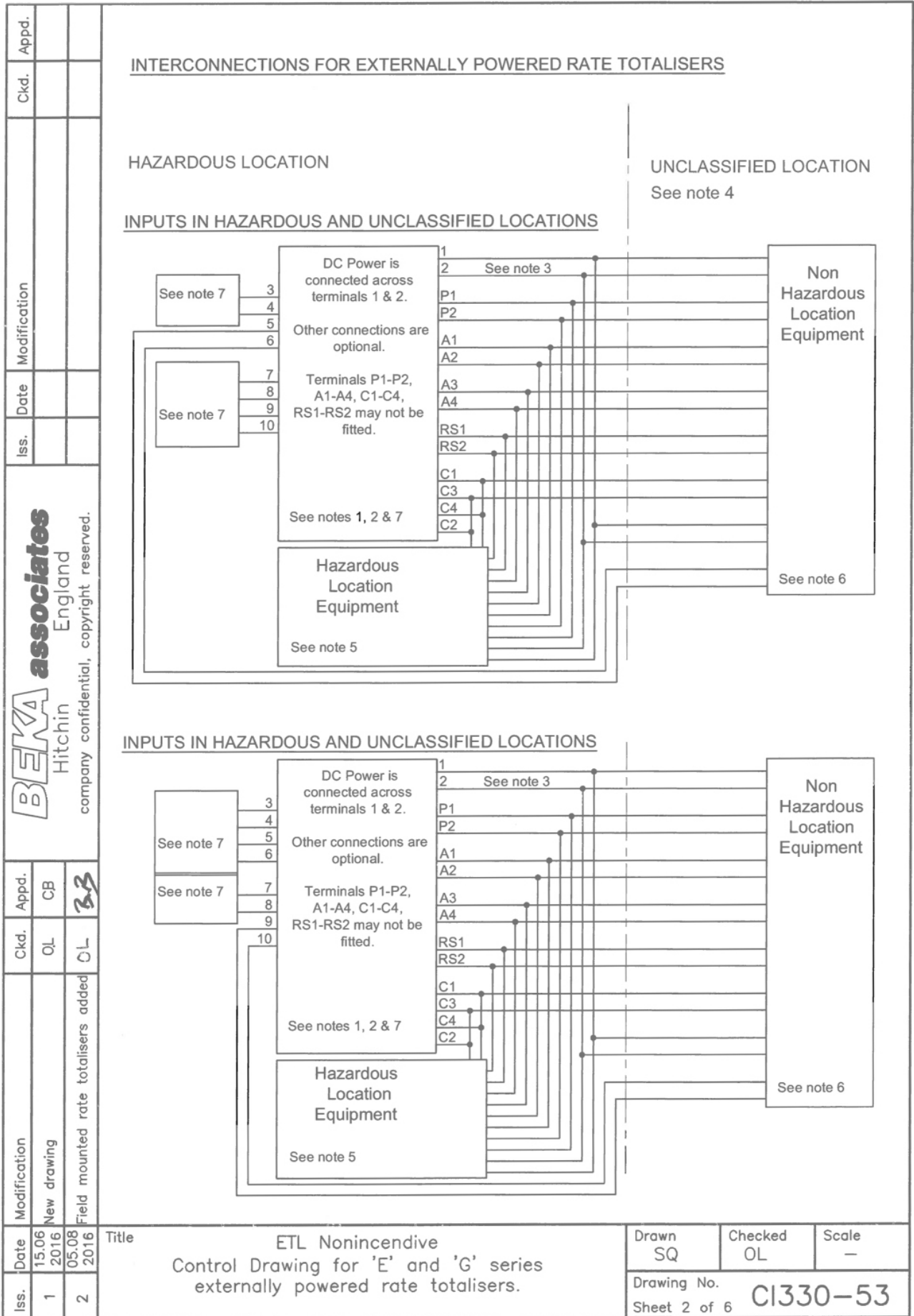| Iss.	Date	Modification	Ckd.	Appd.
1	15.06 2016	New drawing	OL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	OL

Title	ETL Nonincendive Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ / Checked OL / Scale —

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Notes

1. 1 and 2 input externally powered rate totalisers with model numbers and coding as shown in the following tables.

NE PANEL MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking (see note 8)	Ambient Temp. (see note 9)
1 input tachometer 1 input rate totaliser 1 input counter 1 input timer	BA317NE BA337NE BA367NE BA377NE	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	Zone 2 AEx nA ic IIC T5 Gc Zone 22 AEx ic tc IIIC T80°C Dc	−40°C to +60°C

E PANEL MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 2 input rate totaliser 1 input counter 2 input counter 1 input timer 2 input timer	BA317E BA318E BA337E BA338E BA388E BA367E BA368E BA377E BA378E	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	None	−40°C to +70°C

E-SS PANEL MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 1 input counter 1 input timer	BA317E-SS BA337E-SS BA367E-SS BA377E-SS	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	None	−40°C to +70°C

NG FIELD MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking (see note 8)	Ambient Temp. (see note 9)
1 input tachometer 1 input rate totaliser 2 input rate totaliser 2 input counter 2 input timer	BA314NG BA334NG BA384NG BA364NG BA374NG	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	Zone 2 AEx nA ic IIC T5 Gc Zone 22 AEx ic tc IIIC T80°C Dc	−40°C to +60°C

G FIELD MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 2 input rate totaliser 2 input counter 2 input timer	BA314G BA334G BA384G BA364G BA374G	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	None	−40°C to +70°C

E FIELD MOUNTING INSTRUMENTS

Type	Model Nos.	Division Marking	Zonal Marking	Ambient Temp.
1 input tachometer 1 input rate totaliser 2 input rate totaliser 2 input counter 2 input timer	BA314E BA334E BA384E BA364E BA374E	Class I Division 2 Groups A, B, C & D T5 Class II Division 2 Groups F & G Class III Division 2	None	−40°C to +70°C

Left margin (title block, rotated):

Appd. | Ckd. | Modification | Date | Iss.

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Appd. CB 3.3
Ckd. QL OL

Modification: New drawing | Field mounted rate totalisers added
Date: 05.05 2016 | 05.08 2016
Iss.: 1 | 2

Title block (bottom):

Title		Drawn SQ	Checked OL	Scale −

Title: ETL Nonincendive
Control Drawing for 'E' and 'G' series
externally powered rate totalisers.

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2. Terminals 7, 8, 9 and 10 only exist on 2 input instruments.

3. Nonincendive field wiring installations shall be in accordance with the National Electrical Code ANSI/NFPA 70. The Nonincendive Field Wiring concept allows interconnection of Nonincendive Field Apparatus with Associated Nonincendive Field Wiring Apparatus using any of the wiring methods permitted for unclassified locations. Installations in Canada shall be in accordance with the Canadian Electrical Code C22.2.

4. Classified location equipment shall br NRTL Approved Nonincendive Field Wiring Apparatus or simple apparatus as defined in ANSI/NFPA70. For Canadian installations classified location equipment shall be NRTL or CSA Approved Nonincendive Field Wiring Apparatus.

5. Simple Apparatus as defined in the National Electrical Code ANSI/NFPA 70, 3r for installations in Canada by the Canadian Electrical Code C22.2 or as defined in note 2.

6. The unclassified location equipment shall not use or generate more than 250V rms or 250V dc.

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Iss.	Date	Modification	Ckd.	Appd.
1	15.06 2016	New drawing	QL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	Z.Z

Title	ETL Nonincendive Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale —
		Drawing No. Sheet 4 of 6	CI330-53	

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7. Safety parameters

DC Power terminals 1 & 2

$Ui = 30V$
$Ii = 100mA$

Terminals 4,5,6 (input A for models in notes 5 and 6), terminals 8,9,10 (input b for models in note 6).

$Ui = 30V$
$Uo = 1.1V$
$Io = 0.5mA$

Optional pulse output terminals P1 & P2

$Ui = 30V$
$Ii = 100mA$
$Uo = 0$
$Io = 0$

Optional alarm output terminals A1, A2, A3 and A4

$Ui = 30V$
$Ii = 200mA$
$Uo = 1.47V$
$Io = 1\mu A$

Terminals RS1-RS2, (optional reset input)

$Ui = 30V$
$Uo = 3.8V$
$Io = 1mA$

Terminal 3,4,5,6 (for models in notes 5 and 6), terminals 7,8,9,10 (input b with terminals for models in note 6).

$Ui = 15V$
$Uo = 10.5V$
$Io = 9.2mA$

Optional 4-20mA output terminals C1, C2, C3 and C4

$Ui = 30V$
$Uo = 0$
$Io = 0$

8.   The 'AEx ic' in codes refers to instrument push button contacts which are nonincendive.

9. When installed purely as non-incendive equipment, the ambient temperature range of the BA317NE, BA337NE, BA367NE, BA377NE, BA314NG, BA334NG, BA364NG, BA374NG, and BA384NG is: $-40°C \leq Ta \leq +70°C$.

Iss.	Date	Modification	Ckd.	Appd.
1	15.06 2016	New drawing	OL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	

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Title	ETL Nonincendive Control Drawing for 'E' and 'G' series externally powered rate totalisers.	Drawn SQ	Checked OL	Scale —
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10. **CAUTION** The BA317E, BA318E, BA337E, BA338E, BA367E, BA368E, BA377E, BA378E and the BA388E Externally Powered rate totaliser enclosures may carry the following potential electrostatic warning:

<div align="center">

WARNING

Potential electrostatic charging hazard clean only with a damp cloth

AVERTISSEMENT

Risque potentiel de charge
électrostatique Nettoyer uniquement
avec un chiffon humide

</div>

Alternatively, the enclosures may be manufactured from a conducting plastic per Article 250 of the National Electrical Code.

11. When mounting the BA317E, BA318E, BA337E, BA338E, BA367E, BA368E, BA377E, BA378E, BA388E, BA317E-SS, BA337E-SS, BA367E-SS, BA377E-SS, BA317NE, BA337NE, BA367NE & BA377NE panel mounting Externally Powered Rate Totalisers in an enclosure to maintain Type 4 front panel rating:

Minimum panel thickness should be 2mm (0.08inches) Steel
3mm (0.12inches) Aluminium

Outside panel finish should be smooth, free from particles, inclusions, runs or build-ups around cut-out.

Panel cut-out for BA317E, BA337E, BA367E, and BA377E shall be:
90.0 x 43.5mm -0.0 +0.5mm   (3.54 x 1.71 inches -0.00 +0.02)

Two panel mounting clips are required for BA317E, BA337E, BA367E, and BA377E and each shall be tightened to between: 20 & 22cNm (1.77 to 1.95inLb)

Panel cut-out for BA318E, BA338E, BA368E, BA378E, and BA388E shall be:
136.0 x 66.2mm -0.0 +0.5mm (5.35 x 2.60 inches -0.00 +0.02)

Four panel mounting clips are required for BA318E, BA338E, BA368E, BA378E, and BA388E and each shall be tightened to between: 20 & 22cNm (1.77 to 1.95inLb)

Panel cut-out for BA317E-SS, BA337E-SS, BA367E-SS, BA377E-SS, BA317NE, BA337NE, BA367NE & BA377NE shall be:
(92.0mm -0.0 +0.8) x (45.0mm -0.0 +0.6)
(3.62 inches -0.00 +0.03) x (1.77 inches - 0.00 +0.02)

Four panel mounting clips are required for BA317E-SS, BA337E-SS, BA367E-SS, BA377E-SS, BA317NE, BA337NE, BA367NE & BA377NE and each shall be tightened to at least: 22cNm (1.95inLb)

	Iss.	Date	Modification	Ckd.	Appd.
	1	15.06 2016	New drawing	OL	CB
	2	05.08 2016	Field mounted rate totalisers added	OL	B.B

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Title		Drawn	Checked	Scale
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