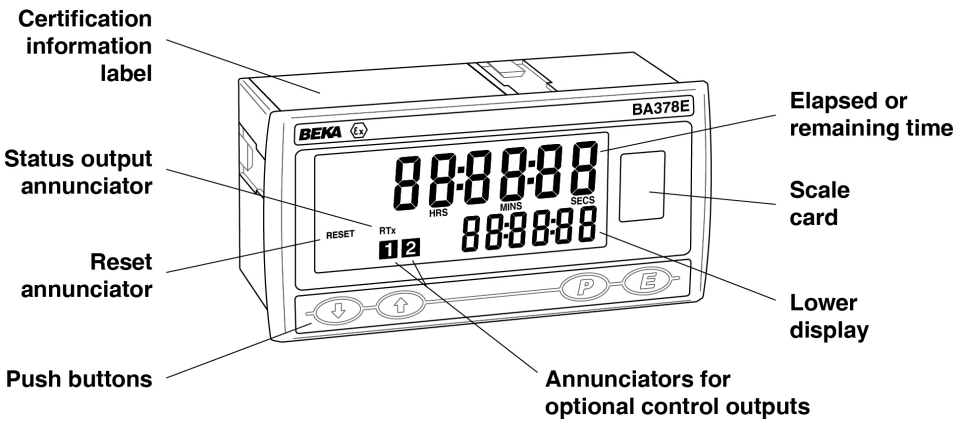
BA378E
Intrinsically safe
Two input
Timer and Clock

Issue 2



Issue: 2
28th September 2016

CONTENTS

The BA378E 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 BA378E is an intrinsically safe, panel mounting instrument with two inputs that can be configured on-site as a Timer or as a Clock.

As a Timer the BA378E can measure and display the elapsed time between external events, or control external events via the status output or optional control outputs.

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

This instruction manual is divided into three sections.

Common features

2. Intrinsic safety certification
3. System design for hazardous areas
4. Installations
5. Accessories

Timer

6. Operation as a timer
7. Configuration example
8. Maintenance

Clock

9. Operation as a clock
10. Configuration example
11. Maintenance

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

For international applications the BA378E has IECEx gas certification which is described in Appendix 1.

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

2. INTRINSIC SAFETY CERTIFICATION

The BA378E has IECEx and ATEX gas certification. This section of the instruction manual describes ATEX gas certification. IECEx and other approvals are described in separate appendixes to this manual. The intrinsic safety of the instrument is unaffected by whether the BA378E is configured as a Timer or as a Clock.

2.1 ATEX gas certification

Notified Body Intertek Testing and Certification Ltd have issued the BA378E 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 BA378E 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 of the BA378E is -40 to +70°C. At temperatures below -20°C the display digits will change more slowly and the contrast will be reduced, but the instrument will continue to function

This allows the BA378E 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.

CAUTION
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 BA378E 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 BA378E power supply terminals 1 and 2 input safety parameters are:

Ui	=	28V dc
Ii	=	200mA dc
Pi	=	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 BA378E.

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

Ci	=	2nF
Li	=	4µH

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 BA378E.

2.5 Input terminals

When configured as a Timer the BA378E is controlled via input A and input b which may be individually configured for use with different type of sensors. Each of the two inputs is a separate intrinsically safe circuit, although the negative side of each input is internally connected to the negative side of the power supply and the reset terminal RS2. See Fig 11. The two inputs should not be connected in parallel.

Some types of sensor that may be connected to the BA378E inputs, 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 of the BA378E for input A and between terminals 7 & 8 for input b, connects an internal 7V, 6mA supply to the respective input. Energising is not required when a BA378E input is connected to a voltage source.

Fitting an energising link changes the output safety parameters of each BA378E input as shown in the following table which also shows the types of sensor requiring energising (link fitting).

		Output safety parameters of each input.		
Type of input	**Link***	**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

*For input A link terminals 3 and 4
*For input b link terminals 7 and 8

2.5.1 Sensors that do not require energising

Sensors with a voltage output do not require energising, therefore terminals 3 & 4 for input A and terminals 7 & 8 for input b should not be linked.

When not energised i.e. without a link each BA378E 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 one of the BA378E inputs in a hazardous area providing that:

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

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	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 BA378E.

The BA378E EC-Type Examination Certificate specifies that the equivalent capacitance and inductance of each BA378E input is:

Ci	=	2nF
Li	=	4µH

To determine the maximum permissible cable parameters these figures should be subtracted from the maximum permitted output parameters Lo and Co specified by the certificate for the sensor connected to the BA378E input terminals. The BA378E 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 BA378E terminals together for each input as described in section 2.5. When energised, the output parameters of each BA378E input are:

Uo	=	10.5V dc
Io	=	9.2mA dc
Po	=	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 BA378E input.

Any certified intrinsically safe sensor may be connected to a BA378E energised input providing that the sensor's input safety parameters are equal to, or greater than, the output safety parameters of the BA378E input shown above. This is not restrictive and most intrinsically safe sensors will comply. A *simple apparatus* sensor, such as a 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 a BA378E 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 BA378E.

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

Co	=	2.4µF
Lo	=	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 BA378E when configured as a Timer and synchronises the displayed time when configured as a Clock. The two reset terminals have the following input and output safety parameters:

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

The equivalent capacitance and inductance between them is:

Ci	=	0nF
Li	=	0µH

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

Co	=	40µF
Lo	=	1H

The reset terminals may be directly connected to any mechanically operated switch located within the same hazardous area as the BA378E. The switch and associated wiring should be able to withstand a 500V rms 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 diode return Zener barrier is not suitable for this application.

When used as a Timer the BA378E may also be reset from the display mode by operating the ⏷ and ⏶ push buttons simultaneously for more than two seconds. See 6.5.20

2.7 Status output

All BA378E models have an intrinsically safe optically isolated open collector output which has zero output safety parameters and complies with the requirements for *simple apparatus*. This allows the status output terminals P1 and P2 to be connected to any intrinsically safe circuit protected by a certified Zener barrier or galvanic isolator providing the output parameters do not exceed:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The equivalent capacitance and inductance of the status output are both zero which allows the maximum permissible cable parameters specified by the certificate for the Zener barrier or galvanic isolator powering the pulse output circuit to be used.

2.8 Optional control outputs

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:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

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

Ci	=	22nF
Li	=	4µH

To determine the maximum permissible cable capacitance Ci should be subtracted from the maximum permitted external capacitance Co specified by the certificate for the intrinsically safe interface powering the circuit being switched by the control output. See figs 4 & 9.

2.9 Certification label information

The BA378E 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.

BA378E 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 BA378E.

Terminals 2, 6, 10 and RS2 of the BA378E are internally connected together as shown in Fig 11. 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 rms insulation to earth.

Any Zener barrier certified for the gas group in which the BA378E is installed may be used providing the output parameters do not exceed the input parameters of the BA378E 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 BA378E Timer installations protected by Zener barriers. BA378E Clock installations are the same, except that the two input terminals are not used. For simplicity the status output and the optional control outputs are described separately in sections 3.1.9 and 3.1.10 of this manual.

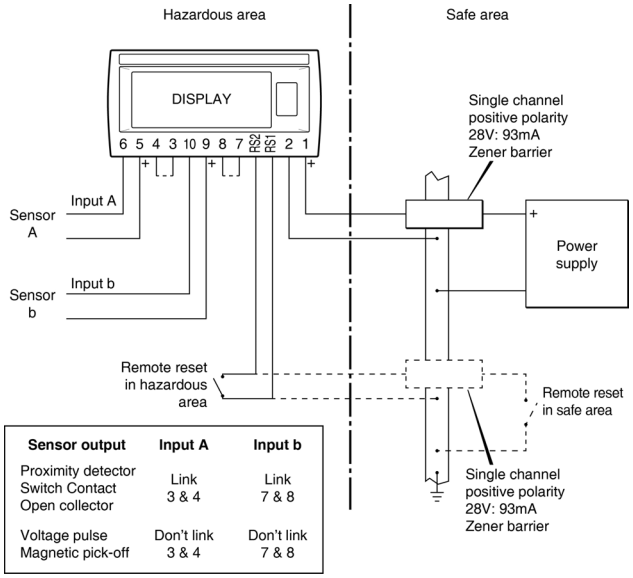


Fig 1 BA378E Timer protected by Zener barriers

Alternatively the sensors may be located in the safe area. Fig 2 shows how additional Zener barriers are 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, 10 and RS2 of the BA378E are connected together within the instrument. Similarly, terminals 2 and RS2 are internally connected together when the BA378E is configured as Clock. See Fig 19.

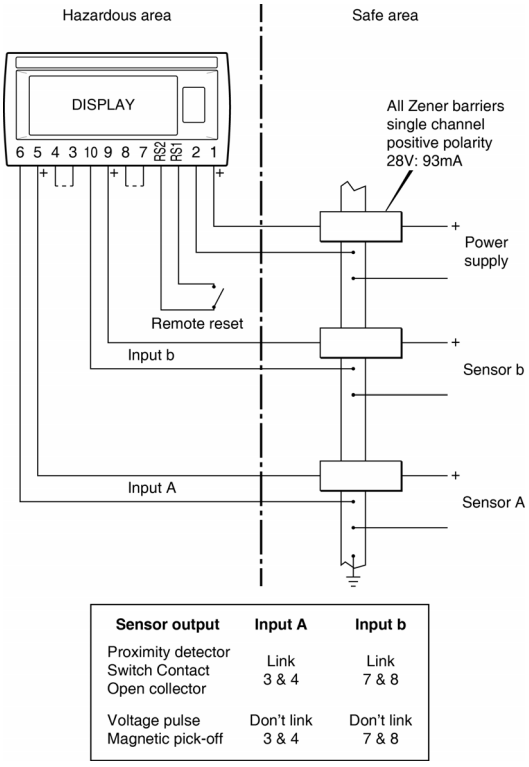


Fig 2 BA378E Timer protected with Zener barriers sensors in the safe area.

3.1.1 Power supply

The BA378E requires a minimum of 10V between terminal 1 & 2 and consumes:

	10mA	BA378E without options
plus	6mA	when terminals 3 & 4 are linked
plus	6mA	when terminals 7 & 8 are linked
plus	16mA	for optional backlight

Any Zener barrier certified for the Zone and gas group in which the BA378E 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	BA378E without options
	18.9V min	BA378E with optional backlight
plus	2.1V	when terminals 3 & 4 are linked
plus	2.1V	when terminals 7 & 8 are linked

3.1.2 Sensor inputs

When configured as a Timer both inputs may be connected to a wide variety of hazardous area sensors as shown in Fig 1, or to safe area sensors as shown in Fig 2. The two BA378E inputs are not used when the instrument is configured as a Clock.

No Zener barrier is required in series with each input if the intrinsically safe sensor is located within the same hazardous area as the BA378E. The following table shows the instrument's input switching thresholds when configured to operate with various sensors. For reliable operation the BA378E input must fall below the lower threshold and rise above the upper threshold.

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

Switch contacts, proximity detectors and open collector sensors require energising which is achieved by linking two BA378E terminals together for each input 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 or 9 &10 providing the switch is located in the same hazardous area as the BA378E, 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 this requirement.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input. See section 6.5.6.

3.1.4 Open collector input

Any open collector sensor located in the same hazardous area as the BA378E, such as a mechanically activated opto-isolator may be directly connected to input terminals 5 & 6 or 9 &10. The sensor and the associated wiring must be able to withstand a 500V rms insulation test to earth.

The BA378E contains a configurable debounce circuit to prevent false triggering. Three levels of debounce protection are available See section 6.5.6.

3.1.5 2-wire proximity detector input

Most intrinsically safe NAMUR 2-wire proximity detectors may be connected to a BA378E input, providing the input safety parameters of the proximity detector are equal to or greater than the output safety parameters of a BA378E input. i.e.

Ui	≥	10.5V dc
Ii	≥	9.2mA dc
Pi	≥	24mW

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 BA378E.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6.

3.1.6 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 BA378E 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:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The maximum permitted cable parameters will be be the sensor's Co and Lo specified on it's intrinsic safety certificate, less the BA378E 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 BA378E and with the associated wiring be able to withstand a 500V rms insulation test to earth.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6.

3.1.7 Voltage pulse input

Two voltage pulse input ranges are independently selectable in the BA378E Timer configuration menu, UoLt5 L and UoLt5 H. When configured for either of the voltage pulse ranges, the input terminals 5 & 6 or 9 & 10 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 BA378E having output parameters equal to or less than:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The BA378E 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 BA378E input parameters which are small and can often be ignored.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6.

3.1.8 Remote reset

Connecting the external reset terminals RS1 and RS2 together will reset the BA378E when configured as a Timer and synchronise the displayed time to a preset 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 BA378E 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. A diode return barrier is not suitable for this application.

Fig 1 illustrates how a BA378E may be reset from both the safe and the hazardous area.

Note: When used as a Timer the BA378E may also be reset from the display mode by operating the ▼ and ▲ push buttons simultaneously for more than two seconds. See 6.5.20

3.1.9 Status output

All BA378E instruments have an opto-isolated open collector output which can be configured to indicate the status of the instrument, or to perform simple control functions. The output has the following electrical parameters:

Ron	=	60Ω + 3V
Roff	=	1MΩ
Imax	=	10mA

The status output is an optically isolated separate intrinsically safe circuit that has zero output safety parameters and complies with the requirements for *simple apparatus*. This allows the status output terminals P1 and P2 to be connected to any intrinsically safe circuit protected by a certified Zener barrier or galvanic isolator providing the output parameters do not exceed:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The equivalent capacitance and inductance of the status output are both zero which allows the maximum permissible cable parameters specified by the certificate for the Zener barrier or galvanic isolator powering the status output circuit to be used. The status output is a passive circuit i.e. un-powered open collector, but it is totally isolated from all other circuits. Subject to complying with intrinsic safety interconnection requirements the terminals P1 and P2 may be connected to another instrument that can accept an open collector input. The output may also be transferred to the safe area via a galvanic isolator or a Zener barrier.

Fig 3 shows how a 2-channel Zener barrier may be used to transfer the status output to the safe area. The positive terminal of the status output P1 is connected to the instrument's positive supply terminal 1. When the status open collector output is activated, the voltage on terminal P2 rises to the supply voltage less 3V and a current flows through the diode return barrier and resistor R1 in the safe area. This current is defined by R1 which should be chosen to limit the current to less than 10mA. For a 24V supply R1 should be great er than 2,200Ω.

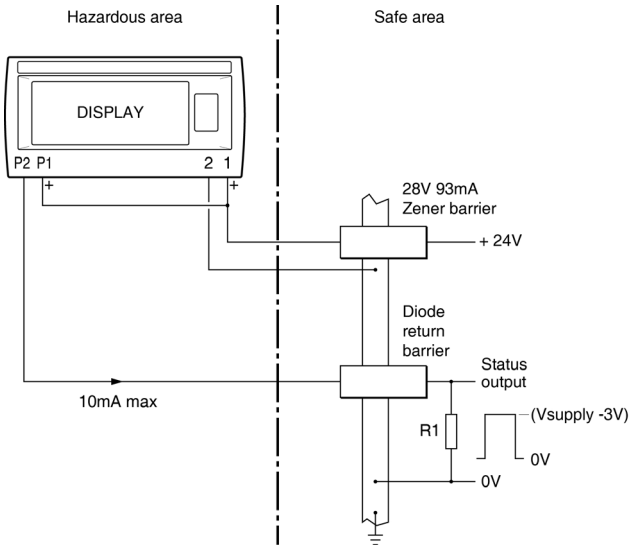


Fig 3 Transferring status output to safe area using Zener barriers.

3.1.10 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 4. 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	=	less than 5Ω + 0.7V
Roff	=	greater than 1MΩ

Note: Because of the series protection diode some test meters may not detect a closed alarm output.

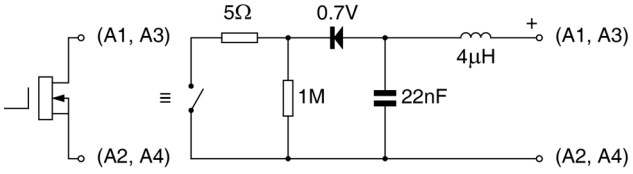


Fig 4 Equivalent circuit of each control output

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 providing the output parameters of the circuit do not exceed:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

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

Ci	=	22nF
Li	=	4µH

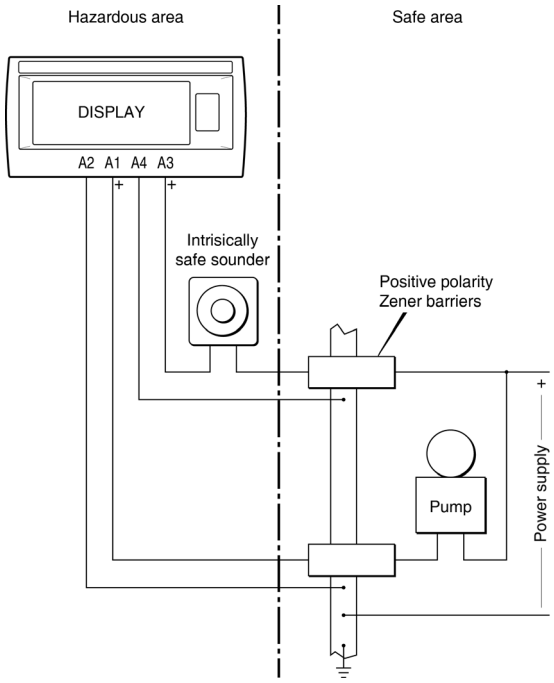


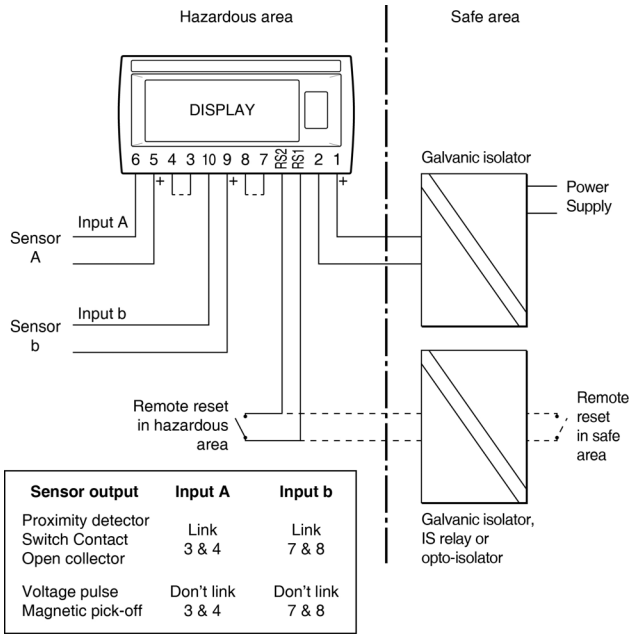
Fig 5 Typical control output application

To determine the maximum permissible cable parameters Ci and Li 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 5.

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 BA378E is installed, with output parameters less than the input parameters of the BA378E having the correct function may be used.

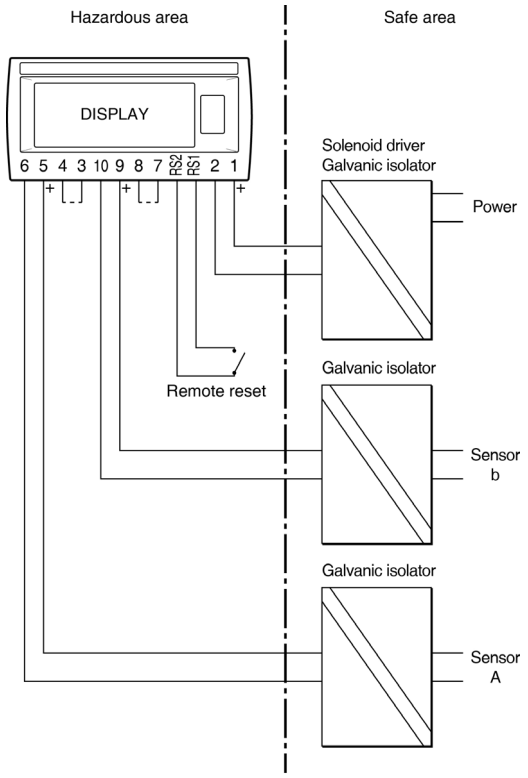


Sensor output	Input A	Input b
Proximity detector Switch Contact Open collector	Link 3 & 4	Link 7 & 8
Voltage pulse Magnetic pick-off	Don't link 3 & 4	Don't link 7 & 8

Fig 6 BA378E used with galvanic isolators

Fig 6 illustrates the basic circuit that is used for all BA378E installations protected by galvanic isolators.

Alternatively sensors may be located in the safe area. Fig 7 shows how additional galvanic isolators are used to transfer the sensor output to the BA378E in the hazardous area, although it may be difficult to find isolators for some sensors. For this application the two BA378E external input conditioning links should be positioned to suite the output of the galvanic isolator not the sensor.



Galvanic isolator output	Input A	Input b
Proximity detector Switch Contact Open collector	Link 3 & 4	Link 7 & 8
Voltage pulse Magnetic pick-off	Don't link 3 & 4	Don't link 7 & 8

Fig 7 BA378E Timer used with galvanic isolators with sensors in safe area.

3.2.1 Power supply

The BA378E requires a minimum of 10V between terminal 1 & 2 and consumes:

	10mA	BA378E without options
plus	6mA	when terminals 3 & 4 are linked
plus	6mA	when terminals 7 & 8 are linked
plus	16mA	for optional backlight

Any galvanic isolator certified for the Zone and gas group in which the BA378E 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 6 both BA378E inputs can be directly connected to hazardous area sensors, or to safe area sensors via isolators as shown in Fig 7. Galvanic isolators are not required in series with the inputs if the intrinsically safe sensors are located within the same hazardous area as the BA378E.

The BA378E 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
Switch	100Ω	1000Ω
Proximity detector	1.2mA	2.1mA
Open collector	2kΩ	10kΩ
Magnetic pick-off	0mV	40mV peak
Voltage pulse low	1.0V	3.0V
Voltage pulse high	3.0V	10.0V

Switch contacts, proximity detectors and open collector sensors require energising which is achieved by linking two BA378E terminals together for each input 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 and 9 &10 providing the switch is located in the same hazardous area as the BA378E, 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 BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6

3.2.4 Open collector input

Any open collector sensor located in the same hazardous area as the BA378E, such as a mechanically activated opto-isolator may be directly connected to input terminals 5 & 6 and 9 &10. The sensor and the associated wiring must be able to withstand a 500V rms insulation test to earth.

The BA378E 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 a BA378E input, providing the input safety parameters of the proximity detector are equal to or greater than the output safety parameters of a BA378E input. i.e.

Ui	≥	10.5V dc
Ii	≥	9.2mA dc
Pi	≥	24mW

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 BA378E.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6

3.2.6 Magnetic pick-off input

[o,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 [o,L input, the BA378E 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:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The maximum permitted cable parameters will be be the sensor's Co and Lo specified on it's intrinsic safety certificate, less the BA378E 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 BA378E and with the associated wiring be able to withstand a 500V rms insulation test to earth.

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6.

3.2.7 Voltage input

Two voltage input ranges are independently selectable in the BA378E configuration menu, UoLt5 L and UoLt5 H. When configured for either of the voltage pulse ranges, the input terminals 5 & 6 and 9 & 10 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 BA378E having output parameters equal to or less than:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The BA378E 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 BA378E input parameters which are small and can often be ignored,

The BA378E contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of debounce protection are independently available for each input, See section 6.5.6

3.2.8 Remote reset

When configured as a Timer the BA378E total display may be remotely reset, depending upon configuration, to zero or to SEt t by connecting terminals RS1 & RS2 together. Permanent interconnection inhibits totalisation. When configured as a Clock connecting terminals RS1 & RS2 together can synchronise the displayed time to a preset time.

Remote resetting or synchronisation may be accomplished by any mechanically operated switch located in the same hazardous area as the BA378E providing it and the associated wiring can withstand a 500V rms insulation test to earth. No galvanic isolator is required.

A BA378E 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 6 illustrates how a BA378E Timer may be reset from both the safe and the hazardous area.

Note: The BA378E can also be configured to reset when the ▼ and ▲ push buttons are operated simultaneously in the display mode for more than two seconds - see 6.5.20.

3.2.9 Status output

All BA378E instruments have an opto-isolated open collector output. This output has the following electrical parameters:

Ron	=	60Ω + 3V
Roff	=	1MΩ
Imax	=	10mA

The status output is an optically isolated separate intrinsically safe circuit that has zero output safety parameters. The output therefore complies with the requirements for *simple apparatus*. This allows status output terminals P1 and P2 to be connected to any intrinsically safe circuit protected by a certified galvanic isolator providing the output parameters do not exceed:

Uo	≤	28V dc
Io	≤	200mA dc
Po	≤	0.84W

The equivalent capacitance and inductance of the status output are both zero which allows the maximum permissible cable parameters specified by the certificate for the galvanic isolator powering the status output circuit to be used. The status output is an open collector, but it is totally isolated from all other circuits. Subject to complying with the intrinsic safety interconnection requirements, terminals P1 and P2 may be connected to another instrument that can accept an open collector input. The status output may also be transferred to the safe area via a galvanic isolator as shown in Fig 8.

Some galvanic isolators intended for use with a NAMUR proximity detector are suitable for transferring the status signal to the safe area.

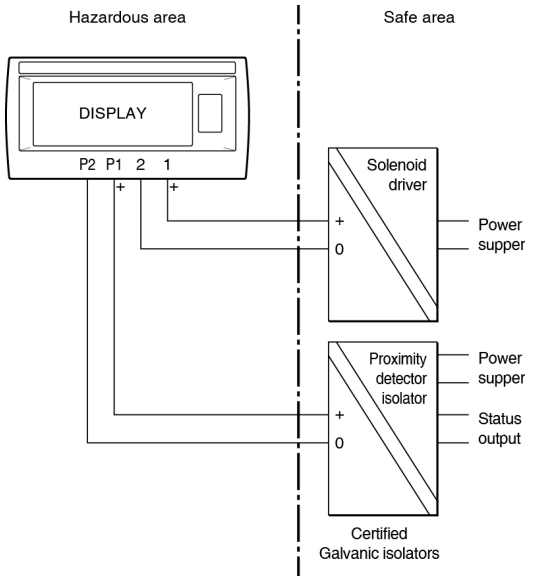


Fig 8 Galvanic isolator used to transfer status output to the safe area.

3.2.10 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 9. 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 = less than 5Ω + 0.7V
Roff = greater than 1MΩ

Note: Because of the series protection diode some test meters may not detect a closed alarm output

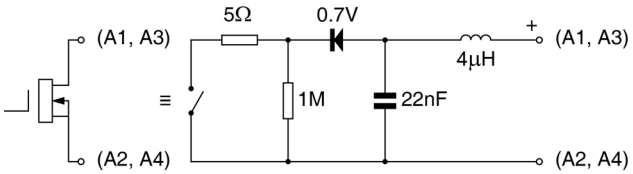


Fig 9 Equivalent circuit of each control output

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 ≤ 28V dc
Io ≤ 200mA dc
Po ≤ 0.84W

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

Ci = 22nF
Li = 4µH (Effectively 0)

To determine the maximum permissible cable parameters Ci and Li 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 10.

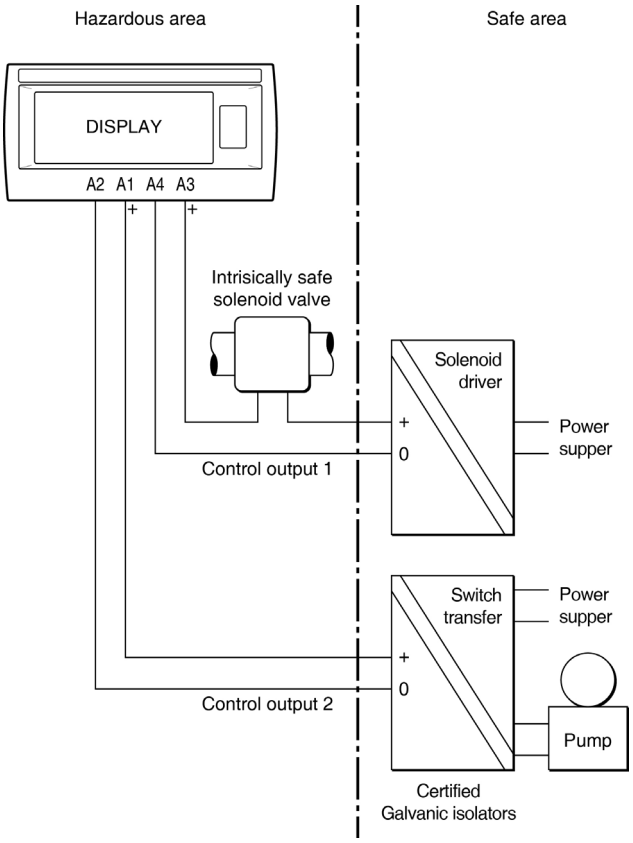


Fig 10 Typical control output application

4. INSTALLATION

4.1 Location

The BA378E 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 BA378E 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 digits will change more slowly and the contrast will be reduced, but the instrument will continue to function

Fig 11 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, and the instrument must be secured with four panel mounting clamps.

Although the front of the BA378E has IP66 protection it should be shielded from continuous direct sunlight and severe weather conditions.

CAUTION
Electrostatic hazard only clean instrument with a damp cloth

4.2 EMC

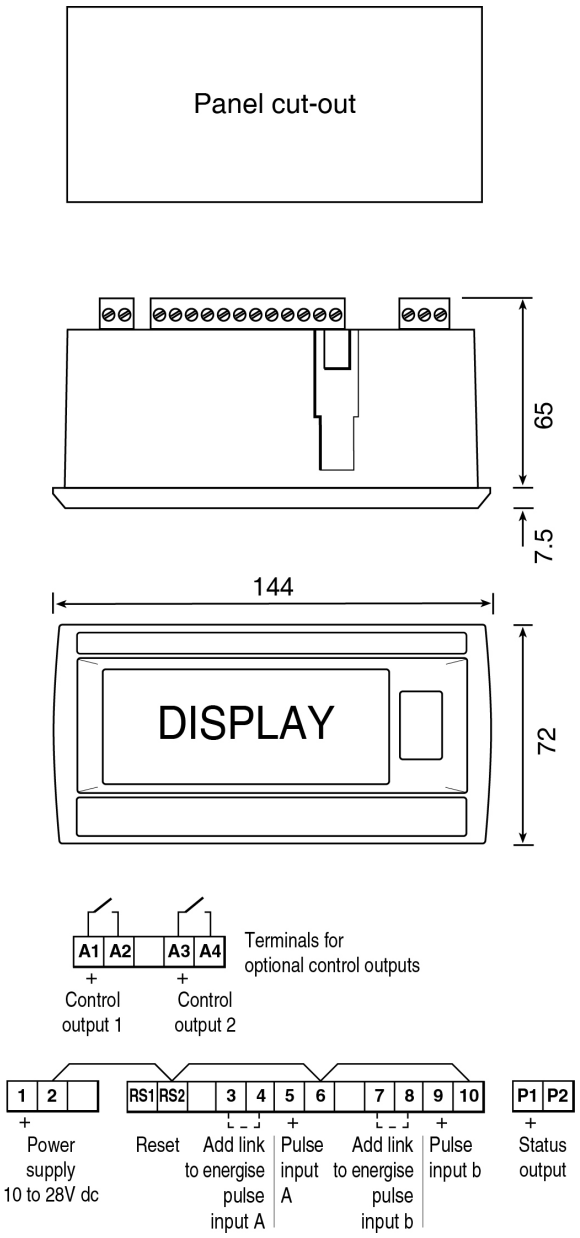
The BA378E complies with the requirements of the European EMC Directive 2014/30/EU. For specified immunity all wiring should be in screened twisted pairs, with the screens earthed at one point within the safe area.

Recommended panel cut-out
dimensions for all installations

Mandatory to achieve an IP66 seal between instrument and panel

136 +0.5/-0.0 x 66.2 +0.5/-0.0

DIN 43700
138.0 +1.0/ -0.0 x 68 +0.7 -0.0



Support panel wiring to prevent vibration damage

Note: Optional backlight is internally powered

Fig 11 BA378E 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 11.

b. Slide the gasket over the body of the BA378E before inserting the instrument into the panel aperture.

c. Firstly ensure that all 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 12. 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. Four panel mounting clamps are required to achieve an IP66 seal between a BA378E and the instrument panel.

f. Connect the panel wiring to the rear terminal block(s) as shown in Fig 11. 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.

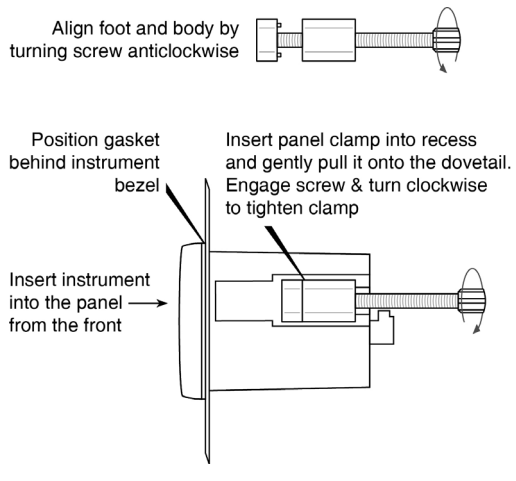


Fig 12 Fitting panel mounting clamps

4.4 Scale card

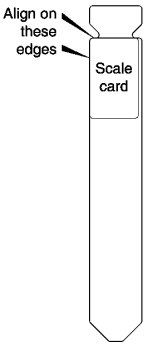
The BA378E's units of measurement are shown on a printed scale card in a window at the right hand side of the display. The scale card is mounted on a flexible strip that is inserted into a slot at the rear of the instrument as shown in Fig 13. Thus the scale card can easily be changed without removing the BA378E 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 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 the self-adhesive printed scale card onto the flexible strip and insert the strip into the instrument as shown below.

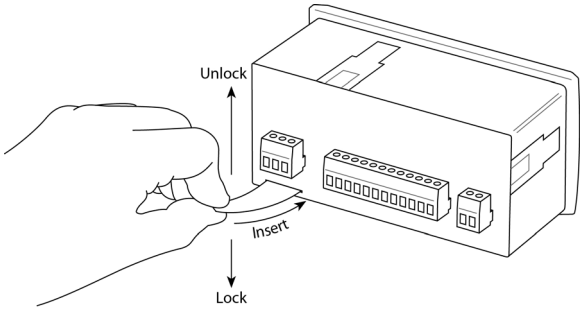


Fig 13 Inserting the flexible strip carrying the scale card into slot at the rear of the instrument.

5. ACCESSORIES

5.1 Display backlight

The BA378E Timer or 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.

	BA378E configured as Timer current consumption
BA378E Timer or Clock	10mA
Additional for backlight	16mA
Addition with terminals 3 & 4 linked	6mA
Addition with terminals 7 & 8 linked	6mA
Total current	38mA max

	BA378E configured as Clock current consumption
BA378E Timer or Clock	10mA
Additional for backlight	16mA
Total current	26mA 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 BA378E 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 to the BA378E 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 BA378E can measure and display the elapsed time between external events. The Timer can be started and stopped by remote sensors, or from the front panel push buttons.

The addition of 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 remote sensors, or from the front panel push buttons. Timed events can be repeated using the CYCLE function which enables the BA378E Timer to repeat the timing period up to 99 times, or continuously, with a configurable delay between timed periods of up to 100 hours.

The BA378E may be configured to time-up from zero to the set time SEt t, or to time-down from the set time to zero. Times may be entered and displayed in hours, minutes or in seconds, or in a combination of units. Elapsed or remaining time is continuously displayed and a separate display may be activated to show the target set time SEt t. Throughout the timing cycle the instrument can be paused and restarted without changing the cycle time. Resetting is accomplished via the front panel push buttons or a remote contact.

A grand total time is maintained by the instrument which can be viewed by operating the front panel push buttons and reset from the display mode or from within the configuration menu.

Fig 14 shows a simplified block diagram of the BA378E when configured as a Timer. The two separate inputs A and b can be individually configured to accept inputs from a wide variety of sensors. When the sensor requires energising to detect its state, such as a switch contact, open collector or a two wire proximity detector, a link connected between external terminals of the BA378E supplies power to the sensor input terminals.

The optically isolated status control output is a current sink intended for monitoring the Timer's status, but may also be used for simple control applications.

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

Internally powered Backlight

Dual isolated Control Outputs

The optional factory fitted dual isolated solid state control outputs may be independently configured to be activated in any of the timer's state allowing the BA378E Timer to perform a wide variety of tasks.

6.1 Initialisation

Each time power is applied to a BA378E initialisation is performed. After a short delay the following display sequence occurs:

All segments of the display are activated

BA378E is ready to start functioning using the configuration information stored in the instrument's permanent memory.

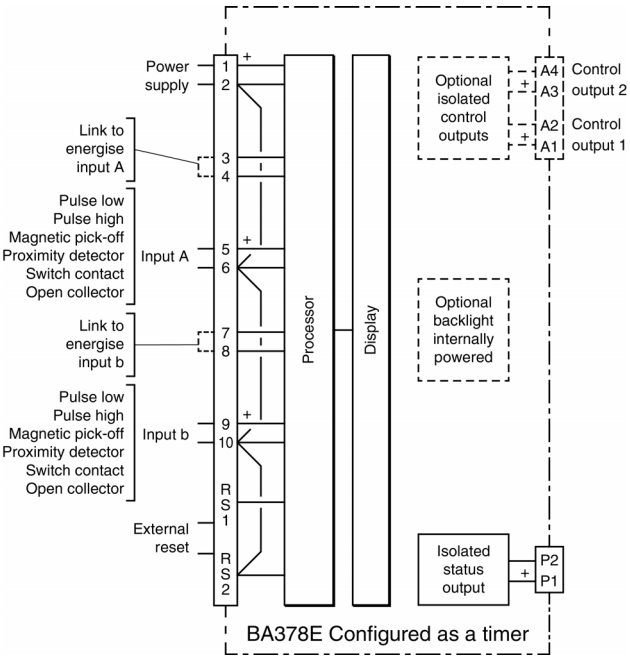


Fig 14 BA378E block diagram with Timer configuration.

6.2 Controls when configured as a Timer

The BA378E is controlled and configured via four front panel push buttons. In the display mode i.e. when the instrument is timing the push button functions are:

Push Button Functions

▼	When local control is enabled starts the Timer. See 6.5.9
▲	When local control is enables stops the Timer. See 6.5.9
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 Ctot` is enabled in the `LoC rSEt` configuration function. See 6.5.21 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 6.5.20
P + ▲	When enabled in the configuration menu, operating these two buttons simultaneously provides direct access from the display mode to the set time `SEt t` and, if the repeat timing cycle is enabled, to the restart delay `rSt dELA` See 6.5.16
P + ▼	Shows firmware version
P + E	Accesses the configuration menu

6.3 Displays when configured as a Timer

The BA378E has two digital displays and associated annunciators as shown on front cover of this manual.

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. 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 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 6.5.8

`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.
Alternatively the lower display may be disabled if not required. See 6.5.8

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

Status output annunciator RTX shown while status output is activated.

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 15 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 15 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 at input A 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 on input b 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 SEt t for timing-down.

Running

Entered by a start event from the *Reset* or *Paused* states. The Timer times-up to SEt 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 CYCLES function is enabled the timing cycle can be specified to repeat up to 99 times, or can be configured to repeat continuously.

6.5 Configuration as a Timer

The BA378E 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 16.

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 BA378E instruments are supplied configured as requested at the time of ordering. If configuration is not requested, the BA378E 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	FunCti on	ELAPSE
Input A	inPut-A	oP.CoL
Input b	inPut-b	oP.CoL
Debounce (each input)	dEbounCE	dEFAuLt
Display 2	di SP-2	Std
Start stop	StArStoP	LoCAL
Units	uni tS	12:00:00
Set time	SEt t	00:00:00
Enable repeat cycle	CYCLES	oFF
Access set time from display mode.	ACSEt t	oFF
Direction of count	uP or dn	dn
Recovery from power supply failure.	P-FAi L	idLE
Local total reset	t-rESEt	on
Local grand total reset	Gt-rESEt	oFF
External reset	E-rSEt	Std
Enable status output	EnbL	oFF
Enable control output 1	EnbL	oFF
Enable control output 2	EnbL	oFF

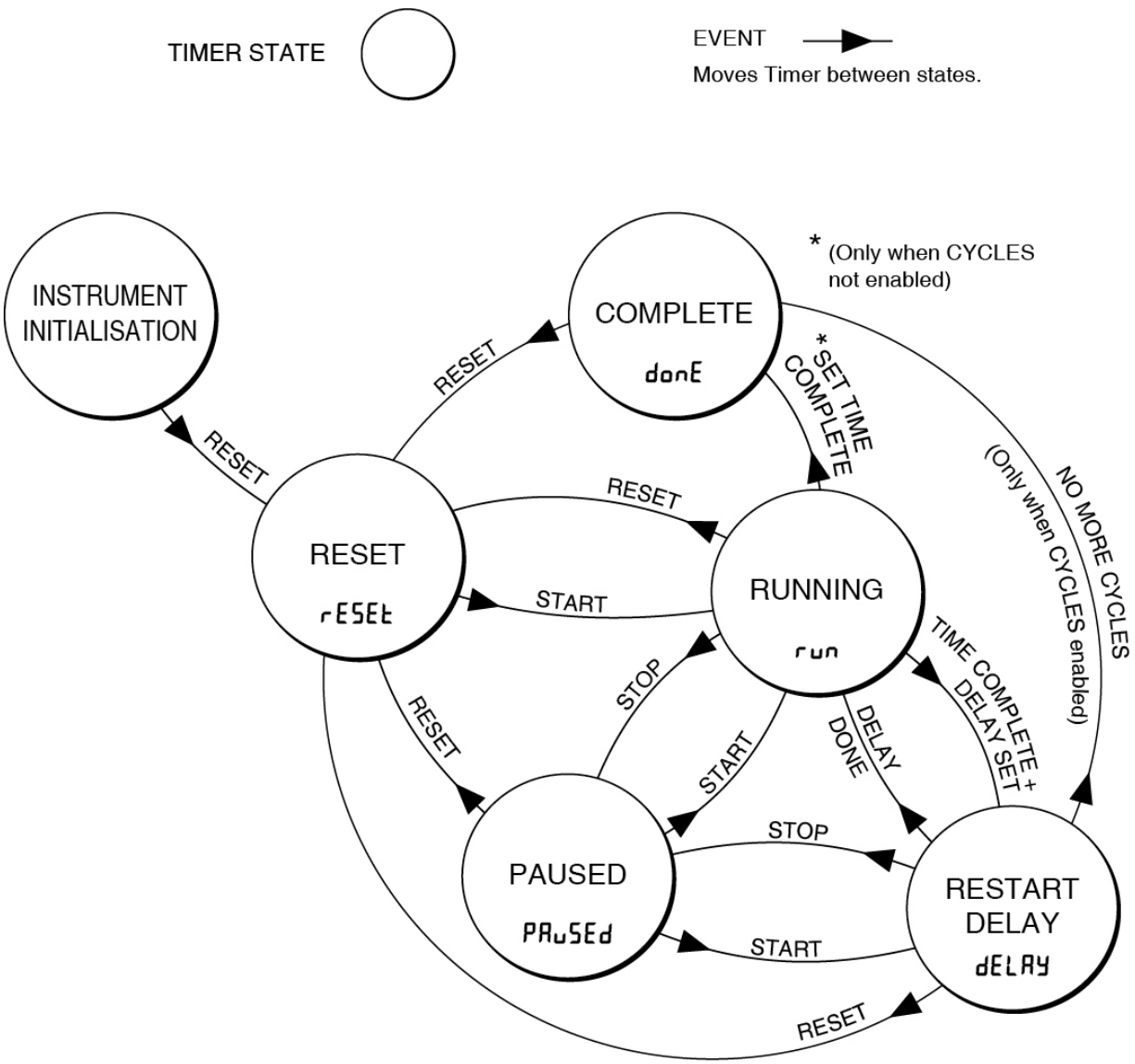


Fig 15 Timer structure showing states and events

6.5.1 Accessing configuration functions

Throughout this manual front panel push buttons are shown as ▼, ▲, P and E. Legends displayed by the instrument are shown in a seven segment font just as they appear on the instrument e.g. inPut-A and CLr Gtot.

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 FunCti on 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 FunCti on 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 parameter can be selected by scrolling through the menu using the ▼ or ▲ push buttons. The Timer configuration menu is shown diagrammatically in Fig 16.

When returning to the display mode following reconfiguration, the Timer will display dAtA followed by SAVE 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 16 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

FunCti on **Instrument function**

Defines the function of the instrument. May be set to:

ELAPSE	Timer configuration
CLoC	Clock configuration

All the entries in this Timer summary assume that the BA378E is configured as a Timer by selecting ELAPSE.

See section 6.5.3

inPut-A **Configuration of Input A**

Contains a sub-menu with two sub-functions:

inPtYPE	Selects input sensor type
dEbounCE	Defines input debounce

See section 6.5.4

inP.tYPE

Configures the Timer sensor Input A to accept one of six types of input:

VoLtS L	Voltage pulse <1 >3V
VoLtS H	Voltage pulse <3 >10V
Coi L	Magnetic pick-off
Pr.dEt	Proximity detector *
ContACt	Switch contact *
oP.CoL	Open collector *

* Energise input by linking terminals 3 & 4 for Input A.

See section 6.5.5

dEbounCE

Defines the level of input debounce applied to the input A to prevent false counting:

dEFAuLt
HEAVY
LiGHt

See section 6.5.6

Display	Summary of function
inPut b	**Configuration of input-b** As configuration of inPut A * Energise input by linking terminals terminals 7 & 8 for Input b. **See section 6.5.7**
di SP-2	**Lower display** Configures the lower display to show set time SEt 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** Std — Set time SEt t oFF — Disables lower display. **See section 6.5.8** **With CYCLES enabled:** **Select** — **Lower display shows** Std — Cycle counts requested and counts 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 Std but with periodic notification of timer status i.e. CYCLE or dELAY. oFF — Disables lower display. **See section 6.5.8**
StArStoP	**Starting and stopping the timer** Defines how the Timer is started and stopped. **Start** / **Stop** Control 1 — A input high / b input high Control 2 — A input low / b input low Control 3 — A input high / A input low Control 4 — A input low / A input high LoCAL — ▼ button / ▲ button High and low inputs are specified for a voltage input. For other types of sensor input, **see section 6.5.9**

Display	Summary of function
uni tS	**Units of display** Enables the format of the displayed time to be selected. 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. **See section 6.5.10**
SEt t	**Set time** This is the BA378E Timer's setpoint. When controlling an external event via the optional control outputs the BA378E 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 SEt t. **See section 6.5.11**
CYCLES	**Repeat timing cycle** Contains a sub-menu with three sub-functions, EnbL, CYCL Cnt and rSt dELA. **See section 6.5.12** **Cycle function enable EnbL** Enables or disables the cycles function without changing the parameters. **See section 6.5.13** **Cycle count CYCL Cnt** Defines the number of times that the timer cycle is repeated. **See section 6.5.14** **Restart delay rSt dELA** Defines the time delay between timer cycles. **See section 6.5.15**
ACSEt t	**Access SEt t from display mode** Contains two sub-functions, EnbL which when activated allows the set time SEt t and restart delay rSt dELA to be adjusted from the display mode. The second sub-function ACCd defines a separate access code to protect access to SEt t from the display mode. **See section 6.5.16**

Display	Summary of function
uP or dn	**Direction of count** Defines whether the Timer times-up from zero to the set time SEt t, or times-down from SEt t to zero. **See section 6.5.17**
P-FAiL	**Power Failure** Defines how the Timer functions when power is restored after a power failure. Contains three alternative options idLE, PAuSE and Continue. **Idle idLE** Timer returns in stopped state as if having completed single timing cycle displaying Timer value when power was lost. Timing resumes when reset followed by start instructions are received. **Pause PAuSE** Timer returns in paused state displaying Timer value when power was lost. Timing resumes when start instruction is received. **Continue Continue** Timer will continue without any manual intervention. **See section 6.5.18**
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 6.5.19** **Local total reset rSEt.EnbL** 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 three seconds in the display mode. **See section 6.5.20** **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 E and ▲ buttons simultaneously for more than 10 seconds in the display mode. **See section 6.5.21**

Display	Summary of function
E-rSEt	**External reset** Defines the time taken for closure of external contacts connected to terminals RS1 & RS2 to reset the Timer. Std 1s FASt 2ms **See section 6.5.22**
StAt oP	**Status output** Contains sub-menu with four sub-functions, EnbL, StAt on, StAt oFF and StAt.dELA **Note:** Output is a current sink. **See section 6.5.23** **Status output enable EnbL** Enables or disables the status output without changing any of the parameters. **See section 6.5.24** **Status output *on* StAt on** Selects one of the five Timer states when the status output comes *on.* Alternatively, selects one of the five timer states when the status output does not comes *on,* but will be *on* in the other four Timer states. **See section 6.5.25** **Status output *off* StAt oFF** Selects one of the five Timer states when the status output goes *off.* Alternatively, selects one of the five timer states when the status output does not go *off,* but will be *off* in the other four Timer states. **See section 6.5.26** **Status *on* delay StAt.dELA** Introduces a specified delay between the *on* condition occurring and the status output being activated. **See section 6.5.27**
oP1	**Control output 1 (Optional)** Contains sub-menu with four sub-functions, EnbL, oP1 on, oP1 oFF and oP1 dELA. **See section 6.5.28** **Control output enable EnbL** Enables or disables control output 1 without changing the parameters. **See section 6.5.29**

Display	Summary of function
	Control output 1 *on* oP1 on Selects one of the five Timer states when Control output 1 comes *on.* Alternatively, selects one of the five timer states when Control output 1 does not come *on,* but will be *on* in the other four Timer states. **See section 6.5.30**
	Control output 1 *off* oP1 oFF Selects one of the five Timer states when Control output 1 goes *off.* Alternatively, selects one of the five timer states when Control output 1 does not go *off,* but will be *off* in the other four Timer states. **See section 6.5.31**
	Control output *on* delay oP1 dELA Introduces a specified delay between the on condition occurring and control output 1 closing. **See section 6.5.32**
oP2	**Control output 2 (Optional)** oP2 Functions as control output 1. **See section 6.5.28 to 6.5.33**
CLr Gtot	**Resets grand total to zero** This function resets the grand total, which represents the total Timer run-time, from within the configuration menu when CLr YES is selected and SurE is entered to confirm the instruction. **Note:** Once reset, the grand total can not be recovered. **See section 6.5.34**
CodE	**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 (P) and (E) buttons are operated simultaneously in the display mode. **See section 6.5.35**
rSEt dEF	**Reset to factory defaults** Resets the BA378E to the Timer factory default configuration shown in section 6.4 Instruction confirmed by entering SurE. **See section 6.5.36**

6.5.3 Instrument function: FunCt, on

The BA378E 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 FunCt, on from the configuration menu and press (P). If ELAPSE is displayed, the instrument is already configured as a Timer therefore press (E) to return to the FunCt, on prompt in the configuration menu. If CLoC is displayed, press the (▲) or (▼) button to change the setting to ELAPSE 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 Timer and return the instrument to the display mode. To configure the Timer enter the configuration menu by pressing the (P) and (E) buttons simultaneously until FunCt, on is displayed.

6.5.4 Input A: , nPut-A

The , nPut-A function contains two sub-functions , nP.tYPE which defines the type of sensor that may be connected to the input and dEbounCE which adjust the amount of input noise rejection.

6.5.5 Input type: , nP.tYPE

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

One of following six types of input may be selected:

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

Notes:

1. Maximum voltage input +28V.

2. For sensors connected to input A that require energising i.e. a proximity detector, a switch contact or an open collector, terminals 3 & 4 of the BA378E Timer should be linked together.

3. To function correctly, the input signal must fall below the lower switching threshold and rise above the higher switching threshold.

6.5.6 De-bounce: dEbounCE

dEbounCE is an adjustable sub-menu in the InPut-A 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 InP.tYPE 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.

De-bounce level	Min input pulse width	
	Type of Input	
	Contact	All others
dEFAuLt	1600µs	40µs
HEAVY	3200µs	350µs
LIGHt	400µs	5µs

6.5.7 Input b: InPut-b

The inPut-b function and sub-functions are identical to the InPut-A function & sub-functions described in sections 6.5.4, 6.5.5 and 6.5.6.

Notes:

1. Maximum voltage input +28V.

2. For sensors connected to input b that require energising i.e. a proximity detector, a switch contact or an open collector, terminals 7 & 8 of the BA378E Timer should be linked together.

3. To function correctly, the input signal must fall below the lower switching threshold and rise above the higher switching threshold.

6.5.8 Lower display: diSP-2

The configuration options for the lower display vary depending upon whether the repeat timer function CYCLES is enabled.

CYCLES disabled

When the lower display is enabled it shows the set time SEt t

CYCLES enabled

When the lower display is enabled it shows the total number of repeat cycles requested together with the number of cycles performed. During the delay time between cycles the display shows the time until the next cycle starts.

Menu options allow each part of the cycle to be briefly identified at the start of each part, or periodically throughout the cycle.

To check or change the configuration of the lower display select diSP-2 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.

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

Std Lower display shows the Timer's set time SEt t, to which the BA378E will time-up to, or time-down from, depending upon the direction of count selected in the uP or dn function.

oFF Lower display disabled – see 6.5.17.

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 between cycles the display times-down from the requested delay to zero. A brief notification of timer status i.e. CYCLE or dELAY is shown at the start of each period.

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.

6.5.9 Starting & stopping the Timer: StArStoP

The Timer may be started and stopped by signals on Input A and Input b, 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 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 in the following tables.

Voltage inputs and control from front panel

Display	Start	Stop
Control 1	A input high	b input high
Control 2	A input low	b input low
Control 3	A input high	A input low
Control 4	A input low	A input high
LoCAL	▼ button	▲ button

Contact and open collector inputs

Display	Start	Stop
Control 1	A open	b open
Control 2	A closed	b closed
Control 3	A open	A closed
Control 4	A closed	A open

Proximity detector input

Display	Start	Stop
Control 1	A low current	b low current
Control 2	A high current	b high current
Control 3	A low current	A high current
Control 4	A high current	A low current

6.5.10 Units of display: unitS

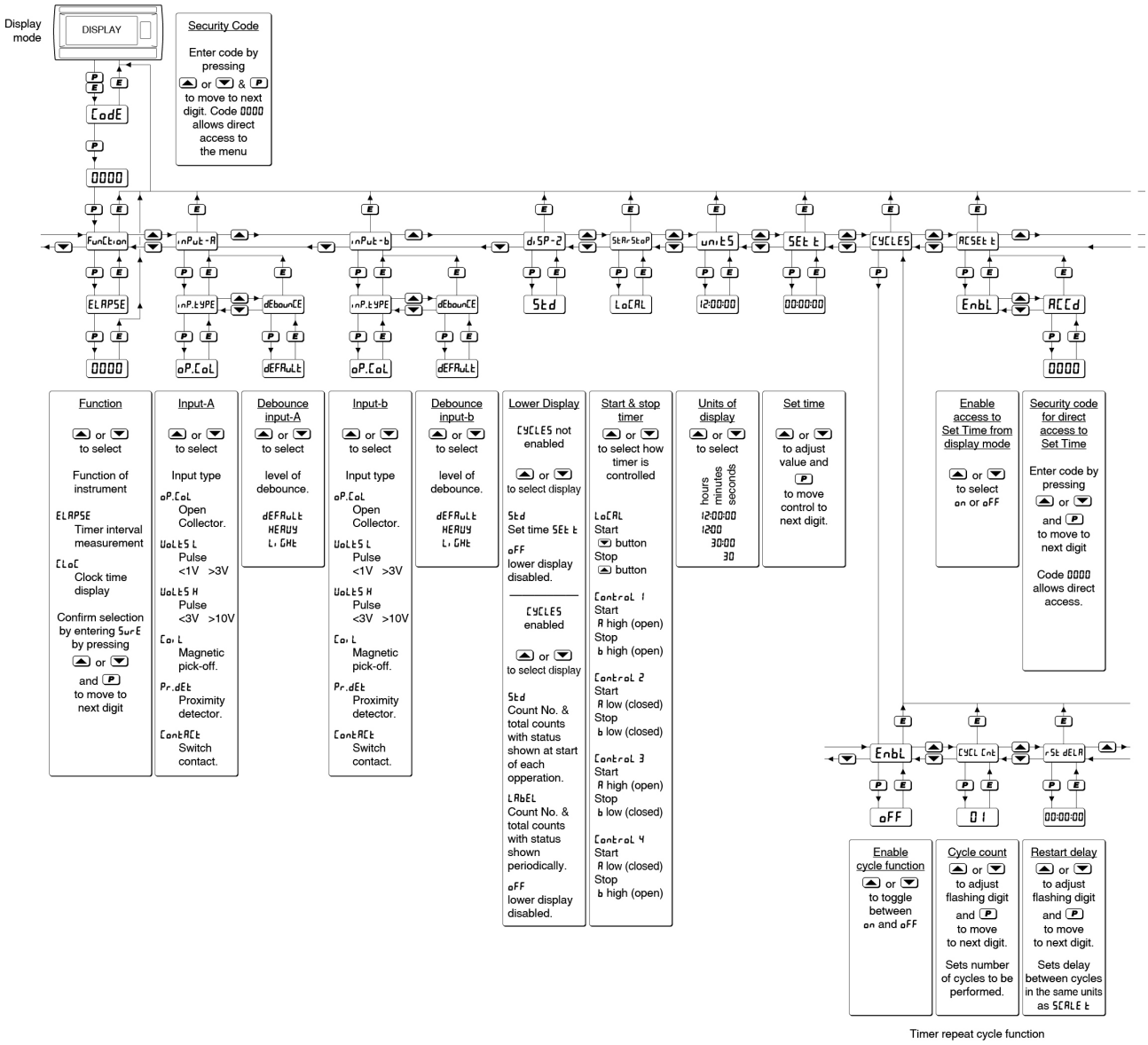
Defines the format of all displayed times, except the delay time of the status output and optional control outputs which are always shown in seconds and the grand total which is always shown in hours and tenths of an hour.

To check or change the units of display, select unitS 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 in the following tables:

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

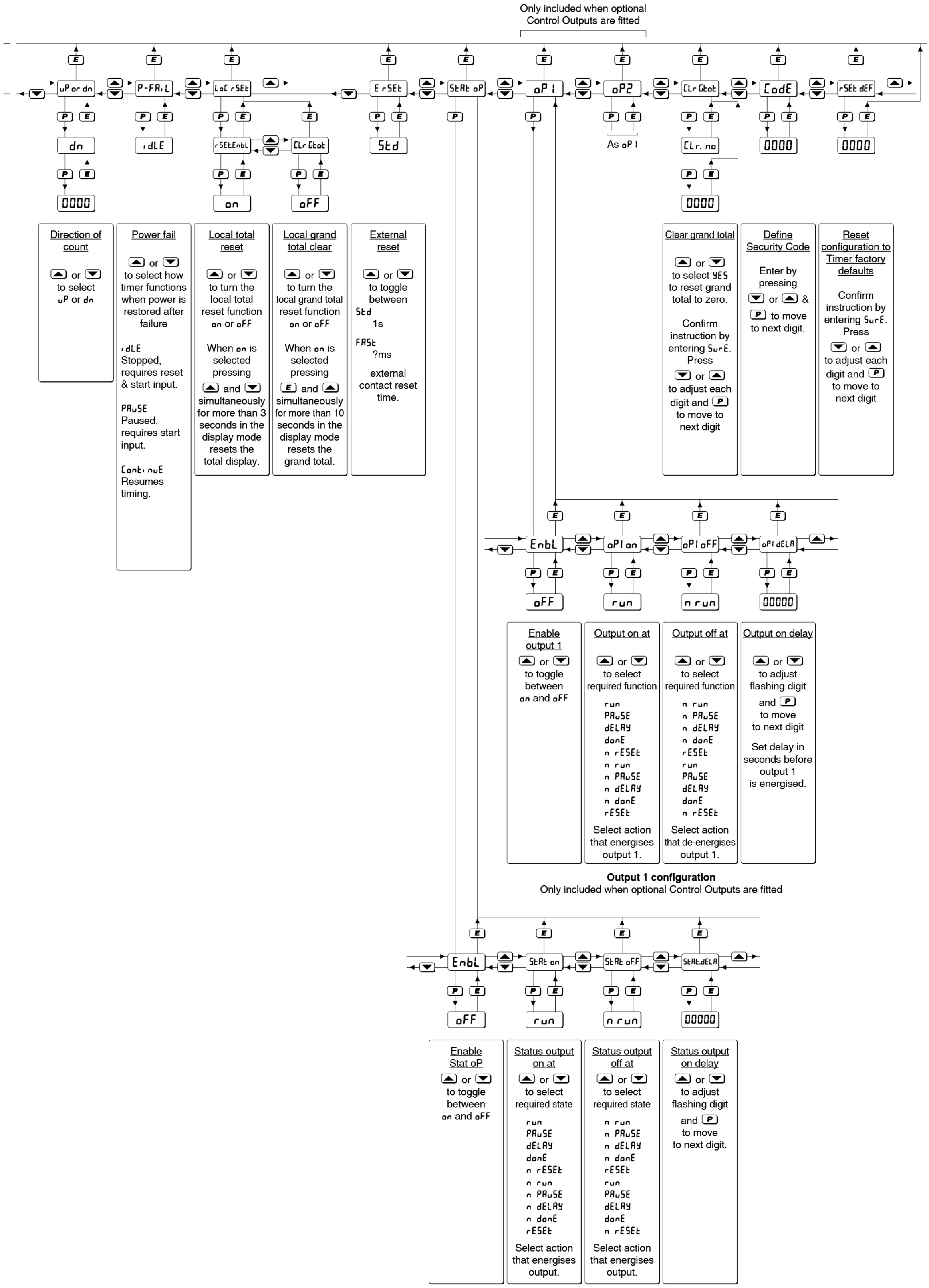
* Only available when time specified in seconds for SEt t and r5t dELA are zero or exactly divisible by 60.

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



Timer repeat cycle function

Fig 16 Timer Configuration menu


Only included when optional Control Outputs are fitted
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.
External reset
or to toggle between
Std 1s
FASt ?ms
external contact reset time.
As oP1
Clear grand total
or to select YES to reset grand total to zero.
Confirm instruction by entering SurE. Press or to adjust each digit and to move to next digit
Define Security Code
Enter by pressing or & to move to next digit.
Reset configuration to Timer factory defaults
Confirm instruction by entering SurE. Press or to adjust each digit and to move to next digit
Enable output 1
or to toggle between on and oFF
Output on at
or to select required function
run PAuSE dELAY donE n rESEt n run n PAuSE n dELAY n donE rESEt
Select action that energises output 1.
Output off at
or to select required function
n run n PAuSE n dELAY n donE rESEt run PAuSE dELAY donE n rESEt
Select action that de-energises output 1.
Output on delay
or to adjust flashing digit and to move to next digit
Set delay in seconds before output 1 is energised.
Output 1 configuration
Only included when optional Control Outputs are fitted
Enable Stat oP
or to toggle between on and oFF
Status output on at
or to select required state
run PAuSE dELAY donE n rESEt n run n PAuSE n dELAY n donE rESEt
Select action that energises output.
Status output off at
or to select required state
n run n PAuSE n dELAY n donE rESEt run PAuSE dELAY donE n rESEt
Select action that energises output.
Status output on delay
or to adjust flashing digit and to move to next digit.

6.5.11 Set time: SEt t

Set time is the Timer's setpoint. When controlling an external event via the optional control outputs the BA378E 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 SEt t from the configuration menu and press P which will reveal the existing setting displayed in the units defined by the unitS function with the most significant digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button followed by the P button to transfer control to the next digit. When set as required, enter the selection and return to the SEt t prompt in the configuration menu by operating the E button.

Can also be adjusted from Timer display mode, see 6.5.16.

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

6.5.12 Repeat timing cycle: CYCLES

This a powerful function which allows the BA378E timing cycle to be repeated up to 99 times or continuously with a configurable delay between cycles of up to 99hours, 59 minutes & 59 seconds.

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

6.5.13 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 CYCLES and press P 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 E button to return to the repeat timing cycle sub-menu.

6.5.14 Cycle count: CYCL Cnt

This sub-function defines the number of times 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 CYCLES and press P which will reveal the number of times the timer cycle is to be repeated with the most significant flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button followed by the P 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 E button.

6.5.15 Restart delay: rSt 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 unitS	Maximum delay
12:00:00	99:59:59
12:00	99:59
30:00	5999:59
30	359999

To check or change the restart delay time select rSt dELA from the repeat timing cycle sub-menu CYCLES and press P 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 P button to transfer control to the next digit. When set as required, enter the selection and return to the rSt dELA prompt in the sub-menu by operating the E button.

Can also be adjusted from Timer display mode, see 6.5.16.

6.5.16 Adjusting the set time SEt t and restart delay rSt dELA from the display mode: ACSEt t

When this function is enabled the Timer's set time SEt t and restart delay rSt dELA can be adjusted from the display mode by simultaneously operating the P 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 SEt t with the Timer in the display mode.

To check or change the function, select ACSEt t in the configuration menu and press P which will reveal the EnbL prompt, pressing P 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 no and then press E twice to return to the configuration menu. If the function is required, select YES and press E 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 SEt t 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 P to enter a new access code. The Timer will display 0000 with one digit flashing. The flashing digit may be adjusted using the ▲ or ▼ push button, when set as required operating the P button will transfer control to the next digit. When all the digits have been entered press E twice to return to the ACSEt t prompt in the configuration menu. The revised access code will be activated when the BA378E is returned to the display mode.
Please contact BEKA associates sales department if the access code is lost.

6.5.17 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 time will be displayed, but the set time 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 P which will reveal the existing setting. This can be changed by pressing the ▲ or ▼ button followed by the E button to enter the selection and return to the configuration menu.

6.5.18 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 zero, 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 – see Fig 15. 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 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.

6.5.19 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.

6.5.20 Local total reset: rESEt.EnbL

rESEt.EnbL 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 P which will reveal the rESEt.EnbL prompt, press P again to show if the local total reset is on or oFF. If set as required operate the E button twice to return to the configuration menu, or the ▲ or ▼ button to change the setting followed by the E 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. See section 3.2.8

6.5.21 Local grand total reset: CLr Gtot

The grand total is the total run-time of the Timer that may be viewed by operating the E 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 E 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 P which will reveal rESEt.EnbL. Using the ▼ or ▲ button select CLr Gtot and press P to show if local grand total reset is on or oFF. If set as required operate the E button twice to return to the configuration menu, or the ▼ or ▲ button to change the setting followed by the E button twice to enter the change and return to the LOC rSEt prompt in the configuration menu.

6.5.22 External reset

The Timer may be reset by connecting terminals RS1 and RS2 together. This function defines how long the connection must exist before resetting occurs. When resetting is performed by a manually operated external push button switch, Std should be chosen. This requires the contact to be closed for one second before resetting occurs which prevents false resetting.

If the Timer is being reset by the a control output or similar apparatus FASt should be selected.

Select	Resetting time
Std	1s
FASt	2ms

6.5.23 Status output: StAt oP

The status output of the Timer is an opto isolated current sink that can be used for transmitting the status of the Timer to other instruments. It may also be used for simple control applications.
The function contains four sub-functions, EnbL, StAt on, StAt oFF and StAt.dELA. To gain access to the sub-menu select StAt oP in the configuration menu and press (P) which will show the EnbL prompt from which the other sub-functions can be accessed using the (▼) or (▲) button.

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

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

If the status output 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

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

StAt on	n run
StAt oFF	rESEt

6.5.24 Status output enable: EnbL

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

6.5.25 Status output *on* : StAt on

The status output is very versatile and may be configured to turn *on* (current sink activated) in any one of the five Timer states, or to turn *on* when Timer is not in one of the states. Status output *on* is shown by the RTX display annunciator. Timer states are shown in Fig 15.

To define when the status output is *on* select StAt on from the sub-menu and press (P) to show the existing setting. Pressing the (▼) or (▲) button will scroll through the options:

Display	Status output *on* when Timer is in
rESEt	*Reset* state
run	*Run* state
PAuSE	*Pause* state
dELAY	*Delay* state
donE	Com*plete* state
	Status output *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 (E) to enter the selection and return to the status output sub-menu.

6.5.26 Status output *off* : StAt oFF

The status output may be configured to turn *off* (current sink not activated) in any one of the five Timer states, or to turn *off* when not in one of the five Timer states. Timer states are shown in Fig 15.

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

Display	Status output *off* when Timer is in
rESEt	*Reset* state
run	*Run* state
PAuSE	*Pause* state
dELAY	*Delay* state
donE	Com*plete* state
	Status output *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 (E) to enter the selection and return to the status output sub-menu.

6.5.27 Status output *on* delay time: StAtdELA

The status output may be delayed from turning on (current sink activated) 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 StAtdELA from the status output sub-menu and press (P) which will reveal the existing delay time with one digit flashing. The flashing digit can be adjusted using the (▼) or (▲) button and the (P) button to move to the next digit. When the required delay has been entered, press (E) to return to the status output sub-menu.

Timer configuration examples in section 7.2. and 7.3 of this manual illustrate how to configure the status output.

6.5.28 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 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, oP1on, oP1oFF and oP1dELA. To gain access to the sub-menu select oP1 in the configuration menu and press (P) which will show the EnbL prompt from which the other sub-functions can be accessed using the (▼) or (▲) button.

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

oP1on	state required	e.g. run
oP1oFF	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

6.5.29 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 (P) to reveal if control output 1 is on or oFF. The setting can be changed by pressing the (▼) or (▲) button followed by the (E) button to return to the control output 1 output sub-menu.

6.5.30 Control output 1 *on* : oP1on

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 15.

To define when output 1 is on select oP1on from the control output 1 sub-menu and press (P) 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 (E) to enter the selection and return to the status output sub-menu.

6.5.31 Control output 1 *off* : 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 15.

To define when the output 1 is *off* select oP1 oFF from the sub-menu and press P 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 E to enter the selection and return to the control output 1 sub-menu.

6.5.32 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 P which will reveal the existing delay time with one digit flashing. The flashing digit can be adjusted using the ▼ or ▲ button and the P button to move to the next digit. When the required delay has been entered, press E to return to the control output 1 output sub-menu.

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

6.5.33 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 6.5.28 to 6.5.32

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

6.5.34 Reset grand total from within the configuration menu: CLr Gtot

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

The grand total can be reset to zero from within the configuration menu using this CLr Gtot function, or from the display mode if CLr Gtot is activated in the local grand total clear function - see 6.5.21

To zero the Timer grand total from within the configuration menu select CLr Gtot and press P which will cause the instrument to display CLr. no with no flashing. Operate the ▼ or ▲ push button until CLr.YES is displayed and then press P 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. Pressing E 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.

6.5.35 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 P which will cause the Timer to display 0000 with one digit flashing. The flashing digit may be adjusted using the ▲ or ▼ push button, when set as required operating the P button will transfer control to the next digit. When the new security code has been entered press E 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.

6.5.36 Reset configuration to factory defaults rSEt dEF

When the BA378E is configured as a Timer this function resets the instrument to the Timer factory defaults shown in sections 6.4

To reset the configuration select rSEt dEF from the configuration menu and press (P). The BA378E 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 S and press (P) to transfer control to the second digit which should be set to u. When SurE has been entered pressing the (E) 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 three applications for the BA378E when configured as a Timer.

7.1 Measuring the time that a contact is closed.

In this example a BA378E 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 (E) + (▲) buttons simultaneously. No security codes are required to protect access to the configuration menu or to the grand total reset.

Figure 17 shows the wiring for the BA378E when powered by a single channel Zener barrier. This example illustrates how the Timer may be started and stopped by one input, the second input is not used in this application.

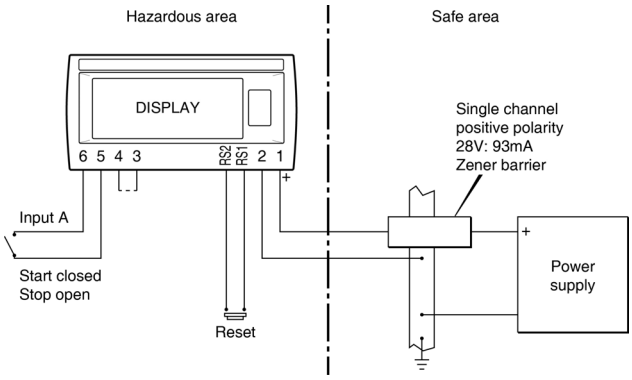


Fig 17 Starting & stopping timer with one input

The required instrument configurations for this example are shown below.

Function	Display	Setting
Access code	CodE	0000
Function	FunCti on	ELAPSE
Input A	inPut-A	ContACt
De-bounce Input A	dEbounCE	dEFAuLt
Display 2	di SP-2	oFF
Start stop	StArStoP	ControL 4
Units	uni tS	12:00
Set time	SEt t	9999:99:99
Local total reset	rESE EnbL	oFF
Local grand total reset	CLr Gtot	on

7.2 Controlling an IS solenoid valve

This example illustrates how a BA378E Timer can open an intrinsically safe solenoid valve for 5 minutes each time a start button is operated. The operator needs to pause the process without affecting the total time that the valve is open. At the end of the process the Timer is required to automatically reset within 10 seconds ready for the next timing cycle to be started.

For this application the BA378E Timer requires dual control outputs which are a factory fitted option and should be specified when the instrument is ordered.

Control output 1 is used to switch the intrinsically safe solenoid valve, and control output 2 is wired to the Timer's reset terminals to perform the automatic resetting at the end of the timing cycle, see Fig 18.

The Timer is configured to perform one timing cycle CYCL CNT with a restart delay RST dELA of 5s and Set time SEt t is adjusted to 5 minutes the required time that that the valve is to be open.

Control outputs are configured so that control output one is only closed when the timer is in the *Run* state. Control output 2 is configured to only close when the Timer is in the *Done* state which occurs after it has been in the Restart-delay state for 5 seconds. The sequence of events is shown in Fig 18 and the Timer's configuration at the end of this section.

This valve opening process is to be linked to other processes, therefore the status output is required to indicate when the 5 minute valve open period has been completed and when the Timer has been reset and is ready for the next cycle.

When the start button is operated the Timer enters the *Running* state and control output 1 closes for 5 minutes opening the solenoid valve. At the end of the 5 minute period control output 1 opens which closes the solenoid valve and the Timer enters the *Restart-delay* state for 5 seconds followed by the *Done* state. Control output 2 is configured to close when the Timer is in the *Done* state. Control output 2 is externally connected to the Timer's reset terminals which causes the Timer to automatically reset ready to start another cycle when the start button is operated.

If at any time during the cycle the stop button is operated the Timer will enter the Pause state which will stop the process until the start button is operated when it will resume without shortening the total valve open time.

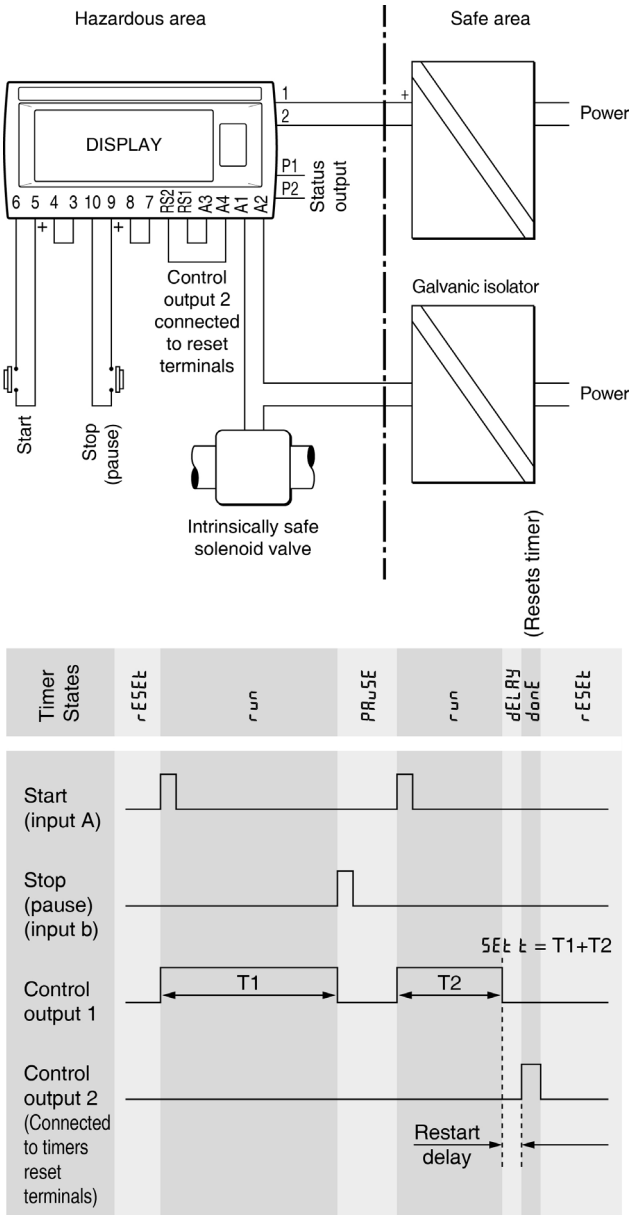


Fig 18 Control of valve in a hazardous area.

The required instrument configurations for this example are shown below.

Function	Display	Setting
Access code	CodE	0000
Function	FunCti on	ELAPSE
Input A	inPut-A	ContACt
Input b	inPut-b	ContACt
De-bounce (both inputs)	dEbounCE	dEFAuLt
Display 2	di SP-2	Std
Start stop	StArStoP	Control 2
Units	uni tS	12:00:00
Set time	SEt t	00:05:00
Timer repeat cycle	CYCLES	
Enable repeat cycle	EnbL	on
Cycle count	CYCL Cnt	01
Reset delay	rSt dELA	0000.05
Access set time from display mode.	ACSEt - t	oFF
Direction of count	uP or dn	dn
Power failure	P-FAi L	i dLE
Local total reset	rESEt.EnbL	oFF
Local grand total reset	CLr Gtot	oFF
External reset	E rSEt	FASt
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	n donE
Control output 2 delay	oP2 dELA	00005
Enable status output	EnbL	on
Status output on at	StAt on	rESEt
Status output off at	StAt oFF	n rESEt
Status output delay	StAtdELA	00000

8. MAINTENANCE when configured as a Timer

8.1 Fault finding during commissioning

If a BA378E 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, 10 & 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.	BA378E may be configured as a clock.	That FunCti on in configuration menu is set to ELAPSE not to CLoC.
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 function has been activated.
	Set time SEt t has not been entered.	Enter time other than zero for SEt t.
Timer will not respond to sensor inputs.	Input A and/or Input b incorrectly configured, or sensor incorrectly connected.	inPut A and inPut b configuration and that 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 BA378E 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.
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 any of the following functions the Timer will be forced into a fail safe idle 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.

inPut A, inPut b, StArtStoP, CYCLES, uP or dn, oP1 and oP2.

8.3 Servicing

We recommend that faulty BA378E 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 BA378E 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.

The optically isolated status open collector output can be used to monitor the clock or to perform simple control functions.

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 19 shows a simplified block diagram of the BA378E configured as a clock.

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

Backlight Internally powered

Dual isolated control outputs

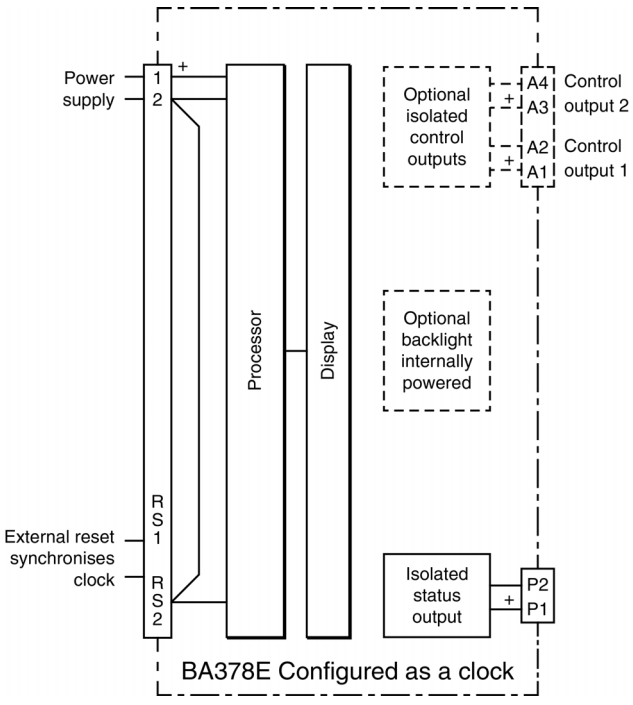


Fig 19 BA378E block diagram with clock configuration.

9.1 Initialisation and loss of power

Each time power is applied to a BA378E 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 information 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. This time may be increased 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 BA378E 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:

Push Button Functions

P + ▼	Shows firmware version
P + E	Access to configuration menu

Note: When optional control outputs are fitted, the BA378E clock may be configured to provide direct access to the control outputs from the display mode when the P + ▲ push buttons are operated. - see section 9.4.16

9.3 Displays when configured as a clock

The BA378E 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.
Status output annunciator	RTX shown while status output is activated.
Control output annunciators	Show status of both optional control outputs.

9.4 Configration as a Clock

The BA378E 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 20.

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

All new BA378E instruments are supplied configured as requested at the time of ordering. If configuration is not requested, the BA378E will be supplied with default Timer configuration as shown in section 6.5.

If a BA378E 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.

Function	Display	Default
Access code	CodE	0000
Function	FunCt, on	CLoC
Display	di SPLAY	12:00
Set display time	SEt	A 12:00:00
Syncronise time	SYnC t	A 12:00:00
Enable status output	EnbL	oFF
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 a factory fitted 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 just 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 FunCt, on 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 FunCt, on 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 parameter can be selected by scrolling through the menu using the ▼ or ▲ push button. The Clock configuration menu is shown diagrammatically in Fig 20.

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.

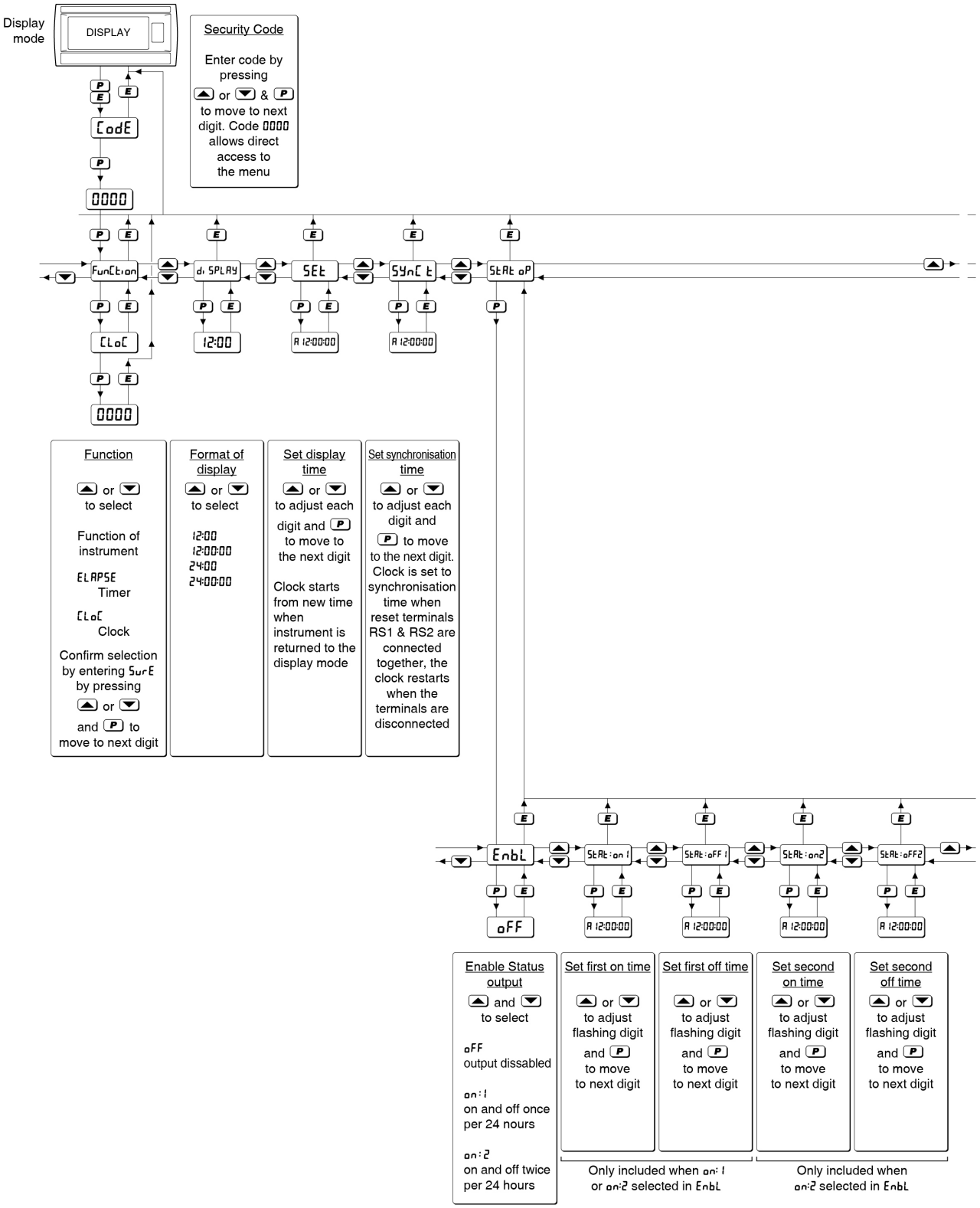
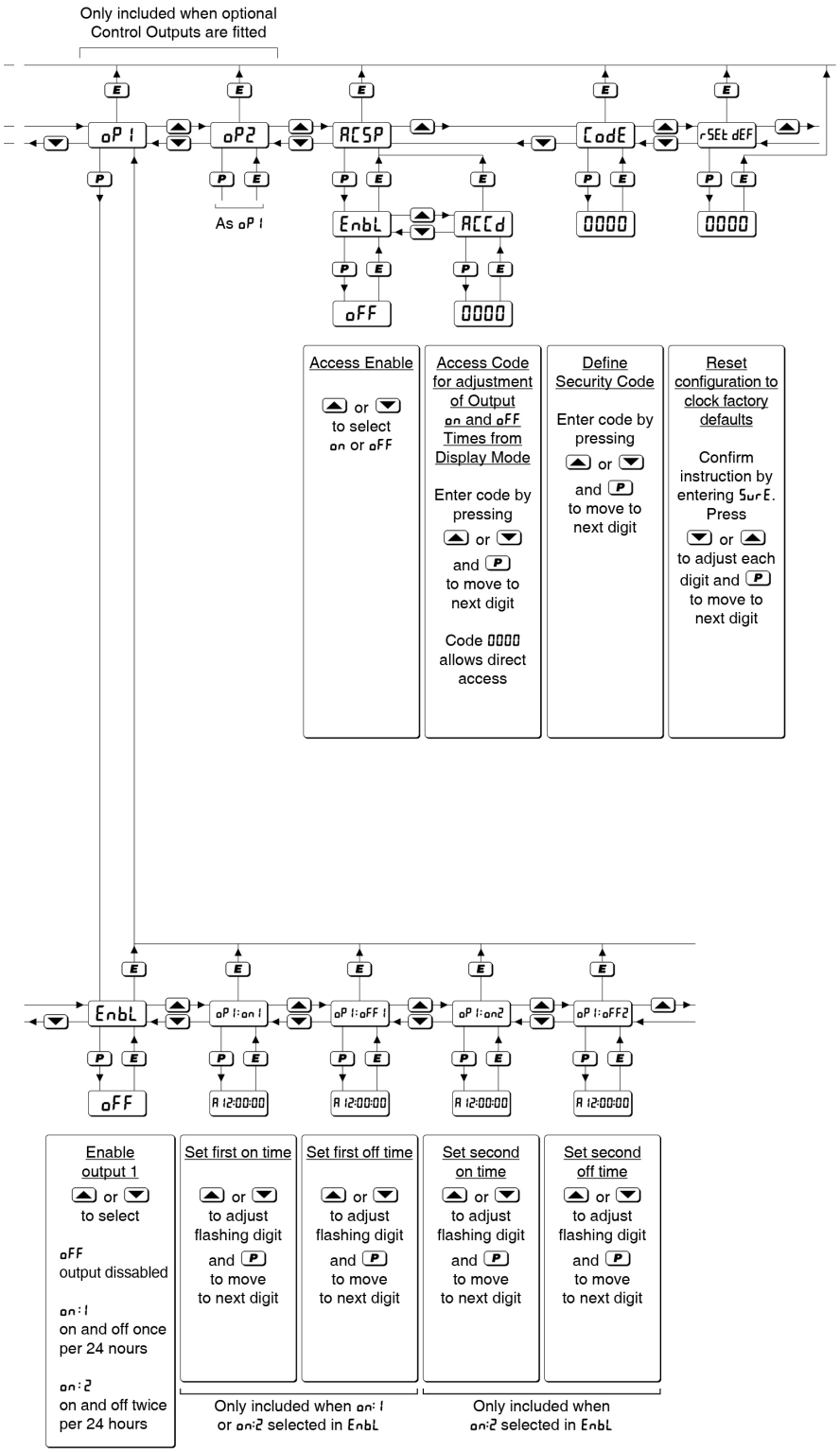


Fig 20 Clock Configuration menu


Only included when optional Control Outputs are fitted
oP1
oP2
As oP1
ACSP
EnbL
oFF
ACCd
0000
CodE
0000
rSEt dEF
0000
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 instruction by entering SurE. Press or to adjust each digit and P to move to next digit
EnbL
oFF
oP1:on1
oP1:oFF1
oP1:on2
oP1:oFF2
Enable output 1
or to select
oFF output dissabled
on:1 on and off once per 24 nours
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
Only included when on:1 or on:2 selected in EnbL
Only included when on:2 selected in EnbL

9.4.2 Summary of Clock configuration functions.

This section summarises all the Clock configuration functions. When read in conjunction with Fig 17 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 BA378E 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 Twelve hours without seconds 12:00:00 Twelve hours with seconds 24:00 Twenty four hours without seconds 24:00:00 Twenty four hours with 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
StAt oP	**Status output** Status output can turn *on* (open collector on) and *off* (open collector off) once or twice in each twenty-four hour period. This function contains five sub-function: EnbL Enables Status output and defines if it turns *on* and *off* once or twice in each 24 hours. StAt:on 1 Time when oP 1 turns *on* 1st time StAt:oFF 1 Time when oP 1 turns *off* 1st time StAt:on 2 Time when oP 1 turns *on* 2nd time StAt:oFF 2 Time when oP 1 turns *off* 2nd time **Note:** Output is a current sink. **See sections 9.4.7 to 9.4.9**
oP 1	**Control output 1 (Optional)** Control output 1 can turn *on* (output closed) and *off* (output open) once or 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 sections 9.4.10 to 9.4.12**
oP2	**Control output 2 (Optional)** As control output 1 described above. **See section 9.4.13 to 9.4.15**
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 control output times from the display mode. Default code 0000 disables this security feature and allows unrestricted access. **See section 9.4.16**

Display	Summary of function
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 9.4.17**
rSEt dEF	**Reset to factory defaults** Resets the BA378E to the Clock factory default configuration shown in section 9.4 Instruction confirmed by entering SurE. **See section 9.4.18**

9.4.3 Instrument function: FunCti on

The BA378E may be configured as a Timer or as a Clock. This section of the instruction manual describes the Clock, for details of Timer configuration see section 6.4.

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 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 ▲ 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 SPLAY

The BA378E 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 A 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 SPLAY 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	Twelve hour format without seconds
12:00:00	Twelve hour format with seconds
24:00	Twenty four hour format without seconds
24:00:00	Twenty four hour format with 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 BA378E Clock is powered. Until a set time is entered the Clock will display a flashing 00:00:00 or 00:00 depending upon how it has been configured.

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 adjustment is complete press E to start the Clock and return to the SEt prompt.

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.

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 Status output: StAt oP

The status output is an optically isolated open collector that can be used for transmitting the status of the Clock to other instruments. It may also be used for simple control applications. Status *on* is indicated by the RTX display annunciator.
The function contains five sub-functions allowing the Status output open collector to be turned *on* and *off* once or twice in each twenty-four hour period.

EnbL	Number of times status output turns *on* & *off* in 24 hours.
StAt:on 1	First time Status oP turns *on*
StAt:oFF 1	First time Status oP turns *off*
StAt:on 2	Second time Status oP turns *on*
StAt:oFF 2	Second time Status oP turns *off*

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

9.4.8 Enable Status output: EnbL

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

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

Display	Status output
oFF	Status output 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 E will enter the selection and return to the EnbL prompt from which another sub-function may be selected.

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

The status output will have one or two *on* and *off* times depending upon whether it 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 StAt from the configuration menu and press P which will result in the EnbL prompt being displayed. The ▲ or ▼ button will scroll through the sub-functions. Only StAt:on 1 and StAt:oFF 1 will be present if the status output has been configured to switch *on* and *off* once in a 24 hour period in the EnbL sub-function.

Select the required sub-function

StAt:on 1	Time status output turns *on* first time
StAt:oFF 1	Time status output turns *off* first time
StAt:on 2	Time status output turns *on* second time
StAt:oFF2	Time status output turns *off* second time

When selected, pressing P will show the existing 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 time has been set as required press E 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 E button twice.

9.4.10 Control output 1: oP1

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 oP1 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 oP1 from the configuration menu and press P which will reveal the first sub-function EnbL.

9.4.11 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 P which will result in the EnbL prompt being displayed. Pressing P 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 E 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.

9.4.12 *On* and *off* times: oP 1:on 1; oP 1:oFF 1 oP 1:on 2; oP 1: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 9.4.11.

All of the times are adjusted in the same way. To adjust any of them select oP1 from the configuration menu and press P which will result in the EnbL prompt being displayed. The ▲ or ▼ button will scroll through the sub-functions. Only oP 1:on 1 and oP 1: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

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

When selected, pressing P will show the existing 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 time has been set as required press E 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 E button twice.

9.4.13 Control output 2: 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 P which will reveal the first sub-funtion EnbL.

9.4.14 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 P which will result in the EnbL prompt being displayed. Pressing P 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 E 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.

9.4.15 *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 9.4.14.

All of the times are adjusted in the same way. To adjust any of them select oP2 from the configuration menu and press P which will result in the EnbL prompt being displayed. The ▲ or ▼ button will scroll through the sub-functions. Only oP2 1: 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:on1	Time oP2 turns *on* first time
oP2:oFF1	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 P will show the existing 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 time has been set as required press E 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 E button twice.

9.4.16 Access control output *on* and *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 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 P 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 P which will reveal the EnbL prompt, pressing P 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 E twice to return to the configuration menu. If the function is required, select on and press E 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 P to enter a new access code. The BA378E 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 P button will transfer control to the next digit. When all the digits have been adjusted press E twice to return to the ACSP prompt in the configuration menu. The revised security code will be activated when the BA378E is returned to the display mode.

9.4.17 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 P which will cause the Clock to display 0000 with one digit flashing. The flashing digit may be adjusted using the ▲ or ▼ push button, when set as required operating the P button will transfer control to the next digit. When all the digits have been adjusted press E 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.

9.4.18 Reset configuration to factory defaults: rSEt dEF

When the BA378E 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 P. 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 S and press P to transfer control to the second digit which should be set to u. When SurE has been entered pressing the E 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 CONFIGRATION EXAMPLE

In this example a BA378E 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 BA378E 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 FunCt, on which is the first item in the configuration menu.
See Fig 20.

Step 2 Configure instrument as a Clock

With FunCt, on displayed press P to reveal the existing function of the instrument. If CLoC is displayed no change is required, therefore return to the FunCt, on 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 ▼ or ▲ button 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 FunCt, on in the configuration menu.
See 9.4.3

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 rSEt 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 outputs *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 outputs 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 display 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.
See 9.4.16

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 9.4.17.

Step 9 Return to the display mode

The BA378E is now configured as required for this example. Pressing the E button will save the configuration and return the BA378E 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 which will 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 BA378E 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, 7, 8, 9 & 10.
Configuration menu does not correspond with the Clock section of this manual.	BA378E is configured as a Timer.	That FunCti on in configuration menu is set to CLoC 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 continuously synchronising.	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.

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 BA378E 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 continuously synchronising.	If reset annunciator on display is activated, if it is 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 BA378E 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 BA378E Two input 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 sections 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 BA378E Two input 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 BA378E 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

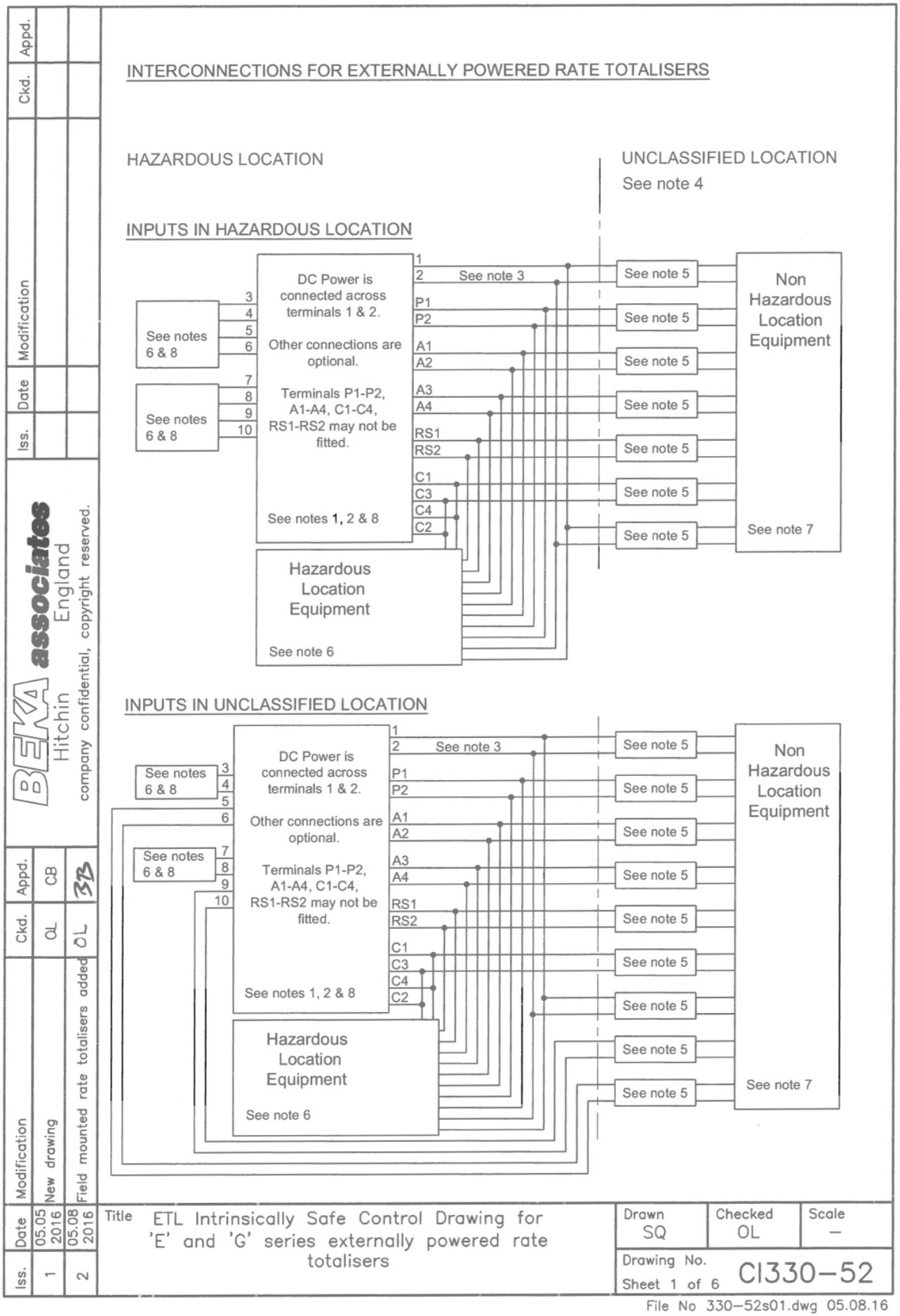
The BA378E Two input Timer or Clock also has ETL and cETL nonincendive approval allowing installation in Division 2 hazardous (classified) locations without the need for Zener barriers or galvanic isolators.

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



Iss.	Date	Modification	Ckd.	Appd.
1	05.05 2016	New drawing	OL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	33

BEKA associates Hitchin England

Title: ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers

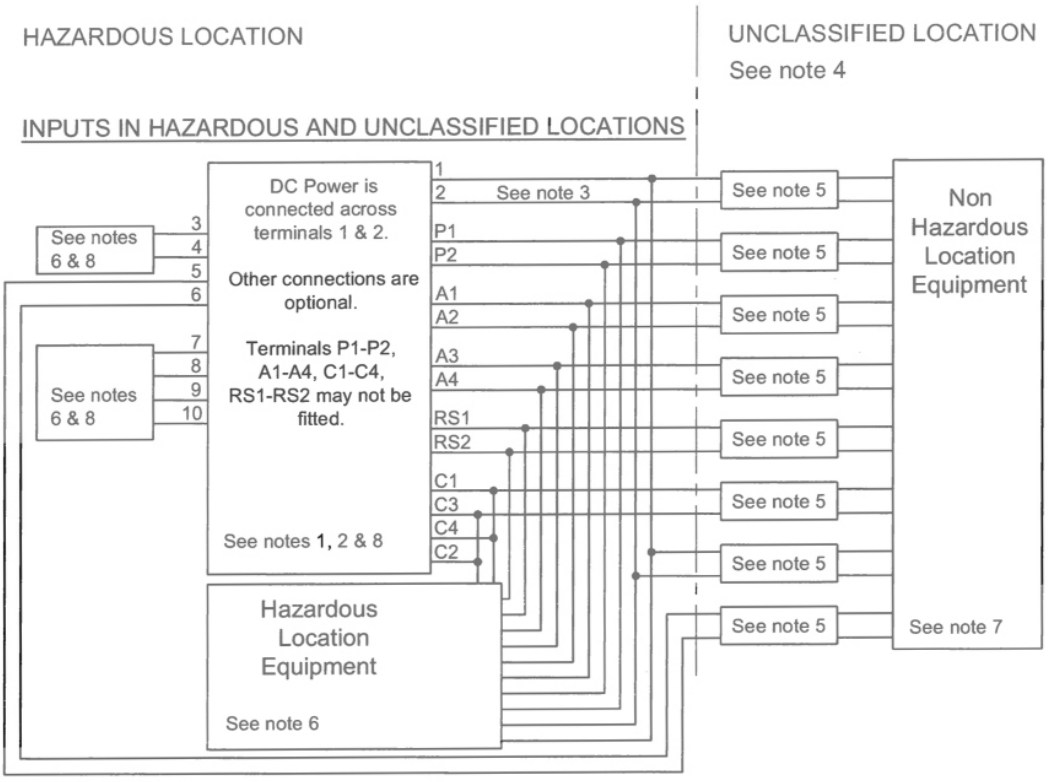
Drawn	Checked	Scale
SQ	OL	–

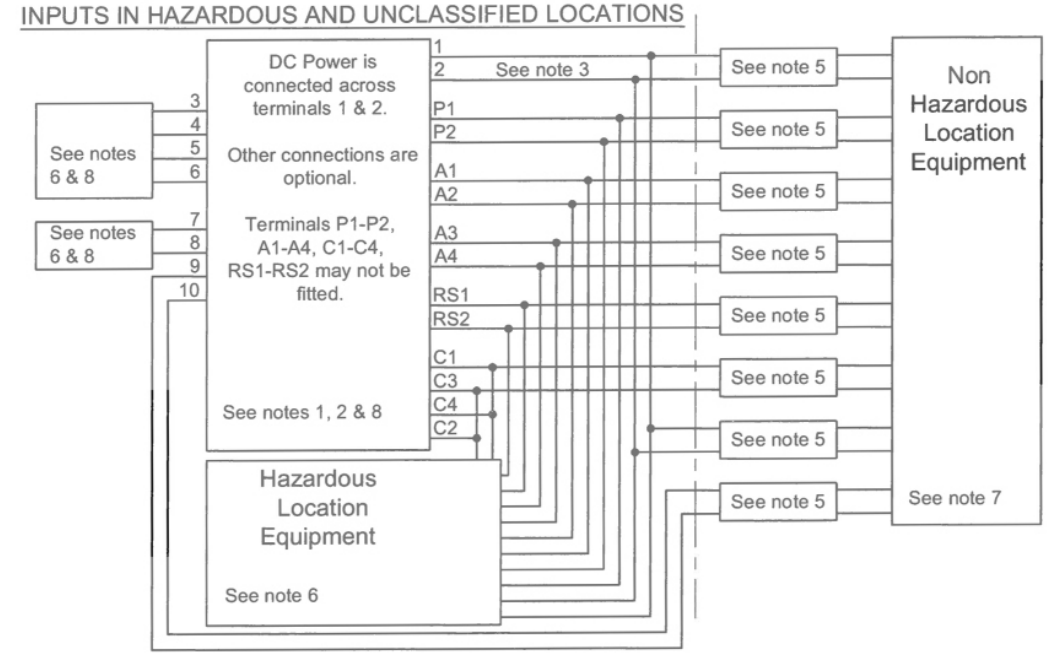
Drawing No. CI330–52

Sheet 1 of 6

File No 330–52s01.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS





Iss.	Date	Modification	Ckd.	Appd.
1	05.05 2016	New drawing	QL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	B.3

BEKA associates Hitchin England

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

Drawn	Checked	Scale
SQ	OL	–

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.

BEKA associates Hitchin England

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

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330−52
Sheet 3 of 6

File No 330−52s03.dwg 05.08.16

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

BEKA associates Hitchin England

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:

Uo	equal or less than	the lowest Ui of the NRTL or CSA approved apparatus installed in the loop.
Io	equal or less than	the lowest Ii of the NRTL or CSA approved apparatus installed in the loop.
Po	equal or less than	the lowest Pi of the NRTL or CSA approved apparatus installed in the loop.
Lo	equal or greater than	the sum of the cable inductances and the internal inductances Li of each NRTL or CSA approved apparatus in the loop.
Co	equal or greater than	the sum of the cable capacitance and the internal capacitance Ci 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:

Ui	equal or greater than	the highest Uo of the NTRL or CSA approved apparatus powering the loop.
Ii	equal or greater than	the highest Io of the NTRL or CSA approved apparatus powering the loop.
Pi	equal or greater than	the highest Po of the NTRL or CSA approved apparatus powering the loop.
Lo	of the NTRL or CSA approved apparatus powering the loop equal or greater than	the sum of the cable inductances and the internal inductances Li of each NTRL or CSA approved apparatus in the loop.
Co	of the NTRL or CSA approved apparatus powering the loop equal or greater than	the sum of the cable capacitances and the internal capacitances Ci of each NTRL or CSA approved apparatus in the loop.

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330–52
Sheet 4 of 6

File No 330–52s07.dwg 05.08.16

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.

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

BEKA associates Hitchin England

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330-52

Sheet 5 of 6

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.

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

BEKA associates Hitchin England

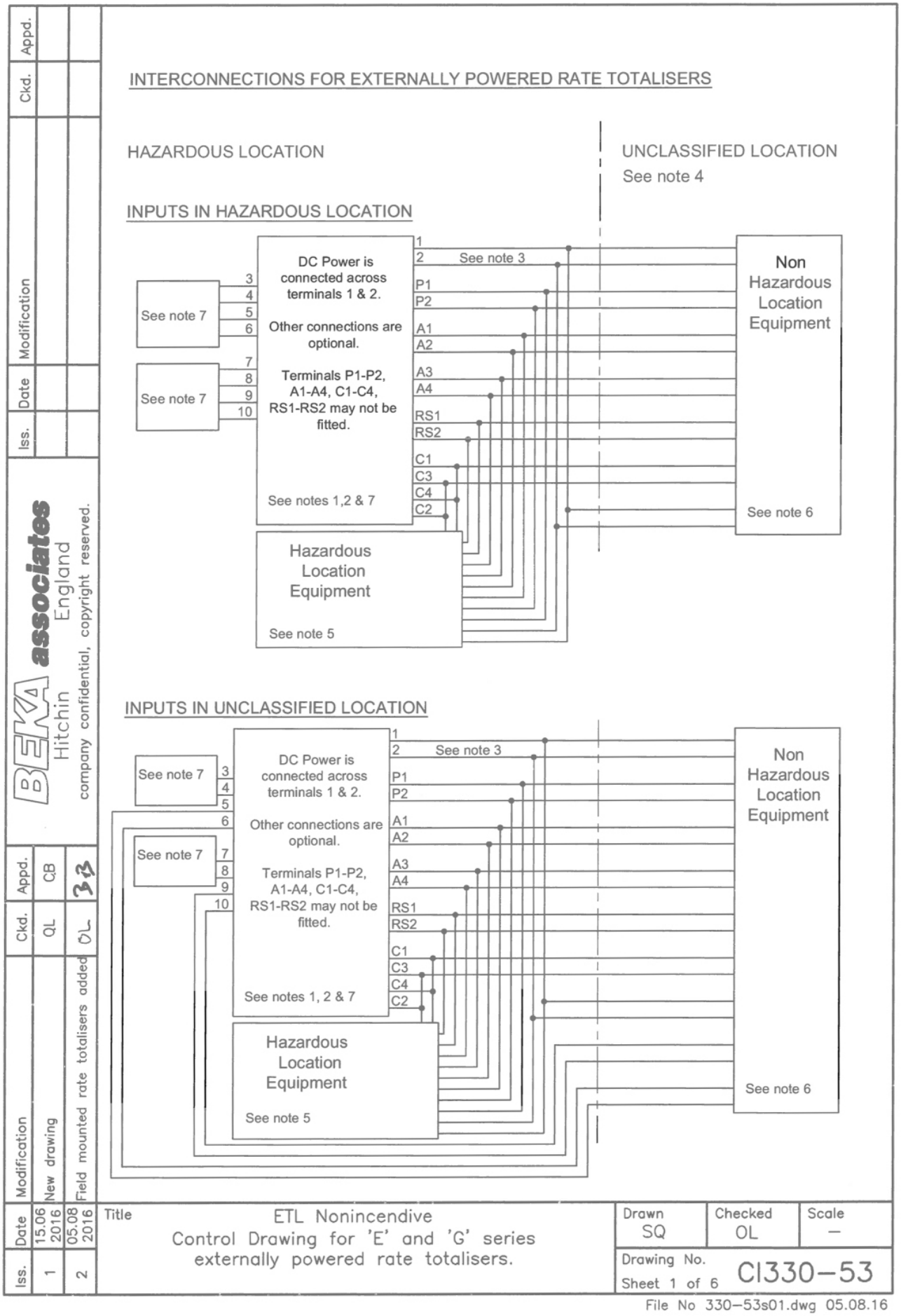
Title: ETL Intrinsically Safe Control Drawing for 'E' and 'G' series externally powered rate totalisers.

Drawn	Checked	Scale
SQ	OL	–

Drawing No. CI330–52
Sheet 6 of 6

File No 330–52s06.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS



Iss.	Date	Modification	Appd.	Ckd.
1	15.06 2016	New drawing	CB	QL
2	05.08 2016	Field mounted rate totalisers added	33	OL

BEKA associates Hitchin England

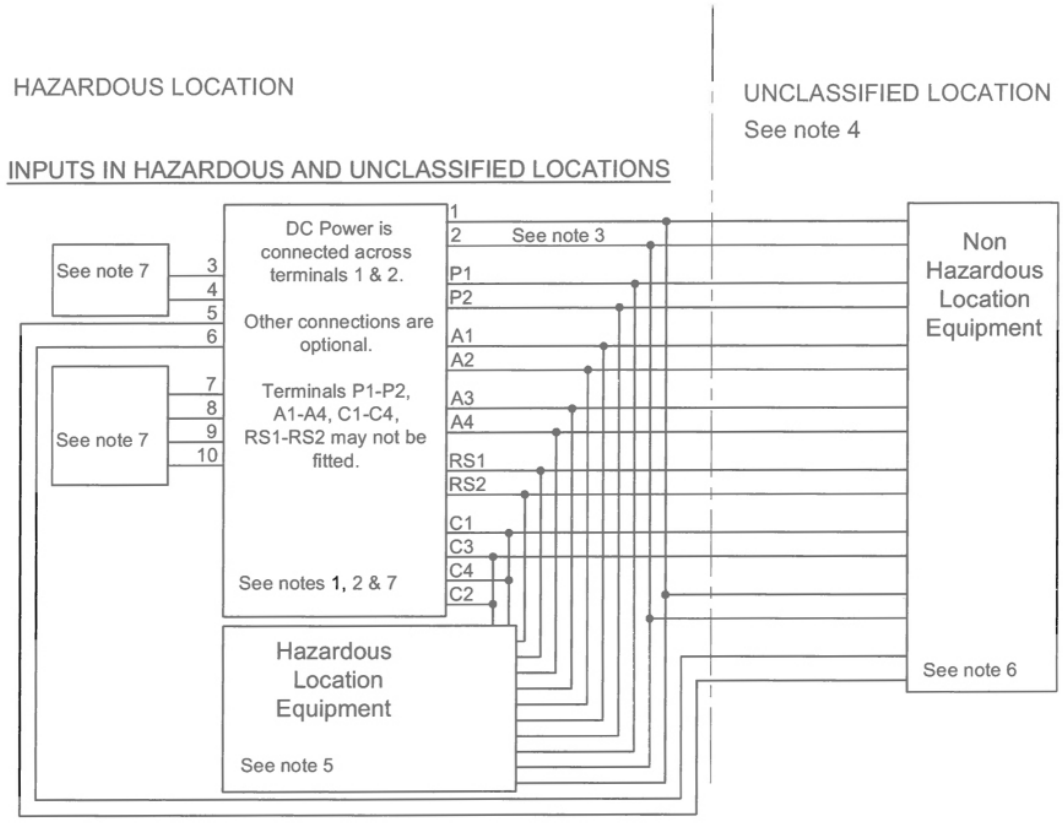
Title: ETL Nonincendive Control Drawing for 'E' and 'G' series externally powered rate totalisers.

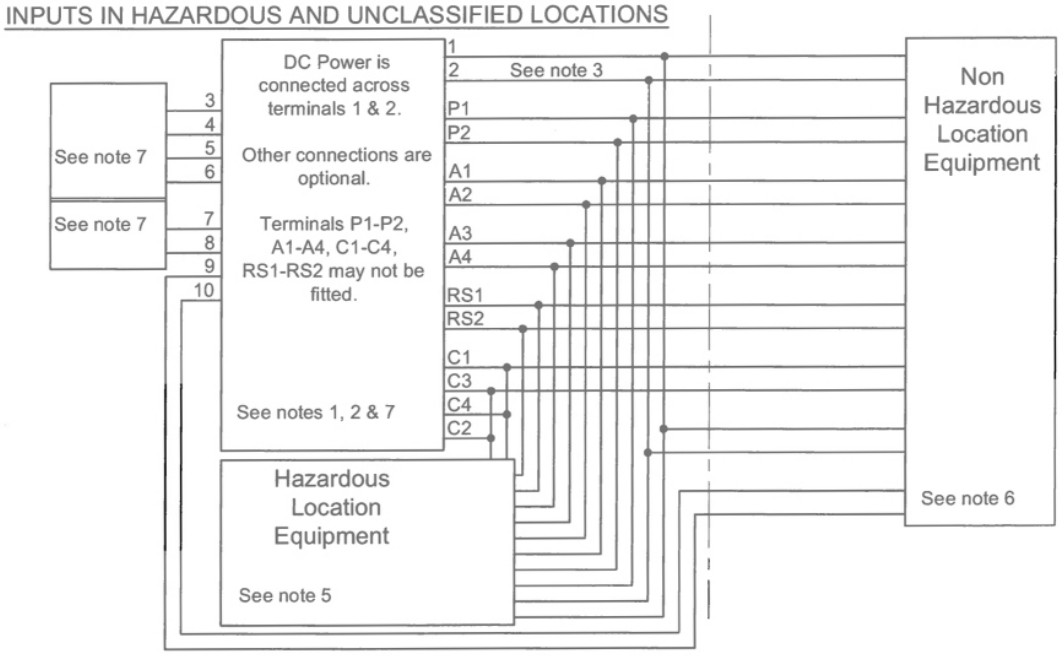
Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330–53
Sheet 1 of 6

File No 330–53s01.dwg 05.08.16

INTERCONNECTIONS FOR EXTERNALLY POWERED RATE TOTALISERS





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

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330–53
Sheet 2 of 6

File No 330–53s02.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.

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

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

BEKA associates Hitchin England

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

Drawn	Checked	Scale
SQ	OL	–

Drawing No. CI330–53

Sheet 3 of 6

File No 330–53s03.dwg 05.08.16

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.

Iss.	Date	Modification	Ckd.	Appd.
1	15.06 2016	New drawing	QL	CB
2	05.08 2016	Field mounted rate totalisers added	OL	2.3

BEKA associates Hitchin England

Iss.	Date	Modification	Ckd.	Appd.

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330-53

Sheet 4 of 6

File No 330-53s04.dwg 05.08.16

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

BEKA associates Hitchin England

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 = 1µA

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 ≤ Ta ≤ +70°C.

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

Drawn	Checked	Scale
SQ	OL	—

Drawing No. CI330–53
Sheet 5 of 6

File No 330–53s05.dwg 05.08.16

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:

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, 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

BEKA associates Hitchin England

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

Drawn	Checked	Scale
SQ	OL	–

Drawing No. CI330–53
Sheet 6 of 6

File No 330–53s06.dwg 05.08.16