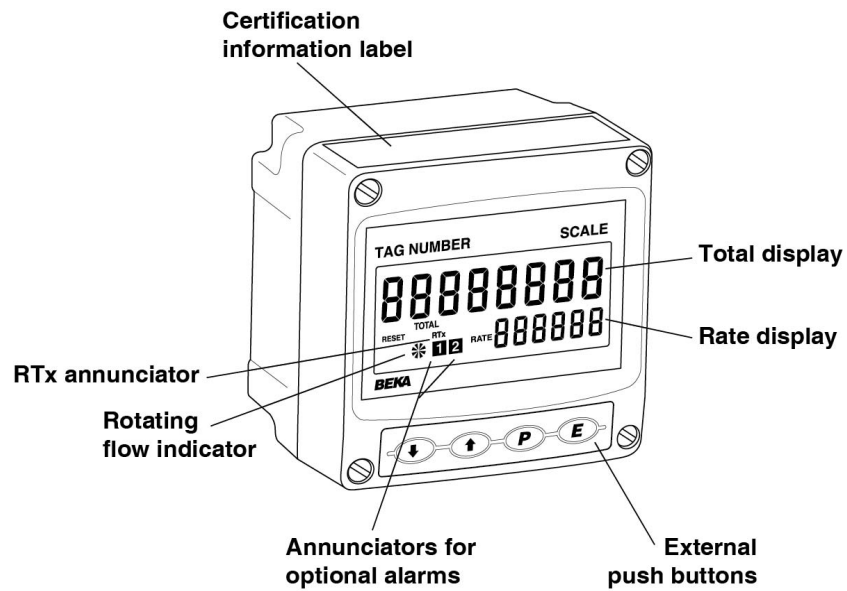


**BA384NG**  
**Ex nA and Ex tc**  
**Two input**  
**Rate Totaliser**  
Issue 6



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## 1. DESCRIPTION

The BA384NG is an Ex nA and Ex tc certified, field mounting rate totaliser with two pulse inputs, primarily intended for use with two flowmeters in Zones 2 or 22.

The BA384NG simultaneously displays the rate of flow and the total flow in the same or different engineering units. Either input, or their sum or difference may be shown. The BA384NG is controlled and configured via the four front panel push buttons, a user defined four digit code may be entered to prevent accidental access to the instrument's configuration menu.

The BA384NG has been issued with a Type Examination Certificate ITS16ATEX48409X by Notified Body Intertek Testing and Certification Ltd. This confirms compliance with the type of protection requirements for non-sparking Ex nA apparatus, and for dust ignition protection by enclosure Ex tc. This certificate has been used to confirm compliance with the European ATEX Directive 2014/34/EU.

The main sections of this manual describe ATEX Ex nA gas certification. Ex tc dust certification is described in Appendix 1.

For international applications the BA384NG also has IECEx certification which is described in Appendix 2.

For applications in the USA and Canada the BA384NG has ETL & cETL certification which is described in Appendix 3.

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

## 2. OPERATION

Fig 1 shows a simplified block diagram of the BA384NG Rate Totaliser. The instrument has two separate inputs 'A' and 'b' which can accept pulses from two flowmeters and display the individual rates and totals, or the sum or difference of the two rates and totals.

Each input may be individually configured to accept pulses from a wide variety of flowmeter sensors and to display the rate of flow and the total flow in the same or different engineering units.

When the flowmeter sensors requires energising to determine their state, such as a switch contact, open collector or a two wire proximity detector, an external link connected between BA384NG terminals supplies power to the appropriate input.

Each Rate Totaliser channel has a separate lineariser with up to sixteen straight-line segments that may be configured to compensate for flowmeter non-linearity.

The BA384NG Rate Totaliser has an isolated pulse output which may be configured to synchronously retransmit either of the two pulse inputs, or a scaleable pulse when the least significant digit of total display is incremented.

The following factory fitted accessories are available:

Internally powered display backlight

Dual isolated alarm outputs

Isolated 4/20mA current sink output

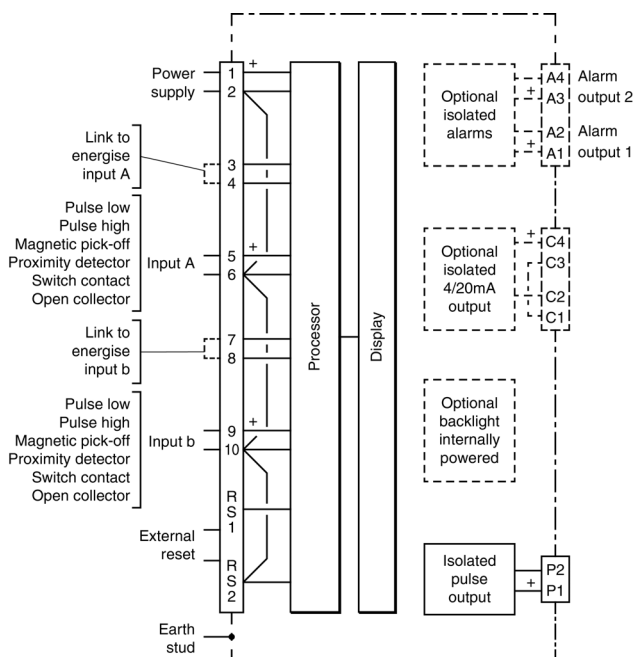


Fig 1 BA384NG Rate Totaliser block diagram

## 2.1 Initialisation

Each time power is applied to a BA384NG initialisation is performed. After a short delay the following display sequence occurs:

























All segments of the display are activated

The Rate Totaliser starts functioning using the configuration information stored in the instrument's permanent memory. Unless the total and grand total displays have been reset to zero, any new flow will be added to the existing totals.

## 2.2 Controls

The BA384NG is controlled and configured via four front panel push buttons. In the totalising mode i.e. when the instrument is displaying rate and total flow the push button functions are:

### Push Button Functions

- |   |  |
|---|--|
|  or     | Scrolls both displays between:<br>Input A<br>Input b<br>Input A + b or Input A – b which is configurable. See 6.9  |
|  +      | Grand total - shows the least significant 8 digits of a 16 digit counter.  |
|  +      | Grand total - shows the most significant 8 digits of a 16 digit counter. If buttons are pressed for longer than 10 seconds the grand total will be reset to zero if the grand total reset function $\overline{CLR} \overline{TOT}$ is enabled. See 6.21<br><br>To reset the grand total to zero from the operating mode press the  and  buttons for ten seconds until $\overline{CLR} \overline{TOT}$ is displayed. Using the  or  button change the display to $\overline{CLR} \overline{YES}$ and press  which will reset the grand total and restore the original display. |
|  +  | If the local total reset function $\overline{CLR} \overline{TOT}$ is enabled in the configuration menu, simultaneously pressing the  and  buttons for more than three seconds allows total A, total b or both totals to be selected by operating the  or  button. Operating the  button will then reset the selected total to zero and clear any stored output pulses. See 6.20   |
|  +  | Shows each for 2 seconds:<br>Firmware and version numbers<br>Function of instrument: $\overline{ZCH} \overline{O} \overline{RL}$<br>Options fitted:<br>-R Alarms<br>-L 4/20mA output<br>-P Pulse output (always fitted)  |
|  +  | Provides direct access to the alarm setpoints when the Rate Totaliser is fitted with optional alarms and the $\overline{RESP}$ setpoints function has been enabled.  |
|  +  | Access to the configuration menu   |

## 2.3 Displays

The BA384NG has two digital displays and associated annunciators, plus a flow indicator as shown on the front cover of this manual.

**Total display** Shows the total flow of the selected input or the composite flow  $A + b$  or  $A - b$  usually on the upper eight digit display. May be reset to zero by the front panel push buttons or a remote reset switch.

**Rate display** Shows the flow rate of the selected input or the composite flow rate  $A + b$  or  $A - b$  usually on the lower six digit display.

**Flow indicator** This disc in the lower left hand corner of the instrument display 'rotates' for two seconds each time an input pulse is received on the input being displayed. Appears to rotate continuously when input frequency exceeds 0.5Hz.

**Hold annunciator** Activated when input frequency is below the clip-off threshold for the input being displayed.

**Reset annunciator** Activated while the instrument is being reset.

**Rate annunciator** Identifies the rate display

**Total Annunciator** Identifies the total display

**RTx annunciator** Retransmitted pulse annunciator. Depends upon the setting of *Source* in the pulse output configuration menu.

### **SCALE**

Annunciator activated each time pulse output open collector is *on*, i.e. Ron is less than  $60\Omega + 3V$ .

### **direct**

Annunciator continuously activated.

### 2.3.1 Display over-range

Over-range of the upper eight digit display or the lower six digit display is indicated by all the digits displaying 9 and all the decimal points flashing.

### 3. CERTIFICATION

The BA384NG has ATEX, IECEx and ETL Ex nA gas and Ex tc dust certification. The main sections of this instruction manual describes ATEX Ex nA gas certification. ATEX dust certification is described in Appendix 1, IECEx gas and dust certification in Appendix 2 and ETL certification in Appendix 3.

#### 3.1 ATEX Ex nA certification

Notified Body Intertek Testing and Certification Ltd have issued the BA384NG with a Type Examination Certificate number ITS16ATEX48409X. This has been used to confirm compliance with the European ATEX Directive for Group II, Category 3G 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 and in EFTA states, Iceland, Liechtenstein and Norway. ATEX certificates are also acceptable in Switzerland and Turkey. The European Commission's Blue Guide lists the member states, overseas countries and territories that have adopted harmonisation legislation.

This section of the instruction manual describes ATEX installations in explosive gas atmospheres conforming with EN 60079-14 *Electrical installations design, selection and erection*. When designing systems for installation outside the UK the local Code of Practice should be consulted.

#### 3.2 Zones, gas groups and T rating

The BA384NG Rate Totaliser has been certified as Group II Category 3G Ex ic nA IIC T5 Gc Ta -40°C to +60°C apparatus. This is non-sparking apparatus complying with EN 60079-15 *Equipment protection by type of protection 'n'* that minimises the risk of arcs or sparks capable of creating an ignition hazard occurring during conditions of normal operation.

The Rate Totaliser's front panel push button contacts are non incandive and have been certified intrinsically safe Ex ic without Zener barriers or galvanic isolators as shown on the Type Examination Certificate. This allows the Rate Totaliser to be adjusted and configured live when installed in Zones 2.

When connected to a suitable system the BA384NG Rate Totaliser may be installed in:

Zone 2 explosive gas air mixture not likely to occur, and if it does will only exist for a short time.

Be used with gases in groups:

Group A	propane
Group B	ethylene
Group C	hydrogen

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

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

At ambient temperatures between -40 and +60°C.

This allows use with all commonly used industrial gases except carbon disulphide CS<sub>2</sub>.

#### 3.3 Safety parameters

The certificate specifies input safety parameters in normal operation i.e. without faults for all the instrument terminals. Where only a voltage or only a current is specified, the unspecified parameter will be defined by components within the BA384NG Rate Totaliser.

#### 3.4 Special conditions for safe use

The Ex nA certificate has an 'X' suffix indicating that the certificate defines special conditions for safe use. These state that the BA384NG Rate Totaliser should be:

- Supplied from a *limited energy* circuit with output parameters in normal operation equal to, or less than the instrument's input parameters. The certificate states that it is **not** necessary to power the instrument from an intrinsically safe interface, such as a certified shunt diode safety barrier or a galvanic isolator to comply with this requirement.
- Fitted with cable entry glands or conduit fittings which maintain the impact and ingress protection of the enclosure. Certified Ex e or Ex n components satisfy these requirements.

The BA384NG is supplied fitted with one certified M20 stopping plug and one temporary hole plug which should be replaced with the required gland or conduit fitting.



### 3.5 Power supply

The input safety parameters for the BA384NG Rate Totaliser power supply terminals 1 and 2 are:

$$\begin{aligned} U_i &= 30V \text{ dc} \\ I_i &= 100mA \end{aligned}$$

This allows the BA384NG to be powered from any dc supply which in normal operation has an output of less 30V and 100mA. See section 4.1 for power supply recommendations.

### 3.6 Pulse input terminals

The BA384NG Rate Totaliser has two pulse inputs, A and b, that may be individually configured for use with different types of flowmeter. Each input is a separate Ex nA 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 1. The two inputs should not be connected in parallel.

For flowmeters with sensors that require energising to determine their state, such as a switch contact, open collector or a 2-wire proximity detector in a turbine flowmeter, fitting an external link between terminals 3 & 4 of the BA384NG 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 BA384NG input is connected to a voltage pulse source.

Fitting an energising link changes the safety parameters of each BA384NG input as shown in the following table which also shows the types of flowmeter sensor requiring energising (link fitting).

Type of input	Link *	Safety parameters		
		Input	Output	
Switch contact	Yes	15V	10.5V	9.2mA
Proximity detector	Yes	15V	10.5V	9.2mA
Open collector	Yes	15V	10.5V	9.2mA
Magnetic pick-off	No	30V	1.1V	0.5mA
Voltage input (low)	No	30V	1.1V	0.5mA
Voltage input (high)	No	30V	1.1V	0.5mA

\*For input A link terminals 3 and 4

\*For input b link terminals 7 and 8

### 3.7 Remote reset terminals

The BA384NG total display may be reset by connecting the external reset terminals RS1 and RS2 together for more than one second. The two reset terminals have the following safety parameters in normal operation:

$$\begin{aligned} U_i &= 30V \\ U_o &= 3.8V \\ I_o &= 1mA \end{aligned}$$

### 3.8 Pulse output

The BA384NG Rate Totaliser has an isolated pulse output which may be configured to synchronously retransmit either of the two pulse inputs, or a scaleable pulse when the least significant digit of total display is incremented.

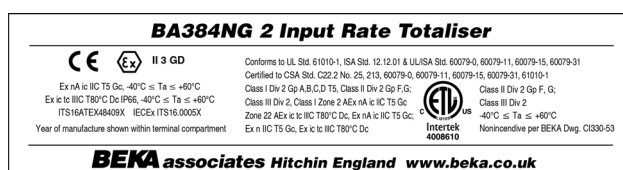
The pulse output is a passive unpowered open collector which is isolated from all other Rate Totaliser circuits. The output has the following Ex nA safety parameters:

$$\begin{aligned} U_i &= 30V \text{ dc} \\ I_i &= 100mA \end{aligned}$$

This allows the pulse output to be connected to any dc circuit providing that in normal operation the maximum supply voltage is not greater than 30V dc and the current is not greater than 100mA.

### 3.9 Certification label information

The BA384NG Rate Totaliser certification information label is fitted in a recess on the top outer surface of the instrument enclosure. It shows the ATEX, IECEx and ETL certification information plus BEKA associates name, location, year of manufacture and the instrument serial number.



BA384NG Certification information label

#### 4. SYSTEM DESIGN FOR HAZARDOUS AREAS.

When correctly installed in Zone 2 the BA384NG Rate Totaliser may be connected to almost any pulse output flowmeter in the safe area and to Ex n, Ex e, Ex p and Ex d protected pulse output flowmeters located in Zone 2. Because the BA384NG is not certified intrinsically safe it should not be connected to an intrinsically safe system.

BEKA Application Guide AG310, *Guide for Installation of [extra low voltage d.c.] Ex nA instrumentation*, which can be downloaded from [www.beka.co.uk](http://www.beka.co.uk), contains explanations and recommendations for the installation of Ex nA equipment.

In addition to being able to be connected to flowmeters in the safe area and in Zone 2, the BA384NG may also be connected to suitably protected and certified flowmeters located in Zone 1. This is explained in Application Guide AG310.

There are four design requirements:

1. The BA384NG should be powered from a circuit that has output safety parameters in normal operation equal to, or less than, the input safety parameters for terminals 1 and 2 specified by the BA384NG ATEX Type Examination Certificate.
2. BA384NG input, reset and output terminals should only be connected to circuits having safety parameters in normal operation compliant with the BA384NG safety parameters which are specified by the ATEX Type Examination Certificate.
3. Hazardous area apparatus to which the BA384NG is connected should be protected by a technique suitable for the Zone in which the equipment is located, such as Ex n or Ex e if located in Zone 2. Equipment protected by intrinsic safety should not be connected to a BA384NG.
4. Wiring should comply with Clause 9 of EN 60079-14.

When designing a system it is important to remember that terminals 2, 6, 10 and RS2 are interconnected within the BA384NG. See Fig 1.

#### 4.1 Power supply

The BA384NG Rate Totaliser requires a minimum of 10V between terminal 1 & 2 and consumes:

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

A 24V dc regulated, current limited supply located in a safe area is suitable.

The power supply should meet the requirements for personnel safety so that 'live maintenance' can safely be performed. The implicit requirement for galvanic isolation from the mains supply ensures that the possible difficulties from circulating earth currents caused by mains faults is minimised. In European terms if the power supply is CE marked it is almost certainly acceptable.

To comply with the requirements of EN 60079:14 *Electrical installations design, selection and erection*, each of the wires entering the hazardous area should be individually fused and contain a means of isolation. These two requirements may be satisfied by using DIN rail mounted terminals incorporating easily removable fuses which can be extracted to achieve isolation as shown in Fig 2.

If an input current safety parameter  $I_i$  is specified, a suitably rated fuse will ensure that it is not continuously exceeded in normal operation.

Clear identification of, and easy access to the means of isolation is essential for their effective use. It is also necessary to ensure that the maintenance procedure makes sure that unauthorised re-closure of the switches does not occur.

It is not considered necessary to have a means of isolation or electrical protection for the screen.

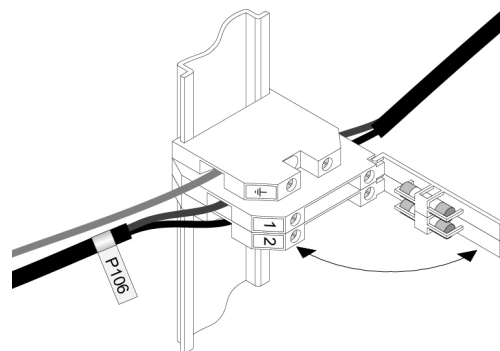


Fig 2 DIN rail mounting terminals incorporating a fuse.

For some applications Ex nA instrumentation energised by a current limited power supply or instrument that can be switched off, is considered adequate and to comply with the requirements of the standard.

## 4.2 Pulse inputs

As shown in Fig 3 both BA384NG Rate Totaliser inputs may be connected to Zone 2 hazardous area flowmeters with a wide variety of outputs, or to safe area flowmeters as shown in Fig 4.

The following table shows the Rate Totaliser's input switching thresholds when configured to operate with various sensors. For reliable operation input pulses must fall below the lower threshold and rise above the upper threshold.

Flowmeter output	Switching thresholds	
	Lower	Upper
Switch contacts	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

Flowmeters with a switch contact, proximity detector or an open collector output require energising to determine their state which is achieved by linking two BA384NG terminals together for each input as shown in Figs 3 and 4.

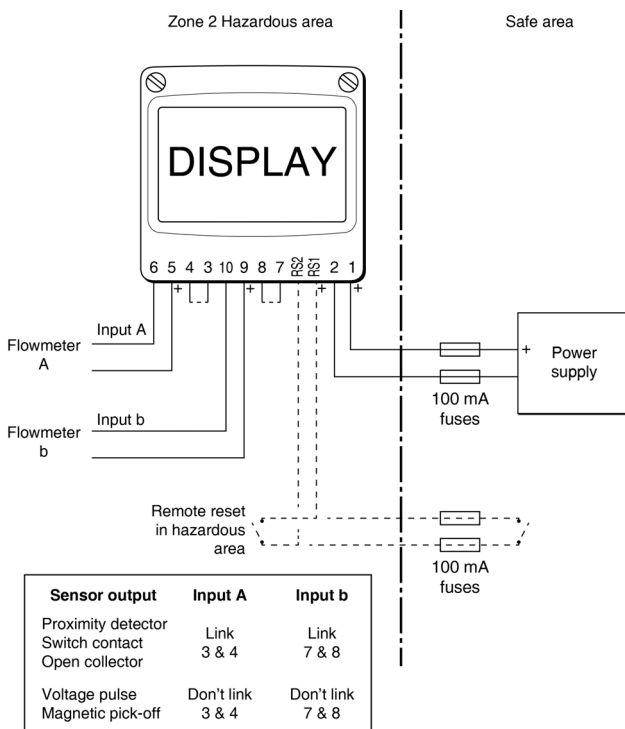


Fig 3 BA384NG flowmeters in Zone 2

The flowmeters may also be located in the safe area as shown in Fig 4.

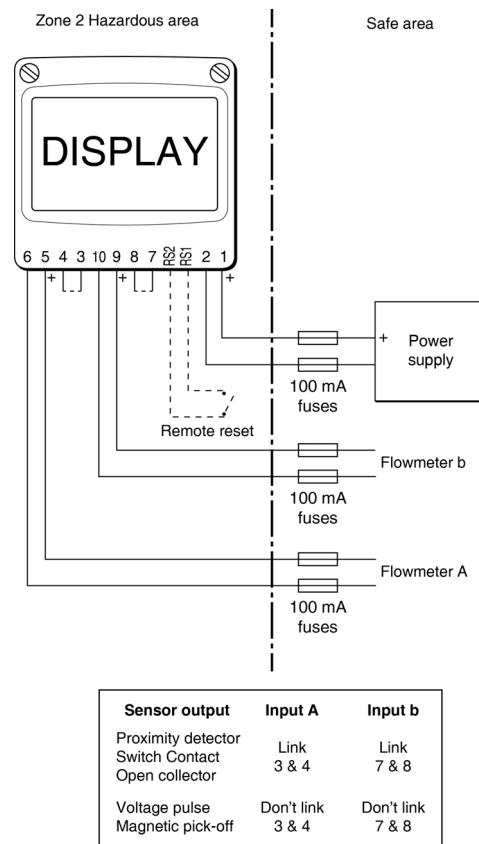


Fig 4 BA384NG flowmeters in the safe area.

### 4.2.1 Switch contact input

Any Zone 2 certified flowmeter, except intrinsically safe instruments, with a mechanically or magnetically activated switch contact output may be directly connected to input terminals 5 & 6 or 9 & 10. The flowmeter should be located in the same hazardous area as the BA384NG, and the flowmeter and associated wiring should be able to withstand a 500V rms insulation test to earth. Most magnetically activated reed relays used in turbine flowmeters comply with these requirements. The BA384NG contains a configurable debounce circuit to prevent contact bounce being counted. Three levels of debounce protection are independently available for each input. See section 6.7.

#### 4.2.2 Open collector input

Most Zone 2 certified flowmeters, except intrinsically safe instruments, with an open collector output may be directly connected to input terminals 5 & 6 or 9 & 10. The flowmeter should be located in the same Zone 2 hazardous area as the BA384NG, and the flowmeter and associated wiring should be able to withstand a 500V rms insulation test to earth.

The BA384NG contains a configurable debounce circuit to prevent false triggering. Three levels of de-bounce protection are independently available for each input. See section 6.7.

#### 4.2.3 2-wire proximity detector input

Most Zone 2 certified flowmeters, except intrinsically safe instruments, incorporating a NAMUR 2-wire proximity detector may be directly connected to a BA384NG input, providing the operating voltage of the flowmeter (proximity detector) is less than 7.5V. The flowmeter should be located in the same hazardous area as the BA384NG and with the associated wiring be able to withstand a 500V rms insulation test to earth.

The BA384NG contains a configurable de-bounce circuit to prevent false triggering. Three levels of debounce protection are independently available for each input. See section 6.7.

#### 4.2.4 Magnetic pick-off input

Flowmeters incorporating a magnetic pick-off to sense flow will have a low level voltage output unless the flowmeter incorporates an amplifier.  $\square$  in the BA384NG input configuration menu is a low level voltage pulse input which will sense this output. Most Zone 2 certified flowmeters, except intrinsically safe instruments, with a low level magnetic pick-off output may be directly connected to input terminals 5 & 6 or 9 & 10.

The flowmeter should be located in the same hazardous area as the BA384NG and with the associated wiring be able to withstand a 500V rms insulation test to earth. The BA384NG contains a configurable de-bounce circuit to prevent false triggering. Three levels of debounce protection are independently available for each input. See section 6.7.

#### 4.2.5 Voltage pulse input



Two voltage pulse input ranges are independently selectable in the BA384NG Rate Totaliser configuration menu,  $\square$  and  $\square$ . When configured for either of the voltage pulse ranges, the Rate Totaliser's input terminals 5 & 6 and 9 & 10 may be directly connected to most certified Zone 2 certified flowmeters, except intrinsically safe instruments, with a high level voltage pulse output.

The BA384NG contains a configurable debounce circuit to prevent false triggering of the instrument. Three levels of de-bounce protection are independently available for each input, See section 6.7.

#### 4.3 Remote reset

The BA384NG Rate Totaliser's total display may be remotely reset to zero by connecting terminals RS1 and RS2 together. Permanent interconnection inhibits totalisation. Remote resetting may be accomplished by any mechanically operated switch located in Zone 2 as the Rate Totaliser's reset circuit is non incandive. The reset switch and the associated wiring should be able to withstand a 500V rms insulation test to earth.

A BA384NG may also be remotely reset from the safe area. Any switch may be used. Fig 3 illustrates how a BA384NG may be reset from both the safe and the hazardous area.

The BA384NG total display may also be reset when the  and  push buttons are operated simultaneously in the totalising mode i.e. when the instrument is displaying flow. See 6.19

#### 4.4 Pulse output

The BA384NG Rate Totaliser has an opto-isolated Ex nA certified open collector pulse output which can be configured to synchronously retransmit either of the two pulse inputs, or a scaleable pulse when the least significant digit of total display is incremented. The output has the following electrical parameters:

V max	=	30V dc
I max	=	10mA
R on	=	60Ω + 3V
R off	=	1MΩ

Providing the BA384NG Rate Totaliser is correctly installed in Zone 2, the pulse output may be connected to any dc circuit in Zone 2 or in the safe area. In normal operation the maximum supply voltage should not be greater than 30V dc and the maximum current should not be greater than 10mA.

The retransmitted RTx annunciator on the instrument display shows the status of the retransmitted pulse output. Annunciator activation depends upon the setting of *SOURCE* in the pulse output configuration menu.

#### SCALE

Annunciator activated each time pulse output open collector is *on*, i.e.  $R_{on}$  is less than  $60\Omega + 3V$ .

#### drift

Annunciator continuously activated

Fig 5 shows a BA384NG Rate Totaliser installed in Zone 2 with the pulse output connected to a safe area load. The pulse output flows through R1 resulting in a voltage output of about 20V in the safe area when the pulse output is activated.

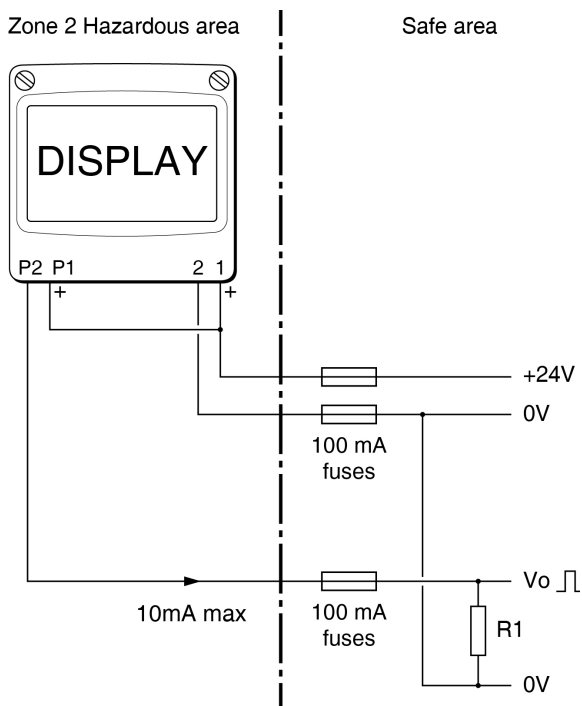


Fig 5 Retransmitting pulse output to safe area.

## 5. INSTALLATION

### 5.1 Location

The BA384NG Rate Totaliser is housed in robust IP66 glass reinforced polyester (GRP) enclosure incorporating an armoured glass window and stainless steel fittings making it suitable for exterior mounting in most industrial Zone 2 on-shore and off-shore installations. The Rate Totaliser should be positioned where the display is not in continuous direct sunlight.

Field wiring terminals are located on the rear of the Rate Totaliser assembly as shown in Fig 7.

To ensure electrical continuity between the two conduit or cable entries, the enclosure back-box is fitted with a bonding plate which includes an M4 earth stud. The bonding plate may be mounted on the inside or outside of the enclosure. If the carbon loaded GRP enclosure is not bolted to an earthed post or structure, this earth stud should be connected to a local earth or the plant potential equalising conductor.

An insulated M4 stud is provided in the bottom right hand corner of the back-box for interconnecting cable screens.

The BA384NG Rate Totaliser may be pipe mounted using a BA393G pipe mounting kit.

### 5.2 Installation Procedure

Fig 6 illustrates the instrument installation procedure.

- Remove the Rate Totaliser assembly by unscrewing the four captive 'A' screws.
- Mount the enclosure back-box on a flat surface and secure with screws or bolts through the four 'B' holes. Alternatively use a pipe mounting kit which is available as an accessories.
- Remove the temporary hole plug and install an appropriate IP and temperature rated certified M20 x 1.5mm cable gland or conduit fitting. If two entries are required, the supplied IP66 stopping plug should be replaced with an appropriate IP and temperature rated certified M20 x 1.5mm cable gland or conduit fitting.
- Pass the field wiring through the cable entry in the back-box and connect it to the instrument terminals as shown in Fig 7. Replace the instrument assembly on the back-box and evenly tighten the four 'A' screws.

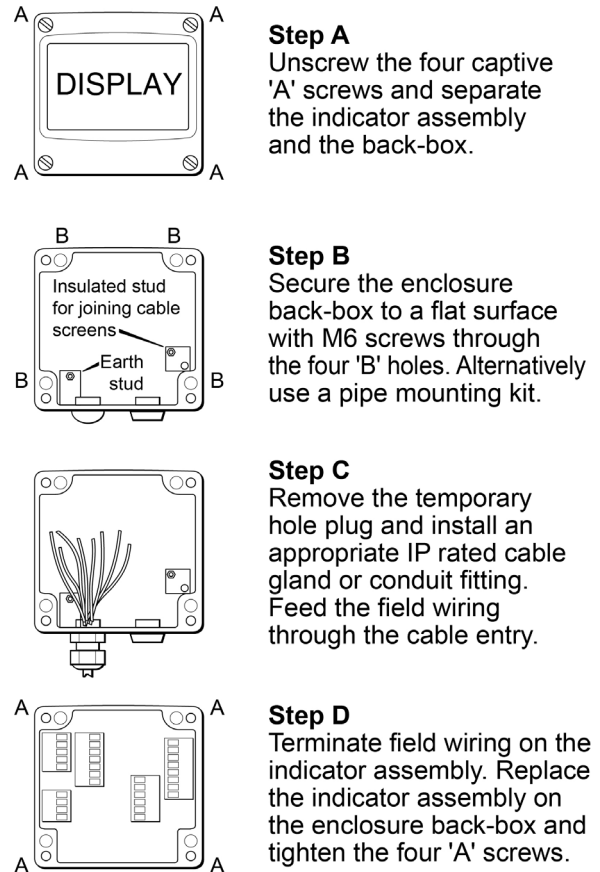


Fig 6 BA384NG installation procedure

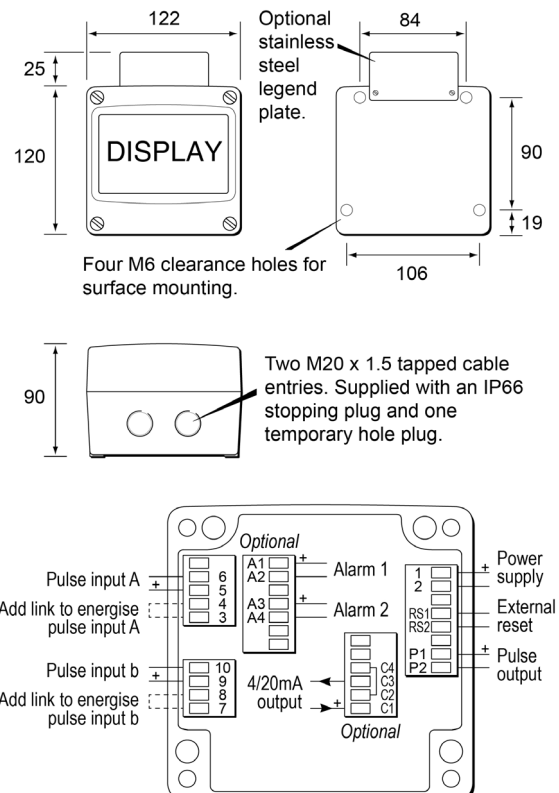


Fig 7 Dimensions and terminal connections

### 5.3 EMC

The BA384NG 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 in the safe area.

### 5.4 Units of measurement and tag marking on scale card.

The Rate Totaliser's units of measurement and tag information are shown on a scale card which slides into the instrument.

New Rate Totalisers are supplied with a printed scale card showing the requested units of measurement and tag information. If this information is not supplied when the instrument is ordered, a blank scale card will be fitted which can easily be marked on-site with a dry transfer or a permanent marker. Custom printed scale cards are available from BEKA associates as an accessory.

To remove the scale card from a Rate Totaliser carefully pull the transparent tab at the rear of the instrument assembly away from the assembly as shown in Fig 8a.

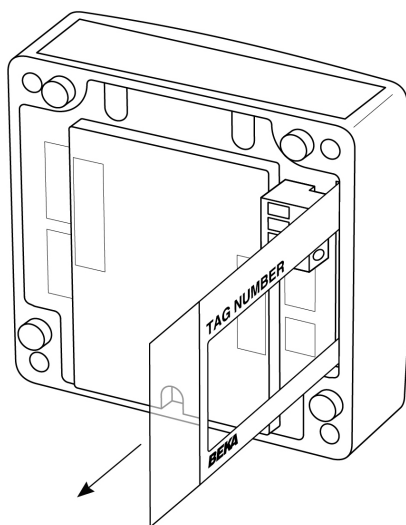


Fig 8a Removing scale card

To replace the scale card carefully insert it into the slot on the right hand side of the input terminals as shown in Fig 8b. Force should be applied evenly to both sides of the scale card to prevent it twisting. The card should be inserted until about 2mm of the transparent tab remains protruding.

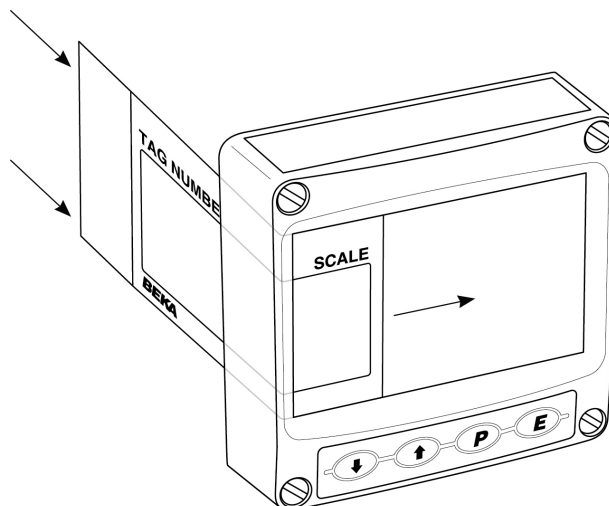


Fig 8b Inserting scale card into the instrument assembly.

## 6.0 CONFIGURATION AND CALIBRATION

The BA384NG Rate Totaliser is configured and calibrated via four front panel push buttons. Figs 9 and 10 show the configuration structure and the menu.

Each menu function is summarised in section 6.3 of this manual and each summary includes a reference to more detailed information. The two sixteen segment linearisers and the pulse output are described separately in sections 7 and 8.

When factory fitted optional alarms and 4/20mA outputs are included, additional functions appear in the configuration menu which are described separately in section 11.

All new BA384NG Rate Totalisers are supplied calibrated as requested at the time of ordering. If calibration is not requested, Rate Totalisers will have default configuration which is shown in the following table, but can easily be re-configured on-site.

Function	Display	Default
Access code	Code	0000
Function	Function	Std
A Input*	INPUT-A	OPOL
Debounce	DEBOUNCE	DEFAULT
Update	UPDATE	0.5
Count	Count	R:b
Upper display	DISP-1	total
Lower display	DISP-2	Std
Decimal point	DP	total00000000 rate 00000
Factor input A*	FACtor-A	00 1.00
Total scale factor input A*	SCALE-t-A	00 1.00
Rate scale factor input A*	SCALE-r-A	00 1.00
Timebase	t-base	t-b-0 (secs)
Filter for input A*	FILTER-A	24
Clip-off for input A*	CLIP-OFF-A	00000
Local total reset	CLR tot	OFF
Local grand total reset	CLR Gtot	OFF
Pulse source	SOURCE DISP, dE duration	SCALEd 1 0.1
External reset	ELR	ELR Rnb
Access code	Code	0000

### Notes:

1. Defaults for input A are shown. Functions which are duplicated for input b are identified with an \*. The input b functions have the same default as the input A function.
2. While the instrument is being configured totalisation continues so that any flow occurring during this time is recorded.

## 6.1 Calibration structure



Fig 9 shows the BA384NG calibration structure. Two identical channels enable the rate and total displays for input A and input b to be independently configured.

Configuration functions which only apply to one Rate Totaliser channel are identified with a suffix, i.e. the rate scale factor  $SCALE-r$  applies to channel A and  $SCALE-r-b$  applies to channel b. Configuration functions that do not have a channel suffix, such as the timebase  $t-base$ , apply to both channels.

The frequency of pulses received at each input is divided by  $FACtor-A$  or  $FACtor-b$ , which is usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. When linearisation  $Lin$  is selected in the Function sub-menu, up to 16 values for  $FACtor-A$  and  $FACtor-b$  may be entered, each starting at a specified input pulse frequency. Linearisation compensates for flowmeter nonlinearity and increases totalisation accuracy. See section 7.

$SCALE-r$  is a dividing factor that converts the output from  $FACtor$  into the required engineering units for the rate display. e.g. if the output from  $FACtor$  is one pulse per litre and the rate display is required in gallons,  $SCALE-r$  should be set to 4.5461 which is the number of litres in an imperial gallon.

The total flow display is independent of the rate display.  $SCALE-t$  is a dividing factor that converts the output from  $FACtor$  into the required engineering units for the total display. e.g. if the output from  $FACtor$  is one pulse per litre and the total display is required in thousands of gallons,  $SCALE-t$  should be set to 4,546.1 which is the number of litres in 1,000 imperial gallons.

The  $Count$  function allows the sum or difference of the two input flow rates and the two flow totals to be displayed, but is only meaningful if they are calibrated to display the same engineering units. When the BA384NG Rate Totaliser is in the totalising mode the following displays can be selected using the  or  push buttons:

Select	Totaliser displays
INPUT A	Input A rate and total flow
INPUT b	Input b rate and total flow
R:b or R:-b	Composite rate and total flow depends upon how the $Count$ function has been configured See 6.9

The timebase  $t-base$  is a multiplying factor that determines if the instrument displays flow rate per second, per minute or per hour.

The BA384NG uses 'real' decimal points, moving the position of a decimal point in a scale factor will therefore affect the instrument calibration.



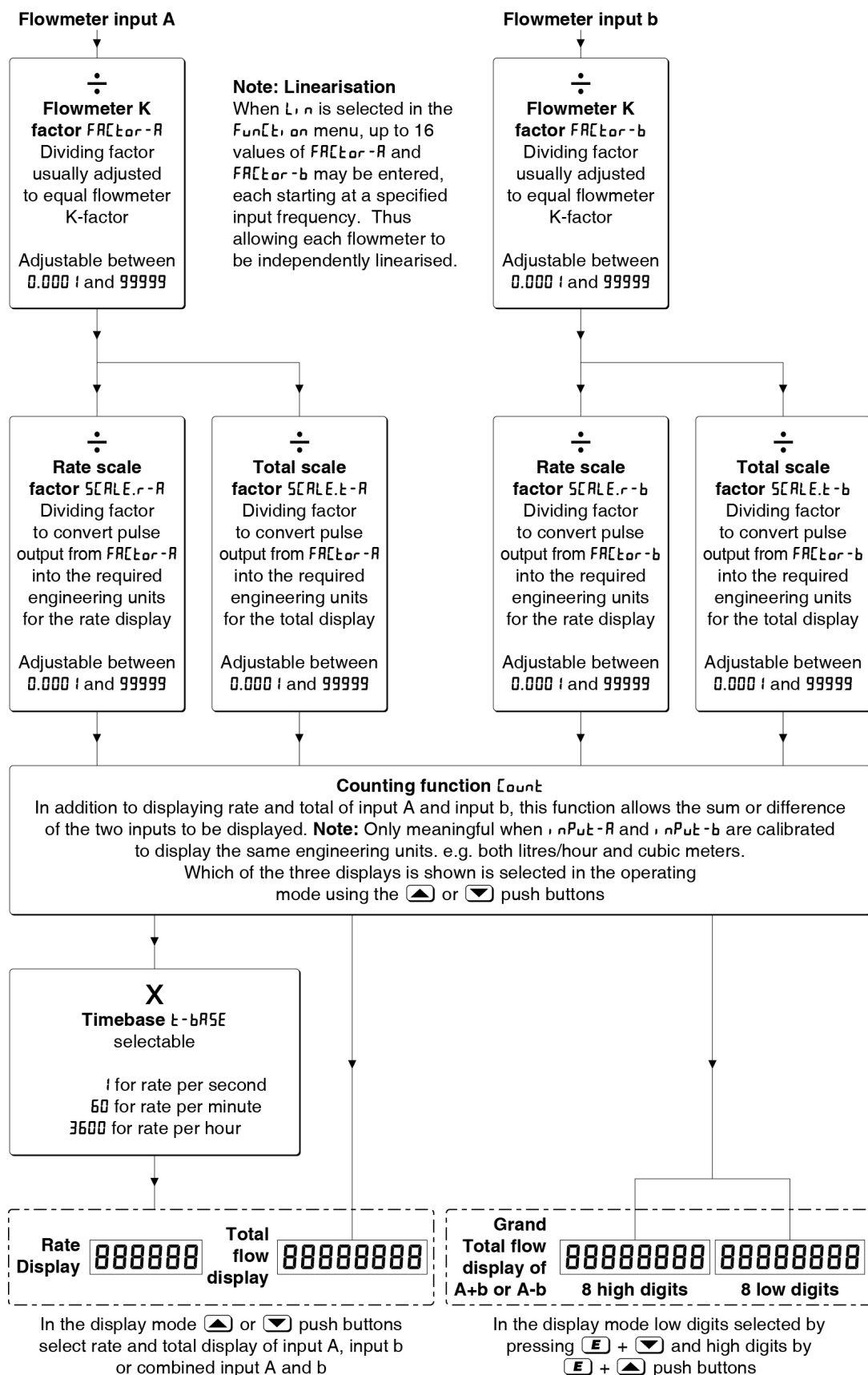


Fig 9 Calibration structure

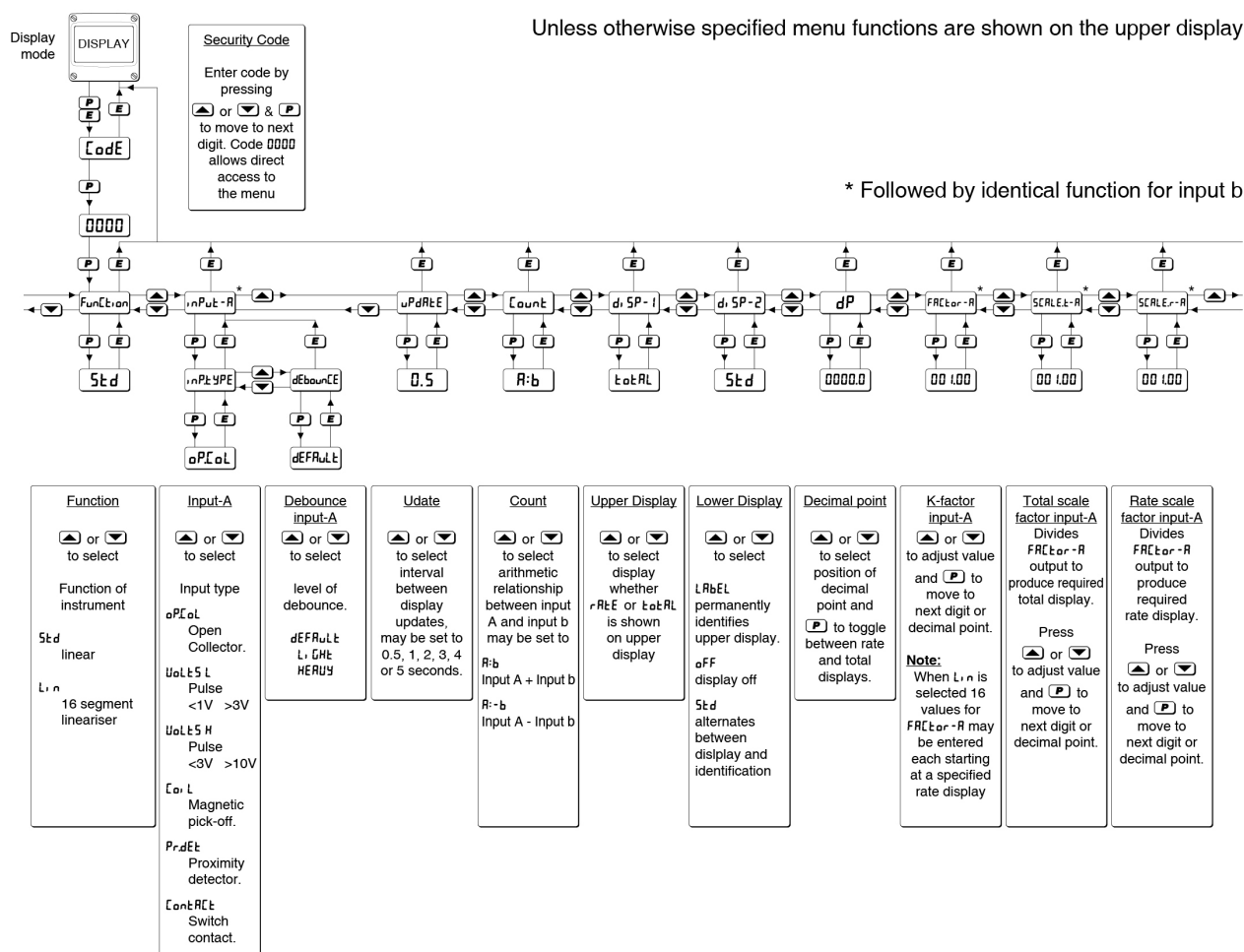
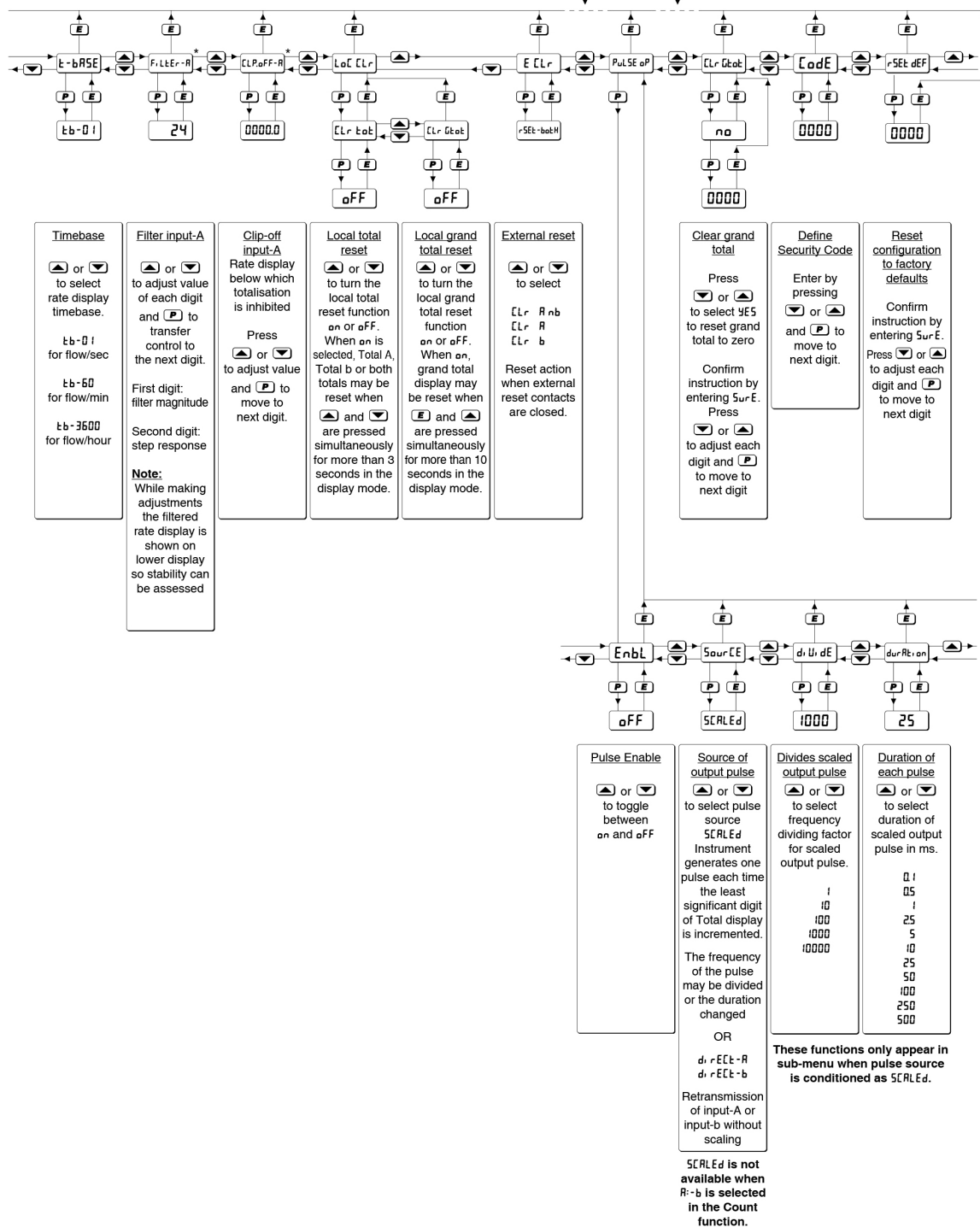













Fig 10 Rate Totaliser Configuration menu





## 6.2 Accessing configuration functions

Throughout this manual push buttons are shown as    and  and legends displayed by the instrument are shown in a seven segment font exactly as they appear on the instrument display e.g.  $\text{Rate-R}$  and  $\text{Filter-R}$ .

Access to the configuration menu is obtained by operating the  and  push buttons simultaneously. If the instrument is not protected by an access security code the first parameter  $\text{Func, on}$  will be displayed. If a security code other than the default code 0000 has already been entered, the instrument will display  $\text{Code}$ . Press  to clear this prompt and enter the security code for the instrument using the  or  push button to adjust the flashing digit, and the  push button to transfer control to the next digit. If the correct code has been entered pressing  will cause the first parameter  $\text{Func, on}$  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 totalising mode.

All configuration functions and prompts are shown on the upper eight digit display except the filter which uses both the upper and lower displays.

Once within the main configuration menu the required parameter can be selected by scrolling through the menu using the  or  push buttons. The configuration menu is shown diagrammatically in Fig 10.

When returning to the totalising mode following reconfiguration, the Rate Totaliser will display  $\text{RateR}$  followed by  $\text{SAVE}$  while the new information is stored in permanent memory.

If during configuration a button is not operated within 60 seconds, the instrument will automatically return to the totalising mode and any configuration changes will not be stored. When configuring a BA384NG Rate Totaliser it is therefore advisable to occasionally return to the totalising mode to ensure that recent configuration changes are stored in permanent memory.

## 6.3 Summary of configuration functions

This section summarises all the configuration functions. When read in conjunction with Fig 10 it provides a quick aid for configuring the Rate Totaliser. If more detail is required, each section of this summary contains a reference to a full description of the function.

For simplicity this summary and Fig 10 only show functions that configure both inputs and those which configure input A. Immediately following each function with an  $\text{R}$  suffix in the configuration menu is an identical function with a  $\text{b}$  suffix that configures the 'b' input. In this instruction manual descriptions of 'A' input functions which are followed by an identical function for the 'b' input are identified with an \*.

Display	Summary of function
$\text{Func, on}$	<b>Rate totaliser function</b> Defines the relationship of both pulse input channels and the Rate Totaliser display. May be set to:  $\text{Std}$ Standard linear relationship  $\text{Lin}$ Separate 16 segment fully adjustable lineariser in each input channel which are described in section 7. <b>See section 6.4</b>
$\text{Input-R}$	<b>Input*</b> Contains two sub-functions: <b>See section 6.5</b>  $\text{InputType}$ Configures the Rate Totaliser input to accept one of six types of input: $\text{OpenCol}$ Open collector ● $\text{Vp1}$ Voltage pulse <1 >3V $\text{Vp3}$ Voltage pulse <3 >10V $\text{MagPick}$ Magnetic pick-off $\text{ProxDet}$ Proximity detector ● $\text{Switch}$ Switch contact ●  ● Requires input to be energised by linking terminals 3 & 4 for input A, and terminals 7 & 8 for input b. <b>See section 6.6</b>

Display	Summary of function	Display	Summary of function
	<b>dBounce</b> Defines level of input de-bounce applied to the pulse input to prevent false counting: DEFRAUL HERUS L, GHE <b>See section 6.7</b>	<b>dP</b> <b>Decimal points</b> Defines the position of the decimal point in both the rate and total displays. <b>See section 6.12</b>	
<b>uPdRE</b>	<b>Display update interval</b> Rate totaliser display update interval adjustable between 0.5 and 5 seconds. <b>See section 6.8</b>	<b>FACtor-A</b> <b>Input A flowmeter K-factor *</b> Each input of the rate totaliser is divided by FACtor-A or FACtor-b, which are usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. FACtor may be adjusted between 0.0001 and 99999. When the 16 segment lineariser 'Lin' is selected in the Funct, on sub-menu, up to 16 values for FACtor-A may be entered, each starting at a specified input pulse frequency to compensate for errors resulting from flowmeter nonlinearity.. <b>See section 6.13 &amp; Fig 9</b>	
<b>Count</b>	<b>Composite display</b> Defines relationship between input A and Input b for composite display.  Select: A:b for Input A + Input b A:-b for Input A – Input b <b>See section 6.9</b>	<b>SCALE-t-A</b> <b>Total Scale Factor *</b> SCALE-t is a dividing factor that converts the pulse output from FACtor into a total with the required engineering units. e.g. if the output from FACtor is one pulse per litre and the total display is required in thousands of gallons, SCALE-t should be set to 4546.1 which is the number of litres in 1,000 imperial gallons. SCALE-t may be adjusted between 0.0001 and 99999.  The total flow display is independent of the rate display. <b>See section 6.14 &amp; Fig 9</b>	
<b>d, 5P-1</b>	<b>Upper display</b> Defines whether tAtRL or rAtE is shown on the upper display. The other variable may be shown on the lower display, providing the lower display is on in function d, 5P-2. <b>See section 6.10</b>		
<b>d, 5P-2</b>	<b>Lower display</b> Defines the function of the lower display. It can show the selected flow variable briefly alternating with the display identification, permanently display the identification of the upper display or it may be disabled.  Select: Std Displays selected flow variable briefly alternating with the display identification, except for composite display.  LABEL Permanently displays identification of upper display.  oFF Lower display disabled. <b>See section 6.11</b>	<b>SCALE-r-A</b> <b>Rate Scale Factor *</b> SCALE-r is a dividing factor that converts the pulse output from FACtor into a rate with the required engineering units. e.g. if the output from FACtor is one pulse per litre and the rate display is required in gallons, SCALE-r should be set to 4.5461 which is the number of litres in an imperial gallons. SCALE-r may be adjusted between 0.0001 and 99999. The flow rate display is independent of the total flow display. <b>See section 6.15 &amp; Fig 9</b>	

Display	Summary of function	Display	Summary of function
<b>⏏-bASE</b>	<b>Timebase</b> Selectable multiplier allowing flow rate to be displayed in units per second, per minute or per hour.  Select: ⏏-01 for flow / second ⏏-60 for flow / minute ⏏-3600 for flow / hour <b>See section 6.16</b>	<b>E CLR</b>	<b>External reset</b> This function defines which totals are reset to zero when terminals RS1 and RS2 are connect together for more than 1 second.  Select: CLR Rnb to reset totals A and b CLR R to reset total A CLR b to reset total b <b>See section 6.22</b>
<b>F, LLEr-A</b>	<b>Display filter *</b> An adjustable digital filter to reduce noise on the rate display. Two parameters each adjustable between 0 and 9. The first digit defines the amount of filtering applied to the display, the second deviation from the displayed rate at which the filter will be overridden and the rate display will move rapidly to the new value. <b>See section 6.17</b>	<b>CLR-GRt</b>	<b>Resets grand total to zero</b> This function resets the grand total to zero from within the configuration menu when CLR.YE5 is selected. <b>Note:</b> Once reset, the grand total can not be recovered. <b>See section 6.23</b>
<b>CLP.off-A</b>	<b>Clip-off *</b> To prevent totalisation of very low flow rates, clip-off enables the user to select a flow rate for each input below which totalisation is inhibited. <b>See section 6.18</b>	<b>Code</b>	<b>Security code</b> Defines a four digit alphanumeric code that must be entered to gain access to the configuration menu. Default code 0000 disables the security function and allows unrestricted access to all configuration functions when the <b>[P]</b> and <b>[E]</b> buttons are operated simultaneously in the totalising mode. <b>See section 6.24</b>
<b>Lo CLR</b>	<b>Local reset</b> Contains sub-menu with two functions which when enabled allow the two totals and the grand total to be reset to zero via the front panel push buttons when the Rate Totaliser is in the totalising mode. <b>See section 6.19</b>  <b>Local total reset CLR tnt</b> When nt is selected, total A, total b or both totals are reset to zero when the <b>[▼]</b> and <b>[▲]</b> buttons are operated simultaneously for more than 3 seconds in the totalising mode. <b>See section 6.20</b>  <b>Local grand total reset CLR GRt</b> When nt is selected, grand total may be reset to zero when <b>[E]</b> and <b>[▲]</b> buttons are operated simultaneously for more than 10 seconds in the totalising mode. <b>Note:</b> Once reset, the grand total can not be recovered. <b>See section 6.21</b>	<b>rSEt dEF</b>	<b>Reset to factory defaults</b> Resets the instrument to the factory defaults shown in section 6 when the instruction is confirmed by entering SurE. <b>See section 6.25</b>

#### 6.4 Rate Totaliser function: **Funct, on**

This function determines whether the BA384NG Rate Totaliser has a standard linear function, or if the two separate adjustable sixteen segment linearisers, one for each of the two flowmeter inputs, are activated. To reveal the existing setting select **Funct, on** from the configuration menu and press **[P]**.

**Std** Linearisers are not activated  
**Lin** Linearisers are activated

If the function is set as required, press **[E]** to return to the configuration menu, or press the **[▼]** or **[▲]** button to change the setting, followed by the **[E]** button to return to the **Funct, on** prompt in the configuration menu.

##### **Std Linear**

Provides a linear relationship between the pulse input and the Rate Totaliser displays for input A and input b.

##### **Lin 16 segment adjustable linearisers**

Activates an independent sixteen segment adjustable lineariser for each input. When **Lin** is selected functions **Funct, on-A** and **Funct, on-b** are expanded to allow up to 16 values to be entered each starting at a specified input pulse frequency. This allows **Funct, on-A** and **Funct, on-b** to be set to the K-factor of each flowmeter at multiple flow rates thus minimising errors caused by the nonlinearity of the flowmeter's K-factor.

Detailed information about the linearisers, including configuration information is contained in section 7 of this instruction manual.

#### 6.5 Input\*: **Input-A**

The Input function contains two sub-functions **Input-A** and **Debounce** described in the following sections which configure the Rate Totaliser input and define the amount of input noise rejection.

#### 6.6 Input type: **Input-A**

**Input-A** is a sub-menu which appears in both the **Input-A** and **Input-B** functions. It defines the type of flowmeter sensor or pulse that may be connected to the input. To check or change the type of input, select **Input-A** or **Input-B** in the configuration menu and press **[P]** which will reveal the **Input-A** prompt, pressing **[P]** again will reveal 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 and then press **[E]** twice to return to the configuration menu.

One of following six types may be selected for each input:

		Switching thresholds	
		Low	High
<b>Voltage pulse low</b> <sup>1</sup>		1	3V
<b>Voltage pulse high</b> <sup>1</sup>		3	10V
<b>Magnetic pick-off</b>		0	40mV
<b>Proximity detector</b> <sup>2</sup>		1.2	2.1mA
<b>Switch contact</b> <sup>2</sup>		100	1000Ω
<b>Open collector</b> <sup>2</sup>		2	10kΩ

#### Notes:

1. Maximum voltage input +30V.
2. For flowmeter sensors connected to input A that require energising i.e. proximity detector, switch contact and open collector, terminals 3 & 4 of the Rate Totaliser should be linked together. Similarly for flowmeter sensors connected to input b that require energising, terminals 7 & 8 should be linked together.
3. To count correctly, the input pulse must fall below the lower switching threshold and rise above the higher switching threshold.
4. See section 6.7 for typical maximum counting frequency.

#### 6.7 Debounce\*: **Debounce**

**Debounce** is an adjustable sub-menu which appears in both the **Input-A** and **Input-B** functions. De-bounce prevents the Rate Totaliser miscounting when the input pulse 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 de-bounce applied depends upon the type of Rate Totaliser input that has been selected in the **Input-A** function.

The following table shows the minimum time that the input pulse must be continuously above the upper input switching threshold and continuously below the lower switching threshold to ensure that the Rate Totaliser processes the input pulse. Input switching thresholds are shown in section 6.6.

De-bounce level	Minimum input pulse width	
	Type of input	
	Contact	All others
<b>Default</b>	1,600μs	40μs
<b>Heavy</b>	3,200μs	350μs
<b>Light</b>	400μs	5μs

The Rate Totaliser's maximum counting frequency depends upon the debounce level selected, the shape of the input pulse and its amplitude. The following table assumes a square wave input and is only included for guidance. The maximum reliable counting frequency will be lower if the input pulses have sloping edges and the pulse amplitude only slightly exceeds the input switching thresholds.

ONLY FOR GUIDANCE		
De-bounce level	Maximum operating frequency	
	Type of input	
	Contact	All others
Default	250Hz	12kHz
Heavy	120Hz	2kHz
Light	1,000Hz	100kHz

The minimum input frequency is 0.01Hz. Below this frequency the rate display will be forced to zero.

The **dBounce** sub-function is located in the **Input-R** and **Input-b** functions. Select **Input-R** or **Input-b** in the configuration menu and press **P** which will reveal the **PULSE** prompt, press the **▼** or **▲** button to select **dBounce** followed by **P** to reveal the existing setting. Pressing the **▼** or **▲** button will scroll through the three levels. When the required level has been selected, pressing **E** twice will enter the selection and return the display to the **Input-R** or **Input-b** prompt in the configuration menu.

### 6.8 Display update interval: **UPdRtE**

If either the rate or the total display is likely to change rapidly, a longer interval between display updates may simplify reading the Rate Totaliser displays. This function allows one of six different display intervals between 0.5 and 5 seconds to be selected. The selected display update interval does not affect the update time of any other instrument function. i.e. instrument accuracy is not affected.

To adjust the update interval select **UPdRtE** from the configuration menu and press **P** to reveal the existing setting. Pressing the **▼** or **▲** button will scroll through the six times. When the required interval has been selected, press **E** to enter the selection and return to the configuration menu.

### 6.9 Composite display: **Count**

The BA384NG can produce a composite rate and total display from the sum or difference of Input-A and Input-b. This composite display is only meaningful if Input-A and Input-b are calibrated to have the same engineering units of display. This function defines the composite display.

To check or change the composite display function select **Count** in the configuration menu and press **P** which will reveal the current setting which may be changed by pressing the **▼** or **▲** button.

Select:

**R:b** to display Input A + Input b

**R:-b** to display Input A – Input b

When set as required press **E** to return to the configuration menu.

### 6.10 Upper display: **d, 5P-1**

Usually total flow is shown on the larger upper eight digit display, but this function allows rate to be shown on the upper display and total flow on the smaller lower display which has six positive digits or five digits with a negative sign.

To check the status of the upper display, select **d, 5P-1** from the configuration menu and press **P** which will reveal if the display is showing **Rate** or **Total**. The setting can be changed by pressing the **▼** or **▲** button followed by the **E** button to enter the selection and return to the configuration menu.



### 6.11 Lower display: **d, 5P-2**

The lower display is normally used for displaying the rate of flow, but this function also allows it to intermittently or continuously identify which of the two inputs is being displayed, or the lower display may be disabled.

To check the status of the lower display, select **d, 5P-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.




The following table shows the effect of the three **d, 5P-2** options when input A, input b or the composite display are selected in the totalising mode.







Display selected using the  or  buttons in the tota-lising mode.	Lower display d1 5P-2 setting in configuration menu.		
	Std	LABEL	oFF
<b>Composite</b>	Composite rate and total shown permanently	Composite rate and total shown permanently	R:b or R:-b shown briefly. No numerical value
<b>r nPulse-R</b>	Numerical value alternating with r n-R shown briefly every few seconds	r n-R shown continuously. No numerical value	r n-R shown briefly. No numerical value
<b>r nPulse-b</b>	Numerical value alternating with r n-b shown briefly every few seconds	r n-b shown continuously. No numerical value	r n-b shown briefly. No numerical value

### 6.12 Position of the decimal points: dP

The upper and lower displays have eight and six digits respectively. This function enables the position of the decimal point on both displays to be independently positioned.


To adjust the position of the decimal points select dP from the configuration menu and press . The upper display defined as the rate or total display by function d1 5P-1 (section 6.10) will be activated and identified by the display annunciator as Rate or Total. The decimal point, which may be positioned between any of the digits or may be absent is positioned by operating the  or  push button.






When the decimal point in the upper display has been positioned pressing the  button will transfer control to the lower display variable, but it will be shown and annunciated on the larger upper display. The decimal point may be positioned in the same way by operating the  or  push buttons. When set as required enter the settings and return to the configuration menu by operating the  button.

### 6.13 Flowmeter K-factor: FRCError-R \*

The rate totaliser pulse input A is divided by FRCError-R, which is adjustable between 0.0001 and 99999. For flow applications FRCError-R should be set to the K-factor of the flowmeter connected to input A. K-factor is the number of pulses that the flowmeter produces per unit volume of flow e.g. 20 pulses per litre. FRCError-R therefore converts the flowmeter output into engineering units ready for further scaling to produce the required rate and total flow displays. See Fig 9.







When the 16 segment lineariser Lin is selected in Function up to 16 values of FRCError-R may be entered, each starting at a specified input pulse frequency, which may be adjusted to compensate for flowmeter non-linearity. See section 7 of this manual.

To check or change the value, select FRCError-R from the configuration menu and press  which will reveal the existing value with one digit flashing.

The flashing digit may be adjusted by pressing the  or  button. When this digit has been adjusted, pressing  will transfer control to the next digit. When all the digits have been adjusted pressing  again will transfer control to the decimal point that may be positioned between any of the digits, or may be omitted by moving it to the right of the least significant digit. Finally press  to return to the FRCError-R prompt in the configuration menu.

### 6.14 Total scale factor\*: SCALE.E-R

SCALE.E-R is a dividing factor adjustable between 0.0001 and 99999 that enables total flow to be displayed in the required engineering units. e.g. if the output from FRCError-R is one pulse per litre and the total display is required in thousands of gallons, SCALE.E-R should be set to 4546.1 which is the number of litres in 1,000 imperial gallons. The total flow display is independent of the rate display.

To check or change the total scale factor select SCALE.E-R from the configuration menu and press  which will reveal the existing value with one digit flashing. The value of the flashing digit may be changed by pressing the  or  button. When this digit has been adjusted as required, pressing  will transfer control to the next digit. When all the digits have been adjusted pressing again  will transfer control to the decimal point that may be positioned between any of the digits, or may be omitted by moving it to the right of the least significant digit. When the required total scale factor has been entered, press  to return to the SCALE.E-R prompt in the configuration menu.

### 6.15 Rate scale factor\*: $SCALE.r-R$

$SCALE.r-R$  is a dividing factor adjustable between 0.0001 and 99999 that enables the flow rate to be displayed in the required engineering units. e.g. if the output from  $FRLE.r-R$  is one pulse per litre and the rate display is required in gallons,  $SCALE.r-R$  should be set to 4.5461 which is the number of litres in an imperial gallons.

The units of the rate display are volume per unit of time. The unit of time is the timebase of the instrument which is determined by  $LBASE$  described in section 6.16.

To check or change the rate scale factor select  $SCALE.r-R$  from the configuration menu and press  $\text{P}$  which will reveal the existing value with one digit flashing. The value of the flashing digit may be changed by pressing the  $\blacktriangledown$  or  $\blacktriangle$  button. When this digit has been adjusted as required, pressing  $\text{P}$  will transfer control to the next digit. When all the digits have been adjusted pressing  $\text{P}$  again will transfer control to the decimal point which may be positioned between any of the digits, or may be omitted by moving it to the right of the least significant digit. When the rate scale factor has been entered, press  $\text{E}$  to return to the  $SCALE.r-R$  prompt in the configuration menu.

### 6.16 Timebase: $LBASE$

The timebase multiplies the rate display by 1, 60 or 3,600 depending upon whether the Rate Totaliser is required to display flow rate per second, per minute or per hour. See Fig 9.

To check or change the timebase, select  $LBASE$  from the configuration menu and press  $\text{P}$  which will reveal the existing setting. Pressing the  $\blacktriangledown$  or  $\blacktriangle$  button will scroll through the following three options to display:

$LB-1$	for flow / second
$LB-60$	for flow / minute
$LB-3600$	for flow / hour

When the required multiplier is displayed press  $\text{E}$  to return to the  $LBASE$  prompt in the configuration menu.

### 6.17 Display filter\*: $FLTER-R$

The digital display filter associated with each input has two independent adjustable parameters enabling the rate display response to be tailored for optimum performance. The filter parameters are controlled by a two digit number. The first digit defines the amount of filtering applied to the display as shown below.

First digit	Filter time constant seconds
0X	0
1X	1.3
2X	4.3
3X	6.5
4X	8.7
5X	11.3
6X	15.7
7X	20.9
8X	25.2
9X	31.5

The second digit defines the deviation from the displayed rate at which the filter will be overridden and the rate display will move rapidly to the new value.

Second digit	Magnitude of step change which will produce a rapid response
X0	off
X1	1%
X2	2%
X3	4%
X4	8%
X5	12%
X6	16%
X7	24%
X8	32%
X9	64%

By careful adjustment of the two parameters a stable display with an acceptable input step response can be obtained for most applications.

During commissioning it is recommended that initially the second digit is set to 0 (off) and the first digit is adjusted to provide acceptable rate display stability. The second digit should then be increased until the selected step size is greater than the noise on the display signal, at which setting the rate display will become stable. These will be the optimum filter parameters for acceptable rate display stability and a fast response to a large rapid flow rate change.

To check or change the filter select **FILTER-R** in the configuration menu and press **P** which will reveal the current settings with the first digit flashing. Pressing the **▼** or **▲** button will change the flashing digit and **P** will transfer control to the second digit. While making adjustments the filtered rate display is shown on the lower display so that stability can be assessed while adjustments are being made. When set as required, press the **E** button to enter the revised parameters and return to the **FILTER-R** prompt in the configuration menu.

#### 6.18 Clip-off\*: **CLP.OFF-R**

To prevent totalisation of very low flow rates that over long periods may result in significant totalisation errors, the BA384NG may be configured to stop totalising when the flow rate falls below an adjustable threshold.

To check or change the clip-off threshold select **CLP.OFF-R** from the configuration menu and press **P** which will reveal the existing setting. The threshold is shown in the units already selected for the flow rate display. One digit will be flashing. The value of the flashing digit may be changed by pressing the **▼** or **▲** button. When this digit is correct, pressing **P** will transfer control to the next digit. When clip-off is set as required, press the **E** button to enter the revised figure and return to the **CLP.OFF-R** prompt in the configuration menu.

When the Input-A flow rate falls below the clip-off threshold, the rate display will show zero flow, totalisation will stop and the **Hold** annunciator will be activated. The flow indicator will continue to rotate for 2 seconds each time an input pulse is received i.e. at input pulse frequencies above 0.5Hz it will appear to rotate continuously.

**Note:** To avoid confusion, when **FREED-R**, **SCALE-R**, **LBASE**, or the position of the rate display decimal point are changed, clip-off will automatically be reset to zero. A new clip-off threshold must be entered after changes to any of these functions have been made.

#### 6.19 Local reset: **LoC CLR**

The Local reset function contains two sub-functions **CLR Tot** and **CLR Gtot** which when enabled allow each input total and the grand total to be reset to zero via the instrument push buttons while the Rate Totaliser is in the totalising mode.

#### 6.20 Local total reset: **CLR Tot**

**CLR Tot** is a sub-menu in the **LoC CLR** function which when activated allows an operator to reset total A, total b or both totals and any stored pulses in the pulse output by operating the **▼** and **▲** push buttons simultaneously for more than three seconds while the BA384NG is in the totalising mode.

To check or change the function select **LoC CLR** in the configuration menu and press **P** which will reveal the **CLR Tot** prompt, operate **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 CLR** prompt in the configuration menu.

**Note:** The total display may also be reset to zero remotely by connecting terminals RS1 and RS2 together for more than one second. See sections 3.7; 4.3 and 6.22 of this manual.

#### 6.21 Local grand total reset: **CLR Gtot**

The grand total is a separate sixteen digit counter which is incremented in parallel with the composite total input A+b or input A-b, but is not zeroed when any of the displayed totals are reset to zero. The grand total may be viewed in the totalising mode in two eight digit sections as described in section 2.2 of this manual.

**CLR Gtot** is a sub-menu in the **LoC CLR** function which when activated allows the operator to reset the grand total display to zero with the BA384NG in the totalising mode by operating the **E** and **▲** push buttons simultaneously for more than ten seconds.

To check or change the local grand total reset select **LoC CLR** in the configuration menu and press **P** which will reveal **CLR Tot**. Using the **▼** or **▲** button select **CLR Gtot** and press **P** which will show if the local grand total reset function 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 CLR** prompt in the configuration menu.

### 6.22 External reset: E Lr

The BA384NG total displays can be remotely reset to zero when terminals RS1 and RS2 are connected together for more than one second. See sections 3.7 and 4.3 This function defines which totals are reset.

To check or change which totals are reset, select E Lr from the configuration menu and press **P** which will reveal the existing setting. Using the **▼** or **▲** button select the required option:

ELr Rnb	to reset total A and total b
ELr R	to reset total A
ELr b	to reset total b

When the required option is displayed press **E** to save the selection and return to the E.Lr prompt in the configuration menu.

### 6.23 Grand total reset from configuration menu: ELr Gt0t

The grand total is a separate sixteen digit counter which is incremented in parallel with the composite total input A+b or input A-b, but is not zeroed when the two individual totals input A and input b are reset to zero. The grand total may be viewed with the instrument in the totalising mode as two eight digit sections as described in section 2.2 of this manual.

The grand total can be reset to zero from within the configuration menu using this ELr Gt0t function, or from the totalising mode if sub-function ELr Gt0t is activated in the L0t ELr function – see 6.21.

To zero the grand total from within the configuration menu select ELr Gt0t and press **P** which will cause the instrument to display ELr.n0 with n0 flashing. Press the **▼** or **▲** push button until ELr.5E5 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 5urE using the **▼** or **▲** button to adjust the flashing digit and the **P** button to move control to the next digit. When entered pressing **E** will reset the grand total to zero and return the Rate Totaliser to the configuration menu.

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

### 6.24 Security code: L0dE

Access to the instrument configuration menu may be protected by a four digit alphanumeric security code which must be entered to gain access. Unless otherwise requested, 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 L0dE from the configuration menu and press **P** which will cause the Rate Totaliser 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 save the new code and return to the L0dE prompt in the configuration menu. The revised security code will be activated when the Rate Totaliser is returned to the totalising mode.

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

### 6.25 Reset to factory defaults: r5Et dEF

This function resets the BA384NG Rate Totaliser including the two linearisers, to the factory default configurations which are shown in section 6.0

To reset the Rate Totaliser to the factory default configurations select r5Et dEF from the configuration menu and press **P** which will result in a 0000 display with the first digit flashing. This is a request to confirm the reset to factory default instruction by entering 5urE. Using the **▼** or **▲** button set the flashing digit to 5 and press **P** to transfer control to the second digit which should be set to u. When 5urE has been entered, pressing the **E** button will reset the BA384NG to the factory defaults and return the instrument to the totalising mode.

## 7. LINEARISERS

The BA384NG Rate Totaliser can produce accurate results when used with flowmeters having K-factors that vary with the flow rate, such as a turbine meter used over a wide range of flows. Each channel of the Rate Totaliser has an independent sixteen segment straight-line lineariser that may be adjusted to compensate for the nonlinearity of the flowmeter connected to the input as shown in Fig 11.

The two linearisers are enabled by selecting **LIN** in **FUNCT** – see section 6.4. The configuration menu shown in Fig 10 remains basically unchanged, except that up to 16 values of the flowmeter K-factor, can be entered as **L-FRector**, together with **PULSE F** the corresponding input frequency at which each starts in the **FRector A** and **FRector B** functions. Fig 12 shows how the **FRector A** is extended.

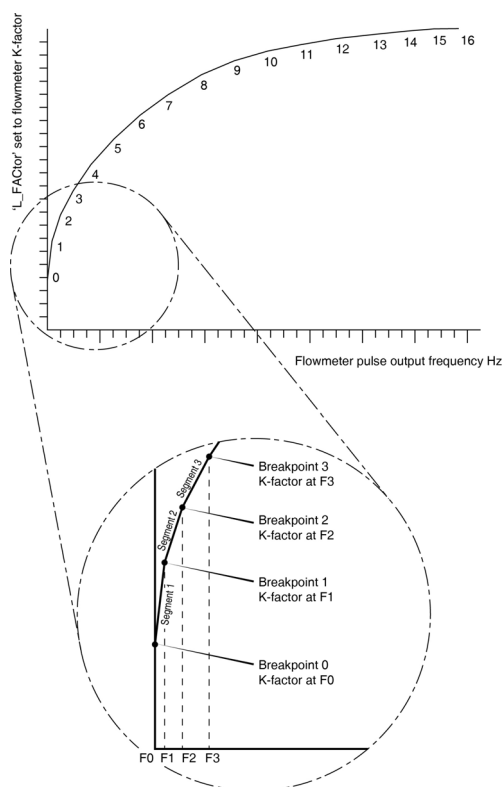


Fig 11 shows a typical linearising characteristic

The lineariser configuration is retained irrespective of how **FUNCT** in the Rate Totaliser configuration menu is subsequently changed. It is therefore possible to select and deselect the linearisers without having to reconfigure them.

### 7.1 Flowmeter specification

Flowmeters are usually supplied with a calibration certificate specifying the average K-factor and the flow range over which it applies. For use over extended flow ranges and for non-linear devices, multiple K-factors will be specified, often in a table similar to the one shown below.

Flow Rate Litres/minute	K-factor Pulse/litre
5	200
10	230
15	239
20	242

From this calibration certificate information the output frequency of the flowmeter, which is required for conditioning the Rate Totaliser lineariser, can be calculated.

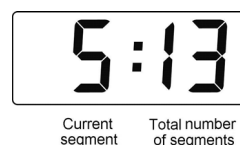
$$\text{Output frequency Hz} = \frac{(\text{Flow rate per min}) \times (\text{K-factor})}{60}$$

Flow Rate Litres/min	K-factor Pulses/litre	Output frequency Hz
0	0	0
5	200	16.66
10	230	38.33
15	239	59.75
20	242	80.66

### 7.2 Summary of lineariser configuration functions

This section summarises the lineariser configuration functions. When read in conjunction with Fig 12 it provides a quick aid for configuring each of the two linearisers. If more detail is required, each section contains a reference to a full description of the function.

The number of straight-line lineariser segments required should first be entered using the **Add** and **DEL** functions. In both of these sub-functions the Rate Totaliser displays the current segment and the total number of segments being used as shown below.



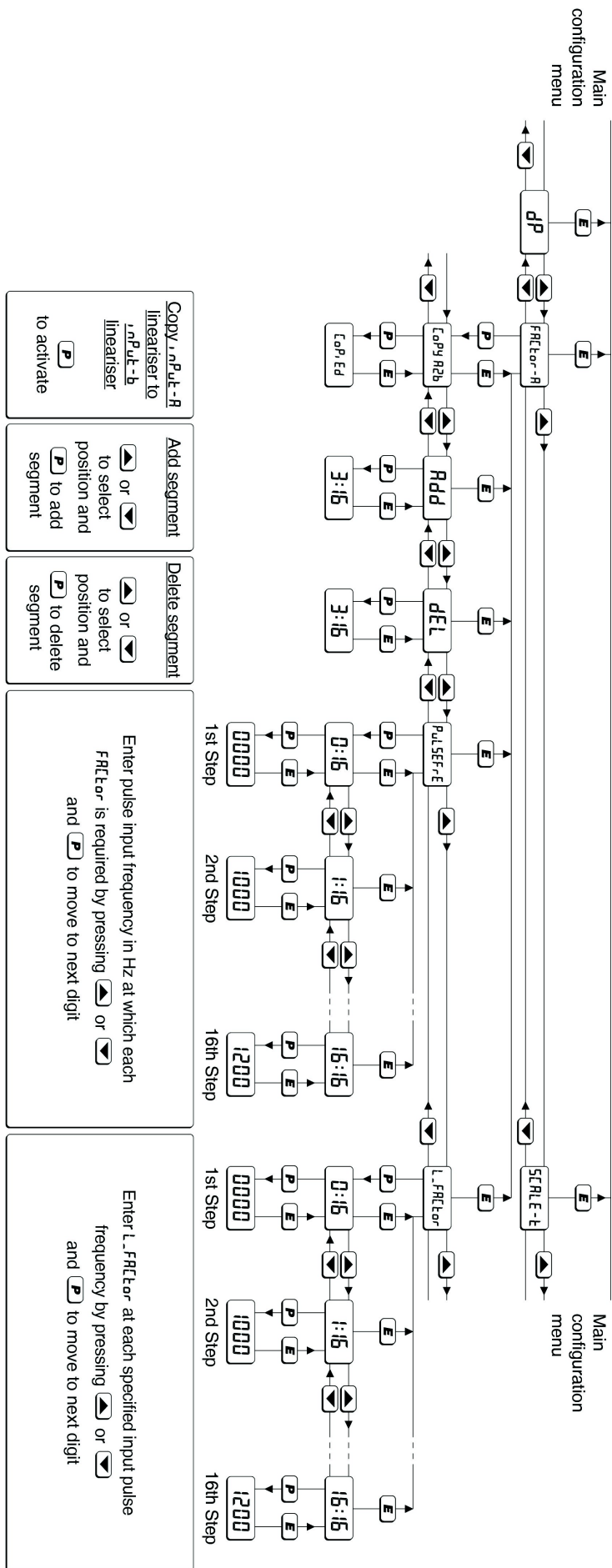


Fig 12 Lineariser configuration menu

Increasing the number of segments will provide a more accurate approximation of the flowmeter characteristic and increase totalisation accuracy.

**Note:** The pulse input frequency,  $PULSE\ Fr$ , of successive breakpoints must be monotonic i.e. the pulse input frequency must increase with breakpoint number. See 7.8

Display	Summary of function
---------	---------------------

<b>Copy A2b</b>	<b>Copy A lineariser configuration to b lineariser.</b>
-----------------	---

When the **P** push button is pressed the configuration of the A input lineariser is copied to the b input configuration lineariser.

See section 7.3

<b>Add</b>	<b>Add a segment</b>
------------	----------------------

Adds a new segment before the displayed segment. The calibration of existing segments is not changed, but the identification number of all subsequent segments is increased by one.

See section 7.4

<b>dEL</b>	<b>Remove a segment</b>
------------	-------------------------

Removes the displayed segment, the identification number of all subsequent segments is decreased by one.

See section 7.5

<b>PULSE Fr</b>	<b>Pulse input frequency</b>
-----------------	------------------------------

Defines the input frequency in Hz at which the selected lineariser segments starts.

See section 7.6

<b>L_FACTOR</b>	<b>Flowmeter K-factor</b>
-----------------	---------------------------

The rate totaliser pulse input is divided by **L\_FACTOR**, which is usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. **L\_FACTOR** may be adjusted between 0.0001 and 99999. Up to 16 values for **L\_FACTOR** may be entered, each at a specified input pulse frequency.

See section 7.7

**Note:** The following detailed description of the lineariser configuration functions refer to the input A lineariser. The input b lineariser has separate identical functions.

### 7.3 Copy A lineariser configuration to b lineariser: Copy A2b

When both inputs of the BA384NG Rate Totaliser are connected to separate flowmeters with the same non-linearity, this sub-function simplifies configuration by copying input A lineariser configuration to the input b lineariser so that the information only has to be entered once.

Select **Factor-A** in the configuration menu and press **P**, which will reveal one of five sub-functions. If **Copy A2b** is not displayed, repeatedly press the **▼** or **▲** button to select **Copy A2b**. Pressing the **P** button will initiate the copy, when complete the instrument will display **Copy Ed** followed by the **Copy A2b** prompt from which another sub-function may be selected, or pressing the **E** button will return the instrument to the configuration menu.

### 7.4 Add a segment: Add

**Add** is a sub-function in the **Factor-A** function that enables a straight-line segment to be added to the lineariser at any point. Select **Factor-A** in the configuration menu and press **P**, which will reveal one of five sub-functions. If **Add** is not displayed, repeatedly press the **▼** or **▲** button to select **Add** followed by **P** which will display the current segment and the total number of segments as shown below:

5:13	
Current segment	Total number of segments

Each time the **P** push button is operated a segment will be added to the lineariser. If configuring the lineariser for the first time, repeatedly press **P** until the required total number of segments is shown on the right hand side of the display. Any number between 1 and 16 may be selected.

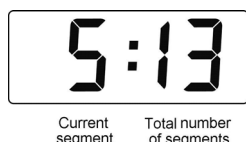
If adding an additional segment to an already configured lineariser, the insertion position, which is shown on the left hand side of the display, can be selected using the **▼** or **▲** push button. When inserting an additional segment, the identification numbers of all segments equal to and above the insertion point are increased by one.

An additional segment may be placed below segment 0:n providing the frequency at which segment 0:n starts is greater than zero.

To return to the **Add** prompt in the **Factor-A** sub-menu press **E**.

### 7.5 Remove a segment: **dEL**

**dEL** is a sub-menu in the **FRCEor-R** function that enables any segment to be removed from the lineariser configuration. To remove a segment, select **FRCEor-R** in the configuration menu and press **[P]**, which will reveal one of five sub-functions. If **dEL** is not displayed, repeatedly press the **[▼]** or **[▲]** button to select **dEL** followed by **[P]** which will display the current segment and the total number of segments as shown below:



Each time the **[P]** push button is operated the current segment will be deleted from the lineariser. If configuring the lineariser for the first time, repeatedly press **[P]** until the total number of segments is reduced to the required number.

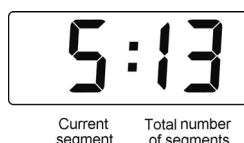
If removing a segment from a configured lineariser, the segment to be deleted, which is shown on the left hand side of the display, can be selected using the **[▼]** or **[▲]** push button. When a segment is deleted, the identification numbers of all segments above the deleted segment are decreased by one.

To return to the **dEL** prompt in the lineariser sub-menu press **[E]**.

### 7.6 Input frequency: **PuLSE Fr**

**PuLSE Fr** is a sub-menu in the **FRCEor-R** function for entering the pulse input frequency at which each of the lineariser segments starts, see Fig 12.

To enter the input pulse frequency at which a lineariser segment starts, select **FRCEor-R** in the configuration menu and press **[P]**, which will reveal one of four sub-functions. If **PuLSE Fr** is not displayed press the **[▼]** or **[▲]** button repeatedly to select **PuLSE Fr** followed by **[P]** to display the current segment for which the start frequency will be entered and the total number of segments that have already been defined using the **Add** and **dEL** functions, see below.



The required segment, which is shown on the left hand side of the display, can be selected using the **[▼]** or **[▲]** push buttons. When selected press

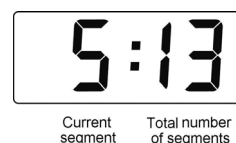
**[P]** which will reveal the current input frequency with one digit flashing. The value of the flashing digit may be changed by pressing the **[▼]** or **[▲]** button. When this digit is correct pressing **[P]** will transfer control to the next digit. When the input frequency for this lineariser segment is set as required, press the **[E]** button to return to the segment identification display from which the next segment may be selected using **[▼]** or **[▲]** push buttons. When the input frequency for all of the segments has been entered, return to the **FRCEor-R** prompt in the configuration menu by operating the **[E]** push button.

### 7.7 Flowmeter K-factors: **L\_FRCEor**

**L\_FRCEor** is a sub-menu in the **FRCEor-R** function for entering the flowmeter K-factor for each of the lineariser segments, see Fig 12.

The rate totaliser pulse input is divided by **L\_FRCEor** which is adjustable between 0.0001 and 99999; for flow applications it should be set to the K-factor of the flowmeter. K-factor is the number of pulses that the flowmeter produces per unit volume of flow e.g. 20 pulses per litre. **L\_FRCEor** therefore converts the flowmeter output into engineering units ready for further scaling to produce the required rate and total flow displays.




To enter the flowmeter K-factor for one or more segments, select **FRCEor-R** in the configuration menu and press **[P]**, which will reveal one of four sub-functions. If **L\_FRCEor** is not displayed in the sub-menu repeatedly press the **[▼]** or **[▲]** button to select **L\_FRCEor** and followed by **[P]** to display the current segment for which **L\_FRCEor** will be entered. The required segment, which is shown on the left hand side of the display, can be selected using the **[▼]** or **[▲]** push button, see below.



When selected, press **[P]** which will reveal the current **L\_FRCEor** for the selected segment with one digit flashing. The value of the flashing digit may be changed by pressing the **[▼]** or **[▲]** button. When this digit has been adjusted as required, pressing **[P]** will transfer control to the next digit. When all the digits have been adjusted pressing **[P]** will transfer control to the decimal point that may be positioned between any of the digits, or may be omitted by moving it to the right of the least significant digit.

When **L\_FRCEor** for this lineariser segment is set as required, press the **[E]** button to return to the segment identification display from which the next



segment may be selected using  or  push button. When  $L\_FREQ$  for all of the segments has been entered, return to the  $FREQ-R$  prompt in the configuration menu by operating the  push button twice.

### 7.8 Lineariser error message

If an attempt is made to position a segment at an input frequency which is not greater than the frequency of the preceding segment, or at an input frequency which is not less than the frequency of the following segment, the error message  $VALUE.ERR$  will be displayed.

To avoid generating an error it may be easier to enter the bottom and top frequencies first and then insert new break points between them.

### 7.9 Lineariser factory defaults

The linearisers factory defaults are two breakpoints, producing one segment starting at 0Hz and finishing at 5000Hz with an  $L\_FREQ$  of 1.0.

Break point	PULSE Fr	$L\_FREQ$
0:1	0Hz	1.00
1:1	5000Hz	1.00

## 8. PULSE OUTPUT

The BA384NG Rate Totaliser pulse output may be configured as a synchronous duplicate of pulse input A or pulse input b, or it may be derived from the least significant digit of the composite total display. When derived from the composite total display the output pulse frequency may be divided and the output pulse width defined.

### 8.1 Configuration

The pulse output sub-menu is accessed via the **PULSE.oP** function in the configuration menu. The pulse output sub-menu allows the source of the output pulse to be selected in the **Source** sub-function. For re-transmission applications the output pulse may be a duplicate of one of the input pulses by selecting **direct-R** or **direct-b** in the **Source** sub-function. Alternatively, selecting **SCALed** derives the output pulse from incrementation of the least significant digit of the composite total display input A+ input b.

**Note:** The **SCALed** function is not available when the composite total is **input R – input b**.

When **SCALed** is selected two additional functions, **divide** and **duration** are added to the sub-menu allowing the output pulse frequency to be divided and the output pulse width (duration) to be defined – see Fig 13.

### 8.2 Access Pulse output sub-menu: **PULSE.oP**

Access the Rate Totaliser configuration menu as described in section 6.2. Using the  $\nabla$  or  $\blacktriangle$  push buttons scroll through the menu until **PULSE.oP** is displayed, pressing **P** will then access the pulse output sub-menu which is shown in Fig 13.

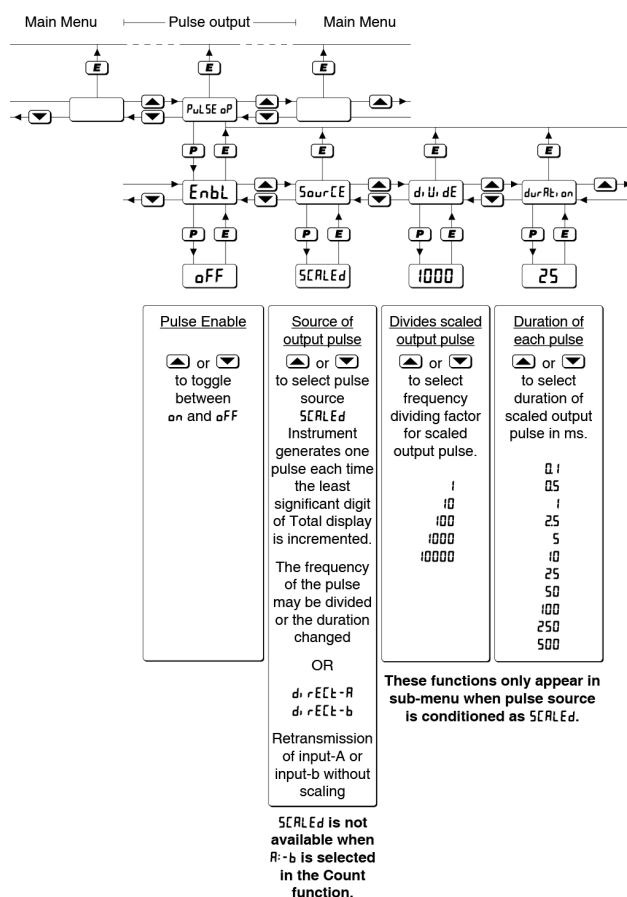


Fig 13 Pulse output configuration sub-menu

### 8.3 Enable pulse output: **EnbL**

This function allows the pulse output to be disabled or enabled without altering any of the pulse output parameters. Using the  $\nabla$  or  $\blacktriangle$  push button select **EnbL** in the pulse output sub-menu and press **P** to reveal the existing setting **on** or **off**. The function can be changed by pressing the  $\nabla$  or  $\blacktriangle$  push button followed by the **E** button to return to **EnbL** prompt.

#### 8.4 Source of output pulse: **Source**

The output pulse may be derived from:







**Rate-A** **Rate Totaliser input-A pulse.**  
Output is a duplicate of input-A pulse.

**Rate-b** **Rate Totaliser input pulse-b**  
Output is a duplicate of input-b pulse.

**SCALD** **Composite total**  
Input A+b which is defined by the Count function in the configuration menu.

A pulse output occurs each time the least significant digit of the composite total is incremented. The frequency of the pulse output may be divided and width defined by functions **Div** and **durA, on** which are only available when **SCALD** is selected.







**Note:** When input A – input b is selected in the Count function, the scaled pulse output **SCALD** is not available.

Using the  or  push button select **Source** in the pulse output sub-menu and press  to reveal the existing pulse source. The function can be changed by pressing the  or  push button followed by the  button to return to **Source** prompt.

#### 8.5 Divide output pulse frequency: **Div**

When the output pulse is derived from the least significant digit of the composite total, the output pulse frequency may be divided by:

1  
10  
100  
1000  
10000







Using the  or  push button select **Div** in the pulse output sub-menu and press  to reveal the existing divisor. The value can be changed by pressing the  or  push button to select the required value followed by the  button to return to **Div** prompt.

**Note:** This function only appears in the pulse output sub-menu when the output pulse is derived from the least significant digit of the composite total display.

#### 8.6 Output pulse width: **durA, on**

When the output pulse is derived from the least significant digit of the composite total, the output pulse width in milliseconds is defined by this function. One of 11 pulse widths may be selected:

0.1  
0.5  
1  
2.5  
5  
10  
25  
50  
100  
250  
500

Using the  or  push button select **durA, on** in the pulse output sub-menu and press  to reveal the existing pulse duration. The value can be changed by pressing the  or  push button to select the required value followed by the  button to return to **durA, on** prompt.

**Note:** This function only appears in the pulse output sub-menu when the output pulse is derived from the least significant digit of the composite total display.

#### 8.7 Stored pulses

If the **Div** and **durA, on** functions are configured such that the output pulse frequency with the specified pulse width can not be output in real time, the number of pulses will be stored and transmitted at the maximum possible speed.

When total-A or total-b are reset to zero, any stored pulses which have yet to be transmitted will be discarded.

Stored pulses which have yet to be transmitted will not be retained when the BA384NG Rate Totaliser power supply is interrupted.

## 9. CONFIGURATION EXAMPLE

In this example a BA384NG Rate Totaliser is required to display the total flow rate and the sum of the total flow in two pipes. Identical flowmeters are fitted in each pipe which have a K-factor of 105 pulses per litre with a magnetic pick-off output.

The BA384NG is required to display rate of flow in imperial gallons per hour with a resolution of one gallon and total flow in cubic metres with a maximum total of 100000 and a resolution of 0.01 cubic metres. Linearisation is not required. Totalisation is to stop when the flow rate on each input falls below 10 gallons per hour. The display is to be updated twice per second.

For this application the operator needs to reset the total display to zero from the totalising mode, but should not be able to reset the grand total. To prevent tampering the instrument configuration menu is to be protected by security code of 1209

### 9.1 Configuration procedure

The BA384NG Rate Totaliser may be configured on-site without disconnection from the power supply or from the flowmeters.

#### Step 1 Enter the configuration menu

Enter the configuration menu by simultaneously pressing **[P]** and **[E]**. Assuming a security code has not already been entered the instrument will respond by displaying **FUNCTION** which is the first function in the configuration menu.  
See Fig 10.

#### Step 2 Select a linear function

With **FUNCTION** displayed press **[P]** to reveal the function of the Rate Totaliser. Using the **[▼]** or **[▲]** button select **SLD** to switch off the linearisers and provide a linear function. Press **[E]** to enter the selection. See 6.4

#### Step 3 Select the type of input & debounce

Using the **[▼]** or **[▲]** button select **INPUT-A** in the configuration menu and press **[P]** which will reveal the sub-menu. Again using the **[▼]** or **[▲]** button select **INPUT-DEB** and press **[P]** to reveal the current input. The Rate Totaliser is required to work with a magnetic pick-off so using the **[▼]** or **[▲]** button select **CM** followed by **[E]** to return to the **INPUT-DEB** prompt in the sub-menu.

Using the **[▼]** or **[▲]** button select **DEBOUNCE** from the sub-menu and press **[P]**. Using the **[▼]** or **[▲]** button select **DEFRAULT** which will provide moderate noise protection. If the Rate Totaliser is subsequently found to miscount the noise rejection can be increased. Enter the selection and return to the **INPUT-A** prompt in the configuration menu by pressing the **[E]** button twice.

As both flowmeters are the same repeat for input b using the **INPUT-B** function. See 6.6 and 6.7

#### Step 4 Select the interval between display updates.

Using the **[▼]** or **[▲]** button select **UPDATE** in the configuration menu and press **[P]** to reveal how frequently the Rate Totaliser display is updated. Using the **[▼]** or **[▲]** push button select **0.5** (0.5 seconds i.e. 2 display updates per second). Enter the selection and return to the **UPDATE** prompt in the configuration menu by pressing the **[E]** button.  
See 6.8







#### Step 5 Count

Using the **[▼]** or **[▲]** button select **COUNT** in the configuration menu and press **[P]** to reveal the existing arithmetic relationship between input A and input b. In this example the Rate Totaliser is required to display the sum of the two inputs, therefore using the **[▼]** or **[▲]** push button select **A+B**. Enter the selection and return to the **COUNT** prompt in the configuration menu by pressing the **[E]** button.  
See 6.9

#### Step 6 Upper display




Using the **[▼]** or **[▲]** button select **DISPLAY** in the configuration menu and press **[P]** to select whether flow rate or flow total is shown on the upper 8 digit display. The required maximum total of 100000 with 0.01 resolution can only be accommodated on the top eight digit display. Using the **[▼]** or **[▲]** button select **SCALE** and press **[E]** to enter the selection and return to the **DISPLAY** prompt in the configuration menu.  
See 6.10




**Step 7 Lower display**


Using the  or  button select  $d, 5P-2$  in the configuration menu and press  to select if the lower display function. The Rate Totaliser is required to display both total flow and the rate of flow so the lower display is required. Using the  or  button select  $5Ed$  and press  to enter the selection and return to the  $d, 5P-2$  prompt in the configuration menu.

See 6.11

**Step 8 Position rate & total decimal points**

Select  $dP$  from the configuration menu and press . The upper display already defined as the total display by function  $d, 5P-1$  will be activated and identified by the Total annunciator. Using the  or  push button position the decimal point in front of the second least significant digit to give a total display resolution of 0.00.







Pressing the  button will show the rate display, but in the upper display position with the Rate annunciator activated. Using the  or  push button position the decimal point to the right of the least significant digit so that it is not visible to give a total display resolution of 1.


Finally press the  button to enter the selections and return to the  $dP$  prompt in the configuration menu.

See 6.12

**Step 9 Enter the flowmeter K-factor**

K-factor is the number of pulses that a flowmeter produces per unit volume of flow. The Rate Totaliser pulse input A is divided by  $FREt_{or}-R$ , which is adjustable between 0.0001 and 99999; when set to the K-factor of the flowmeter it converts the flowmeter output into engineering units ready for further scaling to produce the required rate and total flow displays

Using the  or  push button select  $FREt_{or}-R$  from the configuration menu and press  to show the existing value with one digit flashing. This should be changed to  $105$  using the  and  push buttons to adjust the flashing digit and the  button to transfer control to the next digit and to position the decimal point.








Finally, enter the new figure and return to the  $FREt_{or}-R$  prompt in the configuration menu by pressing . The output from FACTor-A will now be in litres which may be scaled to produce required rate and total displays.

Repeat for input b using the  $FREt_{or}-b$  function.

See 6.13

**Step 10 Enter the total scale factor**

The Total Scale Factor  $SCALE.t-R$  is a dividing factor adjustable between 0.0001 and 99999 that enables total flow to be displayed in the required engineering units. In this example the total flow display is required in cubic metres. There are 1,000 litres in a cubic metre so  $SCALE.t-R$  should be set to  $1000$ .

Using the  or  push button select  $SCALE.t-R$  from the configuration menu and press  to reveal the existing value with one digit flashing. This should be changed to  $1000$  using the  or  push button to adjust the flashing digit and the  button to transfer control to the next digit and to position the decimal point. Finally, enter the new value and return to the  $SCALE.t-R$  prompt in the configuration menu by pressing .

The total flow display is independent of the rate display.




Repeat for input b using the  $SCALE.t-b$  function.

See 6.14

**Step 11 Enter the rate scale factor**

$SCALE.r-R$  is a dividing factor adjustable between 0.0001 and 99999 that enables the input A flow rate to be displayed in the required engineering units. The rate display timebase is determined by  $t-bR5E$  that is adjusted in Step 12.

In this example the rate of flow display is required in imperial gallons.  $FREt_{or}-R$ , which was adjusted in Step 8, has an output in Litres that must be converted to imperial gallons. There are 4.5461 Litres in an imperial gallon therefore  $SCALE.r-R$  should be adjusted to 4.5461

Using the  or  push button select  $SCALE.r-R$  from the configuration menu and press  to reveal the existing value with one digit flashing.

This should be changed to 4.5461 using the  $\blacktriangledown$  or  $\blacktriangle$  push button to adjust the flashing digit and the  $\text{P}$  button to transfer control to the next digit and to position the decimal point. Finally, enter the new value and return to the  $\text{SCALE-R}$  prompt in the configuration menu by pressing  $\text{E}$ .

The flow rate display is independent of the total flow display.

Repeat for input b using the  $\text{SCALE-R-b}$  function.

See 6.15

#### Step 12 Enter the rate timebase

The rate timebase determines if rate is displayed per second, per minute or per hour. In this example gallons per hour are required. Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select  $\text{t-RSE}$  from the configuration menu and press  $\text{P}$ . Again using the  $\blacktriangledown$  or  $\blacktriangle$  push button select  $\text{t-3600}$  from the three options which will multiply the rate display by 3600. Enter the selection and return to the  $\text{t-RSE}$  prompt in the configuration menu by pressing  $\text{E}$ .

See 6.16

#### Step 13 Adjust the display filter

The digital display filter has two independent adjustable parameters enabling the rate display response to be tailored for optimum performance. The filter parameters are controlled by a two digit number. The first digit defines the amount of filtering applied to the display, for initial configuration it is recommended it is set to 2 which is a time constant of 4.3 seconds. The second digit controls jump-out following a step input change and it is recommended that this is initially set to 0.

After configuration during commissioning both parameters should be adjusted experimentally to provide a stable display with an acceptable step response. To allow the effect of filter changes to be seen immediately, the live rate display is shown on the lower display while the filter parameters are shown and may be adjusted on the upper display.

Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select  $\text{FILTER-R}$  from the configuration menu and press  $\text{P}$ . The first digit, which controls the filter time constant, will be flashing and should be set to 2 using the  $\blacktriangledown$  or  $\blacktriangle$  push button. The  $\text{P}$  button will transfer control to the second digit, which controls the step response and should be set to 0 in the same way. Finally, enter the selection and return to the  $\text{FILTER}$  prompt in the configuration menu by pressing  $\text{E}$ .

Repeat for input b using the  $\text{FILTER-b}$  function.

See 6.17

#### Step 14 Define clip-off

To prevent totalisation of low flow rates clip-off defines an adjustable flow rate threshold below which totalisation is inhibited. In this example it is required that totalisation does not occur at flow rates below 10 gallons per hour on each input.

Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select  $\text{CLP.OFF-R}$  from the configuration menu. Press  $\text{P}$  which will reveal the existing clip-off threshold in gallons per hour i.e. the same units already selected for the rate display. Change the display to 10 using the  $\blacktriangledown$  or  $\blacktriangle$  push buttons to adjust the flashing digit and the  $\text{P}$  button to transfer control to the next digit. Finally, enter the new clip-off threshold and return to the  $\text{CLP.OFF-R}$  prompt in the configuration menu by pressing  $\text{E}$ .

Repeat for input b using the  $\text{CLP.OFF-b}$  function.

See 6.18

#### Step 15 Local reset of total and grand total

Two separate functions in the  $\text{LOCAL}$  sub-menu may be individually activated to allow the operator to reset the individual totals and the composite grand total displays from the totalising mode without entering the configuration menu.

In this example the operator is required to reset the total displays but not the composite grand total display when the BA384NG Rate Totaliser is in the totalising mode.

Using the ▼ or ▲ button select **LoC CLR** in the configuration menu and press **P** which will reveal the sub-menu. Again using the ▼ or ▲ button select the local total reset function **CLR tot** and press **P**. This is required so using the ▼ or ▲ button select **on** followed by **E** to return to the **CLR tot** prompt in the sub-menu.

Using the ▼ or ▲ button select the local grand total reset function **CLR Gtot** and press **P**. This is not required so using the ▼ or ▲ button select **off**. Enter the selection and return to the **LoC CLR** prompt in the configuration menu by pressing the **E** button twice. See 6.20 and 6.21

#### Step 16 Reset the grand total to zero

Before completing configuration, the Rate Totaliser's composite grand total should be reset to zero. Using the ▼ or ▲ button select **CLR Gtot** in the configuration menu and press **P** which will cause **CLR tot** to be displayed. Again using the ▼ or ▲ button select **CLR YES** and press **P** which will result in a **0000** display with one digit flashing. This is a request for the instruction to be confirmed by entering **5urE** using the ▼ or ▲ buttons to set each digit and the **P** button to move control to the next digit.

Pressing **E** will then reset the composite grand total to zero and return the instrument to the **CLR Gtot** prompt in the configuration menu. See 6.23

#### Step 17 Define the security code

Defining a security code prevents unauthorised access to the configuration menu. Using the ▼ or ▲ 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 ▼ or ▲ 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 configuration menu. See 6.24

#### Step 18 Return to the totalising mode

Configuration of the BA384NG is now complete. Pressing the **E** button will save the new configuration and return the Rate Totaliser to the totalising mode. The BA384NG will display **drRr** followed by **5RUE** while the new information is stored in permanent memory, which will be protected from unauthorised adjustment by the security code.

In the totalising mode, operating the ▼ or ▲ button will scroll the BA384NG display between Input-A, Input-b and the composite display Input-A + Input-b.

## 10. MAINTENANCE

### 10.1 Fault finding during commissioning

If a BA384NG fails to function 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 30V on terminals 1 & 2 with terminal 1 positive.
Rate Totaliser is receiving power but flow indicator is not rotating when either input is selected.	No input pulses, or incorrect input configuration	Input configuration.  Correct linking of terminals 3 & 4 for input A and terminals 7 & 8 for input b.  Input pulses have correct polarity.
Flow indicator rotating, but incorrect rate display on one or both inputs.	Incorrect rate display calibration.	$FR\check{E}t_{or}-R$ $FR\check{E}t_{or}-b$ $SC\check{A}LE.r-R$ $SC\check{A}LE.r-b$ $t-b\check{A}SE$
Flow indicator rotating, but incorrect total display.	Incorrect total display calibration.  Remote reset switch contacts are closed.	$FR\check{E}t_{or}-R$ $FR\check{E}t_{or}-b$ $SC\check{A}LE.t-R$ $SC\check{A}LE.t-b$  If reset annunciator is activated, check reset wiring and switch.
Unstable rate display.	Noisy pulse input signal.	Eliminate electrical noise. Increase input de-bounce and/or display filter.
Alarms do not function.	Alarms have been automatically disabled following rate display recalibration.	Enable both alarm outputs.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used.  Contact BEKA if code is lost.

### 10.2 Fault finding after commissioning

EN 60079-17 *Electrical installations inspection and maintenance* permits live maintenance in Zone 2 if a risk analysis demonstrates that this does not introduce an unacceptable risk. The removal of covers [opening of Ex n instrument enclosure] is permitted if this can be done without contaminating the interior of the instrument with dust or moisture. Some end-users may prefer not to permit live maintenance to minimise risk.

#### ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

**Live maintenance within the hazardous area should only be performed when it is permitted by risk analysis, or when there is no risk of a flammable atmosphere being present.**

Symptom	Cause	Check:
No display	No power supply	That there is between 10 and 30V on terminals 1 & 2 with terminal 1 positive.
Flow indicator not rotating on one or both inputs.	No input pulses	Output from flowmeter. Wiring between flowmeters and BA384NG.
Flow indicator rotating. HOLD annunciator activated.	Input is below clip-off threshold	$\check{C}L.P\check{o}FF$ threshold and adjust if necessary.
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.

### 10.3 Servicing

We recommend that faulty BA384NG rate totalisers are returned to BEKA associates or to your local BEKA agent for repair.

### 10.4 Routine maintenance

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



**10.5 Guarantee**

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

**10.6 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.

## 11. ACCESSORIES

### 11.1 Units of measurement & instrument identification.

New BA384NG Rate Totalisers are supplied with a printed scale card showing the units of measurement and tag information specified when the instrument was ordered. If this information was not supplied a blank scale card will be fitted which can easily be marked with a dry transfer or a permanent marker on-site.

Custom printed scale cards are available as accessories and may be easily fitted as shown in section 5.4 of this manual.

### 11.2 Legend plate

The BA384NG can also be supplied with a blank or custom laser engraved stainless steel legend plate - see Fig 7. The plate, which after installation is visible from the front of the instrument, is supplied loose with two fixing screws for securing it to the rear of the instrument's back-box. This plate can typically accommodate:

- 1 row of 5 alphanumeric characters 10mm high
- or 1 row of 6 alphanumeric characters 7mm high
- or 2 rows of 10 alphanumeric characters 5mm high

### 11.3 Backlight

The BA384NG Rate Totaliser 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 therefore no additional wiring is required, but the instrument supply current increases to 32mA.

### 11.4 Alarms

The BA384NG can be supplied with factory fitted dual solid state single pole alarm outputs. These may be independently configured as high or low, rate or total alarms with normally open or normally closed outputs functioning on input A, input b, or on the calculated composite rate or total.

Configurable functions for each alarm include adjustable setpoint, alarm delay time and alarm silence time. Hysteresis may be applied to rate alarms.

#### CAUTION

**These alarm outputs should not be used for critical safety applications such as a shut down system.**

When the BA384NG power supply is turned off or disconnected, alarm outputs will open irrespective of whether normally open or normally closed outputs have been selected. When designing a system an open output should therefore be chosen for the alarm condition.

Alarm annunciators on the instrument display indicate the status of both alarms. If an alarm delay or silence time has been selected the annunciator will flash during the delay or silence period. The BA384NG internal counters are up-dated and compared with the alarm setpoint twice per second, irrespective of the display update time selected. This may result in an alarm being delayed for up to half a second after the rate or total has exceeded the setpoint.

#### 11.4.1 Solid state output

Each alarm has a galvanically isolated single pole solid state switch output as shown in Fig 14. 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.

$$\begin{aligned} R_{on} &= \text{less than } 5\Omega + 0.7V \\ R_{off} &= \text{greater than } 1M\Omega \end{aligned}$$

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

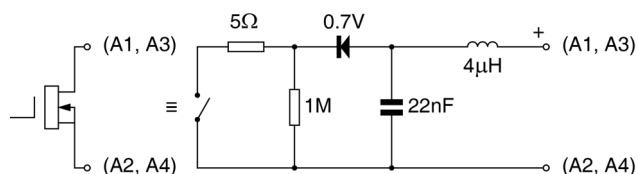


Fig 14 Equivalent circuit of each alarm output

### 11.4.2 Ex nA certification

Each alarm output is a separate galvanically isolated Ex nA circuit with the following input safety parameters:

$$\begin{aligned} U_i &= 30\text{V dc} \\ I_i &= 200\text{mA} \end{aligned}$$

This allows each alarm output to switch any dc circuit providing that in normal operation the maximum supply voltage is not greater than 30V dc and the switched current is not greater than 200mA.

Providing that the BA384NG Rate Totaliser is correctly installed in Zone 2 the two alarm outputs may be used to switch suitably protected equipment located in Zone 1 or 2 of a hazardous area, or equipment located in a safe area.

Fig 15 shows a typical application in which a Zone 2 mounted BA384NG Rate Totaliser is displaying the output from a Flameproof Ex d 2-wire flowmeter located in Zone 1. Alarm 1 is switching an Ex e sounder in Zone 1 and alarm 2 is switching a sounder located in the safe area.

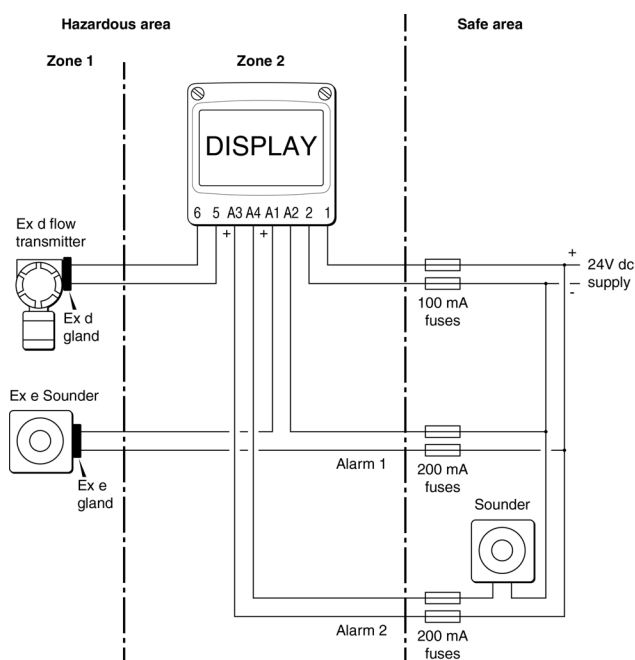


Fig 15 Typical alarm application  
(Shown without recommended screened cables)

To comply with the requirements of EN 60079-14 *Electrical installations design, selection and erection*, each of the wires entering the hazardous area should be individually fused and contain a means of isolation. These two requirements are frequently satisfied by using fuse holders with easily removable fuses and removing the fuses to achieve isolation. This is a satisfactory method at the low voltages and

currents common in instrumentation systems. Clear identification of, and easy access to the means of isolation is essential for their effective use. It is also necessary to ensure that the maintenance procedure makes sure that unauthorised re-closure of the switches does not occur. It is not considered necessary to have a means of isolation or electrical protection for the screen. Fig 2 illustrates an example of this type of fused terminal block.

For some applications Ex nA instrumentation energised by a current limited power supply or instrument that can be switched off, is often considered adequate and to comply with the requirements of the standard.

### 11.4.3 Configuration and adjustment

When a BA384NG is supplied with alarms the configuration menu is extended as shown in Fig 16. Each alarm may be configured to operate on the rate or total display of input A, input b or on the composite display input A + input b or input A – input b.

For simplicity Fig 16 only shows the configurable functions on the rate option of alarm AL1, the total options are identical except that the total alarms can not have hysteresis. Alarm AL2 is identical to alarm AL1.

The following table summarises each of the alarm configuration functions and includes a cross reference to more detailed information. Again only the functions on alarm AL1 are listed.

Display	Summary of function
<b>EnbL</b>	<b>Alarm enable</b> Enables or disables the alarm without changing the alarm configuration. <b>See section 11.3.4</b>
<b>TYPE</b>	<b>Type of alarm</b> Defines whether the alarm operates on the rate or total of input A, input b or the composite rate or total. <b>See section 11.3.5</b>
<b>SP Ir-R</b>	<b>Alarm setpoint</b> Adjusts the alarm setpoint. The alarm is activated when the rate or total display equals the setpoint.  <b>Note:</b> setpoints are identified as: SP Ir-R Alarm 1, Rate, Input A SP Ir-b Alarm 1, Rate, Input b SP Ir Alarm 1, Rate (A+b or A-b) SP It-R Alarm 1, Total, Input A SP It-b Alarm 1, Total, Input b SP It Alarm 1, Total (A+b or A-b)  Similarly for alarm 2 setpoints. <b>See section 11.3.6</b>
<b>Hi.Lo</b>	<b>Alarm function</b> Defines whether the alarm has a high or low function. <b>See section 11.3.7</b>
<b>no.nC</b>	<b>Normally open or normally closed output.</b> Determines whether the single pole alarm output is open or closed in the non-alarm condition. <b>See section 11.3.8</b>
<b>HSt-r</b>	<b>Hysteresis</b> Adjusts the alarm hysteresis. Only available on a rate alarm. <b>See section 11.3.9</b>
<b>dELR</b>	<b>Alarm delay time</b> Adjusts the delay between the display equaling the setpoint and the alarm output being activated. <b>See section 11.3.10</b>

Display	Summary of function
<b>Si.L</b>	<b>Alarm silence time</b> Defines the time that the alarm output remains in the non-alarm condition following acceptance of an alarm. <b>EE EEL on 11311</b>
<b>FLSH</b>	<b>Flash display when alarm occurs</b> When enabled, alternates the rate or total display between process value and alarm reference RL1 or RL2 when an alarm output is activated. <b>See section 11.3.12</b>
<b>RCSP</b>	<b>Access setpoint</b> Sub-menu that enables access to the alarm setpoints from the totalising mode and defines a four digit access code. <b>See section 11.3.13</b>

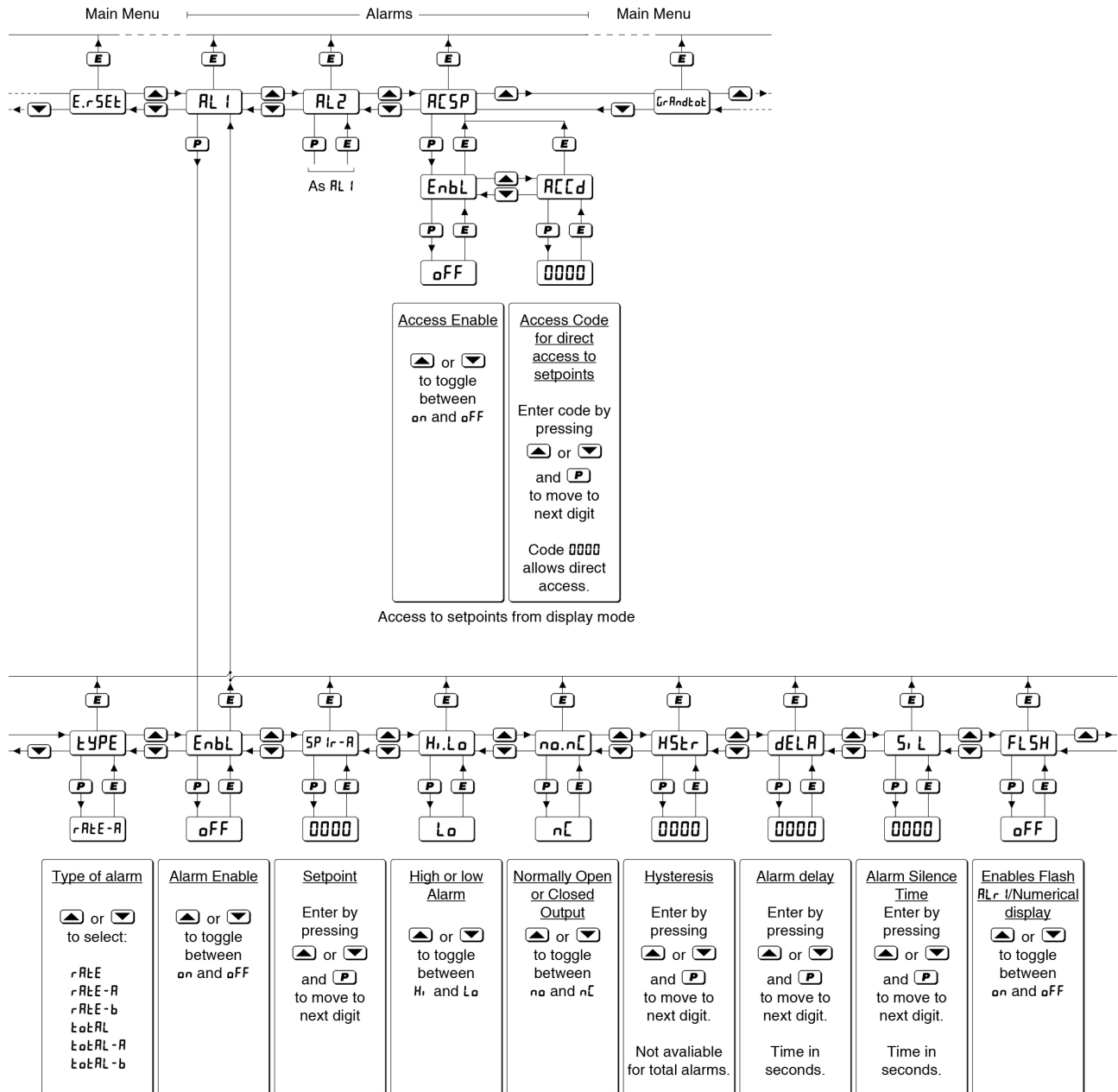














Fig 16 Alarm menu


### 11.3.4 Alarm enable: **ENBL**

This function allows the alarm to be enabled or disabled without altering any of the alarm parameters. Using the  or  push button select **RL1** or **RL2** from the configuration menu and press  to reach **ENBL** in the alarm sub-menu. Pressing  will then reveal the existing setting. The function can be changed by pressing the  or  push button followed by the  button to return to the alarm sub-menu.

### 11.3.5 Type of alarm: **TYPE**

Alarm 1 and Alarm 2 are totally independent, both may be rate or total alarms, or one may be configured for rate and the other for total. Similarly both may function on input-A and the other on input-b. Using the  or  push button select **TYPE** from the selected alarm sub-menu and press  to check or change the function. The  or  push button will scroll through the following options:

<b>RL1E</b>	Alarm 1, Rate (A+b or A-b)
<b>RL1E-A</b>	Alarm 1, Rate, input A
<b>RL1E-b</b>	Alarm 1, Rate, input b
<b>TL1RL</b>	Alarm 1, Total (A+b or A-b)
<b>TL1RL-A</b>	Alarm 1, Total, Input A
<b>TL1RL-b</b>	Alarm 1, Total, input b

When the required alarm has been selected press the  button to enter the selection and return to the alarm sub-menu.




Alarm 2 has the same selectable options.





**Note:** When **TYPE** is changed, the alarm configuration is automatically reset to the default values and the alarm is disabled. It must therefore be reconfigured before use.

### 11.3.6 Setpoint adjustment: **SP1 -** and **SP2 -**







The function of each alarm is determined by the **TYPE** function, the setpoint name will change to reflect this selection. For example, if **RL1E-b** was selected in the **TYPE** function for alarm 1, the setpoint will be identified as **SP1r-b**.

Rate alarm setpoints may be positioned anywhere between -99999 and 99999; total alarm setpoints may be anywhere between -999999 and 9999999.

All setpoints are adjusted in the same way. Using the  or  push button select the required setpoint in the alarm sub-menu and press  which will reveal the existing setpoint value with one digit flashing.







The required setpoint can be entered using the  or  push button to adjust the flashing digit and the  button to transfer control to the next digit. When set as required press  to enter the value and return to the setpoint prompt in the alarm sub-menu.

### 11.3.7 Alarm function: **Hi.Lo**

Alarm 1 and Alarm 2 are totally independent, both may be Hi or Lo, or one may be conditioned as a Hi alarm and the other as a Lo alarm. Using the  or  push button select **Hi.Lo** from the alarm sub-menu and press  to check or change the function. The  or  push button will toggle the alarm function between **Hi** and **Lo**, when set as required, press the  button to return to the **Hi.Lo** prompt in the alarm sub-menu.








### 11.3.8 Alarm output status: **no.nf**

Each single pole alarm output may be open or closed in the non-alarm condition. When the BA384NG power supply is turned off or disconnected, the alarm outputs will open irrespective of whether normally open or normally closed outputs have been selected. Therefore, when designing an alarm system normally closed **nf** should be selected so that the output opens when an alarm occurs or if the power supply fails.

Using the  or  push button select **no.nf** from the selected alarm sub-menu and press  to check or change the function. The  or  push button will toggle the contact status between **no** and **nf**, when set as required, press the  button to return to the **no.nf** prompt in the alarm sub-menu.

### 11.3.9 Hysteresis: **H5tr**








Hysteresis is only available for rate alarms therefore the **H5tr** function only appears in the configuration sub-menu when alarm **TYPE** has been set to **RL1E-A**, **RL1E-b** or **RL1E**. During configuration hysteresis is shown in the units of rate previously configured for the rate display.

Using the  or  push button select **H5tr** in the selected alarm sub-menu and press  which will reveal the existing hysteresis with one digit flashing. The required hysteresis can be entered using the  or  push button to adjust the flashing digit and the  button to transfer control to the next digit. When set as required press  to enter the value and return to the **H5tr** prompt in the alarm sub-menu.

e.g. A BA384NG configured to display a flow rate of 0 to 5000, with a high alarm set at 4000 and hysteresis of 100 will perform as follows:  
High alarm will be activated when flow rate increases to equal or exceed 4000, but will not reset until the flow rate falls below 3900.


### 11.3.10 Alarm delay: *dELR*


This function enables activation of the alarm output to be delayed for a fixed time following the alarm condition occurring. The delay can be set in 1 second increments up to 3600 seconds. If a delay is not required zero should be entered.








To adjust the delay select *dELR* using the  or  push button in the selected alarm sub-menu and press  which will reveal the existing delay time in seconds with one digit flashing. The required delay time can be entered using the  or  push button to adjust the flashing digit and the  button to transfer control to the next digit. When set as required press  to enter the value and return to the *dELR* prompt in the alarm sub-menu.

The alarm annunciator will start flashing immediately an alarm condition occurs and will continue for the delay time, after which the alarm output will be activated and the alarm annunciator will be permanently activated.

### 11.3.11 Alarm silence time: *S, L*

The alarm silence function is primarily intended for use in small installations where the alarm output directly operates an annunciator such as a sounder. When the alarm silence time is set to any figure other than zero, the BA384NG Rate Totaliser  push button becomes an alarm accept button.

After an alarm has occurred, operating the  button will cause the alarm output to revert to the non-alarm condition for the configured alarm silence time. When an alarm is silenced the alarm annunciator will flash until the silence time expires.

To adjust the alarm silence time select *S, L* using the  or  push button in the selected alarm sub-menu and press  which will reveal the existing alarm silence time in seconds with one digit flashing. The required silence time can be entered using the  or  push button to adjust the flashing digit and the  button to transfer control to the next digit. When set as required press  to enter the value and return to the *S, L* prompt in the alarm sub-menu.







### 11.3.12 Flash display when alarm occurs: *FLASH*

In addition to the two alarm annunciators on the lower left hand side of the Rate Totaliser display which show the status of both alarms irrespective of which input is being displayed, this function provides an even more conspicuous indication that an alarm condition has occurred.



When enabled and the Rate Totaliser is displaying the input on which the alarm has occurred, the *FLASH* function alternates the rate or total display










between the numerical value and the alarm identification. For example if alarm 1 has been activated by a rate alarm occurring on input A the rate display will alternate between the numerical rate value and *RL 1*, plus the input identification *in - R* if *SLd* has been selected for the lower display function *d, SP-2* configuration – see 6.11.








**Note:** When an alarm occurs on one input the flash function will only be seen when viewing that input, not when the Rate Totaliser is showing the other input or the composite display. However, the two alarm annunciators, which indicate the status of each alarm, are activated irrespective of which input is being displayed.

To enable the function select *FLASH* from the alarm sub-menu using the  or  push button and press  to check or change the function. The  or  push button will toggle the function between *OFF* and *on*, when set as required, press the  button to return to the *FLASH* prompt in the alarm sub-menu.

### 11.3.13 Access Setpoints: *RESP*

This function activates a separate menu that provides direct access to the alarm setpoints from the totalising mode by simultaneously operating the  and  buttons. An operator can therefore adjust the alarm setpoints without having access to the configuration and alarm sub-menus. Protection against unauthorised or accidental adjustment is provided by a separate optional security access code.

Using the  or  push button select *RESP* from the configuration menu and press  to reach the enable sub-function *ENBL*. Pressing  will reveal the existing setting which can be toggled between *on* and *OFF* by pressing the  or  push button. When set as required, press the  button to return to the *ENBL* prompt from which a separate security access code can be entered using the *REEd* sub-function which can be selected using the  or  push button.

To enter a new security access code select *REEd* from the sub-menu and press  which will cause the Rate Totaliser to display *0000* with one digit flashing. The flashing digit may be adjusted using the  or  push buttons, when set as required operating the  button will transfer control to the next digit. When all the digits have been adjusted press  to return to the *REEd* prompt. The revised security code will be activated when the Rate Totaliser is returned to the totalising mode. Default security access code *0000* will disable the security code allowing direct access to the setpoints in the totalising mode by pressing the  and  buttons simultaneously.

### 11.3.14 Adjusting alarm setpoints from the totalising mode.

Access to the two alarm setpoints from the Rate Totaliser totalising mode is obtained by operating the **[P]** and **[▲]** push buttons simultaneously as shown in Fig 17. If the setpoints are not protected by an access security code the alarm setpoint prompt **SP 1x** or **SP 2x** will be displayed depending upon whether a rate or total alarm has been conditioned. If the setpoints are protected by a security code, **Code** will be displayed first. Pressing **[P]** again will allow the alarm setpoint security code to be entered digit by digit using the **[▼]** or **[▲]** buttons to change the flashing digit and the **[P]** push button to move control to the next digit. If the correct code is entered pressing **[E]** will then cause alarm setpoint prompt **SP 1x** or **SP 2x** to be displayed. If an incorrect security code is entered, or a button is not pressed within ten seconds, the instrument will automatically return to the totalising mode.

Once within the menu pressing the **[▼]** or **[▲]** buttons will toggle the display between the two alarm setpoint prompts.

To adjust an alarm setpoint select the required alarm and press **[P]** which will reveal the existing value with one digit flashing. The flashing digit may be adjusted using the **[▼]** or **[▲]** push button followed by the **[P]** button to move control to the next digit. When the required setpoint has been entered, pressing **[E]** will return the display to the setpoint prompt from which the other setpoint may be selected, or the instrument may be returned to the totalising mode by pressing **[E]** again.

**Note:** Direct access to the alarm setpoints is only available when the menu is enabled - see section 11.3.13

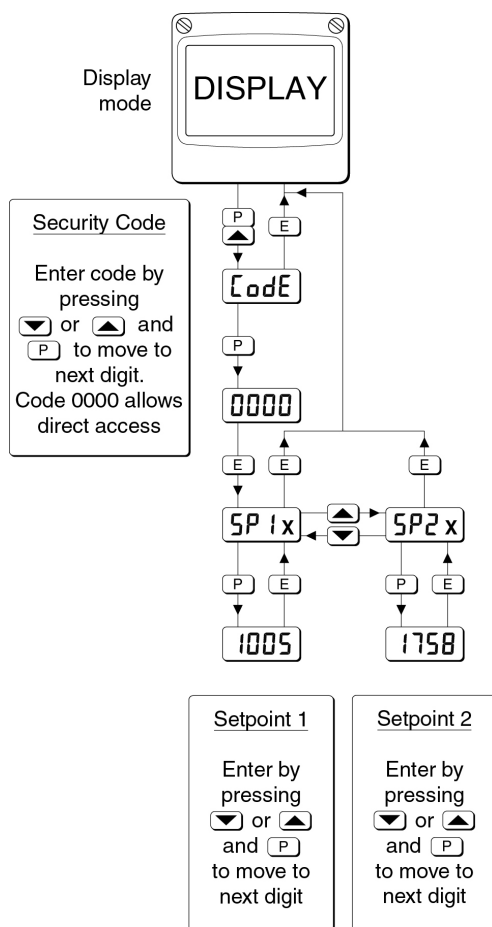


Fig 17 Setpoint adjustment from the totalising mode



## 11.4 4/20mA output

The BA384NG Rate Totaliser can be supplied with a factory fitted galvanically isolated 4/20mA output which may be configured to represent the rate or total display.

### 11.4.1 Ex nA certification

The optional 4/20mA output is a separate galvanically isolated Ex nA circuit with the following input parameters:

$$U_i = 30V \text{ dc}$$

This allows the 4/20mA output to be connected to any dc circuit providing that in normal operation the maximum supply voltage is not greater than 30V dc.

Providing that the BA384NG Rate Totaliser is correctly installed in Zone 2 the 4/20mA current output may be transmitted to any suitably protected equipment, located in Zone 1 or 2 of a hazardous area, or to equipment located in a safe area. The BA384NG Rate Totaliser does not have intrinsic safety certification, therefore it should not be connected to intrinsically safe equipment.

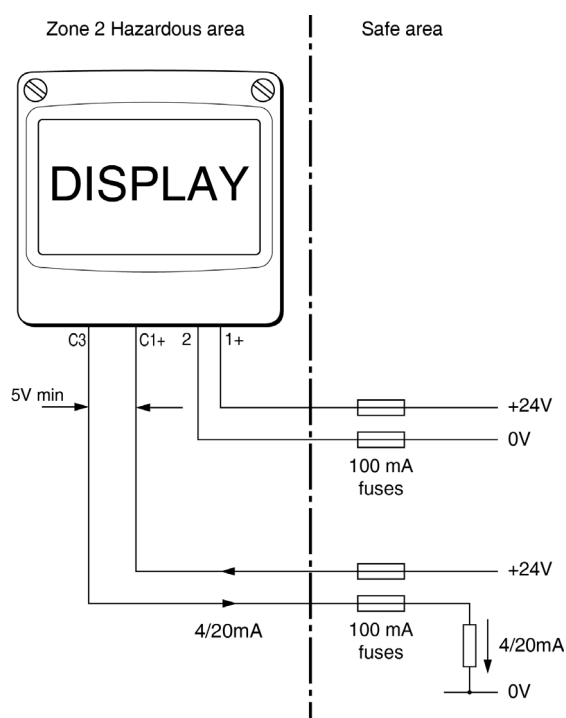


Fig 18 Application of 4/20mA output  
(Shown without recommended screened cables)

Fig 18 shows a typical application in which a Zone 2 mounted BA384NG Rate Totaliser is transmitting a 4/20mA current to the safe area.

To comply with the requirements of EN 60079-14 *Electrical installations design, selection and erection*, each of the wires entering the hazardous area should be individually fused and contain a means of isolation. These two requirements may be satisfied by installing DIN rail mounted terminals incorporating a fuse which can easily be opened as shown in Fig 2 to provide isolation. Clear identification of, and easy access to the means of isolation is essential for their effective use. It is also necessary to ensure that the maintenance procedure makes sure that unauthorised re-closure of the switches does not occur. It is not considered necessary to have a means of isolation or electrical protection for cable screens.

For some applications Ex nA instrumentation energised by a current limited power supply or instrument that can be switched off, is often considered adequate and to comply with the requirements of the standard.

### 11.4.2 Configuration

When a Rate Totaliser is supplied with an optional 4/20mA output the configuration menu is extended as shown in Fig 19. The 4/20mA output sub-menu is accessed via the 4-20mA P function.

The 4/20mA output sub-menu allows the 4/20mA output to be controlled by the rate or the total display and to be scaled.

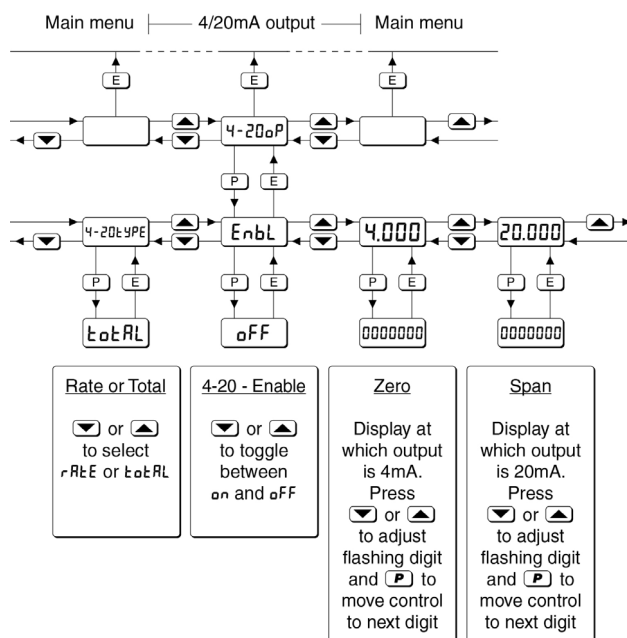


Fig 19 4/20mA output configuration sub-menu

#### 11.4.3 Access 4/20mA output sub-menu: 4-20 oP

Access the Rate Totaliser's configuration menu as described in section 6.2. Using the  $\blacktriangledown$  or  $\blacktriangle$  push buttons scroll through the menu until 4-20 oP is displayed, pressing  $\text{P}$  will then access the 4/20mA output sub-menu which is shown in Fig 19.

#### 11.3.4 4/20mA enable: EnbL

This function allows the 4/20mA output to be enabled or disabled without altering the calibration. Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select 4-20 oP from the configuration menu and press  $\text{P}$  to reach EnbL in the 4/20mA sub-menu. Pressing  $\text{P}$  will then reveal the existing setting. The function can be changed by pressing the  $\blacktriangledown$  or  $\blacktriangle$  push button followed by the  $\text{E}$  button to return to the 4/20mA output sub-menu.

#### 11.4.5 Select rate or total source: 4-20tYPE

The 4/20mA output current can represent the Rate Totaliser's rate or total display, this should be defined before any other current output functions are adjusted.

Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select 4-20tYPE in the 4-20 oP output sub-menu and press  $\text{P}$  to reveal the existing setting tOtAL or rATE. The function can be changed by pressing the  $\blacktriangledown$  or  $\blacktriangle$  push button followed by the  $\text{E}$  button to return to the 4-20tYPE prompt in the sub-menu.

#### 11.4.6 Display which corresponds to 4mA output: 4.000

The Rate Totaliser display which corresponds to a 4.000mA output current is defined by this function. Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select 4000 in the 4/20mA output sub-menu and press  $\text{P}$  which will reveal the existing rate or total display with one digit flashing. The required display can be entered using the  $\blacktriangledown$  or  $\blacktriangle$  push button to adjust the flashing digit and the  $\text{P}$  button to transfer control to the next digit. When set as required press  $\text{E}$  to enter the value and return to the 4.000 prompt in the 4/20mA output sub-menu.

#### 11.4.7 Display which corresponds to 20mA output: 20.000

The Rate Totaliser display which corresponds to a 20.000mA output current is defined by this function. Using the  $\blacktriangledown$  or  $\blacktriangle$  push button select 20.000 in the 4/20mA output sub-menu and press  $\text{P}$  which will reveal the existing rate or total display with one digit flashing. The required display can be entered using the  $\blacktriangledown$  or  $\blacktriangle$  push button to adjust the flashing digit and the  $\text{P}$  button to transfer control to the next digit. When set as required press  $\text{E}$  to enter the value and return to the 20.000 prompt in the 4/20mA output sub-menu 4-20 oP.

#### Notes:

1. If the calibration of the rate or total display defined as the source for the 4/20mA output is changed, the 4/20mA output will automatically be set to give a constant 3.5mA output irrespective of the display. The 4/20mA output should always be reconfigured following reconfiguration of the source display.
2. If the Rate Totaliser and the 4/20mA current sink output are powered from separate supplies, the 4/20mA output current will continue to flow when the Rate Totaliser supply fails or is turned off. Powering both from a common supply eliminates this effect.

## APPENDIX 1

### ATEX Dust Certification

#### A1.0 ATEX dust certification

In addition to ATEX Ex nA certification permitting installation in Zone 2 explosive gas atmospheres, which is described in the main section of this instruction manual, the BA384NG Rate Totaliser has ATEX Ex tc dust ignition protection by enclosure certification permitting installation in Zone 22 combustible dust atmospheres. The front panel push button switches are non incendive and have been certified intrinsically safe Ex ic without the need for Zener barriers or galvanic isolators.

This appendix describes ATEX installations in explosive dust atmospheres conforming with EN 60079-14 *Electrical installations design, selection and erection*. When designing systems for installation outside the UK the local Code of Practice should be consulted.

The Rate |Totaliser's Ex tc dust input and output safety parameters are identical to the Ex nA gas parameters, therefore all the electrical circuits shown in the main section of this manual may also be used for Ex tc dust applications.

#### A1.1 Zones, and Maximum Surface Temperature

The BA384NG has been ATEX dust certified

Group II, Category 3D  
Ex ic tc IIIC T80°C Dc  $-40 \leq T_a \leq 60^\circ\text{C}$

When connected to a suitable system the Rate Totaliser may be installed in:

Zone 22 explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation, but if it does occur, will only persist for a short period.

Be used with dust in subdivisions:

IIIA	combustible flyings
IIIB	non-conductive dust
IIIC	conductive dust

Having a Minimum Ignition Temperature of:

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

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

#### A1.2 Special conditions for safe use in dust atmospheres.

Special conditions for safe use are specified by the Ex ic tc certificate indicated by the certificate number's 'X' suffix. These state that the BA384NG Rate |Totaliser should be:

- Supplied from a *limited energy* circuit with output parameters in normal operation equal to, or less than the instrument's input parameters. The certificate states that it is **not** necessary to power the instrument from an intrinsically safe interface, such as a certified shunt diode safety barrier or a galvanic isolator to comply with this requirement.
- Fitted with cable entry glands or conduit fittings which maintain the impact and ingress protection of the enclosure. Certified Ex e or Ex n components satisfy these requirements.

The BA384NG is supplied fitted with one certified M20 stopping plug and one temporary hole plug which should be replaced with the required gland or conduit fitting.

#### A1.3 Maintenance

The IEC guidance on maintenance procedures EN 60079-17 permits live maintenance in Zone 22 if a risk analysis demonstrates that this does not introduce an unacceptable risk. The removal of covers [opening of Ex tc enclosure] is permitted if this can be done without contaminating the interior of the enclosure and instrument with dust or moisture. Some end-users may prefer not to permit live maintenance to minimise risk.

#### ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

**Live maintenance within the hazardous area should only be performed when it is permitted by risk analysis or when there is no risk of a flammable atmosphere being present.**

The instrument assembly should only be removed from the enclosure back-box when dust can not enter the instrument enclosure. Before replacing the instrument assembly the sealing gasket should be inspected to ensure that it is undamaged and free from foreign bodies.

Inspection of the Rate |Totalisers mechanical condition and removal of accumulated dust from the front of the instrument and the outside of the enclosure should be regularly performed. The interval between inspections depends upon environmental conditions. Removal of flammable dust should be performed with care to avoid creating a dust cloud.

## APPENDIX 2

### IECEX certification

#### A2.0 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](http://www.iecex.com)

#### A2.1 IECEx Certificate of Conformity

The BA384NG Rate Totaliser and the optional accessories have been issued with an IECEx Certificate of Conformity number IECEx ITS 16.0005X which specifies the following certification codes:

Ex nA ic IIC T5 Gc  
Ex ic tc IIIC T80°C Dc IP66  
Ta = -40°C to 60°C

The specified IECEx gas and dust parameters are identical to the ATEX safety parameters described in the main section and Appendix 1 of this manual.

The IECEx certificate may be downloaded from the BEKA associates or the IECEx website, or may be requested from the BEKA sales office.

#### A2.2 Installation

The IECEx and ATEX certificates specify identical safety parameters and installation requirements for both gas and dust approvals as defined by IEC 60079-14. The ATEX installation requirements specified in the main section and Appendix 1 of this manual may therefore be used for IECEx installations, but the local code of practice should also be consulted.

#### A2.3 Special conditions for safe use

The IECEx certificate number has an 'X' suffix indicating that special conditions apply for safe use. These conditions are identical to the ATEX special conditions for safe use specified in the main sections and in Appendix 1 of this manual.

## APPENDIX 3

### ETL & cETL certification for installations in USA and Canada.

#### A3.0 cETL Mark

For installations in the USA and Canada, the BA384NG Rate Totaliser has ETL and cETL Ex nA and Ex tc approval, Control Number 4008610. Copies of the Authorisation to Mark may be downloaded from the BEKA associates website [www.beka.co.uk](http://www.beka.co.uk) or requested from the BEKA associates sales office.

#### A3.1 ETL and cETL certification

The US and Canadian standards used for assessment and certification of the BA384NG are listed on the cETL Authorisation to Mark.

##### ETL codes for USA

Class I Zone 2 AEx nA ic IIC T5 Gc  
 Zone 22 AEx ic tc IIIC T80°C Dc  
 Ta = -40°C to 60°C

##### cETL codes for Canada

Ex nA ic IIC T5 Gc  
 Ex n IIC T5 Gc  
 Ex ic tc IIIC T80°C Dc  
 Class III Div 2 Class II Div 2 Gp F G  
 Ta = -40°C to 60°C

The ETL and cETL safety parameters are the same as ATEX and IECEx parameters, therefore the systems shown in the main section of this manual and in Appendix 1 may be used for US and Canadian installations subject to complying with the local codes of practice.

The Rate Totaliser's front panel push button contacts are non incensive and have been certified intrinsically safe Ex ic, without the need for an external Zener barrier or galvanic isolator, as shown on the ETL Authorisation to Mark. This allows the Rate Totaliser to be adjusted and configured live when installed in Zone 2 or 22 hazardous areas.