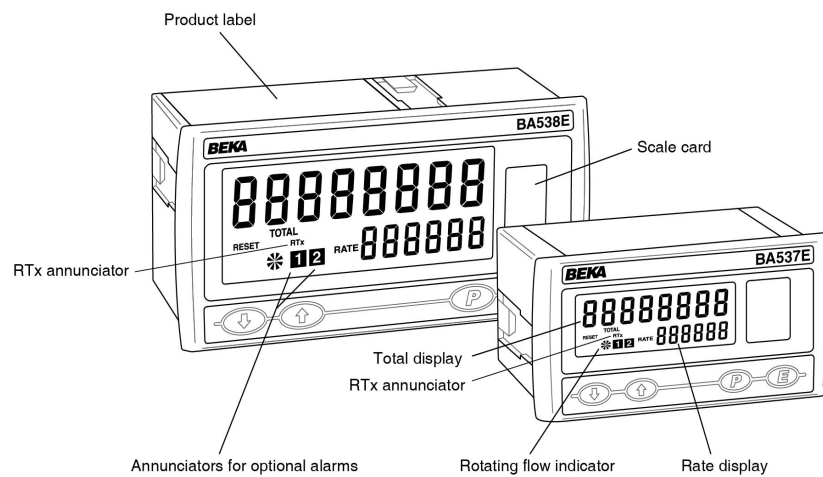


BA537E and BA538E
One input
General Purpose
pulse input
Rate Totalisers
Issue 6



CONTENTS

- 1. Description**
- 2. Operation**
 - 2.1 Initialisation
 - 2.2 Controls
 - 2.3 Displays
 - 2.3.1 Display over-range
- 3. System Design**
 - 3.1 Power supply
 - 3.2 Pulse input
 - 3.2.1 Switch contact input
 - 3.2.2 Open collector input
 - 3.2.3 2-wire proximity detector input
 - 3.2.4 Magnetic pick-off input
 - 3.2.5 Voltage pulse input
 - 3.3 Remote reset
- 4. Installation**
 - 4.1 Location
 - 4.2 EMC
 - 4.3 Installation procedure
 - 4.4 Scale card
- 5. Configuration and Calibration**
 - 5.1 Configuration structure
 - 5.2 Accessing configuration functions
 - 5.3 Summary of configuration functions
 - 5.4 Rate totaliser function: `FUNCTION`
 - 5.5 Input: `INPUT`
 - 5.6 Input type: `INPUTTYPE`
 - 5.7 Debounce: `DEBOUNCE`
 - 5.8 Display update interval: `UPDATE`
 - 5.9 Upper display: `DISP-1`
 - 5.10 Lower display: `DISP-2`
 - 5.11 Position of decimal points: `DP`
 - 5.12 Flowmeter K-factor: `KFACTOR`
 - 5.13 Total scale factor: `SCALE.T`
 - 5.14 Rate scale factor: `SCALE.R`
 - 5.15 Timebase: `TIMEBASE`
 - 5.16 Display filter: `FILTER`
 - 5.17 Clip-off: `CLIPOFF`
 - 5.18 Local reset: `LOCALRST`
 - 5.19 Local total reset: `LOCALTRST`
 - 5.20 Local grand total reset: `LOCALGRANDTRST`
 - 5.21 Grand total reset from configuration menu: `GRANDTRST`
 - 5.22 Define security code: `SECDEF`
 - 5.23 Reset to factory defaults: `RESETDEF`
- 6. Lineariser**
 - 6.1 Flowmeter specifications
 - 6.2 Summary of lineariser configuration functions.
 - 6.3 Add a segment: `ADD`
 - 6.4 Remove a segment: `DEL`
 - 6.5 Input frequency: `PULSEFREQ`
 - 6.6 K-factors: `KFACTOR`
 - 6.7 Lineariser error messages
- 7. Configuration example**
 - 7.1 Configuration procedure
- 8. Maintenance**
 - 8.1 Fault finding during commissioning
 - 8.2 Fault finding after commissioning
 - 8.3 Servicing
 - 8.4 Routine maintenance
 - 8.5 Guarantee
 - 8.6 Customer comments
- 9. Accessories**
 - 9.1 Scale card
 - 9.2 Tag information
 - 9.3 Backlight
 - 9.4 Alarms
 - 9.4.1 Solid state output
 - 9.4.2 Configuration and adjustment
 - 9.4.3 Alarm enable: `ENBL`
 - 9.4.4 Type of alarm: `TYPE`
 - 9.4.5 Setpoint adjustment: `SP1x` and `SP2x`
 - 9.4.6 Alarm function: `HLA`
 - 9.4.7 Alarm output status: `STAT`
 - 9.4.8 Hysteresis: `HST`
 - 9.4.9 Alarm delay: `DELAY`
 - 9.4.10 Alarm silence time: `SILE`
 - 9.4.11 Flash display: `FLASH`
 - 9.4.12 Access setpoint: `RCSP`
 - 9.4.13 Adjusting alarm setpoints from totalisation mode:
 - 9.5 Pulse Output
 - 9.5.1 System design
 - 9.5.2 Configuration
 - 9.5.3 Pulse output: `PULSEOP`
 - 9.5.4 Enable: `ENBL`
 - 9.5.5 Pulse source: `SOURCE`
 - 9.5.6 Output pulse frequency: `DISP.DF`
 - 9.5.7 Output pulse width: `DURATE.ON`
 - 9.5.8 Pulse storage
 - 9.6 4/20mA output
 - 9.6.1 System design
 - 9.6.2 Configuration
 - 9.6.3 4/20mA output: `4-20OP`
 - 9.6.4 Enable 4/20mA output: `ENBL`
 - 9.6.5 Select rate or total source: `4-20TYPE`
 - 9.6.6 Display for 4mA output: `4.000`
 - 9.6.7 Display for 20mA output: `20.000`

1. DESCRIPTION

These general purpose, one input rate totalisers are primarily intended for use with pulse output flowmeters. The instruments simultaneously display the rate of flow and the total flow in the same or different engineering units on two separate displays. They are 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 two models are electrically similar, but have different size displays and enclosures. The available factory fitted accessories also vary.

Model	Displays	Bezel size
BA537E	8 digits 9mm high 6 digits 6mm high	96 x 48mm
BA538E	8 digits 18mm high 6 digits 12mm high	144 x 72mm

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

2. OPERATION

Fig 1 shows a simplified block diagram of the BA537E and BA538E Rate Totalisers. The instruments can accept pulses from most types of flowmeter transducers. When connected to a pulse output flowmeter the BA537E and BA538E will provide an accurate display of the rate of flow and the total flow in the same or different engineering units. The internal lineariser, which can have up to sixteen straight-line segments, may be calibrated to compensate for flowmeter non-linearity.

The BA537E and BA538E have a single pair of input terminals for connection to all types of transducer. When counting pulses from a transducer requiring energising, such as a switch contact, open collector or a two wire proximity detector, an external link between terminals 3 and 4 supplies power to the transducer input terminals.

Factory fitted accessories include an internally powered display backlight, dual alarms and an isolated 4/20mA output which may be configured to retransmit the rate or total display.

The larger BA538E Rate Totaliser is always supplied with an isolated pulse output which can be configured to synchronously retransmit the pulse input, or the flow total. This output is only available on the smaller BA537E Rate Totaliser as an option.

Factory fitted optional accessories for the two models are shown below:

BA537E 96 x 48mm	BA538E 144 x 72mm
Backlight	Backlight
Isolated dual alarms*	Isolated dual alarms
or	
Isolated 4/20mA output*	Isolated 4/20mA output
or	
Isolated pulse output*	
<i>*Only one output option may be fitted to BA537E</i>	<i>Isolated pulse output always fitted to BA538E</i>

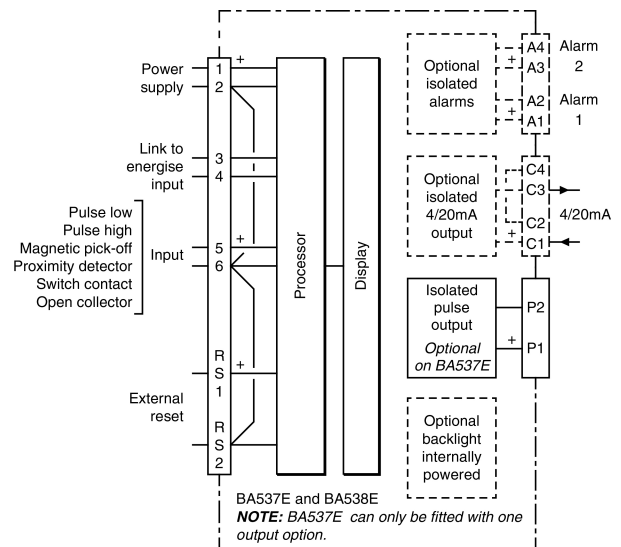


Fig 1 BA537E and BA538E block diagram

2.1 Initialisation

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

All segments of the display are activated

Instrument starts functioning using the configuration information stored in permanent memory. Unless total and grand total displays have been reset to zero, new flow will be added to the existing totals.

2.2 Controls

The BA537E and BA538E are controlled and configured via four front panel push buttons. In the totalisation mode i.e. when the instrument is displaying rate and total flow the push button functions are:

Push Button Functions

- [E] + [▼]** Grand total - shows L_0 followed by least significant 8 digits of the 16 digit grand total.
- [E] + [▲]** Grand total - shows H_1 followed by the most significant 8 digits of the 16 digit grand total.
If Local Grand Total Reset $CLr \text{ t}0t$ in the instrument configuration menu has been activated, operating the **[E] + [▲]** buttons for ten seconds will result in $CLr.n0$ being displayed with the $n0$ flashing. Operating the **[▼]** or **[▲]** button will change the display to $CLr.4E5$, the **[E]** button will then reset the grand total to zero which will be confirmed by a brief display of $t0t \text{ CLrd}$. See 5.20
- [▼] + [▲]** If Local Total Reset $CLr \text{ t}0t$ in the instrument configuration menu has been activated, operating the **[▼] + [▲]** buttons for three seconds will reset the total display to zero and clear any pulses stored in the optional pulse output. The Grand Total is not reset. See 5.19
- [P] + [▼]** Shows in succession, firmware version number, instrument function $t0tRL.5E$ and any output accessories that are fitted:
 - R Dual alarm outputs
 - P Pulse output
 - E 4/20mA output
- [P] + [▲]** Provides direct access to the alarm setpoints when the Rate Totaliser is fitted with optional alarms and the $RESP$ setpoints function has been enabled. See 9.4.13
- [P] + [E]** Access to configuration menu

2.3 Displays

The BA537E and BA538E have 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 on the upper eight digit display. May be reset to zero via front panel push buttons or by a remote reset switch.
Rate Display	Shows the flow rate on the lower six digit display.
Flow indicator	This disc in the lower left hand corner of the display 'rotates' for two seconds each time an input pulse is received. Appears to rotate continuously when input frequency exceeds 0.5Hz.
Hold annunciator	Activated when input frequency is below the clip-off threshold.
Reset annunciator	Activated while instrument is being reset via the front panel push buttons, or the external reset terminals.
Rate annunciator	Identifies rate display
Total annunciator	Identifies total display
RTx annunciator	Retransmitted pulse annunciator. Depends upon the setting of $50urEE$ in the pulse output configuration menu.
	SCALE# Annunciator activated each time pulse output open collector is <i>on</i> , i.e. R_{on} is less than $60\Omega + 3V$.
	d, rEE# 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. SYSTEM DESIGN

Fig 2 illustrates the basic circuit that is used for all BA537E and BA538E installations. For simplicity, connections for the pulse output and optional alarms and 4/20mA output are shown separately in section 10 of this manual.

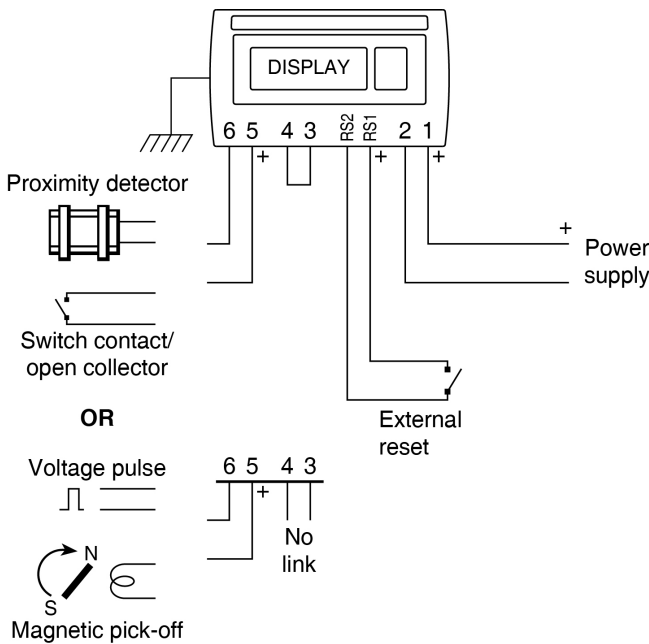


Fig 2 Basic BA537E and BA538E system

When designing a system it is important to remember that terminals 2, 6 and RS2 are interconnected within the BA537E and the BA538E See Fig 1.

3.1 Power supply

The BA537E and the BA538E Rate Totalisers require a dc supply voltage between 10V and 30V at terminals 1 & 2 and consume:

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

As shown in Fig 1 terminals 2, 6 and RS2 of the BA337E and BA338E Rate Totalisers are internally connected together. Therefore these terminals should only be connected to the same, or to an isolated circuit.

3.2 Pulse input

As shown in Figs 2 the BA537E and the BA538E can display the rate and total flow from flowmeters with a wide variety of pulse outputs.

The following table shows the Rate Totaliser's input switching thresholds when conditioned for use with flowmeters having different outputs. For reliable totalisation the Rate Totaliser pulse input must fall below the lower threshold and rise above the upper threshold.

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

Flowmeters with a switch contact, proximity detector or an open collector output collector output require energising which is achieved by linking Rate Totaliser terminals 3 and 4 together.

3.2.1 Switch contact input

Any flowmeter with a mechanically or magnetically activated switch contact may be directly connected to the pulse input terminals 5 and 6. The BA537E and the BA538E contain a configurable debounce circuit to prevent contact bounce being counted. See section 5.7.

3.2.2 Open collector input

Flowmeters with an open collector output may be directly connected to input terminals 5 & 6. Polarity of the sensor should be observed. The BA537E and BA538E contain a configurable debounce circuit to prevent false triggering. Three levels of debounce protection are independently available. See section 5.7.

3.2.3 2-wire proximity detector input

Most flowmeters incorporating a NAMUR 2-wire proximity detector may be directly connected to a BA537E or BA538E input, providing the minimum operating voltage of the flowmeter (proximity detector) is less than 7.5V. The Rate Totalisers contain a configurable debounce circuit to prevent false triggering. Three levels of debounce protection are independently available. See section 5.7.

3.2.4 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. I_{OL} in the BA537E and BA538E input configuration menu is a low level voltage pulse input intended for use with a magnetic pick-off. The Rate Totalisers contain a configurable debounce circuit to prevent false triggering of the instrument. See section 5.7.

3.2.5 Voltage pulse input

Two voltage pulse input ranges are selectable in the BA537E and BA538E Rate Totaliser configuration menu, $\text{V}_{\text{OL}} \text{L}$ and $\text{V}_{\text{OL}} \text{H}$ as shown in section 3.2. The Rate Totalisers contain a configurable debounce circuit to prevent false triggering of the instrument. Three levels of de-bounce protection are independently available. See section 5.7.

3.3 Remote reset

The Rate Totaliser's total display may be remotely reset to zero by connecting terminals RS1 and RS2 together for more than one second. Permanent interconnection inhibits totalisation. Remote resetting may be accomplished by any switch contact.

Note: Both Rate Totalisers may be configured to reset the total display to zero by operating the  and  push buttons simultaneously for more than two seconds in the totalising mode i.e. when the instrument is displaying flow. See 5.19

4. INSTALLATION

4.1 Location

Both models have a robust glass reinforced Noryl enclosure with a toughened glass window. The fronts of the Rate Totalisers have IP66 ingress protection and a gasket seals the joint between the instrument enclosure and the panel. The rear of both Rate Totalisers have IP20 ingress protection.

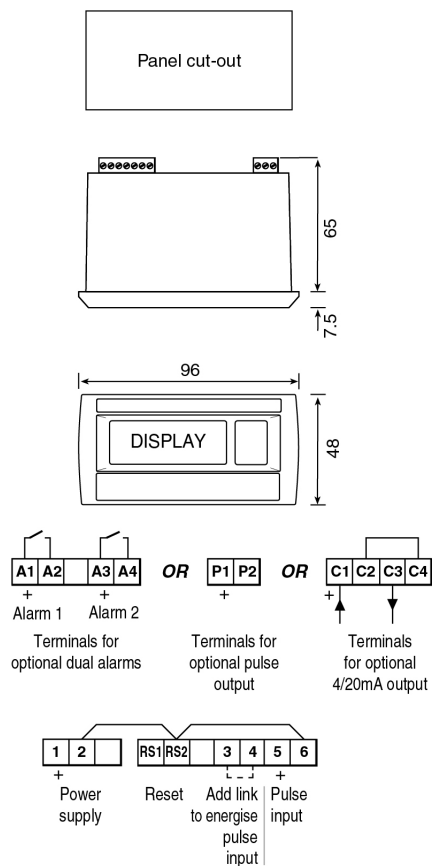
Figs 3A and 3B show the overall dimensions of the 96 x 48mm BA537E and the 144 x 72mm BA538E and the recommended panel cut-out dimensions. To achieve an IP66 seal between the instrument enclosure and the panel the smaller tolerance aperture must be used, and the BA538E must be secured with four panel mounting clamps.

Cut-out dimensions

Recommended for all installations.
Mandatory to achieve an IP66 seal
between the instrument and the panel
 $90 +0.5/-0.0 \times 43.5 +0.5/-0.0$

DIN 43 700

$92.0 +0.8/-0.0 \times 45 +0.6 -0.0$



Support panel wiring to prevent vibration damage

Note: Optional backlight is internally powered

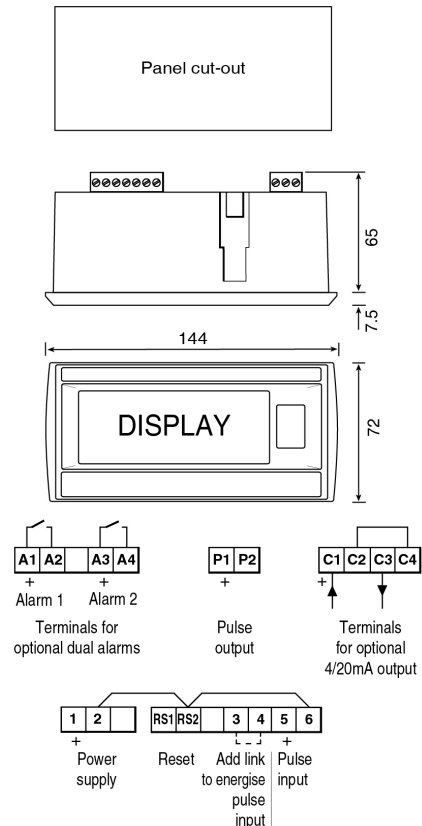
Fig 3A BA537E dimensions & terminals

Cut-out dimensions

Recommended for all installations.
Mandatory to achieve an IP66 seal
between the instrument and the panel
 $136.0 +0.5/-0.0 \times 66.2 +0.5/-0.0$

DIN 43 700

$138.0 +1.0/-0.0 \times 68.0 +0.7/-0.0$



Support panel wiring to prevent vibration damage

Note: Optional backlight is internally powered

Fig 3B BA538E dimensions & terminals

Although the front of both Rate Totalisers have IP66 protection, they should be shielded from direct sunlight and severe weather conditions.

The Rate Totalisers may be installed in any panel providing that the operating temperature is between -40°C and $+70^{\circ}\text{C}$. At temperatures below -20°C the display digits will change more slowly and contrast will be reduced, but the instruments will continue to function and totalise.

4.2 EMC

The BA537E and BA538E comply with the requirements of the European EMC Directive 2014/30/EU and UK Electromagnetic Compatibility Regulations UKSI 2016:1091 (as amended). For specified immunity all wiring should be in screened twisted pairs, with the screens earthed at one point.

4.3 Installation Procedure

- Cut the specified aperture in the panel. To achieve an IP66 seal between the instrument enclosure and the instrument panel the aperture must have the tighter tolerances specified in Figs 3A and 3B.
- Slide the gasket over the body of the Rate Totaliser before inserting the instrument into the panel aperture.
- Firstly ensure that all the panel mounting clamps are closed by turning the knurled screws fully anti clockwise until the two pips in the clamp foot align with holes in the clamp body.
- Place a clamp in the recess on each side of the Rate Totaliser, pulling gently to slide it onto the dovetail as shown in Fig 4. Push the knurled screw slightly forward to engage the thread and tighten by turning clockwise until it is just finger tight. When the clamps are fitted ensure that the gasket behind the front panel bezel is correctly positioned before fully tightening the clamps to secure the instrument. The maximum recommended clamp tightening torque is 22cNm (1.95 lbf in) which is approximately equivalent to finger-tight plus one half turn. **Do not over tighten.**
- Four panel mounting clamps are required to achieve an IP66 seal between a BA538E and the instrument panel.
- Connect the panel wiring to the rear terminal block(s) as shown in Figs 3A and 3B. To simplify installation, the terminals are removable so that the panel wiring can be completed before the instrument is installed. To prevent vibration damage **ensure that panel wiring is supported.**

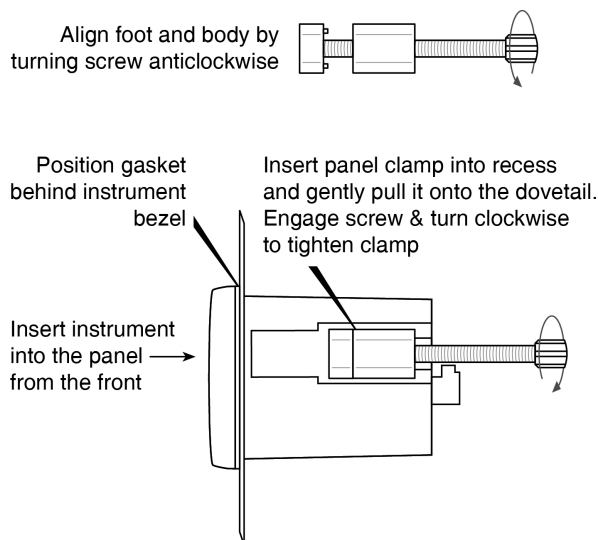


Fig 4 Fitting panel mounting clamps

4.4 Scale card

The Rate Totaliser's units of measurement are shown on a printed scale card in a window at the right hand side of the display. The scale card is mounted on a flexible strip that is inserted into a slot at the rear of the instrument as shown in Fig 5. Thus the scale card can easily be changed without removing the Rate Totaliser from the panel or opening the instrument enclosure.

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

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

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

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

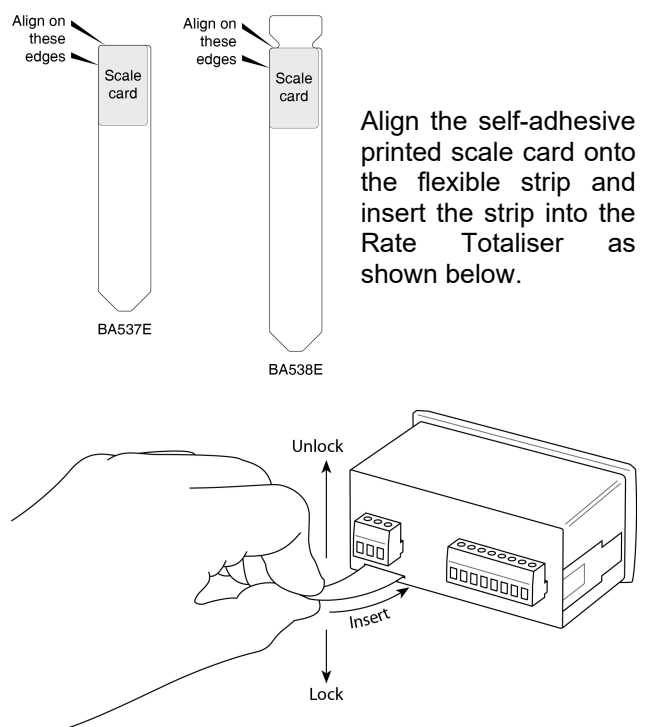


Fig 5 Inserting the flexible strip carrying the scale card into slot at the rear of Rate Totaliser.

5.0 CONFIGURATION & CALIBRATION

The BA537E and BA538E Rate Totalisers are configured and calibrated via four front panel push buttons. All the configuration functions are contained in an easy to use intuitive menu that is shown diagrammatically in Fig 7.

Each menu function is summarised in section 5.3 of this manual and each summary includes a reference to more detailed information. The sixteen segment lineariser is described separately in section 6.

Configuration of the isolated pulse output, which is fitted to all BA538E Rate Totalisers but is an option on the BA537E, and the optional alarms and 4/20mA output are described separately in section 9. When fitted they appear as additional functions within the configuration menu.

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

Function	Display	Default
Access code	Code	0000
Function	Function	Std
Input	Input type	oP.oL
Debounce	deBounCE	dEFRAULt
Update	uPdRtE	0.5
Upper display	diSP-1	totRL
Lower display	diSP-2	on
Decimal point	dP	Rate 00 Total 0
K Factor	FACtor	1.0
Total scale factor	SCALE.t	1.0
Rate scale factor	SCALE.r	1.0
Timebase	t-bRSE	SEC
Filter	FLtEr	24
Clip-off	CLP-oFF	0
Local total reset	t-rESEt	oFF
Local grand total reset	Gt-rESEt	oFF
Security code	Code	0000

Note: While the instrument is being configured totalisation continues so that any flow occurring during this time is recorded.

5.1 Configuration structure

Fig 6 shows the BA537E and BA538E calibration structure. The rate and total display calibrations are independent which allows the displays to have different engineering units.

The rate totaliser pulse input is divided by FACtor which is usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. When the 16 segment lineariser L₁₆ is selected in the Function sub-menu, up to 16 values for FACtor may be entered each at a specified input pulse frequency to compensate for flowmeter nonlinearity. See section 6.

SCALE-r is a dividing factor that converts the output from FACtor into the required rate display in 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 gallon.

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

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 total display 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.

The BA537E and the BA538E uses 'real' decimal points. Moving the position of a decimal point in a scale factor will affect the instrument calibration.

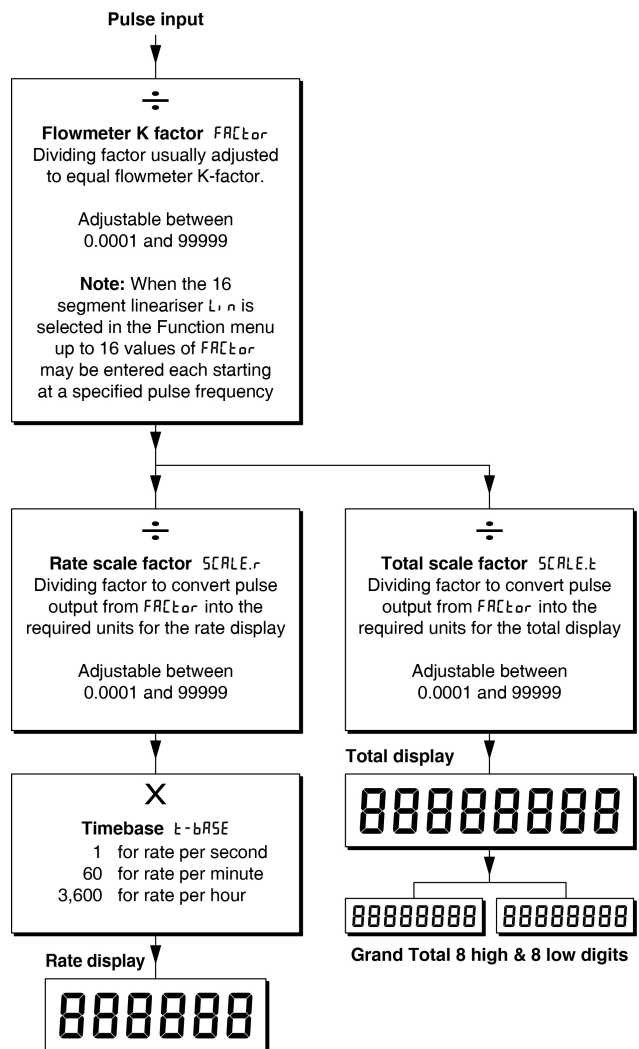















Fig 6 Calibration structure

5.2 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. r nPUL and uPdRE .

Access to the configuration menu is obtained by operating the  and  push buttons simultaneously. If the instrument is not protected by a security code the first parameter FunCE, on will be displayed. If a security code other than the default code 0000 has already been entered, the instrument will display CodE . Press  to clear this prompt and enter the security code for the instrument using the  or  push button to adjust each 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 FunCE, 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 totalisation mode.

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

Once within the main configuration menu the required parameter can be selected by scrolling through the menu using the  or  push button. The configuration menu is shown diagrammatically in Fig 7.

When returning to the totalisation mode following reconfiguration, the Rate Totaliser will display dRE followed by SRUE while the new information is stored in permanent memory.

5.3 Summary of configuration functions

This section summarises all the configuration functions. When read in conjunction with Fig 7 it provides a quick aid for configuring the Rate Totaliser. If more detail is required, each section contains a reference to a full description of the function.

Display	Summary of function
FunCE, on	Rate Totaliser function Defines the relationship between the pulse input and the Rate Totaliser display. May be set to: 5Ed Standard linear relationship LIN 16 segment adjustable lineariser - see section 7. See section 5.4
r nPUL	Input Contains sub-menu with two functions r nP.ETYPE Select Input type dEbounCE Set debounce See section 5.5 r nP.ETYPE Configures the Rate Totaliser to accept one of six types of input: aP COL Open collector * VOLT5 L Voltage pulse <1 >3V VOLT5 H Voltage pulse <3 >10V COL Magnetic pick-off Pr.dET Proximity detector * CONTACT Switch contact * * Link terminals 3 & 4 See section 5.6 dEbounCE Defines level of input debounce applied to the pulse input to prevent false counting: dEFault HEAVY LIGHT See section 5.7
uPdRE	Display update interval Define the interval between display updates between 0.5 and 5 seconds. See section 5.8

Display	Summary of function	Display	Summary of function
d, SP-1	Upper display Defines whether RATE or TOTAL is shown on the upper display. The other variable will be shown on the lower display, providing the lower display is on in function d, SP-2. See section 5.9	SCALE	Rate scale factor SCALE.r is a dividing factor that converts the pulse output from FRCOR into the required rate display in engineering units. e.g. if the output from FRCOR is one pulse per litre and the rate display is required in gallons, SCALE.r should be set to 4.546 l which is the number of litres in an imperial gallon. SCALE.r may be adjusted between 0.000 l and 99999. The flow rate display is independent of the total flow display. See section 5.14
d, SP-2	Lower display Turns the lower display, which normally shows rate, on or off. See section 5.10		
dP	Decimal points Defines the position of the decimal point in both the rate and total displays. See section 5.11	BASE	Timebase Selectable multiplier allowing flow rate to be displayed in units per second, per minute or per hour. Select: 00-0 l for flow / second 00-60 for flow / minute 00-3600 for flow / hour See section 5.15
FRCOR	Flowmeter K-factor The rate totaliser pulse input is divided by FRCOR, which is usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. FRCOR may be adjusted between 0.000 l and 99999. When the 16 segment lineariser LIN is selected in the Function sub-menu, up to 16 values for FRCOR may be entered, each at a specified input pulse frequency to compensate for flowmeter non-linearity. See section 5.12		
SCALE	Total Scale Factor SCALE-t is a dividing factor that converts the pulse output from FRCOR into the required total display in engineering units. e.g. if the output from FRCOR is one pulse per litre and the total display is required in thousands of gallons, SCALE-t should be set to 4546 l which is the number of litres in 1,000 imperial gallons. SCALE-t may be adjusted between 0.000 l and 99999. The total flow display is independent of the rate display. See section 5.13	FLTER	Display filter An adjustable digital filter to reduce noise on the rate display is controlled by 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. See section 5.16
		CLP-off	Clip-off To prevent totalisation of very low flow rates, clip-off enables the user to select a flow rate display below which totalisation is inhibited. See section 5.17

Display	Summary of function	Display	Summary of function
LoL Lr	<p>Local reset Contains sub-menu with two functions enabling total and grand total to be reset to zero via the front panel push buttons when the Rate Totaliser is in the totalisation mode. See section 5.18</p> <p>Local total reset Lr tot When on is selected total display is reset when ▼ and ▲ buttons are operated simultaneously for more than 3 seconds in the operating mode. See section 5.19</p> <p>Local grand total reset Lr Gtot When on is selected the grand total is reset when E + ▲ buttons are operated simultaneously for more than 10 seconds in the operating mode. Note: Once reset, the grand total can not be restored. See section 5.20</p>	Lr-Gtot	<p>Reset grand total from configuration menu. This function resets the grand total to zero from within the configuration menu when Lr GE5 is selected, and Sure is entered to confirm the instruction. Note: Once reset, the grand total can not be recovered. See section 5.21</p>
		Code	<p>Security code Defines a four digit alphanumeric code which 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. See section 5.22</p>
		r5Et dEF	<p>Reset to factory defaults Returns the Rate Totaliser configuration functions to the factory default shown in section 6. To prevent accidental use the request must be confirmed by entering Sure before the reset will be executed. See section 5.23</p>

5.4 Rate Totaliser function: $F_{un}L_{i}on$

The Rate Totaliser contains an adjustable sixteen segment lineariser which may be used to compensate for flowmeter non-linearity. This function turns this lineariser on or off .

$5Ld$	Lineariser not activated
$L_{i}n$	Lineariser activated

To reveal the existing Rate Totaliser function select $F_{un}L_{i}on$ from the configuration menu and press $[P]$. If the function is set as required, press $[E]$ to return to the configuration menu, or press the $[V]$ or $[A]$ button to change the setting, followed by the $[E]$ button to return to the $F_{un}L_{i}on$ prompt in the configuration menu.

$5Ld$ Linear

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

$L_{i}n$ 16 segment adjustable lineariser

Enables a sixteen segment adjustable lineariser. When $L_{i}n$ is selected the $F_{un}L_{i}on$ function is expanded to allow up to 16 values to be entered for different input pulse frequencies. Detailed information about the lineariser including configuration is contained in section 7 of this instruction manual.

Notes:

1. Maximum voltage input +30V.
2. For flowmeter transducers that require energising i.e. proximity detectors, switch contacts or open collectors, terminals 3 & 4 of the Rate Totaliser 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 5.7 for maximum counting frequency.

5.5 Input: i_nP_{ut}

The Input function contains two sub-functions $i_nP_{ut}TYPE$ and $dEbounCE$ which configure the Rate Totaliser input and input noise rejection.

5.6 Input type: $i_nP_{ut}TYPE$

$i_nP_{ut}TYPE$ is a sub-menu in the i_nP_{ut} function which defines the type of flowmeter or input pulse that the Rate Totaliser will count. To check or change the type of input, select i_nP_{ut} in the main configuration menu and press $[P]$ which will reveal the $i_nP_{ut}TYPE$ prompt, pressing $[P]$ again will show the Rate Totaliser input. If set as required press $[E]$ twice to return to the configuration menu, or repeatedly press the $[V]$ or $[A]$ button until the required type of input is displayed, then press $[E]$ twice to return to the configuration menu.

One of following six types of input may be selected:

		Switching thresholds	
		Low	High
oP_{ut}	Open collector ²	2	10k Ω
$UoL_{ut}L$	Voltage pulse low ¹	1	3V
$UoL_{ut}H$	Voltage pulse high ¹	3	10V
$L_{ut}L$	Magnetic pick-off	0	40mV
$P_{ut}dEt$	Proximity detector ²	1.2	2.1mA
$L_{ut}nREt$	Switch contact ²	100	1000 Ω

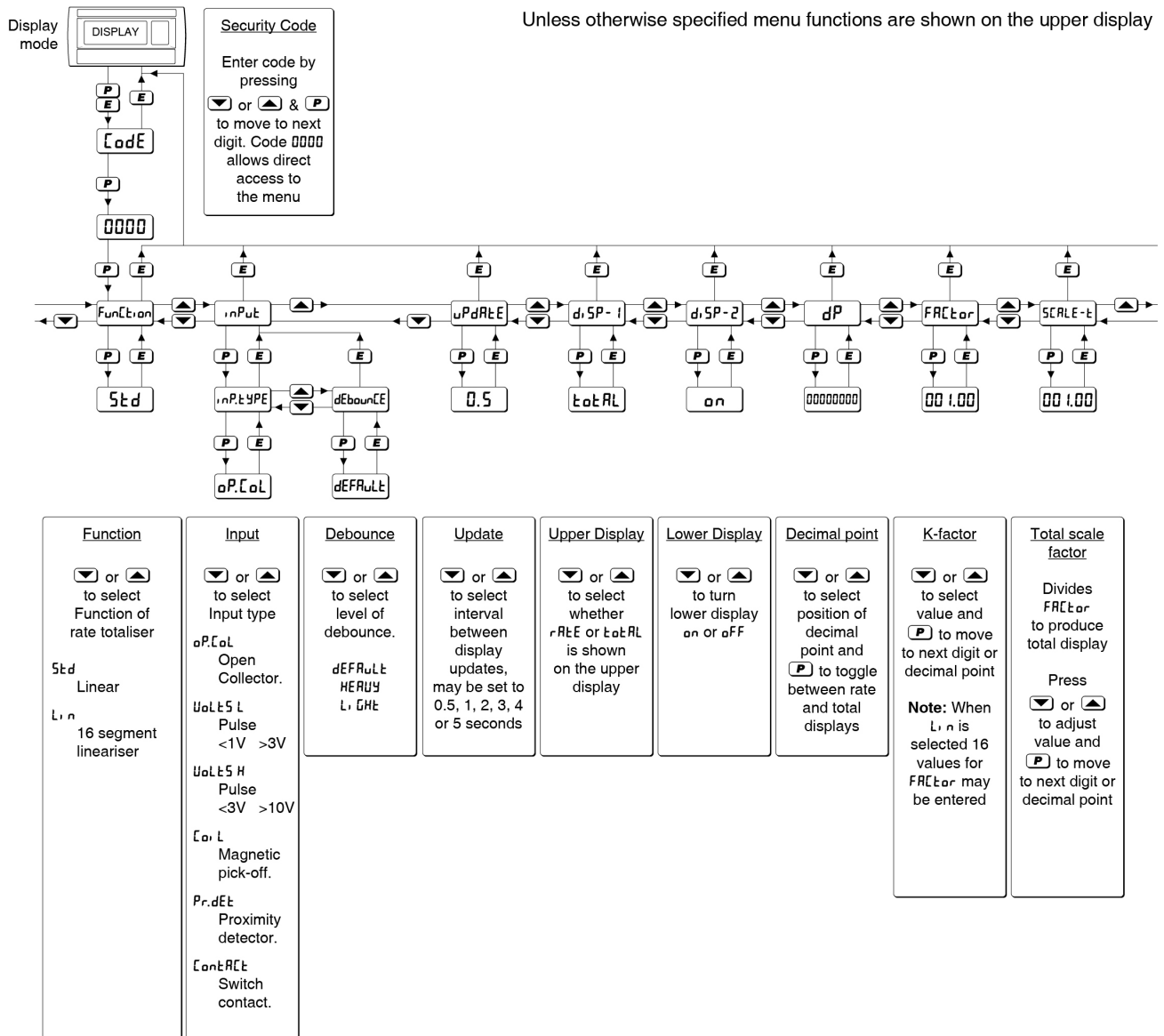
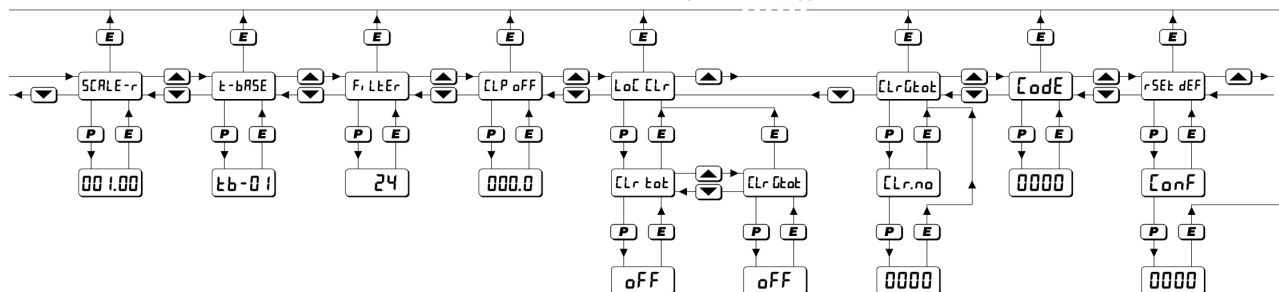


Fig 7 Configuration menu

When fitted optional alarms,
pulse output and 4/20mA
output functions appear here.



<p>Rate scale factor</p> <p>Divides FRAcEor to produce rate display</p> <p>Press or to adjust value and to move to next digit or decimal point</p>	<p>Timebase</p> <p> or to select rate display timebase</p> <p>t-b-01 for flow/sec</p> <p>t-b-50 for flow/min</p> <p>t-b-3600 for flow/hour</p>	<p>Filter</p> <p> or to adjust value of each digit and to transfer control to other digit</p> <p>First digit: filter magnitude</p> <p>second digit: step response</p> <p>Note: While making adjustments the filtered rate display is shown on lower display so stability can be assessed</p>	<p>Clip off</p> <p>Rate display below which totalisation is inhibited</p> <p>Press or to adjust value of each digit and to move to next digit</p>	<p>Local total reset</p> <p> or to turn the local total reset function on or oFF. When on, total display is reset to zero when and are operated simultaneously in display mode for more than 2 seconds</p>	<p>Local grand total reset</p> <p> or to turn the local grand total reset function on or oFF. When on, grand total display may be reset to zero when and are operated simultaneously in display mode for more than 10 seconds</p>	<p>Clear grand total</p> <p>Press or to select YES to reset grand total to zero</p> <p>Confirm instruction by entering SurE. Press or to adjust each digit and to move to next digit</p>	<p>Define Security Code</p> <p>Enter by pressing or and to move to next digit</p>	<p>Reset configuration menu to factory defaults</p> <p>Confirm instruction by entering SurE. Press or to adjust each digit and to move to next digit</p>
---	--	--	---	--	---	---	---	---

5.7 Debounce: $dE_{boun}EE$

$dE_{boun}EE$ is an adjustable sub-menu in the r_{nput} function which 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 debounce applied depends upon the type of Rate Totaliser input that has been selected in the $r_{nput}TYPE$ 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 3.2.

De-bounce level	Min input pulse width	
	Type of Input	
	Contact	All others
Default	1600 μ s	40 μ s
Heavy	3200 μ s	350 μ s
Light	400 μ s	5 μ s

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 for guidance. The maximum 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	Max counting frequency	
	Type of input	
	Contact	All others
Default	250Hz	12kHz
Heavy	120Hz	2kHz
Light	1000Hz	100kHz

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

The $dE_{boun}EE$ function is a sub-menu located in the r_{nput} function. Select r_{nput} in the configuration menu and press \boxed{P} which will reveal the $r_{nput}TYPE$ prompt, press the \blacktriangledown or \blacktriangleleft button to select $dE_{boun}EE$ followed by \boxed{P} to reveal the existing setting. Pressing the \blacktriangledown or \blacktriangleleft button will scroll through the three levels. When the required level has been selected, pressing \boxed{E} twice will enter the selection and return the display to the r_{nput} prompt in the configuration menu.

5.8 Display update interval: $\mu P_{dRt}EE$

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 display. 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.

To adjust the update interval select $\mu P_{dRt}EE$ from the configuration menu and press \boxed{P} to reveal the existing time. Pressing the \blacktriangledown or \blacktriangleleft button will scroll through the six times. When the required interval has been selected press \boxed{E} to enter the selection and return to the configuration menu.

5.9 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 on the smaller lower display which can show six positive digits.

To check the status of the upper display, select d_{5P-1} from the configuration menu and press \boxed{P} which will reveal if the display is showing $r_{Rt}EE$ or $t_{ot}RtL$. The setting can be changed by pressing the \blacktriangledown or \blacktriangleleft button followed by the \boxed{E} button to enter the selection and return to the configuration menu.

5.10 Lower display: d_{5P-2}

This function turns the lower display *on* or *off*. When turned *off*, the BA537E or the BA538E will only have one eight digit display which may be configured in the d_{5P-1} function to show total flow or rate of flow.

To check the status of the lower display, select d_{5P-2} from the configuration menu and press \boxed{P} to reveal if the lower display is *on* or *off*. The setting may be changed by pressing the \blacktriangledown or \blacktriangleleft button followed by the \boxed{E} button to enter the selection and return to the configuration menu.

5.11 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 \boxed{P} . The upper display defined as the rate or total display by function $d, SP-1$ (section 5.9) will be activated and identified by the display annunciator as Rate or Total. The decimal point is positioned by operating the \blacktriangledown or \blacktriangleleft push button.

In the total display the \blacktriangledown button moves the position of the decimal point to the left and the \blacktriangleleft button moves it to the right. It may be positioned between any of the six right hand digits or absent by moving it to the right of the least significant digit.

There are no restriction on the position of the decimal point in the rate display.

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

5.12 Flowmeter K-factor: $FRCtar$

The rate totaliser pulse input is divided by $FRCtar$, which is adjustable between 0.0001 and 99999, for flow applications $FRCtar$ 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, $FRCtar$ therefore converts the flowmeter output into engineering units ready for further scaling to produce the required rate and total flow displays. See Fig 6.

When the 16 segment lineariser L_n is selected in $Funct$, up to 16 values of $FRCtar$ may be entered, each at a specified input pulse frequency to compensate for flowmeter non-linearity. See section 6 of this manual.

To check or change the value select $FRCtar$ from the configuration menu and press \boxed{P} which will reveal the existing value with one digit flashing.

The flashing digit may be adjusted by pressing the \blacktriangledown or \blacktriangleleft button. When this digit has been adjusted pressing \boxed{P} will transfer control to the next digit. When all the digits have been adjusted pressing \boxed{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 set as required, press \boxed{E} to return to the $FRCtar$ prompt in the configuration menu.

5.13 Total scale factor: $SCALE.t$

$SCALE.t$ 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 $FRCtar$ 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. The total flow display is independent of the rate display.

To check or change the total scale factor select $SCALE.t$ from the configuration menu and press \boxed{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 \blacktriangleleft button. When this digit has been adjusted as required, pressing \boxed{P} will transfer control to the next digit. When all the digits have been adjusted pressing \boxed{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 the required total scale factor has been entered, press \boxed{E} to return to the $SCALE.t$ prompt in the configuration menu.

5.14 Rate scale factor: $SCALE.r$

$SCALE.r$ 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 $FRCtar$ 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 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 $t-base$ described in section 5.15.

To check or change the rate scale factor select $SCALE.r$ from the configuration menu and press \boxed{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 \blacktriangleleft button. When this digit has been adjusted as required, pressing \boxed{P} will transfer control to the next digit. When all the digits have been adjusted pressing \boxed{P} 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 required rate scale factor has been entered, press \boxed{E} to return to the $SCALE.r$ prompt in the configuration menu.

5.15 Timebase: $t-bR5E$

The timebase multiplies the rate display by 1, 60 or 3,600 depending upon whether the Rate Totaliser is required to display rate per second, per minute or per hour. See Fig 6.

To check or change the timebase, select $t-bR5E$ from the configuration menu and press \boxed{P} which will reveal the existing setting. Pressing the \blacktriangledown or \blacktriangle button will scroll through the three options:

$t-b-1$	for flow / second
$t-b-60$	for flow / minute
$t-b-3600$	for flow / hour

When the required multiplier is displayed press \boxed{E} to return to the $t-bR5E$ prompt in the configuration menu.

5.16 Display filter: $F, LLEr$

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 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 rate signal change.

To check or change the filter select $F, LLEr$ in the configuration menu and press \boxed{P} which will reveal the existing settings with the first digit flashing. Pressing the \blacktriangledown or \blacktriangle button will change the flashing digit and \boxed{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 \boxed{E} button to enter the revised parameters and return to the $F, LLEr$ prompt in the configuration menu.

5.17 Clip-off: $CLP oFF$

To prevent totalisation of very low flow rates that over long periods may result in significant totalisation errors, the BA537E and the BA538E may be configured to stop totalising when the flow rate falls below an adjustable threshold.

To check or change the clip-off threshold select $CLP oFF$ from the configuration menu and press \boxed{P} which will reveal the current 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 \blacktriangledown or \blacktriangle button. When this digit is correct pressing \boxed{P} will transfer control to the next digit. When clip-off is set as required, press the \boxed{E} button to enter the revised figure and return to the $CLP oFF$ prompt in the configuration menu.

When the 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 the K-factor $FRCtor$, rate scale factor $SCALE.r$, timebase $t-bR5E$, 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 therefore be entered after any of these functions have been adjusted.

5.18 Local reset: $\text{LoC } \text{CLr}$

The Local reset function contains two sub-functions $\text{CLr } \text{tOt}$ and $\text{CLr } \text{GTot}$ which when enabled allow the total display and grand total to be reset to zero via the instrument push buttons while the Rate Totaliser is in the totalisation mode.

5.19 Local total reset: $\text{CLr } \text{tOt}$

$\text{CLr } \text{tOt}$ is a sub-menu in the $\text{LoC } \text{CLr}$ function which when activated allows an operator to reset the total display to zero while in the totalisation mode by operating the \blacktriangledown and \blacktriangle push buttons simultaneously for more than two seconds.

Select $\text{LoC } \text{CLr}$ in the configuration menu and press P which will reveal the $\text{CLr } \text{tOt}$ prompt and operate P again which will 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 \blacktriangledown or \blacktriangle button to change the setting followed by the E button twice to enter the change and return to the $\text{LoC } \text{CLr}$ 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 section 3.3 of this manual.

5.20 Local grand total reset: $\text{CLr } \text{GTot}$

The grand total is a separate sixteen digit counter which is incremented in parallel with the total display, but is not zeroed when the total display is reset to zero. The grand total may be viewed in the totalisation mode in two eight digit sections as described in section 2.2 of this manual.

$\text{CLr } \text{GTot}$ is a sub-menu in the $\text{LoC } \text{CLr}$ function which when activated allows the operator to reset the grand total display to zero in the totalisation mode by operating the E and \blacktriangle push buttons simultaneously for more than ten seconds.

Select $\text{LoC } \text{CLr}$ in the configuration menu and press P which will reveal $\text{CLr } \text{tOt}$. Using the \blacktriangledown or \blacktriangle button to select $\text{CLr } \text{GTot}$ and press P which will show if local grand total reset is on or off . If set as required operate the E button twice to return to the configuration menu, or the \blacktriangledown or \blacktriangle button to change the setting followed by the E button twice to enter the change and return to the $\text{LoC } \text{CLr}$ prompt in the configuration menu.

5.21 Grand total reset from configuration menu: $\text{CLr } \text{GTot}$

The grand total is a separate sixteen digit counter which is incremented in parallel with the total display, but is not zeroed when the total display is reset to zero. The grand total may be viewed in the totalisation mode in 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 $\text{CLr } \text{GTot}$ function, or from the totalisation mode if sub-function $\text{CLr } \text{GTot}$ in the $\text{LoC } \text{CLr}$ function is activated - see 5.20.

To zero the grand total from within the configuration menu select $\text{CLr } \text{GTot}$ and press P which will cause the instrument to display $\text{CLr } . \text{no}$ with no flashing. Press the \blacktriangledown or \blacktriangle push button until $\text{CLr } . \text{9E5}$ 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 \blacktriangledown or \blacktriangle buttons and the P button to move control to the next digit. Pressing E will then 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.

5.22 Security code: CodE

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

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

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

5.23 Reset configuration to factory defaults

r5Et dEF

This function resets the Rate Totaliser including the lineariser, to the factory default configurations which are shown in section 5.0

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 BA537E or BA538E to the factory defaults and return the instrument to the totalising mode.

6. LINEARISER

The BA537E and BA538E Rate Totalisers can produce accurate results when used with a flowmeter having a K-factor that varies with the flow rate, such as a turbine meter used over a wide range of flows. Both models include a sixteen segment straight-line lineariser that may be adjusted to compensate for flowmeter non-linearity.

The lineariser is enabled by selecting **LIN** in the **FUNCTION** section of the configuration menu. The configuration menu shown in Fig 7 remains basically unchanged, except that up to 16 values of the flowmeter K-factor can be entered as **L-FRector**, together with **PULSE Fr** the corresponding input frequency at which each starts.

Fig 9 shows how the Rate Totaliser configuration function **FRector** is extended when the lineariser is activated by selecting **LIN** in the **FUNCTION** menu.

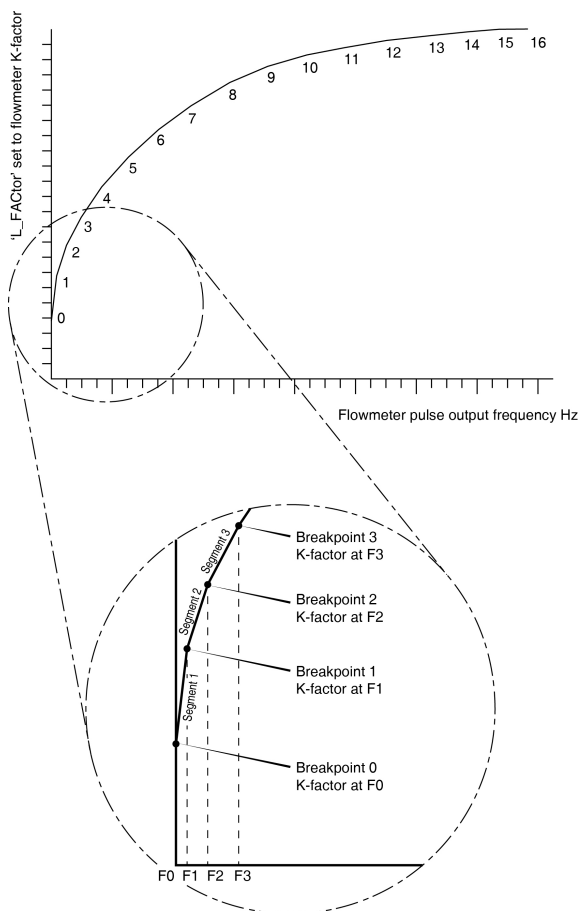


Fig 8 shows a typical linearising characteristic

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

6.1 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/min	K-factor Pulses/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	16.666
10	230	38.333
15	239	59.750
20	242	80.666

6.2 Summary of lineariser configuration Functions.

This section summarises the lineariser configuration functions. When read in conjunction with Fig 9 it provides a quick aid for configuring the lineariser. 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.

5:13	
current breakpoint	total number of breakpoints

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

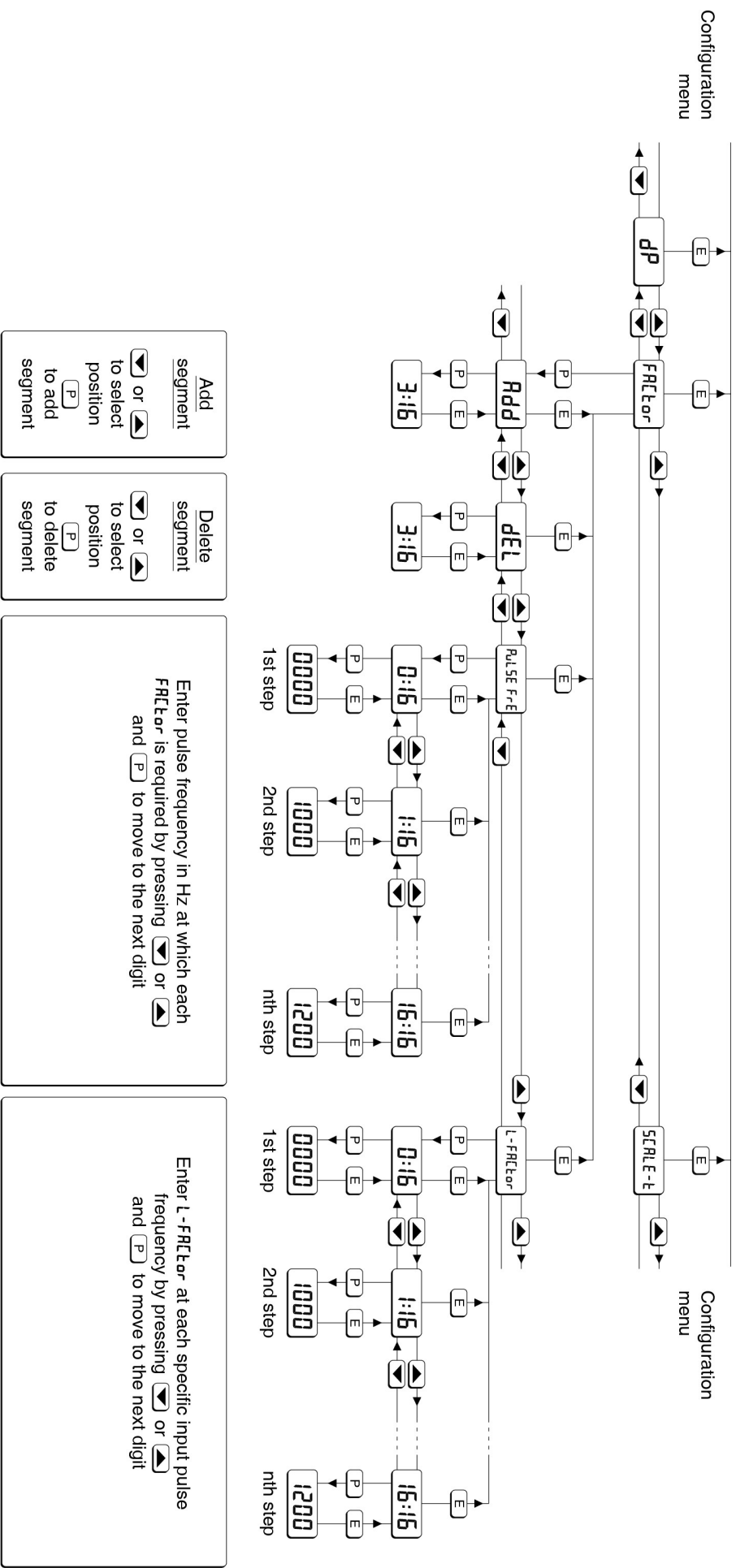


Fig 9 Lineariser configuration menu

For each segment an input pulse frequency in Hz *PuLSE Fr* and a corresponding flowmeter K-factor *L-FRACtor* are required. See section 6.1

Lineariser factory defaults are shown below:

Break point	<i>PuLSEFrE</i>	<i>L-FRACtor</i>
0.1	0Hz	1.00
1.1	5000Hz	1.00

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

Add**Add a segment**

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 6.3

dEL**Remove a segment**

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

See section 6.4

PuLSE Fr**Pulse input frequency**

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

See section 6.5

L-FRACtor**Flowmeter K-factor**

The rate totaliser pulse input is divided by *L-FRACtor*, which is usually set to the K-factor of the flowmeter, thus converting the flowmeter output into engineering units. *L-FRACtor* may be adjusted between 0.0001 and 99999.

Up to 16 values for *L-FRACtor* may be entered, each starting at a specified input pulse frequency *PuLSE Fr*.

See section 6.6

6.3 Add a segment: Add

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

current total number
breakpoint of breakpoints

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 **[V]** or **[A]** push button. When inserting an additional segment, the identification numbers of all segments equal to and above the insertion point are increased by one.



Press **[E]** to return to the *Add* prompt in the *FRACtor* sub-menu.


6.4 Remove a segment: dEL

dEL is a sub-menu in the *FRACtor* function that enables any segment to be removed from the lineariser configuration. Select *FRACtor* in the configuration menu and press **[P]**, which will reveal one of four sub-functions. If *dEL* is not displayed repeatedly press the **[V]** or **[A]** button to select *dEL* followed by **[P]** which will cause the current segment with the total number of segments to be displayed as shown below:

current total number
breakpoint of breakpoints





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.

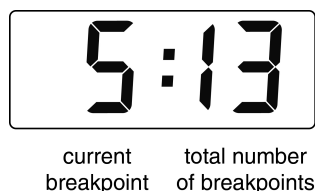
If removing a segment from a configured lineariser, the segment to be deleted, which is shown on the left hand side of the display, can be selected using the  or  push button. When a segment is deleted, the identification numbers of all segments above the deleted segment are decreased by one.










Press  to return to the *dEL* prompt in the lineariser sub-menu.


6.5 Input frequency: *PuLSE Fr*

PuLSE Fr is a sub-menu in the *FR[Error]* function for entering the pulse input frequency at which each of the lineariser segments starts, see Fig 8.

To enter the input pulse frequency at which one or more lineariser segments start, select *FR[Error]* in the configuration menu and press  which will reveal one of four sub-functions. If *PuLSE Fr* is not displayed repeatedly press the  or  button to select *PuLSE Fr* followed by  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 *Rdd* 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 button. When selected press  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  will transfer control to the next digit. When the input frequency for this lineariser segment is set as required, press the  button to return to the segment identification display from which the next segment may be selected using  or  push button.





When the input frequency for all of the segments has been entered, return to the *FR[Error]* prompt in the configuration menu by operating the  push button.



6.6 Flowmeter K-factor *L-FR[Error]*

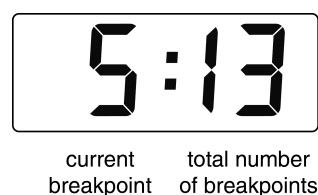
L-FR[Error] is a sub-menu in the *FR[Error]* function for entering the flowmeter K-factor for each of the lineariser segments, see Fig 9.






The rate totaliser pulse input is divided by *L-FR[Error]*, 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-FR[Error]* 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 *FR[Error]* in the configuration menu and press , which will reveal one of four sub-functions. If *L-FR[Error]* is not displayed in the sub-menu repeatedly press the  or  button to select *L-FR[Error]* followed by  to display the current segment for which *L-FR[Error]* will be entered and the total number of segments that have already been defined using the *Rdd* and *dEL* functions.

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  which will reveal the current *L-FR[Error]* 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  will transfer control to the next digit. When all the digits have been adjusted pressing  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-FR[Error]* for this lineariser segment is set as required, press the  button to return to the segment identification display from which the next segment may be selected using  or  push button. When *L-FR[Error]* for all of the segments has been entered, return to the *FR[Error]* prompt in the configuration menu by operating the  push button twice.

6.7 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 *URLuErr* will be displayed.

7. CONFIGURATION EXAMPLE

In this example a BA537E Rate Totaliser is connected to a turbine flowmeter having a K-factor of 105 pulses per litre with a magnetic pick-off.

The BA537E 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 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 totalisation 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

8.1 Configuration procedure

The BA537E Rate Totaliser may be configured on-site without disconnection from the power supply or from the flowmeter.

Step 1 Enter the configuration menu

Enter the configuration menu by simultaneously pressing **[P]** and **[E]**. Assuming a security code has not already been entered the instrument will respond by displaying *Funct, on* which is the first function in the configuration menu. See Fig 7.

Step 2 Select a linear function

With *Funct, on* displayed press **[P]** to reveal the function of the Rate Totaliser. Using the **[▼]** or **[▲]** button select *5td* to switch off the lineariser and provide a linear function. Press **[E]** to enter the selection. See 5.4

Step 3 Select the type of input & debounce

Using the **[▼]** or **[▲]** button select *, nPdt* in the configuration menu and press **[P]** which will reveal the sub-menu. Again using the **[▼]** or **[▲]** button select *, nP.tYPE* and press **[P]** to reveal the existing input. The Rate Totaliser is required to work with a magnetic pick-off so using the **[▼]** or **[▲]** button select *[m, L]* followed by **[E]** to return to the *, nP.tYPE* prompt in the sub-menu. Using the **[▼]** or **[▲]** button select *dEbauncEE* from the sub-menu and press **[P]**. Using the **[▼]** or **[▲]** button select *dEFRuLE* which will provide moderate pulse edge noise protection. If the Rate Totaliser is subsequently found to miscount the noise rejection can be increased. Enter the selection and return to the *, nPdt* prompt in the configuration menu by pressing the **[E]** button twice. See 5.6 and 5.7

Step 4 Select the interval between display updates

Using the **[▼]** or **[▲]** button select *, PdRE* 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 *, PdRE* prompt in the configuration menu by pressing the **[E]** button. See 5.8

Step 5 Upper display

Using the **[▼]** or **[▲]** button select *d, 5P-1* in the configuration menu and press **[P]** to select whether flow rate or total flow 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 display. Therefore using the **[▼]** or **[▲]** button select *totRL* and press **[E]** to enter the selection and return to the *d, 5P-1* prompt in the configuration menu. See 5.9

Step 6 Lower display

Using the **[▼]** or **[▲]** button select *d, 5P-2* in the configuration menu and press **[P]** which will show if the lower display is *on* or *off*. 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 *on* and press **[E]** to enter the selection and return to the *d, 5P-2* prompt in the configuration menu. See 5.10

Step 7 Position rate & total decimal points

Select *dP* from the configuration menu and press **[P]**. 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 **[P]** 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 **[E]** button to enter the selections and return to the *dP* prompt in the configuration menu. See 5.11

Step 8 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 is divided by FRC_{tor} , which is adjustable between 0.0001 and 99999. When set to the K-factor of the flowmeter FRC_{tor} converts the flowmeter output into engineering units ready for further scaling to produce the required rate and total flow displays.

Using the \blacktriangledown or \blacktriangle push button select FRC_{tor} from the configuration menu and press P to show the existing value with one digit flashing. Enter 105 using the \blacktriangledown or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit and to position the decimal point. Finally return to the FRC_{tor} prompt in the configuration menu by pressing E . The output from FRC_{tor} will now be in litres which may be scaled to produce required rate and total displays. See 5.12

Step 9 Enter the total scale factor

The Total Scale Factor $SC_{LE.t}$ 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 SC_{LE-t} should be set to 1000.

Using the \blacktriangledown or \blacktriangle push button select $SC_{LE.t}$ from the configuration menu and press P to reveal the existing value with one digit flashing. Enter 1000 using the \blacktriangledown or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit and to position the decimal point. Finally, return to the $SC_{LE.t}$ prompt in the configuration menu by pressing E . The total flow display is independent of the rate display. See 5.13

Step 10 Enter the rate scale factor

$SC_{LE.r}$ is a dividing factor adjustable between 0.0001 and 99999 that enables the flow rate to be displayed in the required engineering units. The rate display timebase is determined by $t-b_{RSE}$ that is adjusted in Step 11.

In this example the rate of flow display is required in imperial gallons. FRC_{tor} , which was adjusted in Step 8 of this example produces an output in Litres that must be converted to imperial gallons. There are 4.5461 Litres in an imperial gallon so $SC_{LE.r}$ should be adjusted to 4.5461

Using the \blacktriangledown or \blacktriangle push button select $SC_{LE.r}$ from the configuration menu and press P to reveal the existing value with one digit flashing. Enter 4.5461 using the \blacktriangledown or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit and to position the decimal point. Finally return to the $SC_{LE.r}$ prompt in the configuration menu by pressing E . The flow rate display is independent of the total flow display. See 5.14

Step 11 Enter the rate timebase

The rate timebase determines whether flow 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 $t-b_{RSE}$ from the configuration menu and press P . Again using the \blacktriangledown or \blacktriangle push button select $t-b-3600$ from the three options which will multiply the rate display by 3600. Return to the $t-b_{RSE}$ prompt in the configuration menu by pressing E . See 5.15

Step 12 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 ▼ or ▲ push button select **FILTER** from the configuration menu and press **P**.

The first digit, which controls the filter time constant, will be flashing and should be set to 2 using the ▼ or ▲ push button. The **P** button will transfer control to the second digit, which controls the step response and should be set to 0 in the same way. When entered return to the **FILTER** prompt in the configuration menu by pressing **E**.

See 5.16

Step 13 Define clip-off

To prevent totalisation of low flow rates clip-off defines a 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.

Using the ▼ or ▲ push button select **CLP OFF** from the configuration menu. Press **P** which will reveal the current clip-off threshold in gallons per hour i.e. the same units already selected for the rate display. Enter 10 using the ▼ or ▲ push button to adjust the flashing digit and the **P** button to transfer control to the next digit. Finally, store the new clip-off threshold and return to the **CLP OFF** prompt in the configuration menu by pressing **E**.

See 5.17

Step 14 Local reset of total and grand total

Two separate functions in the **LOCAL LTR** sub-menu may be individually activated to enable the operator to reset the total and grand total displays from the totalisation mode without entering the configuration menu.

In this example the operator is required to be able to reset the total display but not the grand total display when the BA537E Rate Totaliser is in the totalisation mode. Using the ▼ or ▲ button select **LOCAL LTR** in the configuration menu and press **P** which will reveal the sub-menu. Again using the ▼ or ▲ button select the local total reset function **LTR tot** and press **P**. This function is required so using the ▼ or ▲ button select **on** followed by **E** to return to the **LTR tot** prompt in the sub-menu.

Using the ▼ or ▲ button select the local grand total reset function **LTR gtot** and press **P**. This function is not required so using the ▼ or ▲ button select **off**. Finally return to the **LOCAL LTR** prompt in the configuration menu by pressing the **E** button twice.

See 5.18, 5.19 and 5.20.

Step 15 Reset the grand total to zero

Before completing configuration the Rate Totaliser's grand total should be reset to zero. Using the ▼ or ▲ button select **LTR gtot** in the configuration menu and press **P** which will cause **LTR no** to be displayed with **no** flashing. Again using the ▼ or ▲ button select **LTR YES** with **YES** flashing. Press **P** which will result in 0000 being displayed with one digit flashing. This is a request for the instruction to be confirmed by entering 5000 using the ▼ or ▲ button to set each digit and the **P** button to move control to the next digit.

Pressing **E** will then reset the grand total to zero and return the instrument to the **LTR gtot** prompt in the configuration menu.

See 5.21.

Step 16 Define the security code

Defining a security code prevents unauthorised access to the configuration menu. Using the ▼ or ▲ buttons select **SecE** from the configuration menu and press **P** which will result in 0000 being displayed 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 the digits of the new code have been entered press **E** to store the code and return to the main configuration menu.

See 5.22.

Step 17 Return to the totalisation mode

Configuration of the BA537E is now complete. Pressing the **E** button will save the new configuration and return the Rate Totaliser to the totalisation mode. The BA537E will display **RRRR** followed by **SRUE** while the new information is being stored in permanent memory.

8. MAINTENANCE

8.1 Fault finding during commissioning

If a BA537E or a BA538E 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 & RS2 are interconnected within the instrument.	That there is between 10 and 28V on terminals 1 & 2 with terminal 1 positive.
Rate Totaliser is receiving power but flow indicator not rotating	No input pulses, incorrect input configuration, incorrect linking of terminals 3 & 4	Input configuration. Linking of terminals 3 & 4. That input signal polarity is correct.
Flow indicator rotating but incorrect rate display	Incorrect rate display calibration	RESET or SCALE rate display
Flow indicator rotating but incorrect total display	Incorrect total display calibration. Remote reset switch contacts closed	RESET or SCALE That RESET annunciator is not activated. If it is, check reset wiring and switch.
Flow indicator rotating, but zero rate display, no totalisation and HOLD annunciator activated.	CLIP OFF is activated	CLIP OFF and if necessary adjust threshold.
Unstable rate display	Noisy pulse input signal	Eliminate source of electrical noise. Increase debounce and/or display filter.
Unable to enter configuration menu.	Incorrect security code	That the correct security code is being used. Contact BEKA if code is lost.
Clip-off does not function	Clip-off has automatically reset to zero following change of rate display calibration.	Reconfigure CLIP OFF
Alarms do not function	Alarms have been disabled following calibration change	Re-enable both alarms.

8.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

If a BA537E or a BA538E fails after it has been functioning correctly, the following table may help to identify the cause of the failure.

Symptom	Cause	Check:
No display	No power supply.	That there is between 10 and 28V on terminals 1 & 2
Flow indicator not rotating	No input pulses	Output from flowmeter. Wiring between flowmeter and Rate Totaliser.
Flow indicator rotating, rate display is zero and totalisation. HOLD annunciator is not activated.	Input below clip-off threshold.	CLIP OFF threshold and if necessary adjust.
Unstable rate display	Noisy pulse input signal	Locate source of electrical noise, or increase debounce and rate display filter.

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

8.3 Servicing

We recommend that faulty BA537E and BA538E rate totalisers are returned to BEKA associates or to our local agent for repair.

8.4 Routine maintenance

The mechanical and electrical condition of the instrument should be regularly checked. Initially annual inspections are recommended, but the inspection frequency should be adjusted to suit the environmental conditions.

8.5 Guarantee

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

8.6 Customer comments

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

9. ACCESSORIES

Accessories for the two models differ as shown below, all except the scale card, are factory fitted and should be specified when the instrument is ordered:

BA537E 96 x 48mm	BA538E 144 x 72mm
Scale card	Scale card
Tag number	Tag number
Backlight ¹	Backlight ¹
Isolated dual alarms ² or Isolated 4/20mA output ² or Isolated pulse output ²	Isolated dual alarms Isolated 4/20mA output See note 3

Notes:

1. Internally powered
2. Only one of the three output options may be fitted to a BA537E.
3. All BA538E Rate Totalisers are fitted with an isolated pulse output.

9.1 Scale card

Both models have a window on the right hand side of the display through which to view a scale card showing the units of measurement such as Gals/hour or Litres. New Rate Totalisers are fitted with a scale card showing the units of measurement specified when the instrument was ordered, if the units are not specified a blank scale card will be fitted. A pack of scale cards pre-printed with common units of measurement is available as an accessory. These can easily be fitted on-site to the Rate Totaliser without opening the instrument enclosure or removing it from the panel. See section 4.4 of this instruction manual.

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

9.2 Tag information

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

9.3 Backlight

The BA537E and the BA538E Rate Totalisers 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. Both the BA537E and BA538E backlights are internally powered from the instrument power supply so that no additional wiring or intrinsically safe interface is required, but the instrument supply current increases.

	Current consumption	
	BA537E	BA538E
Without backlight	10.0mA	10.0mA
Addition for backlight	22.5mA	16.0mA
Addition with terminals 3 & 4 linked	6.0mA	6.0mA
Total current	38.5mA	32.0mA

9.4 Alarms

The BA537E and BA538E can be supplied with factory fitted dual solid state single pole alarm outputs that may be independently programmed as high or low, rate or total alarms with normally open or normally closed outputs. Only one output option can be fitted to a BA537E.

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

CAUTION

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

When the BA537E or BA538E 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 each alarm. If an alarm delay or silence time has been selected the annunciator will flash during the delay or silence period.

The BA537E and BA538E internal counters are updated 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.

9.4.1 Solid state output

Each alarm has a galvanically isolated single pole solid state switch output as shown in Fig 10. 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.

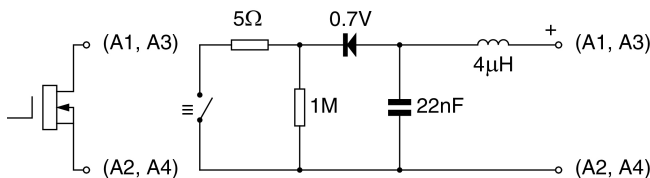


Fig 10 Equivalent circuit of each alarm output

The solid state output of each alarm may be used to switch any circuit with parameters equal or less than:

$$\begin{aligned} V &= 30V \\ I &= 200mA \end{aligned}$$

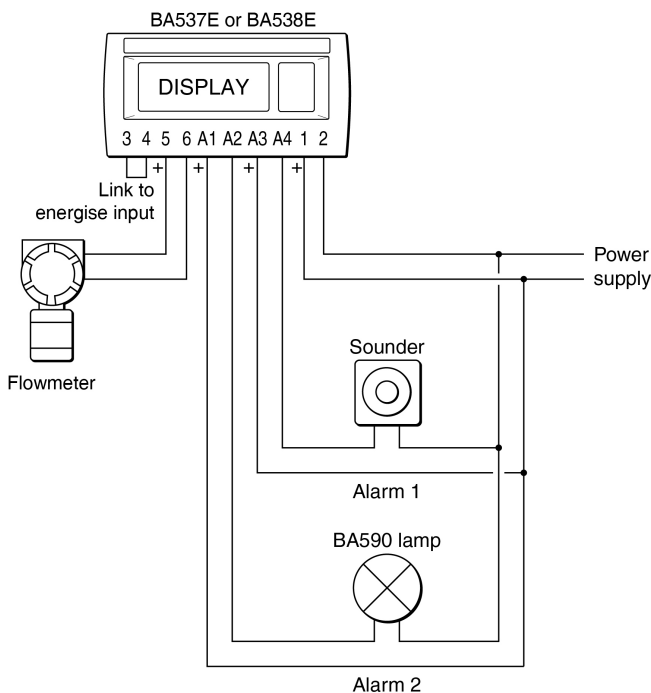


Fig 11 Typical alarm application

9.4.2 Configuration and adjustment

When a BA537E or BA538E is supplied with alarms the configuration menu is extended as shown in Fig 12. The alarm functions appear after CLR ENTER , and each alarm may be configured to operate on the rate or total display.

For simplicity Fig 12 only shows the configurable functions on the rate option of alarm AL1, the total options is identical except that total alarms do 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
---------	---------------------

Enbl	Alarm enable
-------------	---------------------

Enables or disables the alarm without changing the alarm parameters. See section 9.4.3

TYPE	Type of alarm
-------------	----------------------

Defines whether the alarm operates on the rate or total display. See section 9.4.4

SP Ir or SP It	Alarm setpoint 1
-----------------------	-------------------------

Adjusts the alarm setpoint. The alarm is activated when the rate or total display equals the setpoint.
--

Note: SP Ir is displayed for a rate alarm and SP It for a total alarm. See section 9.4.5
--

Hi..Lo	Alarm function
---------------	-----------------------

Defines whether the alarm has a high or low function. See section 9.4.6
--

no.nc	Normally open or normally closed output.
--------------	---

Determines whether the single pole alarm output is open or closed in the non-alarm condition. See section 9.4.7
--

H5tr	Hysteresis
-------------	-------------------

Adjusts the alarm hysteresis. Only available on a rate alarm. See section 9.4.8
--

dELR	Alarm delay time
-------------	-------------------------

Adjusts the delay between the display equaling the setpoint and the alarm output being activated. See section 9.4.9
--

Display	Summary of function
SL	Alarm silence time Defines the time that the alarm output remains in the non-alarm condition following acceptance of an alarm. See section 9.4.10
FLASH	Flash display when alarm occurs When enabled, alternates the rate or total display between process value and alarm reference $RL1$ or $RL2$ when an alarm output is activated. See section 9.4.11
RLSP	Access setpoint Sub-menu that enables direct access to the alarm setpoints from the totalisation mode and defines a separate security code. See section 9.4.12

9.4.3 Alarm enable: $ENBL$

This function allows the alarm to be enabled or disabled without altering any of the alarm parameters. Using the ∇ or \blacktriangle push button select $RL1$ or $RL2$ from the configuration menu and press P to access the alarm sub-menu. Press the ∇ or \blacktriangle button until $ENBL$ is displayed followed by P which will reveal if the function is ON or OFF . The setting can be changed by pressing the ∇ or \blacktriangle push button followed by the E button to return to the alarm sub-menu.

9.4.4 Type of alarm: $TYPE$

Alarm 1 and Alarm 2 are totally independent, both may be rate or total alarms, or one may be conditioned for rate and the other for total.

Using the ∇ or \blacktriangle push button select $TYPE$ from the selected alarm sub-menu and press P to check or change the function. The ∇ or \blacktriangle push button will toggle the selection between $RATE$ and $TOTAL$, when set as required press the E button to return to the alarm sub-menu.

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.

9.4.5 Setpoint adjustment: $SP1r$ & $SP2r$

The rate alarm setpoints $SP1r$ and $SP2r$ may be positioned anywhere between 000000 and 999999 and the total alarm setpoint $SP1t$ and $SP2t$ anywhere between 00000000 and 99999999.

All the setpoints are adjusted in the same way, for example to adjust the setpoint of Alarm 1 which has been configured to operate on the rate display. Using the ∇ or \blacktriangle push button select $SP1r$ in the $RL1$ sub-menu and press P which will reveal the existing setpoint with one digit flashing. The required setpoint can be entered using the ∇ or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit. When set as required press E to enter the value and return to the $SP1r$ prompt in the alarm 1 sub-menu.

9.4.6 Alarm function: $H.La$

Alarm 1 and Alarm 2 are totally independent, both may be H or L , or one may be conditioned as a H alarm and the other as a L alarm.

Using the ∇ or \blacktriangle push button select $H.La$ from the selected alarm sub-menu and press P to check or change the function. The ∇ or \blacktriangle push button will toggle the alarm function between H and L , when set as required, press the E button to return to the $H.La$ prompt in the alarm sub-menu.

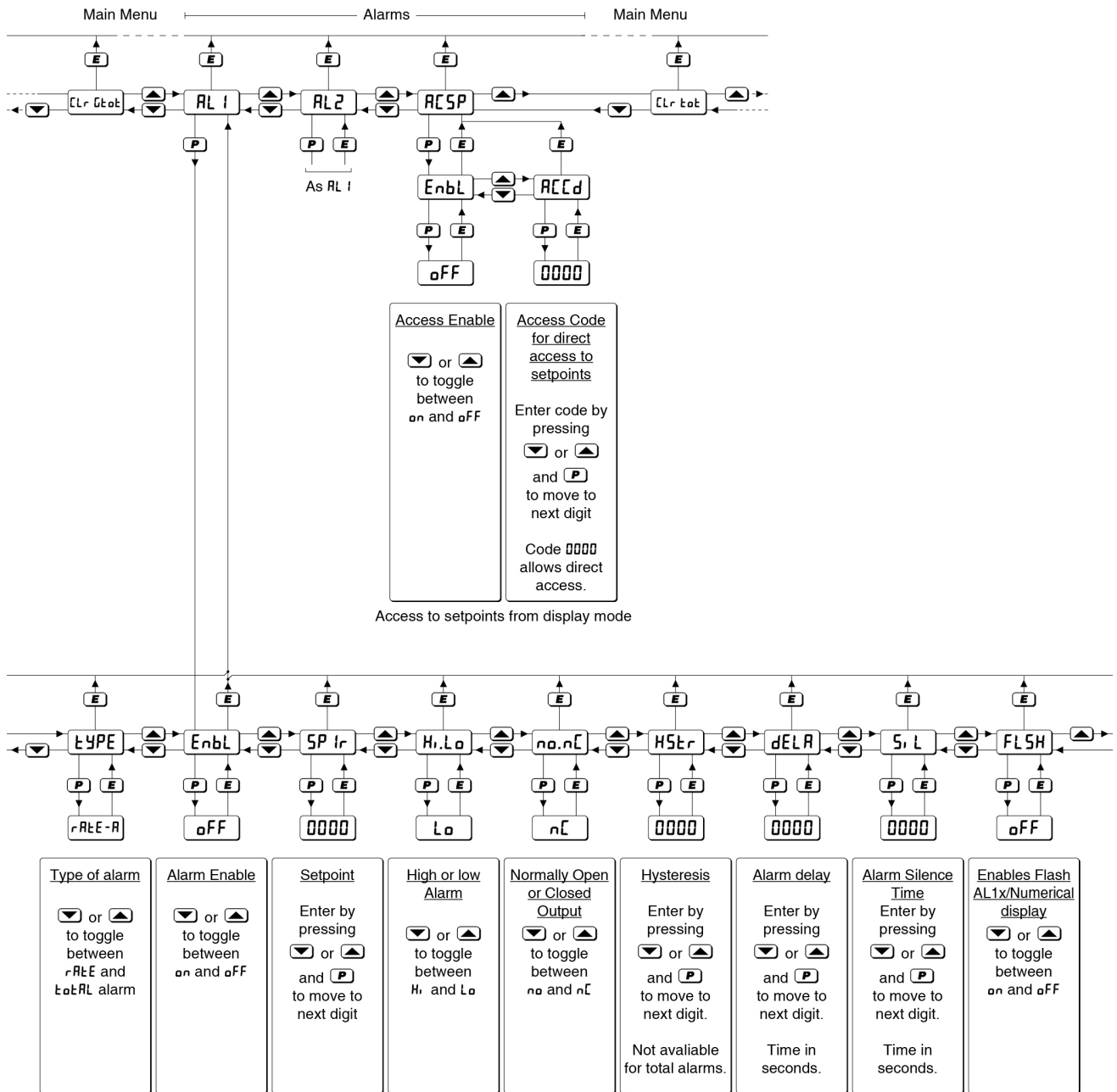


Fig 12 Alarm menu structure

9.4.7 Alarm output status: $\alpha\alpha.n\bar{L}$

Each single pole alarm output may be open or closed in the non-alarm condition. When the BA537E or BA538E power supply is turned off or disconnected, the alarm output(s) will open irrespective of whether normally open or normally closed outputs have been selected. Therefore when designing an alarm system normally closed $n\bar{L}$ should be selected so that the output opens when an alarm occurs or if the power supply fails.

Using the \blacktriangledown or \blacktriangle push button select $\alpha\alpha.n\bar{L}$ from the selected alarm sub-menu and press P to check or change the function. The \blacktriangledown or \blacktriangle push button will toggle the contact status between $n\alpha$ and $n\bar{L}$, when set as required, press the E button to return to the $\alpha\alpha.n\bar{L}$ prompt in the alarm sub-menu.

9.4.8 Hysteresis: $H5\bar{L}r$

Hysteresis is only available on rate alarms so the $H5\bar{L}r$ function only appears in the configuration sub-menu when alarm $\bar{L}YPE$ has been set to $rR\bar{L}E$. During configuration hysteresis is shown in the units of rate previously configured for the rate display.

Using the \blacktriangledown or \blacktriangle push button select $H5\bar{L}r$ in the selected alarm sub-menu and press P which will reveal the existing hysteresis with one digit flashing. The required hysteresis can be entered using the \blacktriangledown or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit. When set as required press E to enter the value and return to the $H5\bar{L}r$ prompt in the alarm sub-menu.

e.g. A Rate Totaliser configured to display a flow 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 equals or exceeds 4000, but will not reset until the flow falls below 3900.

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

The Rate Totaliser's 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.

9.4.10 Alarm silence time: $5, \bar{L}$

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 P push button becomes an alarm accept button.

After an alarm has occurred, operating the P button will cause the alarm output to revert to the non-alarm condition for the programmed alarm silence time. When an alarm is silenced by operating the P push button, the Rate Totaliser's alarm annunciator will flash until the silence time expires.

To adjust the alarm silence time select $5, \bar{L}$ using the \blacktriangledown or \blacktriangle push button in the selected alarm sub-menu and press P which will reveal the existing alarm silence time in seconds with one digit flashing. The required silence time can be entered using the \blacktriangledown or \blacktriangle push button to adjust the flashing digit and the P button to transfer control to the next digit. When set as required press E to enter the value and return to the $5, \bar{L}$ prompt in the alarm sub-menu.

9.4.11 Flash display when alarm occurs: $FL5H$

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

When enabled, this function alternates the rate or total display between the numerical value and the alarm identification $RL1$ or $RL2$ when an alarm occurs.

Using the \blacktriangledown or \blacktriangle push button select $FL5H$ from the selected alarm sub-menu and press P to check or change the function. The \blacktriangledown or \blacktriangle push button will toggle the function between αFF and αn , when set as required, press the E button to return to the $FL5H$ prompt in the alarm sub-menu.

9.4.12 Access Setpoint: $RL5P$

This function activates a separate menu that provides direct access to the alarm setpoints from the totalisation mode by simultaneously operating the P and \blacktriangle 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 security access code.

Using the ▼ or ▲ push button select *RESP* from the configuration menu and press **P** to reach the enable function *EnbL*. Pressing **P** 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 **E** button to return to the *EnbL* prompt from which a separate security access code can be entered using the *REEd* function which can be selected using the ▼ or ▲ push button.

To enter a new security code select *REEd* from the *RESP* sub-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** twice to return to the *RESP* prompt in the configuration menu. The revised security code will be activated when the Rate Totaliser is returned to the totalisation mode. Default security access code 0000 will disable the security code allowing direct access to the setpoints from the totalisation mode by pressing the **P** and ▲ buttons simultaneously.

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

9.4.13 Adjusting alarm setpoints from the totalisation mode

Access to the two alarm setpoints from the Rate Totaliser totalisation mode is obtained by operating the **P** and ▲ push buttons simultaneously as shown in Fig 16. If the setpoints are not protected by a security code the alarm setpoint prompt *SP 1x* or *SP 1t* will be displayed depending upon whether a rate or total alarm has been conditioned. If access to the setpoints is 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 ▲ button 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 result in the alarm setpoint prompt *SP 1x* 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 totalisation mode.

Once within the menu pressing the ▼ or ▲ buttons will toggle the display between the two alarm setpoint prompts *SP 1x* and *SP 2x*.

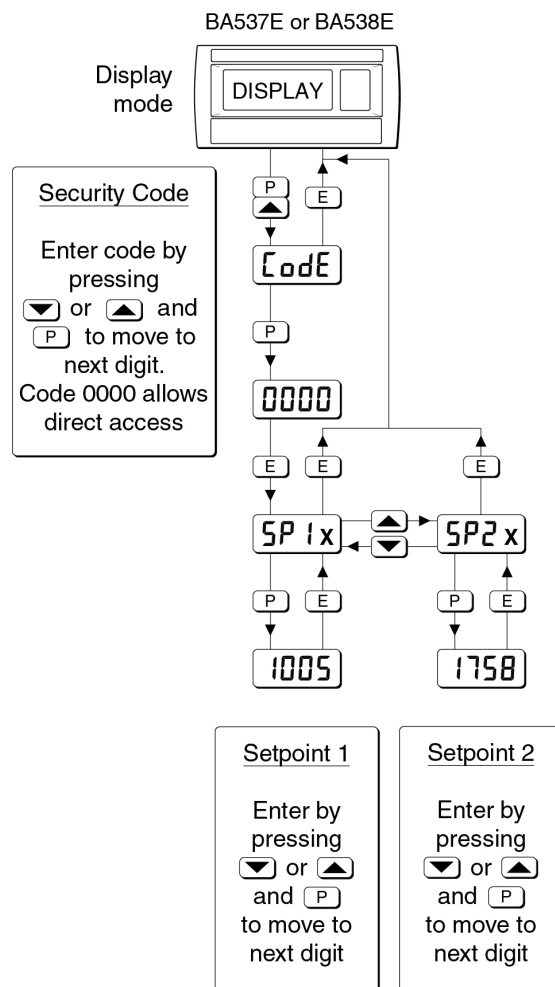


Fig 13 Setpoint adjustment from the totalisation mode

To adjust an alarm setpoint select *SP 1x* or *SP 2x* and press **P** which will reveal the existing value. The flashing digit of the setpoint may be adjusted using the ▼ or ▲ push button and 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 *SP 1x* or *SP 2x* prompt from which the other setpoint may be selected, or the instrument may be returned to the totalisation mode by pressing **E** again.

Note: Direct access to the alarm setpoints is only available when the menu is enabled - see section 9.4.12

9.5 Pulse output

All BA538E Rate Totalisers are supplied with an opto-isolated pulse output. The pulse output is available as a factory fitted option on the smaller BA537E Rate Totaliser, but only one output option can be fitted to this model.

The pulse output is an open collector having the following parameters:

R_{on}	=	$60\Omega + 3V$
R_{off}	=	1M
I_{max}	=	10mA

The output pulse may be a duplicate of the input pulse for re-transmission applications, or it may be derived from the least significant digit of the total display. When derived from the total display the output pulse frequency may be divided and the output pulse width defined.

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 $60\Omega + 3V$.

direct

Annunciator continuously activated

9.5.1 System design

The Rate Totaliser pulse output is a passive circuit i.e. not powered, but it is totally isolated from all other Rate Totaliser circuits. The pulse output terminals P1 and P2 may be connected to another instrument which will accept an open collector input.

Fig 14 shows how a resistor may be used to produce a voltage pulse. The positive terminal of the pulse output circuit P1 is connected to the BA537E or BA538E Rate Totaliser's positive supply terminal 1 at the instrument. When an output pulse occurs and the open collector 'closes', P2 is connected to P1 and a pulse output current flows through the resistor R1. The current flowing in the circuit is determined by resistor R1 which should be chosen to limit the output current to less than 10mA. For a 24V supply R1 should therefore be greater than 2,200 Ω .

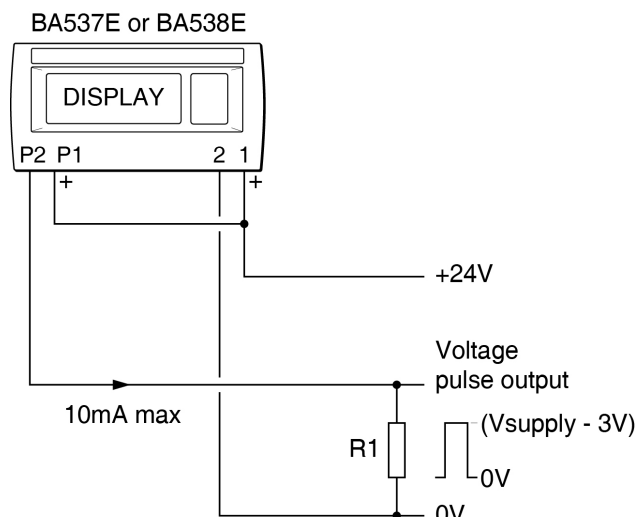


Fig 14 Producing a voltage pulse output

9.5.2 Configuration

All BA538E Rate Totalisers are supplied with an opto-isolated pulse output, the pulse output is also available as a factory fitted option on the smaller BA537E. Therefore the pulse output menu shown in Fig 15 appears in the configuration menu of all BA538E Rate Totalisers, but only in the configuration menu of BA537E Rate Totalisers having an optional factory fitted pulse output.

The pulse output sub-menu enables 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 the input pulse by selecting *direct* in the *SOURCE* sub-function. Alternatively, selecting *SCALE#* derives the output pulse from incrementation of the least significant digit of the total display. When *SCALE#* 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.

9.5.3 Pulse output: PULSE #P

The pulse output is configured in a sub-menu which is accessed via the *PULSE #P* function which is included in all BA538E configuration menus and in BA537E configuration menus when the optional pulse output option is fitted.

Using the or push button scroll through the configuration menu until *PULSE #P* is displayed, pressing will then access the pulse output sub-menu which is shown in Fig 15.

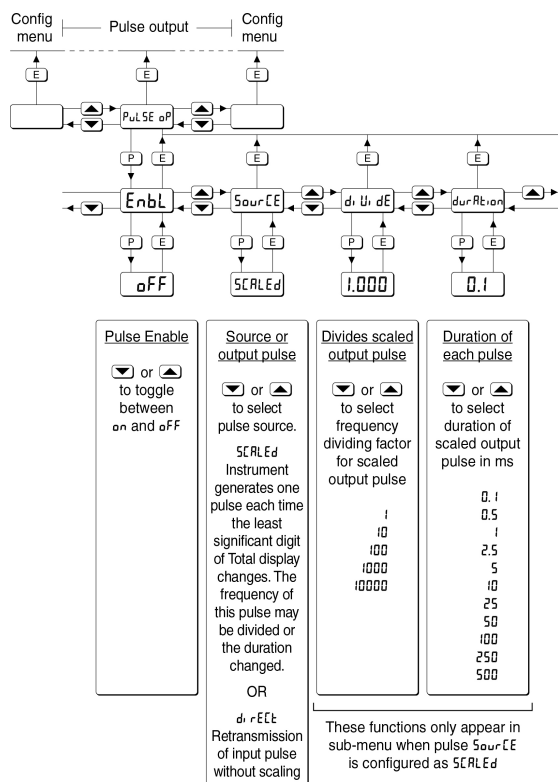


Fig 15 Pulse output configuration sub-menu

9.5.4 Enable pulse output: **Enbl**

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

9.5.5 Source of output pulse: **Source**

The output pulse may be derived from:

- SCALed** Incrementation of least significant digit of the total display. May be divided and width defined by the **d, U, dE** and **duration** functions to generate the required output pulse.
- d, rEEt** Output is synchronous duplicate of the Rate Totaliser input pulse.

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

9.5.6 Divide output pulse frequency: **d, U, dE**

When **SCALed** is selected in the **Source** sub-function (9.5.9) the output pulse is derived from incrementation of the least significant digit of the total display divided by one of the following five factors to produce the output pulse:

1
10
100
1000
10000

Using the ∇ or \blacktriangle push button select **d, U, dE** in the pulse output sub-menu and press **P** which will reveal the existing divisor. The selected divisor can be changed by pressing the ∇ or \blacktriangle push button followed by the **E** button to return to **d, U, dE** prompt in the sub-menu.

Note: This function only appears in the pulse output sub-menu when the **SCALed** is selected in the **Source** sub-function (9.5.5).

9.5.7 Output pulse width: **duration**

When **SCALed** is selected in the **Source** sub-function (9.5.5) the output pulse width is defined by this function. One of following millisecond pulse widths may be selected:

0.1
0.5
1
2.5
5
10
25
50
100
250
500

Using the ∇ or \blacktriangle push button select **duration** in the pulse output sub-menu and press **P** which will reveal the existing pulse duration. The value can be changed by pressing the ∇ or \blacktriangle push button to select the required value followed by the **E** button to return to **duration** prompt in the sub-menu.

Note: This function only appears in the pulse output sub-menu when the **SCALed** is selected in the **Source** sub-function (9.5.5).

9.5.8 Pulse storage

If the **d, U, dE** and **duration** 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 the total display is reset to zero or the power supply to the Rate Totaliser is disconnected or turned off, any stored pulses will not be retained.

9.6 4/20mA output

Both the BA537E and BA538E Rate Totalisers can be supplied with a factory fitted galvanically isolated 4/20mA output which may be configured to represent the rate or total display. Only one output option can be fitted to a BA537E.

9.6.1 System design

The Rate Totalisers 4/20mA output is a galvanically isolated passive current sink i.e. not powered, but it is totally isolated from all other Rate Totaliser circuits. It is effectively a 2-wire 4/20mA transmitter requiring a minimum supply of 5V with its current being controlled by the Rate Totaliser. The 4/20mA output terminals C1 and C3 may be connected to any other instrument which will accept a 4/20mA transmitter input and has a least a 10V output.

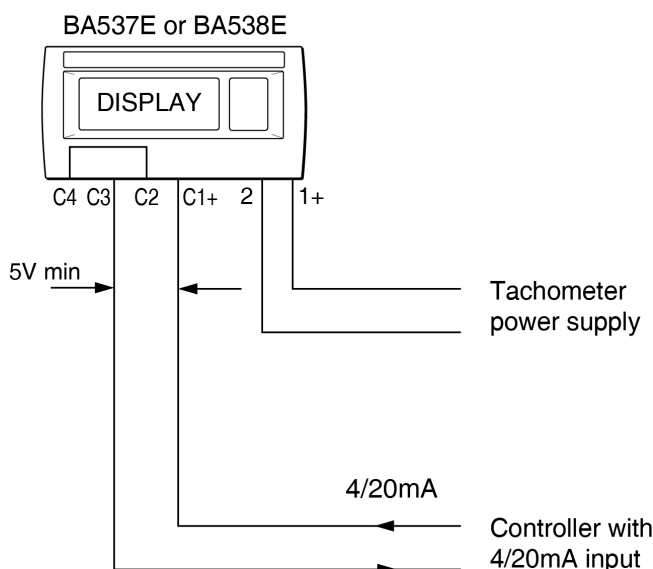


Fig 16 Application of 4/20mA output

9.6.2 Configuration

When a Rate Totaliser is supplied with an optional 4/20mA output the configuration menu is extended as shown in Fig 17. The 4/20mA output sub-menu is accessed via the 4-20 oP 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.

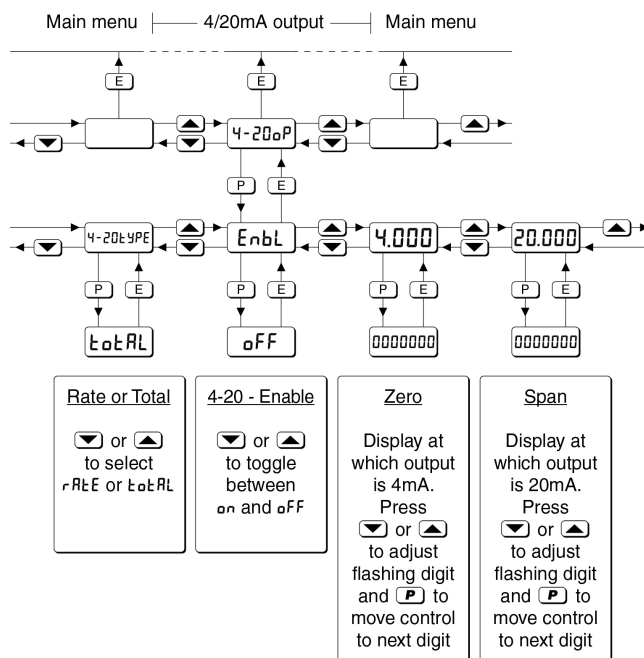


Fig 17 4/20mA output configuration sub-menu

9.6.3 4/20mA output: 4-20 oP

Access the Rate Totaliser's configuration menu as described in section 5.2. Using the ▼ or ▲ push buttons scroll through the menu until 4-20 oP is displayed, pressing P will then access the 4/20mA output sub-menu which is shown in Fig 17.

9.6.4 Enable 4/20mA output: EnbL








This function allows the 4/20mA current output to be disabled or enabled without altering the calibration. Using the ▼ or ▲ push button select EnbL in the 4-20 oP sub-menu and press P to reveal the existing setting on or off. The function can be changed by pressing the ▼ or ▲ push button followed by the E button to return to EnbL prompt in the sub-menu.

9.6.5 Select rate or total source: 4-20 oP E








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 ▼ or ▲ push button select 4-20 oP E in the 4/20mA output sub-menu and press P to reveal the existing setting tOtRL or rRtE. The function can be changed by pressing the ▼ or ▲ push button followed by the E button to return to the 4-20 oP E prompt in the sub-menu.

9.6.6 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  or  push button select 4000 in the 4/20mA output sub-menu and press  which will reveal the existing rate or total display with one digit flashing. The required display 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 4.000 prompt in the 4/20mA output sub-menu.

9.6.7 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  or  push button select 20.000 in the 4/20mA output sub-menu and press  which will reveal the existing rate or total display with one digit flashing. The required display 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 20.000 prompt in the 4/20mA output sub-menu.

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.