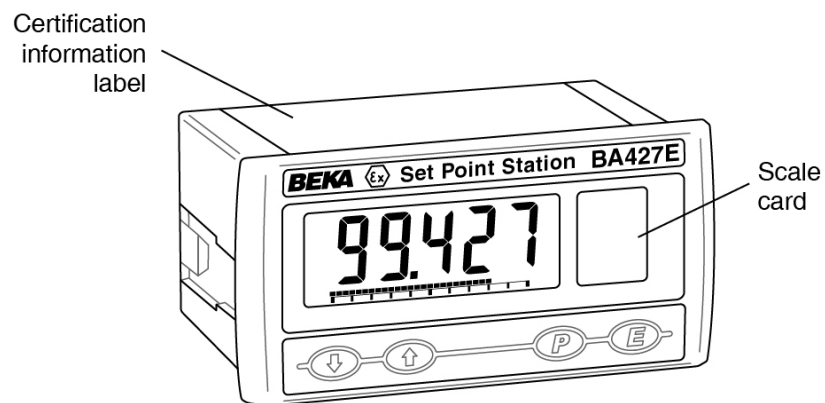


BA427E
intrinsically safe
2-wire 4/20mA
manual set point
station.

**For instruments with firmware 1.04
and later. Issued June 2015.**

Issue 12



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Appendix 1 Dust certification**Appendix 2 IECEx certification**

**The BA427E Set Point Station is CE marked to show compliance with the following European Directives
Explosive Atmospheres 2014/34/EU; EMC 2014/30/EU and RoHS 2015/863/EU plus Annex II to 2011/65/EU .**

**The BA427E Set Point Station is also UKCA marked to show compliance with following UK statutory requirements
Potentially Explosive Atmospheres Regulations UKSI 2016:1107 (as amended); EMC Regulations UKSI 2016:1091
and UKSI 2012/3032 RoHS Regulations 2012.**

1. DESCRIPTION

The BA427E is an intrinsically safe, loop powered, panel mounting Set Point Station which enables the current flowing in a 4/20mA loop to be manually adjusted from within a hazardous process area via the front panel push buttons, or an optional external rotary control. The BA427E output is adjustable between 3 and 22mA but the output range may be restricted if only limited adjustment is required. In addition to the output being continuously variable, five pre-set output currents may be configured and subsequently selected from the front panel push buttons. To minimise plant disturbance the maximum output rate of change may be defined.

Adjustment of a plant parameters represented by a 4/20mA current is the main application for BA427E Set Point Stations. A controller set point, actuator position or any 4/20mA variable may be manually adjusted.

The BA427E incorporates a 5 digit display and a 31 segment bargraph which may be calibrated to display the 4/20mA output current in any linear engineering units. An optional factory fitted backlight, which may be loop or separately powered, enables this display to be read in all lighting conditions.

All BA427E Set Point Stations and the optional backlight have been certified intrinsically safe for use in gas and dust hazardous areas by Notified Body Intertek.

All BA427E Set Point Stations and the optional backlight also have UKCA gas and dust intrinsic safety certification.

For international applications the BA427E has IECEx certification which is described in Appendix 2.

2. OPERATION

This instruction manual describes ATEX system design and installation for use of the BA427E in a gas hazardous area. Please refer to Appendix 1 for details of ATEX dust certification and to Appendix 2 for IECEx certification.

Fig 1 shows a simplified block diagram of the BA427E manual Set Point Station. The 4/20mA current flowing in the loop may be manually set at any value between approximately 3 and 22mA using the front ▲ and ▼ panel push buttons. Initially the output current changes slowly, but after the button has been pressed for five seconds the rate of change accelerates to allow large changes to be made quickly.

The five pre-set outputs, which are selectable via the instruments front panel push buttons, allow the operator to quickly select frequently used plant set points.

To prevent plant disturbance the maximum rate of output current change initiated by operating the front panel push buttons, switching between pre-set outputs or using an optional external encoder may be defined.

The output resistance of the BA427E is very high, within the specified operating voltage range, the loop current will therefore be unaffected by changes in the supply voltage.

Caution

The BA427E output should not be used for critical safety applications.

Versatile calibration facilities allow the 5 digit internal display to show the 4/20mA output current in linear engineering units. For example, in an application where the BA427E is being used to adjust the set point of a speed controller, the internal indicator may be calibrated to display the required speed in RPM.

For applications in poorly illuminated areas a factory fitted green backlight is available which may be loop or separately powered. When loop powered the backlight produces background illumination enabling the display to be read at night or in poor lighting conditions. No additional power supply, intrinsic safety interface or field wiring are required, but the Set Point Station voltage drop is increased. When separately powered, the backlight is brighter but an additional intrinsic safety interface and field wiring are required.

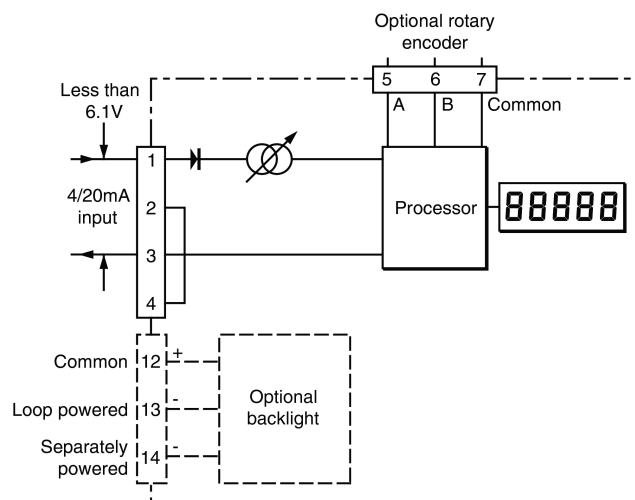


Fig 1 Simplified block diagram of BA427E

2.1 Controls - two handed

The BA427E Set Point Station is controlled and configured via four front panel push buttons located below the display. In the operating mode i.e. when the Set Point Station is controlling the loop current and the display is showing the output in engineering units, these push buttons can have two alternative sets of functions depending upon if the Set Point Station has been configured for two or single handed operation..

Two handed operation is the default configuration which minimises the possibility of accidental adjustment. of the output current by requiring that the **E** button be pressed at the same time as the ▼ or ▲ button to make an adjustment. This configuration also prevents the optional external encoder from adjusting the output current unless the **E** button is operated.

E + ▼ Output current slowly decreases. After five seconds the rate of change accelerates so that large changes may be made quickly. .

E + ▲ Output current slowly increases. After five seconds the rate of change accelerates so that large changes may be made quickly.

E Continuously pushing this button for 5 seconds allows the Set Point Station output to be entered in engineering units digit by digit using the ▲ or ▼ push button to adjust the flashing digit and the **P** button to move control to the next digit. When set as required, pressing the **E** button will enter the new set point.

P While this button is pushed the BA427E Set Point Station will display one of three alternatives depending upon how the instrument has been configured:

Output current mA without bargraph

Output as a % of span

Pre-set outputs in engineering units

The display will flash. While continuing to press the **P** button, operating the ▼ or ▲ button will show the identification of the pre-set closest to the present Set Point Station output, followed by the pre-set value. Operating the ▼ or ▲ button will scroll through the five pre-sets and an 'Abort' position.

Releasing both buttons will leave the selected pre-set value or 'Abort' legend flashing for ten seconds, during which time operating the **E** button will update the Set Point Station output to the displayed pre-set value. If the **E** button is not operated during this period, the Set Point Station output will not be changed and the original engineering display will be shown.

▼ While this button is pushed the Set Point Station will display the numerical value and analogue bargraph the Set Point Station has been calibrated to display with a 4mA* output. When released the normal display in engineering units will return.

▲ While this button is pushed the Set Point Station will display the numerical value and analogue bargraph the Set Point Station has been calibrated to display with a 20mA* input. When released the normal display in engineering units will return.

* If the Set Point Station display has been calibrated using the CAL function, calibration points may not be at 4 and 20mA.

P + ▼ Firmware number followed by version. This manual applies to firmware version 1.04 and above.

P + E Access to configuration menu via optional security code.

2.2 Controls - single handed

The BA427E Set Point Station is controlled and configured via four front panel push buttons located below the display. In the operating mode i.e. when the Set Point Station is controlling the loop current and the display is showing the output in engineering units, these push buttons can have two alternative sets of functions depending upon if the Set Point Station has been configured.

For single handed operation only the ▲ or ▼ push button has to be pressed to adjust the output current as shown below. This configuration also allows the optional external encoder to adjust the output current without the **E** button being operated.:

▼ Output current slowly decreases. After five seconds the rate of change accelerates so that large changes may be made quickly.

▲ Output current slowly increases. After five seconds the rate of change accelerates so that large changes may be made quickly.

E Continuously pushing this button for 5 seconds allows the Set Point Station output to be entered in engineering units digit by digit using the ▲ or ▼ push button to adjust the flashing digit and the **P** button to move control to the next digit. When set as required, pressing the **E** button will enter the new set point.

- P** While this button is pushed the BA427E Set Point Station will display one of three alternatives depending upon how the instrument has been configured:

Output current mA without bargraph

Output as a % of span

Pre-set outputs in engineering units

The display will flash. While continuing to press the **P** button, operating the ▼ or ▲ button will show the identification of the pre-set closest to the present Set Point Station output, followed by the pre-set value. Operating the ▼ or ▲ button will scroll through the five pre-sets and an 'Abort' position.

Releasing both buttons will leave the selected pre-set value or 'Abort' legend flashing for ten seconds, during which time operating the **E** button will update the Set Point Station output to the displayed pre-set value. If the **E** button is not operated during this period, the Set Point Station output will not be changed and the original engineering display will be shown.

- P + ▼** Firmware number followed by version.
This manual applies to firmware version 1.04 and above.
- P + E** Access to configuration menu via optional security code.

2.2 Displays

The BA427E Set Point Station has a 5 digit display plus a 31 segment bargraph.

The digital display may be calibrated using the 'CAL' or '5Et' functions to display the engineering variable represented by the Set Point Station's 4/20mA output, such as temperature, pressure or speed.

The digital display shows the requested Set Point Station output in engineering units, the digital display will flash until the Set Point Station output is the same as the requested output.

The bargraph, which is not adjustable, always shows the actual Set Point Station output. The bargraph starts and finishes at the two currents at which the digital display was calibrated, usually 4 and 20mA. See sections 6.4 and 6.5.

3. INTRINSIC SAFETY CERTIFICATION

All BA427E Set Point Stations have ATEX, UKCA and IECEx gas and dust intrinsic safety certification. This section of the instruction manual describes ATEX & UKCA gas certification. Dust certification is described in Appendix 1 and IECEx approvals Appendix 2.

3.1 ATEX and UKCA gas certification

ATEX certificate ITS12ATEX27718X and UKCA certificate ITS21UKEX0092X have been used to confirm compliance with the European ATEX Directive and UK Statutory Requirements for Group II, Category 1G equipment, Ex ia IIC T5 Ga, Ta = -40 to +70°C.

BA427E Set Point Stations carry both the community CE and UKCA marks. Subject to local codes of practice they may be installed in the UK and any of the European Economic Area (EEA) member countries.

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

3.2 Zones, gas groups and T rating

The BA427E Set Point Station has been certified Ex ia IIC T5 Ga. When connected to a suitable system the Set Point Station may be installed in:

Zone 0	explosive gas air mixture continuously present.
Zone 1	explosive gas air mixture likely to occur in normal operation.
Zone 2	explosive gas air mixture not likely to occur, and if it does will only exist for a short time.

Be used with gases in groups:

Group A	propane
Group B	ethylene
Group C	hydrogen

Having a temperature classification of:

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

At ambient temperatures between -40 and +70°C.

This allows the BA427E Set Point Station to be installed in all gas Zones and to be used with most common industrial gases except carbon disulphide and ethyl nitrite which have an ignition temperature of 95°C.

3.3 Special conditions for safe use

The BA427E ATEX and UKCA certificates have an 'X' suffix indicating that special conditions apply for installations in IIC conductive dust atmospheres. No special conditions apply for installations in gas or in IIIA and IIIB dust atmospheres. See Appendix 1 for information about use in dust atmospheres.

3.4 4/20mA output

Input safety parameters for the 4/20mA output, terminals 1 and 3 are:

$$\begin{aligned} U_i &= 30V \text{ dc} \\ I_i &= 200mA \\ P_i &= 0.84W \end{aligned}$$

Equivalent maximum capacitance and inductance between the two 4/20mA terminals 1 and 3 is:

$$\begin{aligned} C_i &= 2.2nF \\ L_i &= 0.01mH \text{ (8}\mu H\text{)} \end{aligned}$$

The maximum permitted loop cable parameters can be calculated by adding these figures to C_i and L_i of any other instruments in the loop and subtracting the totals from the maximum cable capacitance C_o and cable inductance L_o permitted for the Zener barrier, galvanic isolator or associated apparatus powering the loop.

3.5 Certification label information

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



BA427E certification label

4. SYSTEM DESIGN FOR HAZARDOUS AREAS

4.1 4/20mA loop using Zener barriers

Fig 2 illustrates a typical application in which a BA427E Set Point Station mounted in a hazardous area is being used to adjust the setpoint of a speed controller located in a safe area. To enable the negative side of both the speed controller and the power supply to be connected together and earthed, a Zener barrier is required in series with both the outgoing and return wires connected to the BA427E Set Point Station.

The Zener barrier(s) should be appropriately certified for the country of installation with combined output parameters equal to, or less than, the maximum BA427E input safety parameters. Most Zener barriers are certified Ex ia IIC allowing them to be connected to equipment located in any Zone and to be used with any gas group thus simplifying selection.

For this application a wide range of devices may be used. A 28V; 93mA positive polarity device in the outgoing wire and a diode return barrier in the return wire are industry standard devices which are available from most barrier manufactures often housed in a single package.

The maximum permitted cable parameters are those specified by the Zener barrier certificate, less the sum of equivalent input capacitance and inductance Ci & Li of all the instruments in the loop, in this example just the BA427E.

When designing the loop it is necessary to establish that the maximum voltage drop caused by the Set Point Station, both Zener barrier channels, the load (speed controller input) and the cable resistance is always less than the minimum power supply voltage.

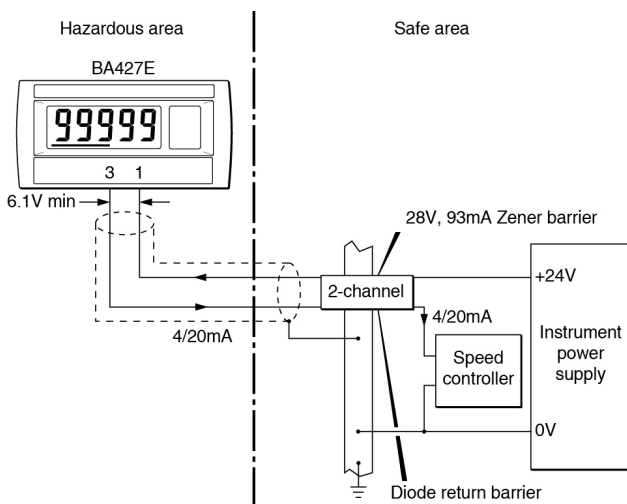


Fig 2 Typical application using barriers

In this example:

Minimum operating voltage of BA427E 6.1V

Maximum voltage drop caused by 28V 93mA Zener barrier
(340Ω end-to-end resistance x 20mA)

Maximum voltage drop caused by diode return barrier 1.3V

Maximum voltage drop caused by speed controller input. (250Ω x 20mA) 5.0V

Maximum voltage drop caused by cable resistance (10Ω x 20mA) 0.2V

Total maximum voltage drop 19.4V

The minimum power supply voltage must therefore be above 19.4V, but below 25.5V which is the maximum working voltage of a typical 28V Zener barrier.

If the BA427E Set Point Station includes an optional backlight which is loop powered, the minimum operating voltage of the instrument increases from 6.1 to 10V. See section 8.3.1

4.2 4/20mA loop using Galvanic Isolators

Galvanic isolators, although more expensive than Zener barriers, do not require a high integrity earth connection. For small systems where a high integrity earth is not already available, the use of galvanic isolators often reduces the overall installation cost.

The example described in section 4.1 can be simplified by the use of a galvanic isolator as shown in Fig 3.

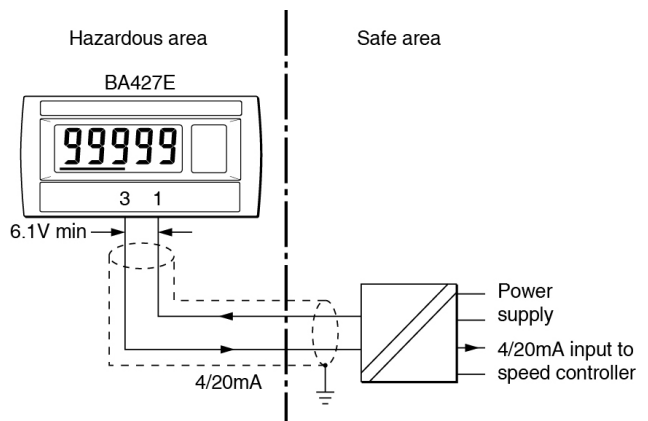


Fig 3 Typical application using a galvanic isolator

Any 4/20mA appropriately certified for the country of installation 4/20mA galvanic isolator with output safety parameters equal to, or less than, the maximum BA427E certified input parameters may be used.

The maximum permitted cable parameters are those specified on the galvanic isolator certificate, less the sum of equivalent input capacitance and inductance C_i & L_i of all the instruments in the loop, in this example just the BA427E.

When designing the loop it is necessary to ensure that the supply voltage between terminals 1 & 3 of the BA427E Set Point Station always exceeds 6.1V which is the minimum operating voltage.

If the BA427E Set Point Station includes an optional backlight which is loop powered, the minimum operating voltage of the instrument increases from 6.1 to 10V. See section 8.3.1

5. INSTALLATION

5.1 Location

The BA427E Set Point Station has a robust glass reinforced modified PPO enclosure with a toughened glass window. The front of the instrument has IP66 protection and a gasket seals the joint between the Set Point Station enclosure and the panel. The rear of the instrument has IP20 protection.

Installation may therefore be in any panel providing that the operating temperature is between -40°C and $+70^{\circ}\text{C}$ and intrinsic safety requirements are satisfied.

Fig 4 shows the overall dimensions of the BA427E together with the recommended panel cut-out dimensions and terminal identifications. To achieve an IP66 seal between the instrument enclosure and the instrument panel an aperture with the recommended tolerance should be used.

The BA427E certification label carries a warning:

**‘Potential electrostatic charging hazard
clean only with a damp cloth’**

Care should be taken when cleaning the front of the instrument, although the warning only applies to the case as the glass window and keypad will not support a static charge.

Cut-out dimensions Recommended for all installations.

Mandatory to achieve an IP66 seal between the BA427E Set Point Station and the instrument panel

$90 +0.5/-0.0 \times 43.5 +0.5/-0.0\text{mm}$

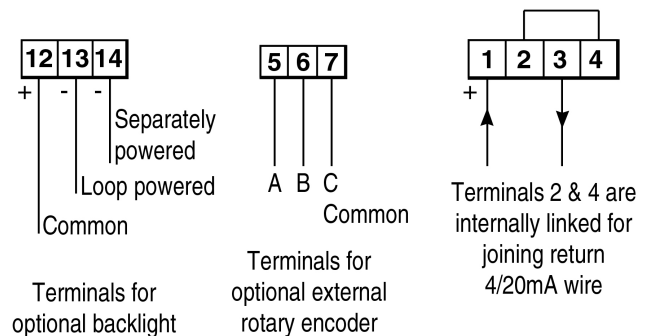
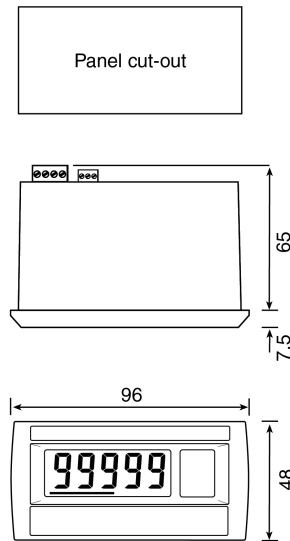


Fig 4 BA427E dimensions

Caution
Although the front of the Set Point Station has IP66 protection, it should be shielded from direct sunlight and severe weather conditions.

5.2 EMC

BA427E Set Point Stations comply with the requirements of the European EMC Directive 2004/108/EC and the UK Electromagnetic Compatibility Regulations UKSI 2016:1091. For specified immunity all wiring should be in screened twisted pairs, with the cable screen earthed at one point within the safe area.

5.3 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 dimensions specified in Fig 4.
- Slide the gasket over the body of the Set Point Station before inserting the instrument into the panel aperture.
- Firstly ensure that both the panel mounting clamps are closed by turning the knurled screws fully anti clockwise until the two pins in the clamp foot align with holes in the clamp body.
- Place a clamp in the recess on each side of the Set Point Station, pulling gently to slide it onto the dovetail as shown in Fig 5. Push the knurled screw slightly forward to engage the thread and tighten by turning clockwise until it is just finger tight. When both 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.**
- Connect the panel wiring to the rear terminal block(s) as shown in Fig 4. To simplify installation, the terminals are removable so that the panel wiring can be completed before the instrument is installed. Wiring should be secured to prevent vibration damage.

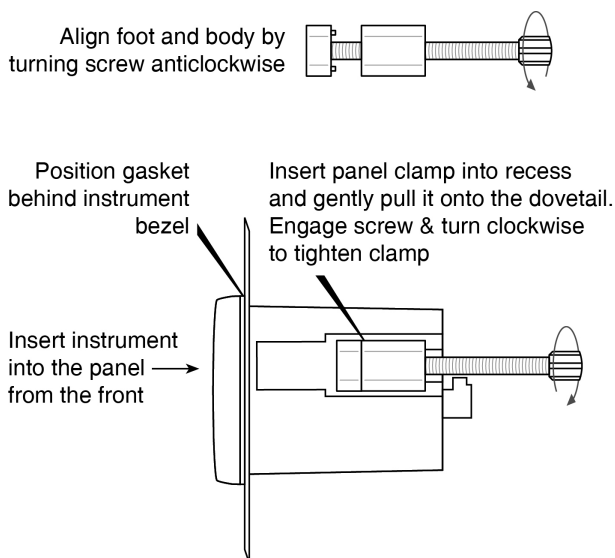


Fig 5 Fitting panel mounting clamps

5.4 Scale card

The engineering units of measurement represent by the Set Point Station's 4/20mA output current may be 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 6. Thus the scale card can easily be changed without removing the Set Point Station from the panel or opening the instrument enclosure.

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

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

To change a scale card, unclip the end of the flexible strip that is accessible from the rear of the instrument by gently pushing the strip 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 in Fig 6. 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 Set Point Station, 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.

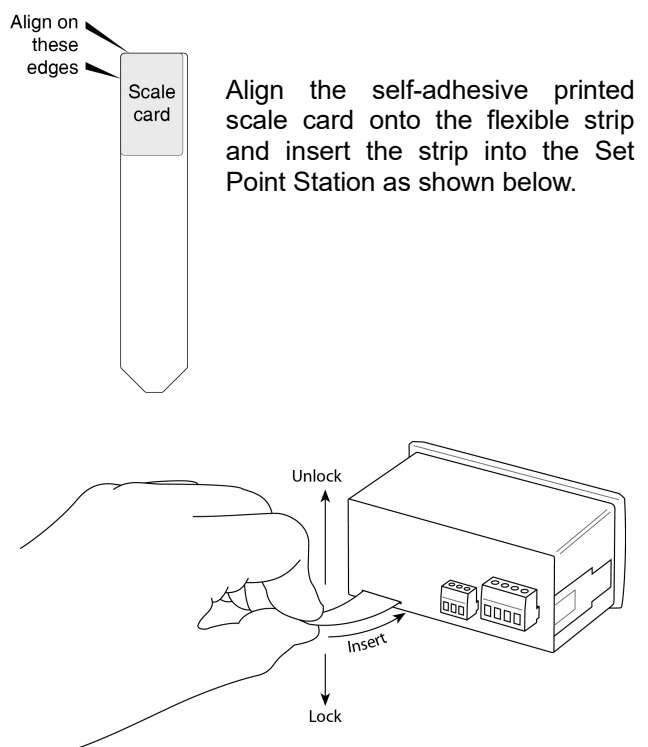


Fig 6 Inserting flexible strip carrying scale card into slot at the rear of Set Point Station.

6. CONFIGURATION AND CALIBRATION

Set Point Stations are configured and calibrated via the four front panel push buttons. All the configuration functions are contained in an easy to use intuitive menu that is shown diagrammatically in Fig 7.

Each menu function is summarised in section 6.1 and includes a reference to more detailed information.

Throughout this manual push buttons are shown as **P**, **E**, **▼** or **▲** and the Set Point Station display legends are shown within inverted commas e.g. 'CAL' and 'CodE'.

Access to the configuration menu is obtained by operating the **P** and **E** push buttons simultaneously. If the Set Point Station security code is set to the default 0000 the first parameter 'rE5n' will be displayed. If a security code other than the default code 0000 has already been entered, the Set Point Station will display 'CodE'. Pressing the **P** button will result in '0000' being displayed with one digit flashing. To gain access the four digit security code should be entered using the **▲** and **▼** push buttons to set the flashing digit and the **P** button to move control to the next digit. When the correct four digit code has been entered, pressing **E** will cause the first parameter 'rE5n' to be displayed. If the code is incorrect, or a button is not pressed within twenty seconds, the Set Point Station will automatically return to the operating mode.

Once within the configuration menu the required parameter can be reached by scrolling through the menu using the **▲** or **▼** push buttons as shown in Fig 7. When returning to the operating mode following recalibration or a change to any function, the Set Point Station will display 'dAtA' followed by 'SAVE' while the new information is stored in permanent memory.

All new Set Point Stations are supplied calibrated as requested at the time of ordering. If calibration is not requested, instruments will be supplied with the following default configuration:

Default Configuration

Resolution 'rE5n'	10
Display at 4mA output 'Zero'	0.00
Display at 20mA output '5PAn'	100.00
Output current limits 'H - - L'	03.000 & 22.000
Maximum output rate of change	000
P button in operating mode 'P.Fn'	PC
Pulses per rev of external encoder 'EnC'	12
One or two handed operation 'Hnd'	'2 H'
Security access code 'CodE'	0000

Default configuration can easily be changed on-site.

6.1 Summary of configuration functions

This section summarises each of the configuration functions and includes a cross reference to a more detailed description. Fig 7 illustrates the location of each function within the configuration menu.

Display	Summary of function
'rE5n'	Adjustment resolution Defines the adjustment resolution of the front panel ▲ and ▼ buttons and the optional external rotary control when adjusting the output current with the Set Point Station in the operating mode. May be set to '1', '10' or '100' least significant digits of the display. See section 6.2
'dP'	Decimal point Positions a dummy decimal point between any of the displayed digits or turns it off. See section 6.3

'CAL' and 'SEt' are alternative ways of calibrating the Set Point Station digital display.

'CAL'	Calibration of the digital display using an external current meter. Preferred method of calibrating the digital display which enables the zero and span of the Set Point Station display to be calibrated to show the engineering units represented by the 4/20mA output. Calibration may be performed at any output current providing the points are at least 4mA apart. Requires an accurate external current meter. See section 6.4
'5Et'	Calibration of digital display using internal references. Using the Set Point Station's internal reference, this function enables the digital display to be calibrated to show the engineering units represented by the output current at 4mA and 20mA. Unlike the 'CAL' function, an accurate external current measuring instrument is not required and the Set Point Station does not have to be disconnected from the loop, but calibration can only be performed at 4 and 20mA. See section 6.5

Display	Summary of function
'H - - L'	High & low current output limits Defines the lower 'Lo' and upper 'Hi' 4/20mA Set Point Station output current limits. See section 6.6
'P5Et'	Pre-set outputs The values of the five pre-set current outputs are defined by this function. The pre-set output currents are identified '5Et1' to '5Et5' and are displayed in engineering units. This function only appears in the configuration menu when 'P5Et', which allows pre-set values to be viewed and selected in the operating mode, is selected in the 'P.Fn' function. See section 6.7
'rAtE'	Maximum output rate of change Enables the maximum rate of change of the 4/20mA output current to be defined. Adjustable between approximately 1 and 100 seconds for full scale output travel. 0 disables this rate of change limit. See section 6.8
'P.Fn'	Function of <i>P</i> push button in operating mode. The Set Point Station may be configured to display the output current in milliamps, the output current as a percentage or to provide access to the five pre-set outputs when the <i>P</i> push button is pressed in the operating mode. See section 6.9

Display	Summary of function
'EnC'	Encoder In addition to the Set Point Station 4/20mA output being adjusted by the front panel push buttons, an external quadrature encoder may be connected to provide control via a rotary knob. This function allows the number of pulses per revolution of the knob to be entered. See section 6.10
'Hnd'	One or two handed operation Allows the Set Point Station output current to be adjusted by the front panel ▲ or ▼ push button and by the optional external encoder with or without the <i>E</i> button be pressed at the same time. See section 6.11
'CodE'	Security code Defines a four digit numeric code that must be entered to gain access to the configuration menu. Default code 0000 disables this security function and allows unrestricted access to all conditioning functions. See section 6.12
'r5Et'	Reset Returns the Set Point Station configuration to the default condition. To prevent accidental use, reset must be confirmed by entering '5urE' before it will be executed. See section 6.13

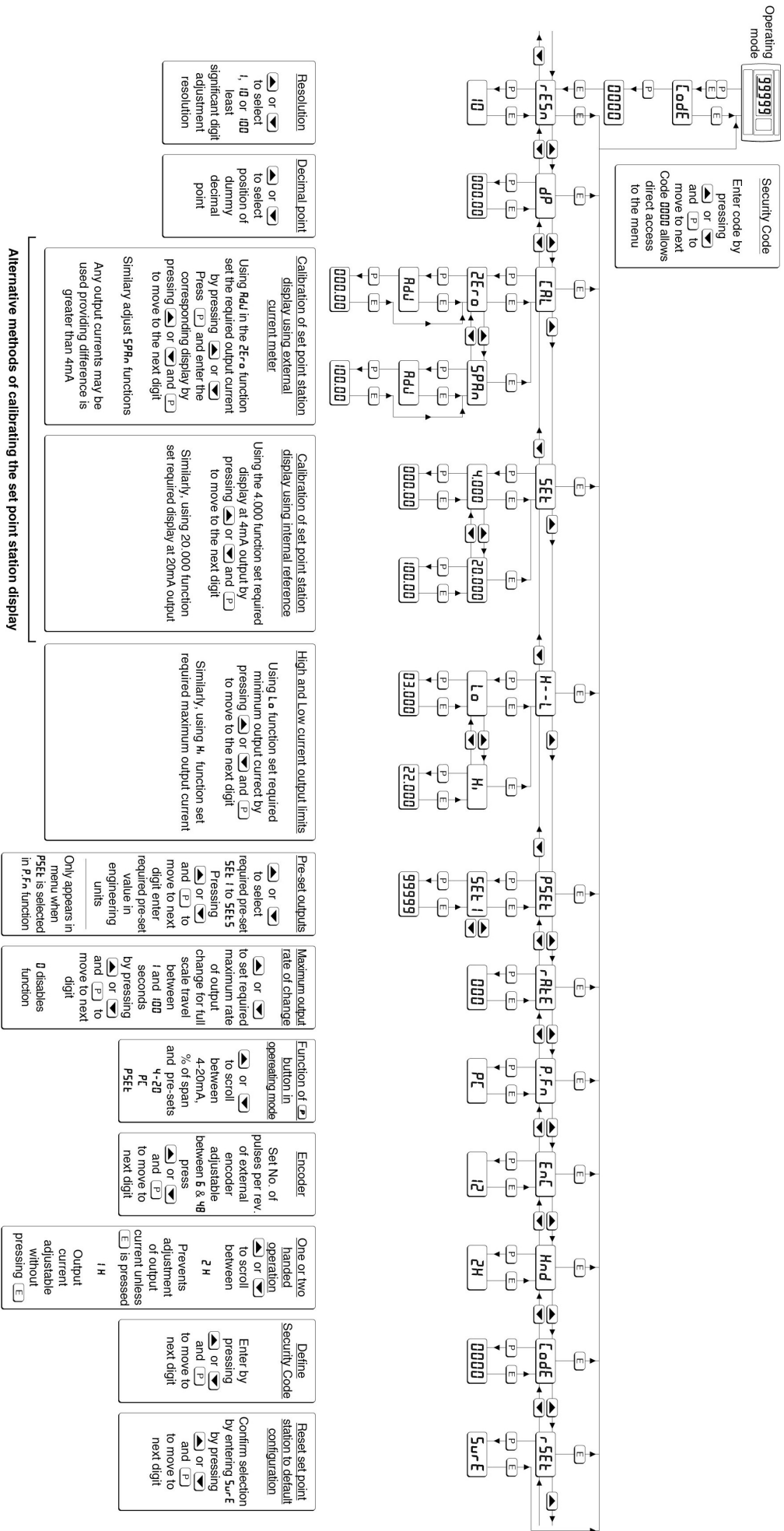


Fig 7 Configuration menu

6.2 Adjustment resolution: 'rE5n'

This function enables the adjustment resolution of the front panel ▲ and ▼ buttons and the optional alternative external rotary control to be defined. One of three different resolutions may be selected '1', '10' or '100' least significant digits of the Set Point Station display. If '10' is selected the least significant displayed digit will always be zero and the second least significant digit will change when the front panel **E** button plus the ▲ or ▼ button are pressed in the operating mode, or the optional external rotary control is turned. Similarly, if '100' is selected the least two significant displayed digits will always be zero and the third least significant digit will change when the front panel buttons are operated, or the optional external rotary control is turned.

To define the adjustment resolution select "rE5n" from the configuration menu and press **P** which will reveal the current adjustment resolution. To change the resolution press the ▲ or ▼ button to select 1, '10' or '100', followed by the **E** button to enter the selection and return to the configuration menu.

Notes:

- This function does not affect the resolution of adjustments made within the configuration menu.
- If a pre-set output has a finer resolution than the selected adjustment resolution, the finer resolution will be used to determine the pre-set output, but the selected resolution will be restored when the output is adjusted using the **E** button plus the ▲ or ▼ button in the operating mode.

6.3 Position of the decimal point: 'dP'

A dummy decimal point can be positioned between any of the displayed digits or it may be absent. To position the decimal point, select 'dP' from the configuration menu and press **P**. The decimal point can be moved by pressing the ▲ or ▼ push button. If a decimal point is not required it should be positioned beyond the most or least significant digit. When positioned as required press the **E** button to enter the selection and return to the 'dP' prompt in the configuration menu.

6.4 Calibration of the digital display using an external current meter: 'CAL'

This function is the preferred method of calibrating the Set Point Station digital display to show the engineering units represented by the 4/20mA output. The function enables the Set Point Station output current to be set at two different values, Zero and Span, measured by a calibrated external current meter and the corresponding Set Point Station display to be entered.

The bargraph is not displayed while using the 'CAL' function.

Although calibration is normally performed at 4.000mA and 20.000mA, other currents may be used providing they differ by more than 4mA.

To calibrate the Set Point Station display, select 'CAL' from the configuration menu and press **P** to enter the '2Ero' sub-menu used for calibrating the display at the lower of the two output currents, usually 4.000mA. Pressing **P** again will result in 'Adj' being displayed which is an invitation to adjust the Set Point Station output current using the ▲ or ▼ push button. Pressing either of these buttons will cause the output current to change, gradually accelerating as the button is held. Alternatively the external rotary encoder may be used. When the external current meter shows the required lower output current e.g. 4.000mA, press **P** to reveal the existing Set Point Station digital display with one digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button, when this digit is set as required pressing **P** will transfer control to the next digit. When all the digits have been adjusted, press **E** to enter the setting and return to the '2Ero' prompt.

Calibration of the Set Point Station display at the upper output current is performed in exactly the same way using the '5Pan' sub-menu which may be selected from the '2ero' prompt using the ▲ or ▼ button.

To obtain a reverse acting display i.e. the Set Point Station display decreases as the output current increases, the required display value entered into '2Ero' should be greater than that entered into '5Pan'. The ▲ and ▼ buttons on the front of the instrument always indicate which way the display will change when the button is pushed.

The bargraph will start at the numerical display entered for '2Ero' calibration and finish at the numerical display entered for '5Pan' calibration, except for reverse acting calibration when the bargraph will also be reversed.

Note:

- If the specified '2Ero' and '5Pan' output currents do not differ by 4 or more milliamps, they will not be stored when the **E** button is pressed to return the Set Point Station to the operating mode.

6.5 Calibration of digital display using internal reference: '5Et'

Using the Set Point Station's internal reference, this function enables the digital display to be calibrated to show the engineering units represented by the output current at 4mA and 20mA.

Unlike the 'CAL' function, an accurate external current measuring instrument is not required and the Set Point Station does not have to be disconnected from the loop, however calibration can only be performed at 4mA and 20mA. Although not traceable to a calibrated standard, accuracy is adequate for many industrial applications.

To calibrate the Set Point Station's digital display select 'SEt' from the configuration menu and press **P**. The Set Point Station will display '4.000', pressing **P** again will reveal the calibrated display at 4mA output with one digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ buttons, when the flashing digit is correct pressing **P** will transfer control to the next digit. When all the digits have been adjusted, press **E** to return to the '4.000' prompt.

Calibration of the Set Point Station display at 20mA output is performed in exactly the same way using the '20.000' sub-menu which may be selected from the '4.000' prompt using the ▲ or ▼ button. When the display corresponding to a 20mA output has been entered pressing **E** twice will enter the setting and return to the '5Et' prompt in the configuration menu.

The bargraph is not displayed while using the '5Et' function

To obtain a reverse acting display i.e. the Set Point Station display decreases as the output current increases, the required display value entered into '4.000' should be greater than that entered into '20.000'. The ▲ and ▼ buttons on the front of the instrument always indicate which way the display will change when the button is pushed.

The bargraph will start at the numerical display entered for 4mA output and finish at the numerical display entered for 20mA output, except for reverse acting calibration when it will also be reversed.

6.6 High & low current output limits: 'H - - L'

The BA427E output is normally adjustable between 3 and 22mA, but may be restricted by this function if a limited adjustment range is required. e.g. to prevent a dangerously high and/or low temperature being selected when used as the set point input for a temperature controller. When the Set Point Station's output current equals the high limit, 'oVer' is displayed, similarly 'undEr' is displayed when the output current equals the low limit.

To restrict the Set Point Station's output current range select 'H - - L' from the configuration menu and press **P**. Using the ▲ or ▼ button select 'Lo' to adjust the lower current output limit, or 'Hi' to adjust upper output current limit. Pressing **E** will display the selected output current limit in milliamps with one digit flashing.

The flashing digit may be adjusted by pressing the ▲ or ▼ button, when the flashing digit is correct pressing **P** will transfer control to the next digit. When all the digits have been adjusted press **E** to return to the 'Lo' or 'Hi' prompt followed by **E** to enter the adjustments and return to the 'H - - L' prompt in the configuration menu.

Notes:

- The Lo limit can not be adjusted to a value above the present Set Point Station output current, and the Hi limit can not be adjusted to a value below the present Set Point Station output current. The actual Set Point Station output current should therefore be adjusted to within the acceptable output range before the Lo and Hi limits are adjusted.
- If any of the five pre-set output currents are set below the Lo limit or above the Hi limit, they will not be selectable and 'oVer' or 'undEr' will be displayed.

6.7 Pre-set outputs: 'P5Et'

Up to five pre-set current outputs may be stored and recalled from the front panel push buttons which enables common output currents to be quickly selected. e.g. frequently used operating temperatures when a BA427E is used as the set point input for a temperature controller.

To enter pre-set values select 'P5Et' from the configuration menu and press **P** which will result in '5Et 1', the first pre-set sub-menu being displayed, pressing **P** will then reveal the present value in engineering units with one digit flashing. The flashing digit may be adjusted by pressing the ▲ or ▼ button, when the flashing digit is correct pressing **P** will transfer control to the next digit. When all the digits have been adjusted, press **E** to return to the '5Et 1' prompt from which any of the other four pre-sets may be selected via the ▲ or ▼ button and adjusted in the same way as '5Et 1'.

Notes:

- 'P5et' only appears in the configuration menu when 'P5Et' is selected in the 'P.Fn' menu which defines the function of the **P** push button in the operating mode. see section 6.9.
- Maximum adjustment resolution is always available for inputting pre-set values and is used to determine the current output when the pre-set is selected, irrespective of the adjustment resolution selected in function 'rE5n' – see 6.2
- If, after calibration of the Set Point Station display, previously entered pre-set values are outside the revised output current range, when selected the pre-set value alternating with 'oVer' or 'undEr' will be displayed.

6.8 Maximum output rate of change: 'rAtE'

To minimise plant disturbance when the Set Point Station output current is adjusted, the maximum rate of change is defined by this function. The maximum rate is adjustable between approximately 1 and 100 seconds for full scale output travel from 4 to 20mA. If 0 seconds is selected the function is disabled.

To define the maximum rate of change of the Set Point Station output select 'rAtE' from the configuration menu and press **P** which will reveal the present maximum rate of change in seconds with one digit flashing. The flashing digit may be adjusted by pressing the **▲** or **▼** buttons, when the flashing digit is correct pressing **P** will transfer control to the next digit. When all the digits have been adjusted, press **E** to enter the new value and return to the configuration menu.

When the output rate of change limitation is functioning, in the operating mode the Set Point Station digital display will show the requested output and will flash until the requested output current is achieved. The bargraph display always shows the Set Point Station's actual output.

Pressing the **E** button while the output is ramping to a new requested value will stop the output changing.

6.9 Function of the **P** push-button in operating mode: 'P.Fn'

Using this function the Set Point Station may be configured to display the output current in milliamps, the output current as a percentage of the output range, or to provide access to the five pre-set outputs when the **P** button is pressed in the operating mode.

To check or change the function of the **P** push button select 'P.Fn' from the configuration menu and press **P** to reveal the present setting. Pressing the **▲** or **▼** button will scroll the setting between:

'PC'	Output as a percentage of output range.
'4-20'	Output current in milliamps
'P5Et'	Access to the five pre-set outputs see 6.7

When set as required, press **E** to return to the 'P.Fn' prompt in the configuration menu.

6.10 Encoder: 'EnC'

For applications requiring the Set Point Station's 4/20mA output current to be controlled by a rotary knob, an external three wire quadrature encoder may be directly connected to terminals 5, 6 and 7.

The BEKA BA490 Is a panel mounting encoder that generates 12 contact pulses per revolution which complies with the requirements for *simple apparatus* and is intended for use with the BA427E. Other encoders that produce a different number of contact pulses per revolution may also be used. So that all external encoders have a similar adjustment resolution, the 'EnC' function enables the number of pulses between 6 and 48 per revolution to be defined.

To enter the number of pulses per revolution that the external encoder generates, select 'EnC' from the configuration menu and press **P** which will reveal the existing setting with one digit flashing. The flashing digit may be adjusted by pressing the **▲** or **▼** button, when the flashing digit is correct pressing **P** will transfer control to the other digit. When both digits have been adjusted press **E** to return to the 'EnC' prompt in the configuration menu.

Section 8.4 contains information about the use of an external rotary encoder.

6.11 One or two handed operation: 'Hnd'

This function defines whether the front panel **E** button has to be pushed at the same time that the **▲** or **▼** button is operated, or the optional external encoder is rotated to adjust the Set Point Station's output current. Selecting the two handed operation which requires the **E** button to be operated which minimises the possibility of accidental adjustment.

To check or change the function select 'Hnd' from the configuration menu and press **P** to reveal the existing setting. Pressing the **▲** or **▼** button will toggle between the two setting:

'2 H'	Output current can only be adjusted when the E button is pressed..
'1 H'	Output current can be adjusted without pressing the E button.

When set as required, press **E** to return to the 'Hnd' prompt in the configuration menu.

6.12 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 Set Point Station to display the existing security code with one digit flashing. The flashing digit can be adjusted using the **▲** and **▼** 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 Set Point Station is returned to the operating mode. Please contact BEKA associates sales department if the security code is lost.

6.13 Reset to factory defaults: 'rSEt'

This function quickly returns to the BA427E Set Point Station to the factory default configurations shown in section 6.

To reset the Set Point Station select 'rSEt' from the configuration menu and press **P**. To prevent accidental resetting the request must be confirmed by entering '5urE'. Using the **▲** button set the first 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 configuration menus and return the display to the 'rSEt' function in the configuration menu.

7. MAINTENANCE

7.1 Fault finding during commissioning

If a BA427E Set Point Station fails to function during commissioning the following procedure should be followed:

Symptom	Cause	Solution
No loop current	Incorrect wiring	Check wiring There should be 6.1 to 30V between terminals 1 & 3 with terminal 1 positive. With an optional backlight which is loop powered, there should be 10V to 30V between terminals 3 & 12 with terminal 12 positive.
No loop current 0V between terminals 1 & 3 or between terminals 3 & 12 if optional backlight is loop powered.	Incorrect wiring or no power supply	Check supply voltage and voltage drop caused by all the instruments in the loop.
Unable to adjust output current using ▲ or ▼ push buttons or the optional external encoder.	Instrument may be configured for 2 hand operation and require E button to be operated at the same time.	Check 'Hnd' function in configuration menu and change if necessary.
Unstable 4/20mA loop current.	Noisy power supply or insufficient voltage to power all the instruments in the loop.	Eliminate ripple on power supply or increase supply voltage.
Unable to enter configuration menu.	Incorrect security code entered.	Enter correct security code, or contact BEKA if the code has been lost.
BA427E displays 'LP Lo'	Voltage between BA427E terminal 1 & 3 is too low,	Increase 4/20mA loop supply voltage.

7.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

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

If a BA427E Set Point Station fails after it has been functioning correctly follow the procedure shown in section 7.1. If this does not reveal the cause of the fault, it is recommended that the Set Point Station is replaced.

7.3 Servicing

We recommend that faulty BA427E Set Point Stations are returned to BEKA associates or to our local agent for repair.

7.4 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.

7.5 Guarantee

Set Point Stations 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.

7.6 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.

8. ACCESSORIES

8.1 Scale card

The BA427E Set Point Station has a window on the right hand side of the display through which the scale card showing the units represented by the output current such as °C or mBar can be seen. New Set Point Stations are fitted with a scale card showing the units specified when the instrument was ordered, if the units are not specified when the instrument is ordered 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 to the Set Point Station without opening the instrument enclosure or removing it from the panel. See section 5.4 of this instruction manual.

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

8.2 Tag information

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

8.3 Display backlight

The BA427E Set Point Station can be supplied with a factory fitted green backlight that may be loop or separately powered.

When loop powered the backlight produces background illumination enabling the display to be read at night or in poor lighting conditions. No additional power supply, intrinsic safety interface or field wiring are required, but the Set Point Station's minimum operating voltage is increased. When separately powered the backlight is brighter, but an additional intrinsic safety interface and field wiring are required.

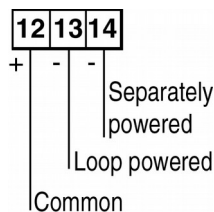


Fig 8 Terminals for optional backlight

8.3.1 Loop powering the backlight

The backlight is loop powered by connecting it in series with the Set Point Station's 4/20mA output as shown in Fig 9, which increases the minimum operating voltage to 10V.

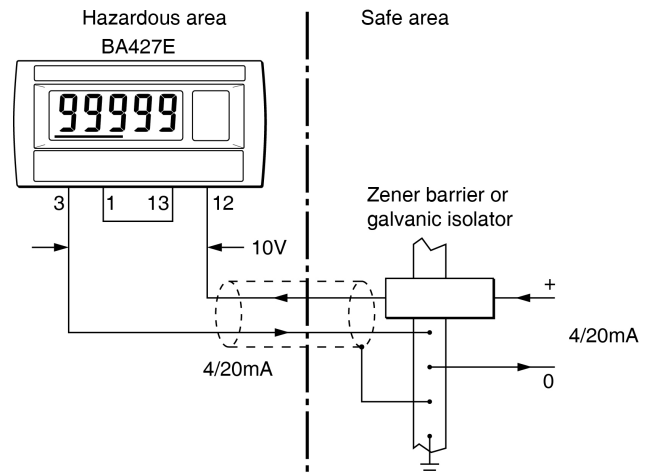


Fig 9 Loop powered backlight

The input intrinsic safety parameters of the combined Set Point Station and backlight are the same as for the Set Point Station alone. Providing the increased voltage drop can be tolerated, the intrinsic safety and system design described in sections 3 and 4 of this manual remain valid with the backlight loop powered.

8.3.2 Separately powering the backlight

The optional backlight may also be powered from a separate safe area power supply via an intrinsically safe interface as shown in Fig 10.

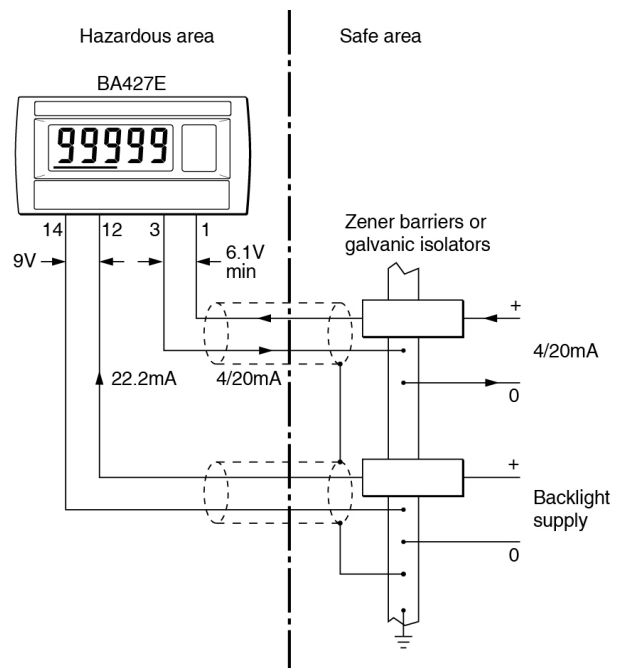


Fig 10 Separately powered backlight

When separately powered the backlight draws a constant current of 22.5mA at or above 9V. Below this voltage the backlight continues to function but with reduced brilliance. Powering the backlight from an adjustable voltage supply allows the backlight brilliance to be adjusted which is a useful feature when the operator's night vision has to be preserved.

Any certified Zener barrier or galvanic isolator may be used to separately power the backlight, providing the output parameters do not exceed:

$$\begin{aligned}U_o &= 30\text{V dc} \\I_o &= 200\text{mA} \\P_o &= 0.84\text{W}\end{aligned}$$

The internal capacitance C_i between terminals 12 & 14 should be subtracted from C_o of the intrinsically safe interface powering the backlight to determine the maximum permissible cable capacitance.

$$\begin{aligned}C_i &= 11\text{nF} \\L_i &= 0\end{aligned}$$

Two separately powered BA427E Set Point Station backlights may be connected in parallel to a single channel 28V, 93mA Zener barrier or galvanic isolator with no noticeable reduction in brilliance when powered from a 24V dc supply.

8.4 External encoder

For applications requiring the output of the BA427E Set Point Station to be controlled externally, terminals 5, 6 and 7 enable a wide range of three wire quadrature encoders with switch contact outputs to be directly connected to the BA427E. Whether the E button must be operated to enable the encoder to adjust the Set Point Station's output is determined by the 'Hnd' function.. See section 6.11.

The Set Point Station's output current can still be controlled by the ▲ and ▼ buttons when an external encoder is connected.

8.4.1 Intrinsic safety

The intrinsic safety parameters for the external encoder terminals 5, 6 and 7 are:

$$\begin{aligned}U_i &= 30\text{V dc} \\I_i &= 200\text{mA} \\P_i &= 0.84\text{W}\end{aligned}$$

$$\begin{aligned}U_o &= 5.0\text{V dc} \\I_o &= 1.0\text{mA} \\P_o &= 1.25\text{mW}\end{aligned}$$

Equivalent maximum capacitance and inductance between the three encoder terminals 5, 6 and 7 is:

$$\begin{aligned}C_i &= 0 \\L_i &= 0\end{aligned}$$

These parameters are not restrictive and allow a wide range of three wire quadrature encoders with a switch contact output to be directly connected to the BA427E Set Point Station.

8.4.2 System design for hazardous areas

The external encoder must be certified intrinsically safe with input parameters equal to or greater than:

$$\begin{aligned}U_i &= 5.0\text{V dc} \\I_i &= 1.0\text{mA} \\P_i &= 1.25\text{mW}\end{aligned}$$

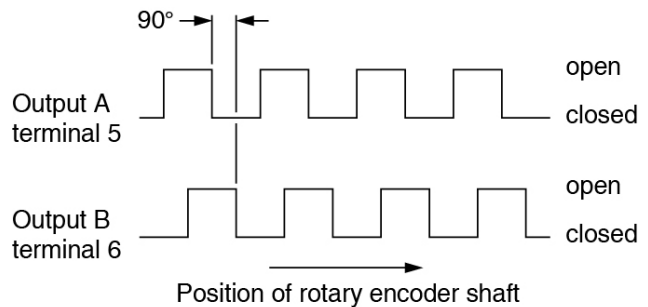
or output parameters equal to or less than:

$$\begin{aligned}U_o &= 30\text{V dc} \\I_o &= 200\text{mA} \\P_o &= 0.84\text{W}\end{aligned}$$

Alternatively, the encoder must comply with the requirements for *simple apparatus* as specified in Clause 5.7 of EN 60079-11. Most encoders comprising of just two mechanically activated switches will comply with these requirements. See 8.4.3.

8.4.3 BEKA BA490 rotary encoder

The BEKA BA490 quadrature output Rotary Encoder has been designed to operate with a BA427E Set Point Station. It is an IP66 panel mounting device with a 20mm diameter control knob which complies with the requirements for *Simple Apparatus*. The two output waveforms are shown in Fig 12.



A & B are referenced to common terminal 7

Fig 12 BA490 rotary encoder output waveforms

Interconnections between the BA427E Set Point Station and the external BA490 Rotary Encoder are shown below.

BA427E Terminal Nos,	BA490 Terminal Nos,
5	A
6	B
7	C

The BA490 Rotary encoder must be located in the same hazardous area as the BA427E Set Point Station and the wiring between them must have 500V ac insulation to earth.

APPENDIX 1

Dust certification

A1.0 ATEX & UKCA dust certification

In addition to ATEX & UKCA certification permitting installation in explosive gas atmospheres which is described in the main section of this instruction manual, all BA427E Set Point Stations have ATEX & UKCA certification permitting installation in combustible dust atmospheres.

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

The Set Point Station's dust input and output safety parameters are identical to the gas safety parameters, so all the electrical circuits shown in the main section of this manual may also be used for dust applications.

A1.1 Zones, and Maximum Surface Temperature

The BA427E has been ATEX & UKCA certified as Group II, Category 2D Ex ia IIIC T80°C Db IP20 apparatus, Ta -40 to 70°C.

When connected to a suitable system the Set Point Station may be installed in:

- Zone 21 explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur occasionally in normal operation.
- Zone 22 explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation, but if it does occur, will only persist for a short period.

Be used with dust in subdivisions:

- IIIA combustible flyings
- IIIB non-conductive dust
- IIIC conductive dust
(For use with IIIC conductive dusts special conditions for safe use apply – see section A1.4)

Having a Minimum Ignition Temperature of:

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

At an ambient temperature between -40 and +70°C

A1.3 Maintenance

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

Live maintenance is permitted on intrinsically safe equipment installed in a hazardous area, but only certified test equipment shall be used.

The BA427E Set Point Station has IP66 front of panel protection and a gasket is provided to seal the joint between the instrument and the mounting panel, thus preventing dust ingress from the outside of the mounting panel. The rear of the instrument is not sealed as the ATEX dust certification relies on the internal conformal coating of the instrument. Dust ingress to the rear terminals is acceptable except for use in IIIC conductive dusts – see A1.4. However, in any installation it is good practice to minimise the amount of dust accumulating on the rear of the instrument and the terminals.

A1.4 Special conditions for use in IIIC dusts

The BA427E Set Point Station ATEX certificate has an 'X' suffix indicating that special conditions for safe use are required for installation in IIIC dust atmospheres, the certificate states:

'For use in Group IIIC conductive dust atmospheres, the Set Point Station shall be mounted such that the instrument terminals have at least IP6X protection.'

To prevent the BA427E Set Point Station terminals becoming contaminated by conductive dust:

The BA427E must be installed in a panel, cubicle or enclosure providing a minimum of IP6X protection.

The panel cut-out dimensions must be as shown in Fig 4 and the supplied gasket must be used.

Note: These special installation conditions only apply for instruments exposed to IIIC conductive dust atmospheres.

APPENDIX 2

IECEX certification

A2.0 The IECEx Certification Scheme

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

A2.1 IECEx Certificate of Conformity

The BA427E Set Point Station and the optional accessories have been issued with an IECEx Certificate of Conformity number IECExITS12.0084X which specifies the following certification codes:

Ex ia IIC T5 Ga
Ex ia IIIC T80°C Db IP20
Ta = -40°C to 70°C

The specified gas and dust intrinsic safety parameters are identical to the ATEX safety parameters described in this manual.

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

A2.2 Installation

IECEX and ATEX certificates specify identical safety parameters and installation requirements for both approvals as defined by IEC / EN 60079-14. The ATEX gas and dust installation requirements specified in section 5 and Appendix 1 of this manual may therefore be used for IECEx installations, but the local code of practice should also be consulted.

A2.3 Special conditions for use in IIIC dusts

The IECEx certificate for the BA427E Set Point Station has an 'X' suffix indicating that special conditions for safe use are required for installation in IIIC dust atmospheres, the certificate states:

'For use in Group IIIC conductive dust atmospheres, the Set Point Station shall be mounted such that the instrument terminals have at least IP6X protection.'

To prevent the BA427E Set Point Station terminals becoming contaminated by conductive dust:

The BA427E must be installed in a panel, cubicle or enclosure providing a minimum of IP6X protection.

The panel cut-out dimensions must be as shown in Fig 4 and the supplied gasket must be used.

Note: These special installation conditions only apply for instruments exposed to IIIC conductive dust atmospheres.