BA478C
Intrinsically safe panel mounting indicating temperature transmitter

Issue 12

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Appendix 1
IECEx certification

Appendix 2
EU Declaration of Conformity

The BA478C is CE marked to show compliance with the European Explosive Atmospheres Directive 2014/34/EU and the European EMC Directive 2014/30/EU

1. DESCRIPTION

The BA478C is a panel mounting, intrinsically safe 4/20mA loop powered temperature transmitter with a large easy to read display. The instrument, which is HART® enabled, may be conditioned on-site to operate with most common thermocouples and resistance thermometers and will provide a linear 4/20mA output proportional to temperature, plus a digital temperature display. Voltage and resistance inputs may be scaled allowing the BA478C to display variables other than temperature such as position and weight.

Optional factory fitted alarms provide two galvanically isolated solid state outputs that may be independently configured for high or low operation.

For installation in poorly illuminated areas, an optional factory fitted loop powered display backlight is available.

The BA478C has been certified intrinsically safe for use in flammable gas atmospheres by European Notified Body Intertek ITALIA S.p.A. and complies with the ATEX Directive 2014/34/EU. It also has UKCA certification.

For international applications, the BA478C has IECEx intrinsic safety certification – see Appendix 1.

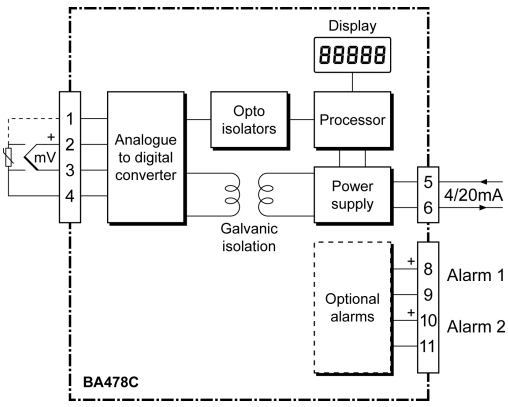


Fig 1 Simplified block diagram

2. DOCUMENTATION

This instruction manual describes the installation and configuration of the BA478C Indicating Temperature Transmitter for ATEX and UKCA intrinsically safe applications.

System design information for IECEx certification is included in a separate appendices to this manual. The transmitter is *HART Registered* and is compliant with HART protocol standard revision 7. HART® commissioning information is included in the BA47X/67X Indicating Temperature Transmitter HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals

3. OPERATION

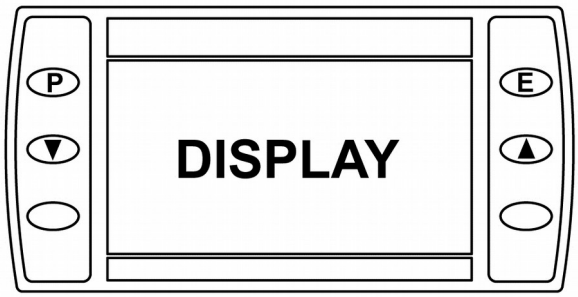
Fig 1 shows a simplified diagram of the BA478C Indicating Temperature Transmitter. The input, which may be from a resistance thermometer, thermocouple, or a dc voltage or resistance, is digitised and transferred to the instrument processor via an optical isolator. The processor linearises the input signal, displays the resulting temperature in the selected units and controls the 4/20mA output current.

3.1 Controls

All functions of the transmitter may be configured via the six front panel push buttons – see Fig 5. Buttons respond within 0.5 seconds of being operated and unless continuously pushed the transmitter display will return to the operating mode after 2 seconds.

In the operational mode, i.e. when the transmitter is displaying the input signal, these push buttons have the following functions:

Button	Function
▼	While this button is operated the transmitter will show the display corresponding to 4mA output.
▲	While this button is operated the transmitter will show the display corresponding to 20mA output.
▼ + ▲	Transmitter displays output current in mA followed by output as % of the range.
P + ▼	Transmitter displays HART® short address followed by firmware version number.
P + E	Entry to configuration menu. See 7.1.1
	When fitted with optional alarms
P + ▲	Entry to alarm set point menu. See 10.3.12
E + ▲	Transmitter displays alarm 1 setpoint
E + ▼	Transmitter displays alarm 2 setpoint
P	Activated alarm reverts to the non-alarm condition for the configured alarm silence time. See 10.3.11



4. INTRINSIC SAFETY CERTIFICATION

The BA478C Indicating Temperature Transmitter is intrinsically safe allowing installation in Zone 1 or 2 when protected by a safe area Zener barrier or galvanic isolator. It may also be installed in Zone 0 if special conditions are observed – see 4.3.

4.1 ATEX and UKCA certification

The BA478C has been awarded EU-Type Examination Certificate ITS09ATEX26156X and similar UK-Type Examination Certificate ITS21UKEX0309X. These state that the transmitter is intrinsically safe and complies with requirements for Group II, Category 1G Ex ia IIC T5 equipment. The transmitter bears the community and UKCA marks and subject to local codes of practice may be installed in any of the European Economic Area (EEA) member countries and in the United Kingdom

This instruction manual describes ATEX and UKCA installations conforming with EN 60079-14 Electrical Installations in Hazardous Areas. When designing systems for installation outside the UK the local Code of Practice should be consulted.

4.2 Zones, gas groups and T rating

The BA478C has been certified as Group II Category 1G Ex ia IIC T5 apparatus. When connected to a suitable certified system the BA478C may be installed in:

Zone 0	explosive gas air mixture continuously present. **Note:** Special conditions apply see section 4.3
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^{O}C
T2	300^{O}C
T3	200^{O}C
T4	135^{O}C
T5	100^{O}C

At an ambient temperature between –40 and +70ºC.

Minimum operating temperature of BA478C is -20°C.

This allows the BA478C to be installed in all Zones and to be used with most common industrial gases.

4.3 Special conditions for Zone 0 installations

The BA478C ATEX certificate has an 'X' suffix which indicates that the transmitter is subject to special conditions for safe use, which are:

CAUTION

The BA478C Indicating Temperature Transmitter when installed in a Zone 0 potentially explosive atmosphere shall be installed such that even in the event of rare incidents, an ignition source due to impact or friction between the aluminium enclosure at the rear of the instrument mounting panel and iron/steel is excluded.

These special conditions only apply in the very unlikely event that the transmitter is installed in a Zone 0 hazardous area. The special conditions result from the aluminium enclosure and mean that when installed in a Zone 0 hazardous area, the rear of the instrument, which will be behind the instrument mounting panel, should be protected from impact.

4.4 Certification label information

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

The instruments serial number is shown on the rear panel adjacent to the terminals.

4.5 Input terminals 1, 2, 3 and 4

The transmitter's input terminals may be connected to any floating or earthed sensor complying with the requirements *for simple apparatus.* i.e. a sensor that generates less than 1.5V; 100mA or 25mW, such as a thermocouple, resistance thermometer or a potentiometer.

The transmitter input may also be connected directly to a voltage source that does not comply with the requirements for *simple apparatus*, providing safety is assessed using the entity concept.

The safety parameters for terminals 1, 2, 3 & 4 are:

Uo	=	6.0V
Io	=	30.3mA
Po	=	46mW
Ui	=	6.0V
Ii	=	100mA
Pi	=	0.194W
Co	=	23.8µF
Lo	=	3mH

4.6 4/20mA output - terminals 5 & 6

The BA478C Indicating Temperature Transmitter is loop powered via these terminals which have the following input safety parameters:

Ui	=	28V
Ii	=	200mA
Pi	=	0.85W

When installed in a hazardous area the transmitter must be powered via an ATEX certified Zener barrier or galvanic isolator with output safety parameters equal to or less than the above.

The equivalent internal capacitance and inductance at terminals 5 & 6 is:

Ci	=	46.5nF
Li	=	0.01mH

5. ELECTRICAL SYSTEM DESIGN

The BA478C is a smart HART® enabled loop powered 4/20mA Indicating Temperature Transmitter. Intrinsic safety certification allows the instrument and sensor to be installed in any gas hazardous area providing that the transmitter is powered via a certified Zener barrier or galvanic isolator.

For installation in poorly illuminated areas the BA478C is available with an optional factory fitted display backlight. No additional wiring of power supply is required, but the minimum operating voltage of the transmitter is increased as shown below.

without backlight	9.0 to 28V
with backlight	15.5 to 28V

When the transmitter is fitted with an optional display backlight the increased minimum operating voltage usually precludes the use of Zener barriers.

5.1 Use with Zener barriers

There are three requirements when designing a BA478C loop using Zener barrier(s):

1. The intrinsic safety output parameters of the Zener barrier must be equal to or less than:

Uo	=	28V
Io	=	200mA
Po	=	0.85W

2. The voltage between terminal 5 & 6 of the BA478C must be between 9 & 28V.
   Note: Zener barriers are not normally able to power a BA478C transmitter fitted with an optional display backlight which requires a minimum operating voltage of 15.5V between terminals 5 & 6.

3. The maximum supply voltage must not exceed the maximum working voltage of the Zener barrier(s).

Fig 2 illustrates the simplest and least expensive configuration in which a BA478C is powered from an isolated (floating) power supply. Only one barrier is required, as the other wire is earthed at the barrier busbar.

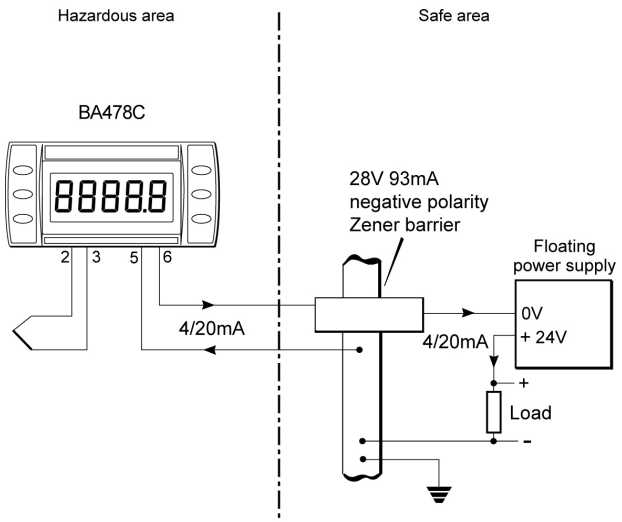


Fig 2 BA478C powered from floating supply

If a common power supply is used to operate multiple loops, the negative side of the supply is normally earthed. To also allow the negative side of the 4/20mA load to be earthed it is necessary to have a Zener barrier in each of the two wires entering the hazardous area as shown in Fig 3.

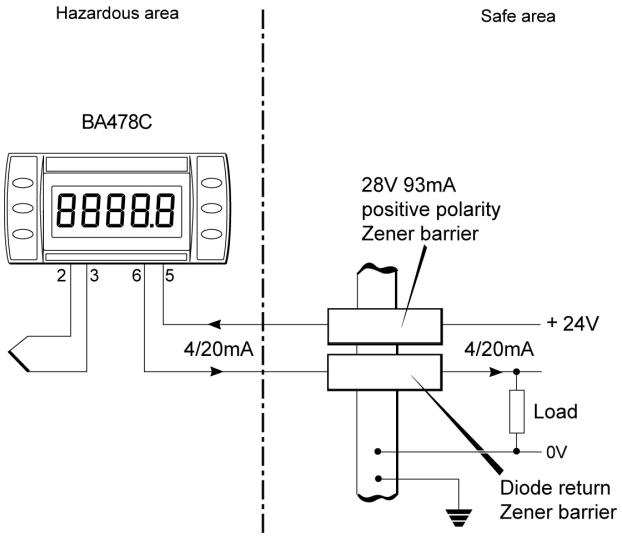


Fig 3 BA478C powered from a common supply

When designing a transmitter loop it is necessary to establish that the sum of the voltage drops caused by the transmitter, Zener barriers, the load and the cable resistance is less than the minimum supply voltage.

For the transmitter loop shown in Fig.3

Minimum operating voltage of BA478C without optional backlight.	9.0V
Maximum voltage drop caused by 28V 93mA Zener barrier. (340Ω x 20mA)	6.8V
Maximum voltage drop caused by diode return Zener barrier.	1.6V
Maximum voltage drop caused by 250Ω load. (250Ω x 20mA)	5.0V
Maximum voltage drop caused by cable resistance. (10Ω x 20mA)	0.2V
Total maximum voltage drop	22.6V

The power supply voltage must therefore be above 22.6V but below the maximum working voltage of the 28V 93mA barrier which is likely to be about 26.5V.

5.2 Use with Galvanic Isolators

A galvanic isolator can supply a higher voltage than a Zener barrier to a loop powered transmitter and is able to power a BA478C transmitter fitted with an optional display backlight which has a minimum operating voltage of 15.5V. Although an isolator is more expensive than a Zener barrier it does not require a high integrity earth. For small systems where a high integrity earth is not already available a galvanic isolator may reduce the overall installation cost. Fig 4 shows a typical temperature transmitter loop.

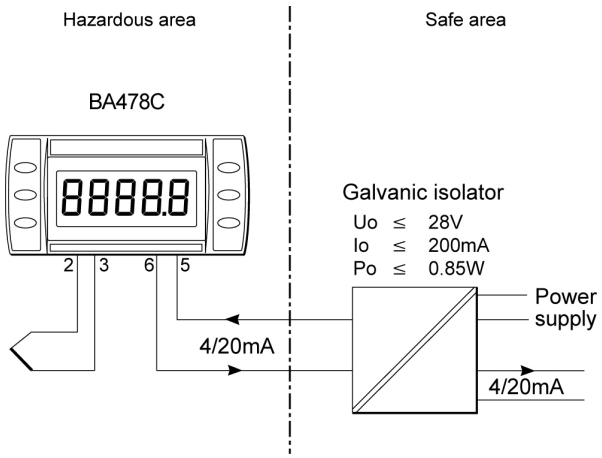


Fig 4 BA478C powered via galvanic isolator

Any ATEX certified 4/20mA repeater power supply or transmitter power supply galvanic isolator may be used. There are three requirements when designing a BA478C loop incorporating a galvanic isolator:

1. The intrinsic safety output parameters of the galvanic isolator must be equal to or less than:

   Uo = 28V
   Io = 200mA
   Po = 0.85W

2. The isolator must supply a minimum output voltage at 20mA of:

   BA478C without backlight 9.0V
   BA478C with backlight 15.5V

3. If HART® communication is to be used the galvanic isolator must be suitable for powering 'smart' transmitters, i.e. it must be transparent to HART® signals.

5.3 Use as a temperature indicator

The BA478C may also be used as just a temperature indicator by ignoring the instrument's 4/20mA output current. The same Zener barriers or galvanic isolators required for transmitter operation are required, but the load resistor may be omitted.

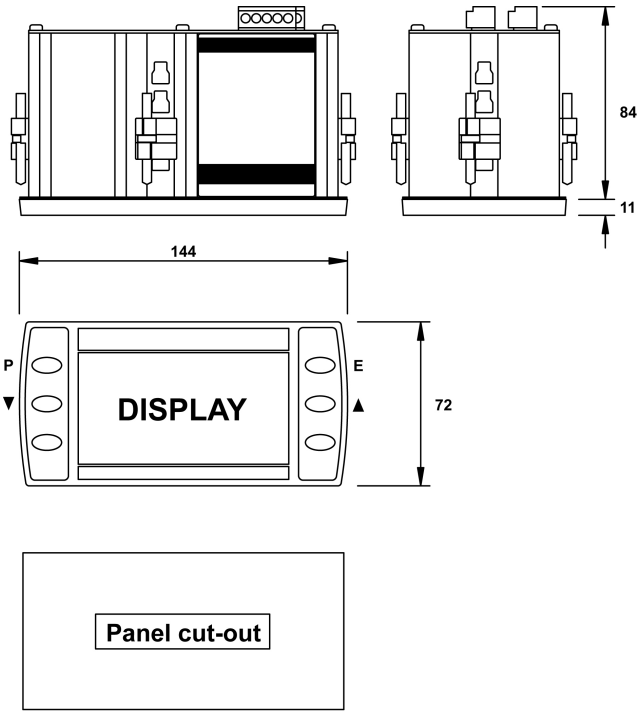
6. INSTALLATION

6.1 Location

The BA478C is housed in a robust aluminium enclosure with a toughened glass window mounted in a Noryl bezel. The front of the instrument provides IP66 protection and a gasket seals the joint between the instrument enclosure and the panel. The instrument may be installed in any panel providing the environmental limits shown in the specification are not exceeded.

Fig 5 shows the overall dimensions of the BA478C and the panel cut-out. To achieve an IP66 seal between the instrument enclosure and the panel, the smaller cut-out must be used and the instrument secured with four panel mounting clips.

The BA478C liquid crystal display has maximum contrast when viewed from directly ahead and slightly below the centre line of the instrument.



Cut-out Dimensions

DIN 43 700
138.0 +1.0/-0.0 x 68.0 +0.7/-0.0

To achieve an IP66 seal between instrument enclosure and panel
136.0 +0.5/-0.0 x 66.2 +0.5/0.0

Fig 5 BA478C dimensions

6.2 Installation Procedure

a. Insert the BA478C into the instrument panel cut-out from the front of the panel with the sealing gasket positioned as shown in Fig 6.

b. Fix panel mounting clips to opposite sides of the instrument and tighten. Recommended tightening torque is 22cNm (1.95lbf in). **Do not over tighten**. Four clips are required to achieve an IP66 seal between the instrument enclosure and the panel.

c. Connect the panel wiring to the rear terminal block as shown in Fig 6. To simplify installation, the terminals are removable so that panel wiring can be completed before the instrument is installed.

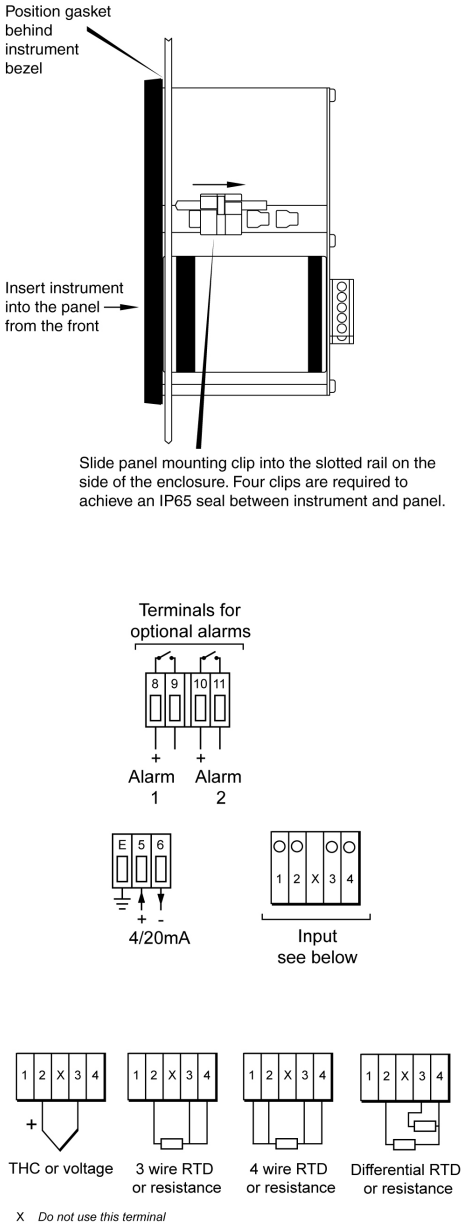


Fig 6 Installation and terminal connections

6.3 EMC

The BA478C complies with the requirements of the European EMC Directive 2014/30/EU. For specified immunity, all wiring should be in screened twisted pairs with the screens earthed at one point in the safe area.

7. CONFIGURATION

The BA478C Indicating Temperature Transmitter may be configured and calibrated via HART® digital communication, or configuration may be performed using the menu accessed via the front panel push buttons see Fig 5.

Configuration and calibration via HART® may be performed using a portable configurator connected directly to the BA478C or to the galvanic isolator powering the transmitter, alternatively proprietary configuration software operating on a personal computer may be used. In addition to the configuration functions available via the transmitter push buttons, HART® communication enables loop calibration and custom linearisation to be performed. Details of the HART® communication are contained in the BEKA HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals

7.1 Configuration menu

Throughout this manual the BA478C push buttons are identified ***P*** ***E*** ▼ ▲ and legends displayed by the transmitter are shown within inverted commas e.g. 'CAL' and 'dEG'. Section 7.1.2 contains a summary of each configuration function including a cross reference to a more detailed description.

The functions contained in the configuration menu vary depending upon the transmitter input selected, see Figs 7, 8 & 9.

When the transmitter is being configured, the transmitter 4/20mA output current is locked at the value prior to entering the configuration menu.

When the optional alarms are fitted additional functions are added to the configuration menu which are described in section 10.3.

7.1.1 Access

Access to the configuration menu is obtained by operating the ***P*** and ***E*** buttons simultaneously. If the transmitter is not protected by an access code the first parameter 'InPut' will be displayed. If the transmitter is protected by an access code, 'CodE' will be displayed first. Pressing ***P*** will allow the four digit security code to be entered digit by digit using the ▼ or ▲ button to adjust the flashing digit and ***P*** to move control to the next digit. When the correct code has been entered, pressing ***E*** will cause the first parameter 'InPut' to be displayed. If an incorrect code is entered, or no button is pressed for ten seconds, the transmitter will automatically return to the operating mode.

If the transmitter displays 'LoC' when the ***P*** and ***E*** buttons are operated simultaneously, the transmitter push buttons have been locked by a HART® command - see the BEKA HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals

7.1.2 Summary of functions

The functions that may be configured vary depending upon the input selected.

Thermocouple and RTD inputs

The BA478C will always display sensor temperature.

Configuration allows:

Digital display units and resolution to be selected.

Bargraph display to represent required part of the digital displayed range.

4/20mA output current to represent required part of transmitter input range.

Voltage and resistance inputs

The BA478C can display the voltage or resistance input in any engineering units.

Configuration allows:

Zero and span of digital display to be adjusted.

Bargraph display to represent required part of the digital displayed range.

4/20mA output current to represent required part of the transmitter input range.

Each of the functions in the configuration menu is summarised below, including a cross-reference to a more detailed description.

Transmitter display	Summary of function
'InPut'	**Transmitter input** Selects **o**ne of the following inputs: Thermocouple 'tHC' 3 wire RTD '3rtd' 4 wire RTD '4rtd' Differential RTD 'd_rtd' Voltage 'Volt' 3 wire resistance '3rES' 4 wire resistance '4rES' See section 7.2.1

The content of the configuration menu depends upon which transmitter input is selected, see following summary and Figs 7, 8 and 9.

For Thermocouple Input – see Fig 7

Transmitter display	Summary of function
't.tYPE'	**Thermocouple type** Selects 1 of 8 common types of thermocouple. See section 7.2.2
'dEG'	**Units of digital display** Selects 1 of 4 units of temperature. See section 7.2.3
'rESn'	**Display resolution** Selects low or high display resolution. See section 7.2.4
'CJC'	**Cold junction compensation** Turns thermocouple cold junction compensation on or off. See section 7.2.5
'FAuLt'	**Sensor fault analogue indication** Selects 1 of 3 under/over range output currents to indicate that a sensor fault has been detected. Analogue fault indication may be disabled. See section 7.2.6
'CAL'	**Configuration of 4/20mA output** Defines transmitter input at which transmitter output is 4 & 20mA. See section 7.2.7
'bAr'	**Configuration of bargraph display** Defines digital display at which bargraph is zero and full scale. See section 7.2.8
'CodE'	**Access code for configuration menu** Enters four digit configuration menu access code. Default code 0000 disables this function. See section 7.2.9

For Resistance Thermometer (RTD) Input see Fig 8

Transmitter display	Summary of function
'r.tYPE'	**Resistance thermometer type** Selects Pt100 or Pt1000 sensor See section 7.2.10
'dEG'	**Units of digital display** Selects 1 of 4 units of temperature. See section 7.2.3
'rESn'	**Display resolution** Selects low or high display resolution. See section 7.2.4
'FAuLt'	**Sensor fault analogue indication** Selects 1 of 3 under/over range output currents to indicate that a sensor fault has been detected. Analogue sensor fault indication may be disabled. See section 7.2.6
'CAL'	**Configuration of 4/20mA output** Defines transmitter input at which transmitter output is 4 & 20mA. See section 7.2.7
'bAr'	**Configuration of bargraph display** Defines digital display at which bargraph is zero and full scale. See section 7.2.8
'CodE'	**Access code for configuration menu** Enters four digit configuration menu access code. Default code 0000 disables this function. See section 7.2.9

For Voltage and Resistance Inputs – see Fig 9

Transmitter display	Summary of function
'dP'	**Decimal point position** Defines position of displayed decimal point. See section 7.2.11
'in-Lo'	**Lower input and display** Defines lower voltage or resistance input 'inVAL' and corresponding digital display 'diSP'. See section 7.2.12
'in-Hi'	**Higher input and display** Defines higher voltage or resistance input 'inVAL' and corresponding digital display 'diSP'. See section 7.2.13
'CAL'	**Configuration of 4/20mA output** Defines the transmitter input at which transmitter output is 4 & 20mA. See section 7.2.7
'bAr'	**Configuration of bargraph display** Defines digital display at which bargraph is zero and full scale. See section 7.2.8
'CodE'	**Access code for configuration menu** Enters four digit configuration menu access code. Default code 0000 disables this function. See section 7.2.9

7.2 Description of configuration menu functions

This section contains a detailed description of each function in the configuration menu. It should be read in conjunction with Figs 7, 8 & 9.

7.2.1 Transmitter input 'InPut'

This function enables the BA478C indicating temperature transmitter to be conditioned to operate with a thermocouple, 3 or 4 wire resistance thermometer, voltage or 3 or 4 wire resistance input. A differential resistance thermometer input may also be selected. A differential thermocouple input is achieved by selecting the thermocouple input in this function and turning the cold junction compensation off in the CJC function – see 7.2.5.

Sensor	Transmitter display
Thermocouple	'tHC'
3 wire RTD	'3rtd'
4 wire RTD	'4rtd'
Differential RTD	'd_rtd'
Voltage	'VoLt'
3 wire resistance	'3rES'
4 wire resistance	'4rES'

The 'InPut' function is the first function displayed when entering the configuration menu, or it may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When the required input has been selected press ***E*** to enter the selection and return to the 'InPut' prompt in the configuration menu.

7.2.2 Thermocouple type 't.tYPE'

This function enables one of eight common thermocouples to be selected. The following table shows the thermocouple types, indicator display and the operating temperature range.

THC Type	BA478C Display	Temperature range °C		
B	'b'	200	to	1820
E	'E'	-200	to	1000
J	'J'	-210	to	1200
K	'H'	-200	to	1372
N	'n'	-200	to	1300
R	'r'	-50	to	1768
S	'S'	-50	to	1768
T	't'	-200	to	400

The 't.tYPE' function may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When the required thermocouple has been selected, press ***E*** to enter the selection and return to the 't.tYPE' prompt in the configuration menu.

7.2.3 Units of digital display 'dEG'

The transmitter digital display may be in one of four units of temperature.

Units	Transmitter Display
°C	°C
°F	°F
r	r
K	H

When °C or °F are selected the units of measurement are shown at the top left hand corner of the display when the transmitter is in the operating mode.

The 'dEG' function may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When the required units have been selected, press ***E*** to enter the selection and return to the 'dEG' prompt in the configuration menu.

7.2.4 Display resolution 'rESn'

This function defines the resolution of the transmitter display but does not affect the resolution of the 4/20mA output current.

Resolution	Transmitter Display
Lo	0 0 0 0 0
Hi	0 0 0 0.0

The 'rESn' function may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When the required resolution has been selected, press ***E*** to enter the selection and return to the 'rESn' prompt in the configuration menu.

7.2.5 Cold junction compensation 'CJC'

The temperature of the thermocouple cold junction, which is the transmitter input terminals, is measured and added to the thermocouple output so that the transmitter displays and transmits the hot junction temperature. If cold junction compensation is not required e.g. for differential measurements with two thermocouples, this function allows it to be turned off.
The 'CJC' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When set as required, press ***E*** to enter the selection and return to the 'CJC' prompt in the configuration menu.

7.2.6 Sensor fault analogue indication 'FAuLt'

The sensor fault analogue indication function appears in the menu when the transmitter is configured for a resistance thermometer or a thermocouple input.

When a fault is detected the transmitter's 4/20mA output current is set to the specified under or over range fault value and the transmitter's digital display is under or overranged as shown below. One of three fault currents may be selected, or the fault indication may be turned off. Irrespective of how the function is set the transmitter display will flash when a sensor fault is detected.

Selected fault current	Output current	Transmitter display
'oFF'	No fault indication	Flashes
'dn3.6'	3.6mA *	Flashes
'dn3.8'	3.8mA	Flashes
'uP 21'	21.0mA	Flashes

* Not recommended when HART® communication is used.

The 'FAuLt' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button. When set as required, press ***E*** to enter the selection and return to the 'FAuLT' prompt in the configuration menu.

The typical detection thresholds and approximate response times are:

Thermocouple	> 5kΩ	10 sec
RTD sensor	< 5Ω >500Ω	1 sec
RTD sense leads	> 50Ω	10 sec

In the time between a fault developing in an RTD sense lead or a thermocouple and the fault being detected, the transmitter output and display may drift from the last correct measured value.

7.2.7 Configuration of 4/20mA output 'CAL'

This function defines the relationship between the transmitter input and the 4/20mA output current. 'Zero' defines the transmitter input at which the output is 4mA and 'Span' defines the input at which the output is 20mA.

This function does not affect the transmitter display which is fixed for thermocouple and resistance thermometer inputs and adjusted via the 'in-Lo and 'in-Hi' functions for resistance and voltage inputs.

The 'CAL' function may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will display the 'ZEro' function in the sub-menu, pressing ***P*** again will reveal the existing transmitter input at which the transmitter output current is 4mA. Input is shown in units which depend upon how the transmitter input 'InPut' and display 'dEG' have been configured, as shown below:

Configured transmitter input	Input shown as
Thermocouple	°C, °F, K or r
Resistance thermometer	°C, °F, K or r
Voltage	mV
Resistance	Ohms

The input, at which the transmitter output current is 4mA, may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When the required input has been selected, press ***E*** to enter the selection and return to the 'ZEro' prompt.

The 'SPAn' function, which defines the input at which the transmitter current output is 20mA, may be selected from within the sub-menu by operating either the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing transmitter input at which the transmitter output current is 20mA. Again the input will be shown in units which depend upon how the transmitter has been configured.

The input, at which the transmitter output current is 20mA, may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When the required input has been selected, press ***E*** to enter the selection and return to the 'SPAn' prompt.

Note: When configured for a voltage input, operating the ***P*** button when the 0.1mV digit is flashing in the 'Zero' or 'SPAn' sub menus increases the input resolution to 0.01mV which is indicated by the display colon being activated. When the required input has been selected, pressing ***E*** enters the selection and returns the transmitter to the 'ZEro' or 'SPAn' prompt in the sub menu.

If, when configured for a voltage or resistance input the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'ZEro' or 'SPAn'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

7.2.8 Configuration of bargraph display 'bAr'

This function contains three sub-functions that justify the bargraph display and define the relationship between the bargraph and the transmitter digital display.

Sub-function 'b.tYPE' enables the bargraph to be left, centre or right justified, or to be turned off. Sub-functions 'bArLo' and 'bArHi' define the transmitter digital display at which the bargraph starts and is at full scale.

The 'bAr' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will display the 'b.tYPE' sub-function, pressing ***P*** again will reveal the existing bargraph justification. The ▼ or ▲ button will scroll through the four options, when the required justification is displayed, pressing ***E*** will enter the selection and return the display to the 'b.tYPE' prompt in the sub-menu from which 'bArLo' may be selected using the ▼ or ▲ button.

'bArLo' defines the transmitter digital display at which the bargraph starts, to enter the function press ***P*** which will reveal the existing setting. The display may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When the required starting display has been selected, press ***E*** to return to the 'bArLo' prompt in the sub-menu from which the 'bArHi' function may be selected.

'bArHi' defines the transmitter digital display at which the bargraph is full scale, to enter the function press ***P*** which will reveal the existing setting. The display may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When the required display has been selected, press ***E*** twice to return to enter the new values and return to the 'bAr' prompt in the configuration menu.

Note: If, when configured for a voltage or resistance input the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'bArLo' or 'bArHi'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

7.2.9 Access code for configuration menu 'CodE'

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

To enter a new access code select 'CodE' in the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the current access code with one digit flashing. The code may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When the required code has been selected, press ***E*** to enter the selection and return to the 'CodE' prompt in the configuration menu. The revised access code will be activated when the transmitter is returned to the operating mode.

If the access code is lost please contact BEKA associates.

7.2.10 Resistance thermometer type 'r.tYPE'

This function configures the BA478C to operate with a Pt100 or Pt1000 resistance thermometer input.

The 'r.tYPE' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing setting which may be changed using the ▼ or ▲ button.

Resistance thermometer	Transmitter display
Pt100	100r
Pt1000	1000r

When the required resistance thermometer has been selected, press ***E*** to enter the selection and return to the 'r.tYPE' prompt in the configuration menu.

7.2.11 Decimal point position 'dP'

This function defines the position of the displayed decimal point when the transmitter is configured for a voltage or a resistance input.

This function does not appear in the configuration menu when the transmitter is configured for a thermocouple or a resistance thermometer input.

The 'dP' function may be selected from within the menu by operating the ▼ or ▲ button. To enter the function press ***P*** to reveal the existing position of the decimal point which may be moved to the required position, or omitted, by operating the ▼ or ▲ button. Autorange, which is selected when all the decimal points are activated, ensures that the transmitter numeric display is always shown with maximum resolution irrespective of the value. When set as required, press ***E*** to enter the selection and return to the 'dP' prompt in the configuration menu.

7.2.12 Lower input & display 'in-Lo'

This function, which only appears in the menu when the transmitter is configured for a voltage or resistance input, defines the transmitter lower input voltage or resistance 'inVAL' and the corresponding transmitter digital display 'diSP'.

This function does not affect the transmitter output current which is defined by the 'CAL' function.

The 'in-Lo' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will display 'inVAL' in the sub-menu, pressing ***P*** again will reveal the existing transmitter lower input voltage or resistance. 'InVAL' is shown in units which depend upon how the transmitter input 'inPut' has been configured, as shown below:

Configured transmitter input	'inVAL' units	resolution
Voltage	mV	0.1 or 0.01mV
Resistance	Ω	0.1Ω

'inVAL' may be adjusted using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When configured for a voltage input, operating the ***P*** button when the 0.1mV digit is flashing increases the resolution to 0.01mV which is indicated by the display colon being activated. When the required input has been selected, press ***E*** to enter the selection and return to the 'inVAL' prompt in the sub menu.

'diSP' which is the transmitter display corresponding to 'inVAL' may be selected from within the sub-menu by operating either the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing lower transmitter display. The display may be changed using the ▼ and ▲ buttons to adjust the flashing digit and the ***P*** button to move control to the next digit. The position of the displayed decimal point is set by the dP function – see section 7.2.11. When the required transmitter display has been selected, press ***E*** twice to enter the selection and return to the configuration menu.

Note: When the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'inVAL'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

7.2.13 Higher input & display 'in-Hi'

This function which only appears in the menu when the transmitter is configured for a voltage or resistance input, defines the transmitter higher input voltage or resistance 'inVAL' and the corresponding transmitter digital display 'diSP'.

This function does not affect the transmitter output current which is defined by the 'CAL' function.

The 'in-Hi' function may be selected from within the configuration menu by operating the ▼ or ▲ button. To enter the function press ***P*** which will display 'inVAL' in the sub-menu, pressing ***P*** again will reveal the existing transmitter higher input voltage or resistance. 'InVAL' is shown in units which depend upon how the transmitter input 'inPut' has been configured, as shown below:

Configured transmitter input	'inVAL' units	resolution
Voltage	mV	0.1 or 0.01mV
Resistance	Ω	0.1Ω

'inVAL' may be adjusted using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When configured for a voltage input, operating the ***P*** button when the 0.1mV digit is flashing increases the resolution to 0.01V which is indicated by the display colon being activated. When the required input has been selected, press ***E*** to enter the selection and return to the 'inVAL' prompt in the sub menu.

'diSP' which is the transmitter display corresponding to 'inVAL' may be selected from within the sub-menu by operating either the ▼ or ▲ button. To enter the function press ***P*** which will reveal the existing higher transmitter display. The display may be changed using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. The position of the displayed decimal point is set by the dP function – see section 7.2.11. When the required transmitter display has been selected, press ***E*** twice to enter the selection and return to the configuration menu.

Note: When the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'inVAL'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

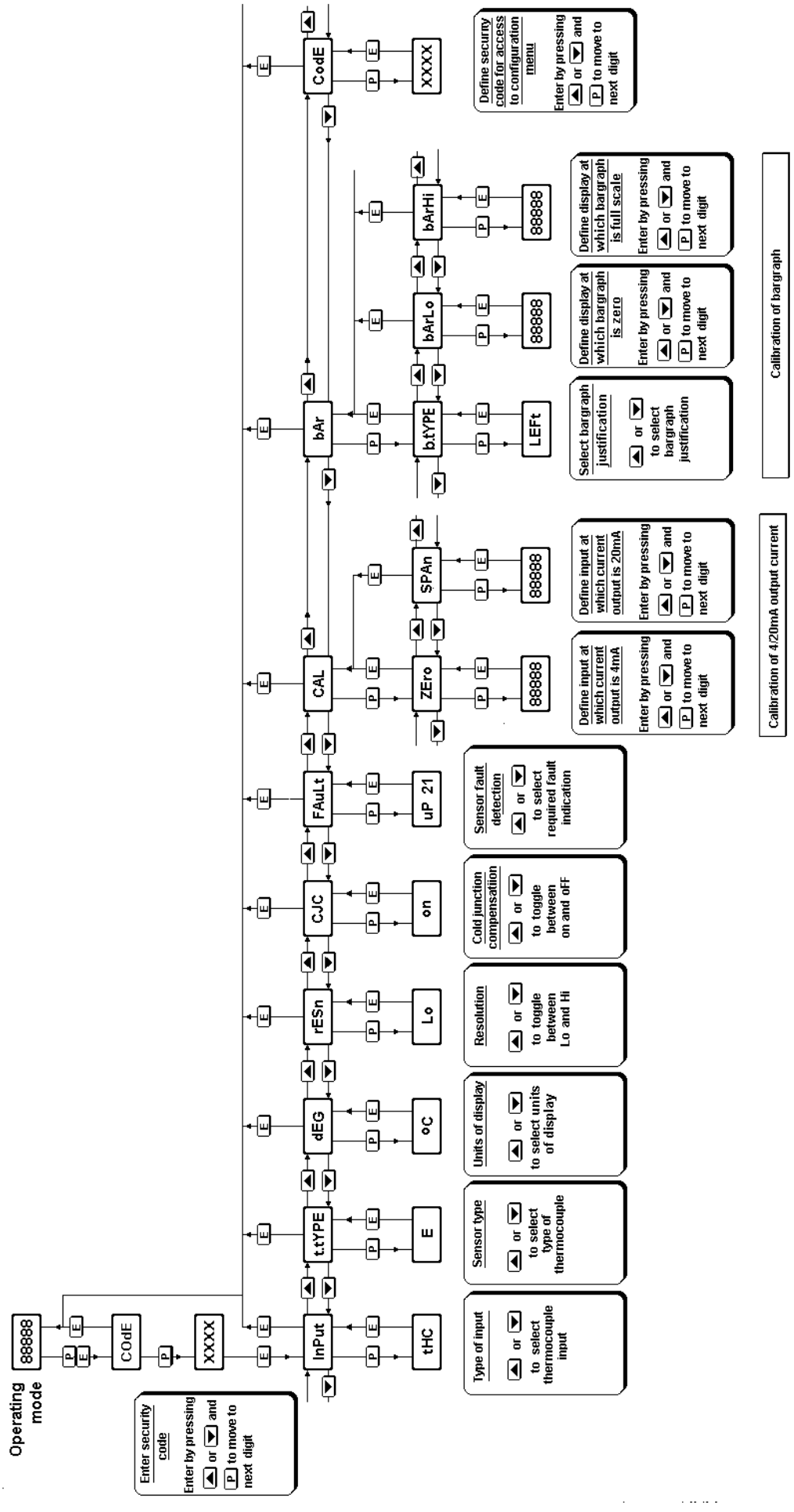


Fig 7 Thermocouple input configuration menu

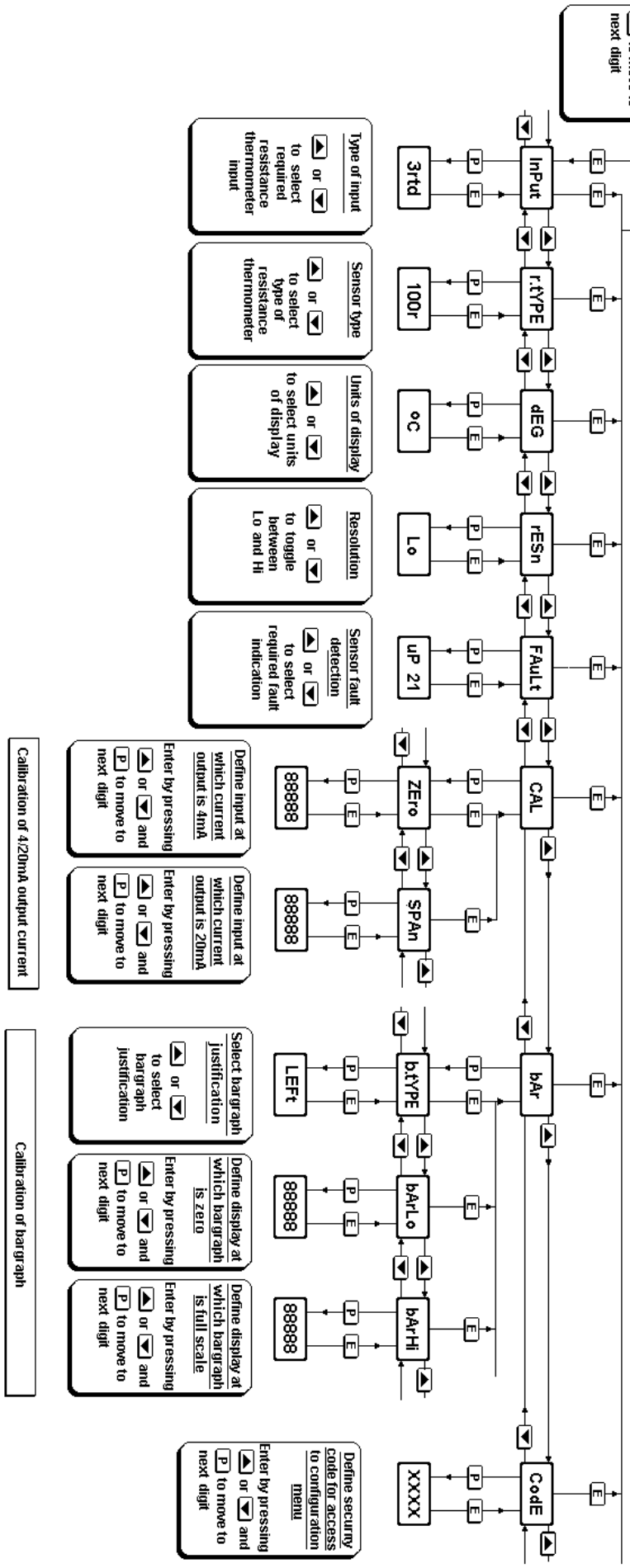


Fig 8 Resistance thermometer input configuration menu

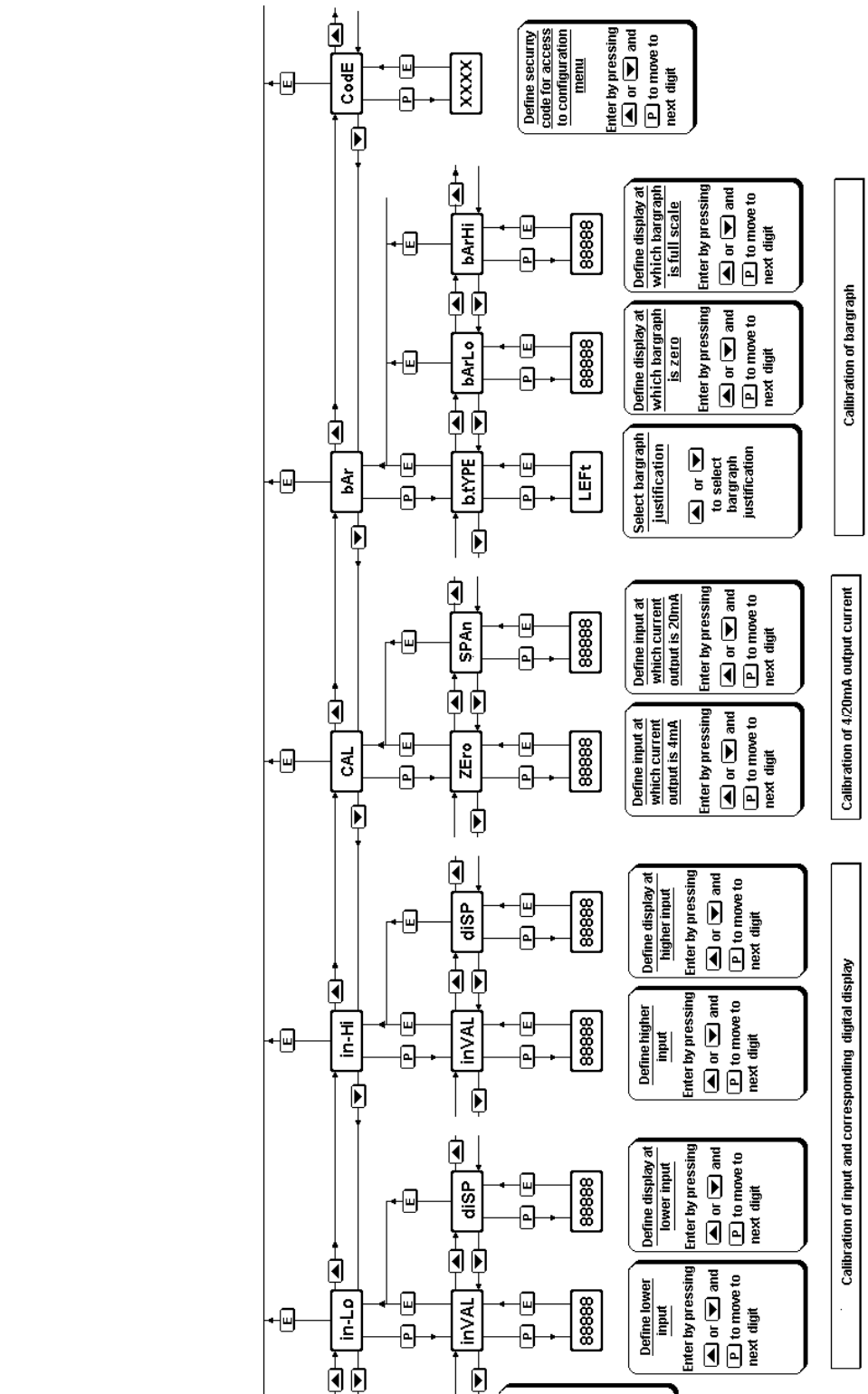


Fig 9 Voltage and resistance input configuration menu

7.3 Default configuration

If the transmitter's configuration is not specified at the time of ordering, the instrument will be configured as follows but can easily be reconfigured on-site.

Function	Factory default
Transmitter input 'InPut'	3 wire RTD
Sensor type 't.tYPE'	Pt100
Units of digital display 'dEG'	ºC
Display resolution 'rESn'	Low
Sensor fault 'FAuLt'	Off
4/20mA output 'CAL'	0.0 to 100.0
Bargraph display 'bAr'	Left hand justification. Bargraph starts at digital display 0.0 and finishes at digital display 100.0
Access code 'CodE'	0000 which disables this function.

8. CONFIGURATION EXAMPLE

In this example a BA478C indicating temperature transmitter is required to display temperature in degrees Celsius with maximum resolution. The temperature sensor is a 3 wire Pt100 resistance thermometer and the 4/20mA transmitter output is required to representing –10 to +250°C. . A left hand justified bargraph representing 100.0 to 200.0°C is required. Resistance thermometer failure is to be indicated by an overrange output current of 21.0mA. After configuration access to the configuration menu is to be protected by code 1209.

Configuration is performed using the front panel push buttons – see Fig 5. The BA478C can be supplied with factory fitted external push buttons if frequent adjustments are required.

The transmitter configuration may also be performed via HART® communication from a local or remote configurator. The HART® communication protocol includes additional functions allowing the complete temperature loop, including the temperature sensor and the transmitter load, to be calibrated - see the BEKA HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals

Step 1 **Access the configuration menu & select the type of input.**

See: Fig 8 and section 7.2.1

New BA478C indicating temperature transmitters are supplied conditioned with default access code ‘0000’ that allows unrestricted access to the configuration menu.

To enter the configuration menu press buttons ***P*** and ***E*** simultaneously which will cause the first prompt ‘InPut’ to be displayed. Press ***P*** to enter the function and the transmitter will display the current type of input. To configure the transmitter to operate with a three wire resistance thermometer press the ▼ or ▲ button until ‘3rtd’ is displayed. When selected press ***E*** to enter the selection and return to the ‘InPut’ prompt in the configuration menu.

Step 2 **Select resistance thermometer type**

See: Fig 8 and section 7.2.10

Using the ▼ or ▲ button select the ‘r,tYPE’ prompt from the configuration menu and press ***P*** to enter the function which enables the type of resistance thermometer to be selected. The transmitter will display the existing type of resistance thermometer, using the ▼ or ▲ button select ‘100r’ which is the required Pt100 sensor. Enter the selection by pressing the ***E*** button that will return the display to the ‘r.tYPE’ prompt in the configuration menu.

Step 3 **Select units of digital display**

See: Fig 8 and section 7.2.3

Using the ▼ or ▲ button select ‘dEG’ from the configuration menu and press ***P*** to enter the function which enables the digital display units of measurement to be selected. Using the ▼ or ▲ button scroll through the options and select ‘ºC’ which represents degrees Celsius. Press ***E*** to enter the selection and return the transmitter display to the ‘dEG’ prompt in the configuration menu.

Step 4 **Select display resolution**

See: Fig 8 and section 7.2.4

Using the ▼ or ▲ button select ‘rESn’ from the configuration menu and press ***P*** to enter the function which determines the resolution of the digital display. Using the ▼ or ▲ button select ‘hi’ to provide the required 0.1 resolution display. Press ***E*** to enter this selection and return the display to the ‘rESn’ prompt in the configuration menu.

Step 5 **Sensor fault detection**

See: Fig 8 and section 7.2.6

Using the ▼ or ▲ button select ‘FAuLt’, the input sensor fault detection function, from the configuration menu and press ***P***. Using the ▼ or ▲ button scroll through the options and select ‘uP 21’ which forces the output current to 21.0mA when a sensor failure is detected. Enter the selection by pressing ***E*** which will also return the transmitter display to the ‘FAuLt’ prompt in the configuration menu.

Step 6 **Configuration of 4/20mA output**

See: Fig 8 and section 7.2.7

The BA478C transmitter input at which the transmitter output current is 4mA and 20mA is defined by the ‘CAL’ function which contains two sub-functions.

Using the ▼ or ▲ button select ‘CAL’ from the configuration menu and press ***P*** which will show the ‘ZEro’ sub-function prompt. Press ***P*** again to enter this sub-function, which will reveal the existing input at which the transmitter output current is 4mA. Adjust the display to the required –0010.0 using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. A negative display is achieved by scrolling the most significant digit below zero using the ▼ button. When set press ***E*** to enter the new value and

return to the 'ZEro' sub-function prompt from which the 'SPAn' sub-function, which defines the display at which the output is 20mA, may be selected using the ▼ or ▲ button. Press ***P*** to enter this sub-function, which will reveal the existing input at which the transmitter output current is 20mA. Adjust the display to 0250.0 using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. Finally press ***E*** twice, first to enter the selection and return to the 'SPAn' sub-function prompt, and again to return to the 'CAL' function prompt in the configuration menu.

Step 7 Configuration of bargraph display

See: Fig 8 and section 7.2.8

This function contains three sub-functions that justify the bargraph display and define the transmitter digital display at which the bargraph starts and finishes.

Using the ▼ or ▲ button select 'bAr' from the configuration menu and press ***P*** which will show the 'b.tYPE' sub-function prompt. Press ***P*** again to enter this sub-function, which will reveal the existing bargraph justification. Using the ▼ or ▲ button scroll through the options and select 'LEFt' which will start the bargraph on the left hand side of the display. Press ***E*** to enter the selection and return to the 'b.tYPE' sub-function prompt from which, using the ▼ or ▲ button, the 'bArLo' sub-function may be selected. Press ***P*** to enter the 'bArLo' sub-function which will reveal the existing digital display at which the bargraph starts. Set the display to 0100.0 using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. When set, press ***E*** to enter the new value and return to the 'bArLo' sub-function prompt from which the 'bArHi' sub-function may be selected. Press ***P*** to enter the 'bArHi' sub-function which will reveal the existing digital display at which the bargraph finishes. Set the display to 0200.0 using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to move control to the next digit. Finally press ***E*** twice, first to enter the selection and return to the 'bArHi' sub-function prompt, and again to return to the 'bAr' function prompt in the configuration menu.

Step 8 Enter the configuration menu access code.

See Fig 8 and section 7.2.9

This function defines the four digit code that must be entered to obtain access to the BA478C transmitter's configuration menu.

Using the ▼ or ▲ button select the 'CodE' prompt from the configuration menu and press ***P*** which, for a new instrument, will show the default code '0000' with the first digit flashing. Using the ▼ or ▲ button to adjust the flashing digit and the ***P*** button to transfer control to the next digit, set the display to 1209. Press ***E*** twice to enter the new access code and return the BA478C to the display mode via the 'CodE prompt.

This completes the instrument configuration. The BA478C transmitter will now function as specified at the beginning of this example. Access to the configuration is protected by code 1209 which must be entered each time a change is made.

9. MAINTENENCE

The BA478C indicating temperature transmitter should only be maintained by trained competent personnel.

9.1 Fault finding during commissioning

If a BA478C fails to function during commissioning the following procedure should be followed:

Symptom	Cause	Check
No display or output current	Incorrect wiring Low supply voltage	Wiring That voltage between terminals 5 & 6 is between 9 & 28V at all output currents. Terminal 5 positive. or between 15 .5 & 28V at all output currents if optional backlight is fitted.
Digital display is over or under range showing 9.9.9.9.9 or -9.9.9.9.9 with all decimal points flashing.	Incorrect wiring of THC or RTD input Input is outside specified range for voltage or resistance input.	Wiring and input configuration. Reconfigure digital display.
Bargraph is over or under range. with scale flashing, bargraph displaying all or just one segment.	Input is outside specified range for bargraph.	Reconfigure bargraph display.
Digital display & bargraph flashing and 4/20mA fixed at 3.6, 3.8 or 21.0mA	Sensor fault detection has been activated.	Sensor and input wiring.

9.2 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 BA478C fails after it has been functioning correctly the following procedure should be followed:

Symptom	Cause	Check
No display or output current	Wiring or power supply fault.	Wiring That voltage between terminals 5 & 6 is between 9 & 28V. Terminal 5 positive. or 15 .5 & 28V if optional backlight is fitted.
Digital display & bargraph flashing and 4/20mA fixed at 3.6, 3.8 or 21.0mA	Sensor fault detection has been activated.	Sensor and input wiring.

If this procedure does not reveal the cause of the fault we recommend that the transmitter is replaced.

9.3 Servicing
We recommend that faulty BA478C indicating temperature transmitters are returned to BEKA associates or to our local agent for repair.

9.4 Routine maintenance
The mechanical and electrical condition of the transmitter should be regularly checked. Initially an annual inspection is recommended, but the inspection frequency should be adjusted to suit the environmental conditions.

9.5 Guarantee
Transmitters 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.

9.6 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.

10. ACCESSORIES
10.1 Scale marking
BA478C transmitters are fitted with a blank escutcheon around the liquid crystal display. If specified when the instrument is ordered, this can be supplied printed with units of measurement and a scale for the horizontal bargraph.

10.2 Tag number
The BA478C can be supplied with a thermally printed tag number on the rear panel adjacent to the terminals.

10.3 Alarms
The BA478C can be supplied with two solid state single pole alarm outputs that may be independently programmed as high or low alarms with normally open or normally closed outputs. Fig 10 illustrates the conditions available and shows which are fail safe, i.e. in the alarm condition the output is open.

WARNING

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

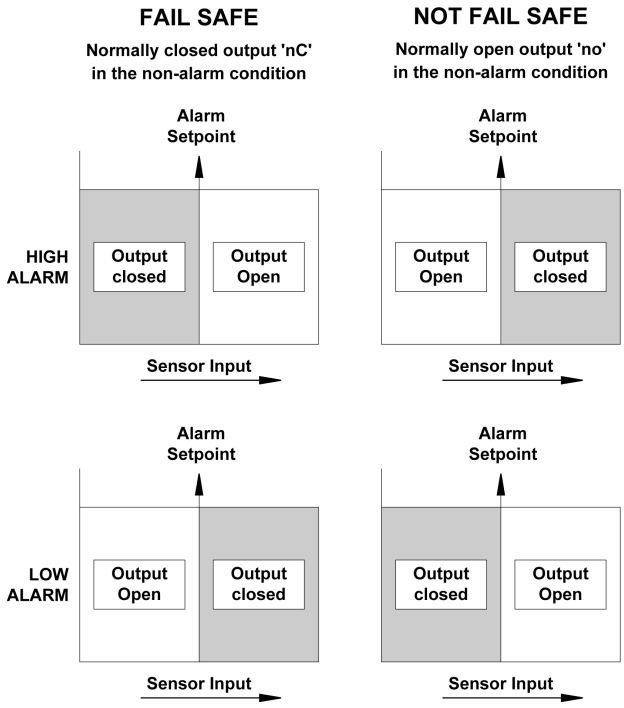


Fig 10 Alarm outputs

When an alarm is activated an annunciator appears on the left hand side of the BA478C display. This shows which alarm has been activated and will flash if the alarm is delayed or silenced.

Programmable functions for each alarm include adjustable setpoint, hysteresis, alarm delay and alarm accept.

10.3.1 Solid state output

Each alarm has a galvanically isolated single pole solid state switch output as shown in Fig 11. The outputs are polarised and current will only flow in one direction. Terminals 8 and 10 should be connected to the positive side of the supply.

Ron	=	5ohms + 0.6V
Roff	=	greater than 180k

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

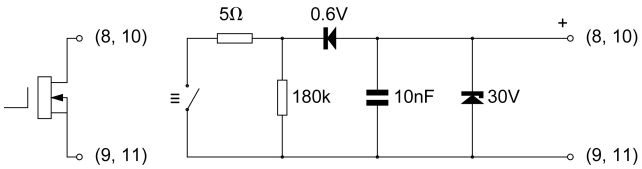


Fig 11 Equivalent circuit of each alarm output

10.3.2 Intrinsic safety

Each alarm output is a separate galvanically isolated solid state switch. The EC-Type Examination Certificate specifies that under fault conditions the voltage, current and power at each alarm output will not exceed those specified for *simple apparatus* in Clause 5.7 of EN60079-11. This allows each of the BA478C alarm outputs to be connected to any intrinsically safe circuit protected by a Zener barrier or galvanic isolator providing that the output parameters of each circuit do not exceed:

Uo	=	30V dc
Io	=	200mA
Po	=	0.85W

Hazardous or safe area loads may be switch as shown in Fig 12.

The maximum equivalent capacitance and inductance of each BA478C alarm output is:

Ci	=	20nF
Li	=	0.01mH

To determine the maximum permissible cable parameters, the equivalent alarm output parameters should be subtracted from the maximum cable capacitance and inductance specified by the certificate for the Zener barrier or galvanic isolator powering the alarm circuit.

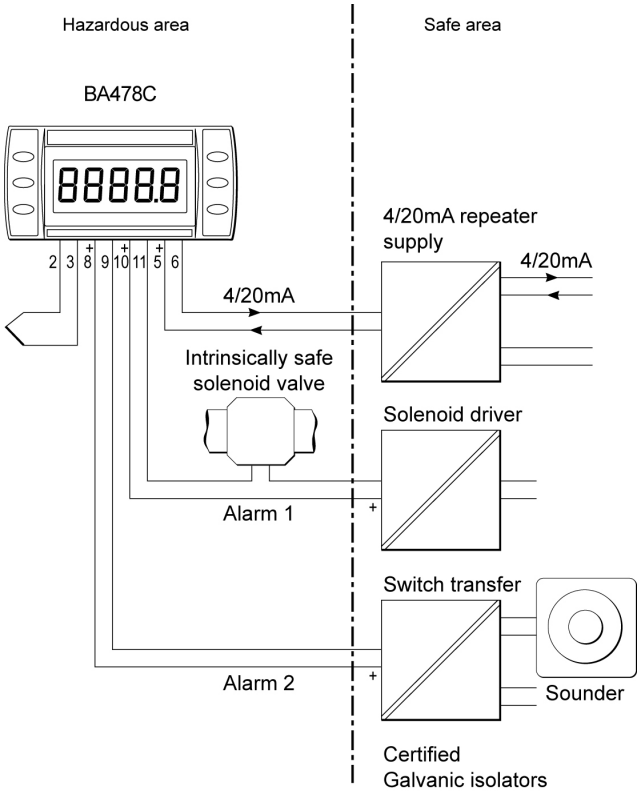


Fig 12 Typical alarm application

10.3.3 Alarm configuration

Alarm configuration may be performed via the HART® digital communication, see the BEKA HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals for details. Alternatively configuration may be performed using the configuration menu which is accessed via the front panel push buttons, see Fig 5.

When a BA478C indicating temperature transmitter is supplied with optional alarms the conditioning menu is extended as shown in Fig 13. The additional alarm functions appear between 'bAr' and 'CodE' in the configuration menu. For simplicity Fig 13 only shows the additional sub-functions for alarm 1, but alarm 2 has identical sub-functions.

The following table summarises each of the alarm configuration functions and includes a cross reference to more detailed information. Again only the functions for alarm 1 are listed, but alarm 2 has identical functions.

Summary of programmable alarm functions

Display	Description of function
'ALr1'	**Alarm 1**
'ALr2'	**Alarm 2** The two functions **e**ach contain seven identical sub-functions, one set for configuration alarm 1 and the other for configuration alarm 2. See section 10.3.4 and Fig 13.
'EnbL'	**Alarm enable** Enables or disables the alarm function without changing the alarm parameters. See section 10.3.5
'SP1'	**Alarm setpoint 1** Adjusts the alarm setpoint. The alarm is activated when the indicator display equals the setpoint. See section 10.3.6
'Hi.Lo'	**Alarm function** Defines whether the alarm has a high or low function. See section 10.3.7
'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 10.3.8
'HStr'	**Hysteresis** Adjusts the alarm hysteresis. See section 10.3.9
'dELA'	**Alarm delay time** Adjusts the delay between the display equalling the setpoint and the alarm output being activated. See section 10.3.10
'SiL'	**Alarm silence time** Defines the time that the alarm output remains in the non-alarm condition following acceptance of an alarm. See section 10.3.11
'ACSP'	**Access setpoint** Enables direct access to the alarm setpoints from the transmitter operational mode i.e. when it is displaying temperature. Access may be protected by a separate security code. See section 10.3.12

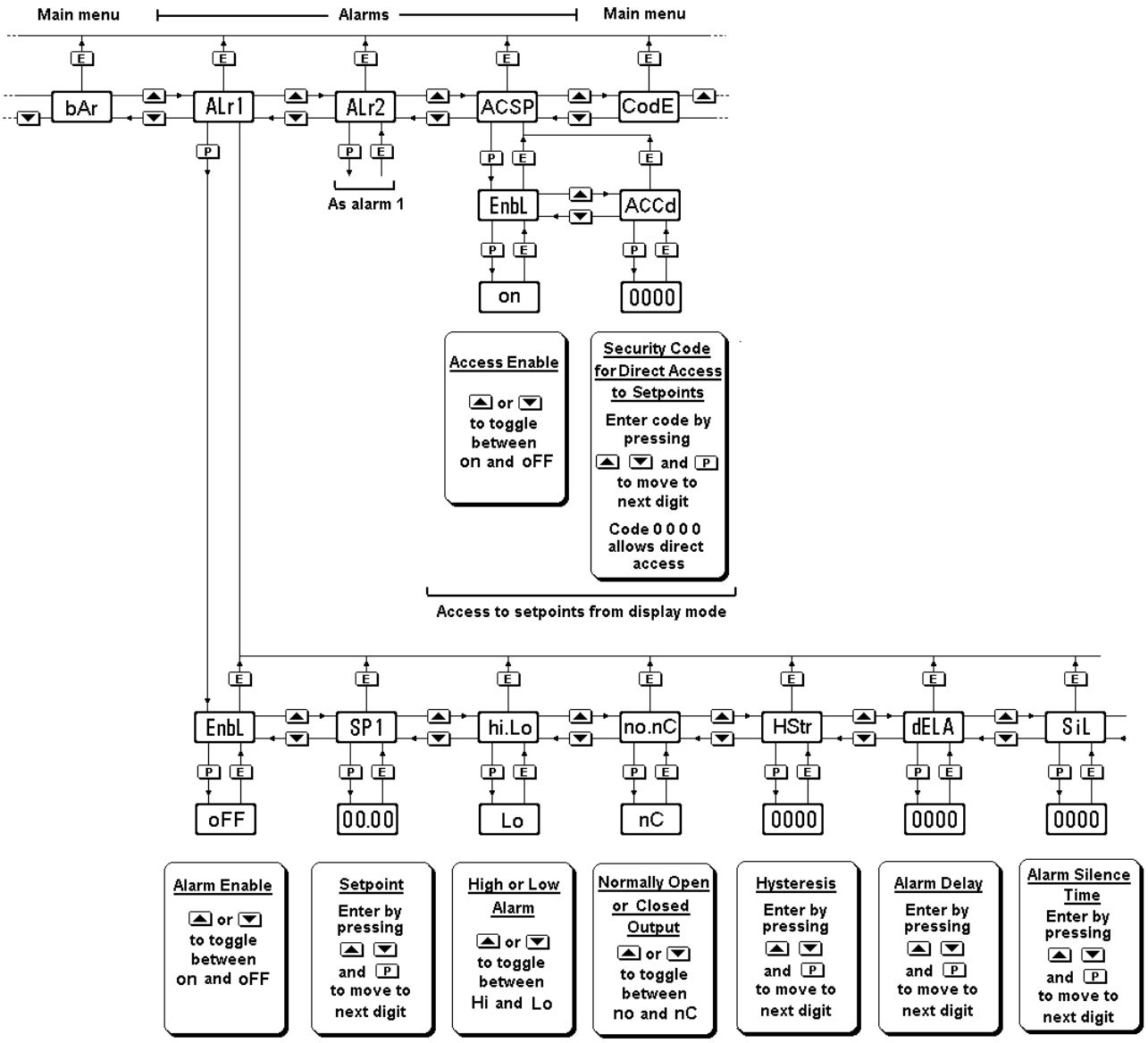


Fig 13 Alarm conditioning menu

10.3.4 Alarm selection: ALr1 or ALr2
As shown in Fig 13, each of the two alarms has an identical set of sub-functions enabling each alarm to be independently conditioned. 'ALr1 provides access to the alarm 1 sub-functions and 'ALr2' provides access to the alarm 2 sub-functions. The following sections 10.3.5 to 10.3.11 describe each of these sub-functions in detail

10.3.5 Alarm enable: EnbL
This sub-function allows the alarm to be enabled or disabled without altering any of the alarm parameters. To check or change the sub-function select 'EnbL' from the alarm sub-menu using the ▼ or ▲ button and press ***P*** which will reveal the current setting. The function can be changed by pressing the ▼ or ▲ button followed by the ***E*** button to enter the selection and return to the 'EnbL' prompt in the alarm menu.

10.3.6 Setpoint adjustment: SP1
The setpoint of each alarm relates to the transmitter digital display and may be positioned anywhere in the transmitter display range.

To adjust the setpoint select 'SP1' from the alarm menu and press ***P*** which will reveal the existing alarm setpoint with one digit flashing. The flashing digit 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 press ***E*** to enter the new setpoint and return to the 'SP1' prompt in the alarm menu.

Note: If, when configured for a voltage or resistance input the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'SP1' or 'SP2'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

10.3.7 Alarm function: Hi.Lo
Each alarm can be independently conditioned as a high or low alarm. To check or change the alarm function select 'Hi.Lo' from the alarm menu using the ▼ or ▲ button and press ***P*** to reveal the current setting. The function may be changed by pressing the ▼ or ▲ button, pressing the ***E*** button will enter the setting and return the display to the 'Hi.Lo' prompt in the alarm menu.

10.3.8 Alarm output status: no.nC
This sub-function allows the alarm output to be open or closed in the non-alarm condition. When deciding which is required, care must be taken to ensure that the alarm output is fail safe. See Fig 10.

'no' Alarm output open in non-alarm condition
'nC' Alarm output closed in non-alarm condition

CAUTION
When the transmitter supply is removed both alarm outputs will be open irrespective of conditioning. Therefore for fail safe operation both alarm outputs should be conditioned to be open in the alarm condition.

To check or change the alarm output status select 'no.nC' from the alarm menu using the ▼ or ▲ button and press ***P*** to reveal the current setting. The function can be changed by pressing the ▼ or ▲ button followed by the ***E*** button to enter the setting and return to the 'no.nC' prompt in the alarm menu.

10.3.9 Hysteresis: HStr
Hysteresis is shown in the same units as the transmitter digital display.
To adjust the hysteresis, select 'HStr' from the alarm menu using the ▼ or ▲ button and press ***P*** which will reveal the existing figure with one digit flashing. The flashing digit can be adjusted using the ▼ or ▲ push buttons, and the ***P*** button to move control to the next digit. When the required hysteresis has been entered, press ***E*** to enter the new setting and return to the 'HStr' prompt in the alarm menu.

e.g. A BA478C transmitter with a high alarm set at 90.0 and hysteresis of 10.0 will perform as follows:

The alarm will be activated when the display equals or exceeds 90.0, but will not be deactivated until the display falls below 80.0.

Note: If, when configured for a voltage or resistance input the displayed decimal point has been set to autorange, it may be necessary to manually position the decimal point before adjusting 'HStr'. This can be achieved by repeatedly operating the ***P*** button until the activated decimal point flashes, the decimal point can then be positioned using either the ▼ or ▲ button. Pressing the ***P*** button again will return control to one of the digits.

10.3.10 Alarm delay: dELA

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 'dELA' using the ▼ or ▲ button from the alarm menu and press ***P*** which will reveal the existing delay with one digit flashing. The flashing digit can be adjusted using the ▼ or ▲ push button, and the ***P*** button to move control to the next digit. When the required delay has been entered, press ***E*** to enter the new setting and return to the 'dELA' prompt in the alarm menu.

When an alarm occurs, the alarm annunciator will flash until the delay time expires, when the alarm will be activated and the annunciator will stop flashing.

10.3.11 Alarm silence time: SiL

This function is primarily intended for use in small installations where the alarm output directly operates a warning sounder or beacon. 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.

To adjust the alarm silence time, which may be between 0 and 3600 seconds, select 'SiL' from the alarm menu using the ▼ or ▲ push button and press ***P*** to reveal the existing silence time with one digit flashing. The flashing digit can be adjusted using the ▼ or ▲ push button and the ***P*** button to move control to the next digit. When the required time has been entered press ***E*** to return to the 'SiL prompt in the alarm menu.

When an alarm is cleared using the ***P*** push button, the alarm annunciator will flash until the silence time expires, if the alarm condition still exists the alarm will be reactivated.

10.3.12 Access Setpoint: ACSP

This function controls a separate menu that provides direct access to the alarm setpoints when the BA478C transmitter is in the operational mode. The function enables an operator to adjust the alarm setpoints without having access to the configuration and alarm menus. Further protection is provided by a separate security code. Both setpoints can always be displayed, but not adjusted, from the operating mode using the **E** plus the ▼ or ▲ button – see section 3.1

This direct access menu is enabled and a separate security code entered from the 'ACSP' function in the configuration menu as shown in Fig 13. To check or change the menu parameters select 'ACSP' from the menu using the ▼ or ▲ button and press ***P*** which will display the enable prompt 'EnbL'. Press ***P*** again to reveal the current setting which may be changed using the ▼ or ▲ button.

If 'oFF' is selected, the operator will not have access to the setpoints from the display mode. If 'on' is selected, the operator will have direct access to the alarm setpoints from the operational mode via a separate optional security code. Press ***E*** to enter the selection and return to the 'EnbL' prompt, pressing ***E*** again will return the 'ACSP' prompt in the configuration menu.

If the 'ACSP' function is enabled, access to the setpoints from the transmitter operational mode may be protected by an optional four digit code. This access code is defined by sub-function 'ACCd' which is reached from the 'EnbL' prompt by pressing the ▼ or ▲ button. Pressing ***P*** will then reveal the current security code with one digit flashing. The flashing digit may be changed by operating the ▼ or ▲ push button and the ***P*** button to move control to the next digit. When the required code has been entered, press ***E*** twice to return to the 'ACSP' prompt in the configuration menu.

Code 0000 disables this security code allowing, when enabled, direct access to the setpoints from the display mode by pressing the ***P*** and ▲ buttons simultaneously.

New instruments with alarms are supplied with this function disabled and the security code set to 0000

10.3.13 Adjusting alarm setpoints from the operational mode

Access to the alarm setpoints from the transmitter operational mode is obtained by operating the ***P*** and ▲ push buttons simultaneously as shown in Fig 14. If the setpoints are not protected by a security code the alarm setpoint prompt 'SP1' will be displayed. If the setpoints are protected by a security code, 'CodE' will be displayed first. Pressing ***P*** again will enable the alarm security code to be entered digit by digit using the ▼ or ▲ button to adjust the flashing digit, and the ***P*** push button to move control to the next digit. If the correct code is entered pressing *E* will cause alarm setpoint prompt 'SP1' to be displayed. Pressing the ▼ or ▲ button will toggle between the two alarm setpoint prompts 'SP1' and 'SP2'.

If an incorrect security code is entered, or a button is not pressed within ten seconds, the transmitter will return to the display mode.

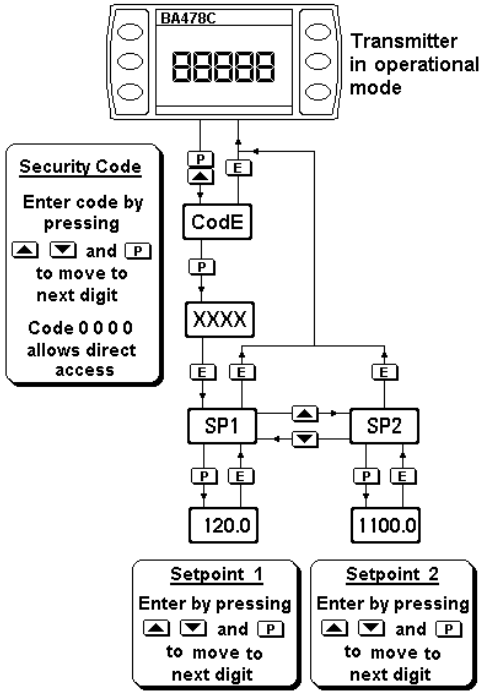


Fig 14 Setpoint adjustment from the display mode

To adjust an alarm setpoint select 'SP1' or 'SP2' and press ***P*** which will reveal the current setting with one digit flashing. Each 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 'SP1' or 'SP2' prompt from which the other setpoint may be selected, or the transmitter may be returned to the operational mode by pressing ***E*** again.

Note: Direct access to the alarm setpoints is only available when the menu is enabled - see section 10.3.12APPENDIX 1

APPENDIX 1
IECEx certification

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

A1.1 IECEx Certificate of Conformity
The BA478C Indicating Temperature Transmitter has been issued with an IECEx Certificate of Conformity number IECEx ITS 09.0006X that specifies the following certification codes and marking:

Ex ia IIC T5 Ga
Ta = -40°C to 70 °C

When connected to a certified IECEx system the BA478C may be installed in:

Zone 0 explosive gas air mixture continuously present.
Note: Special conditions apply see section A1.3

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 an ambient temperature between –40 and +70°C.

Minimum operating temperature of BA478C is -20°C.

A1.2 Installation
The BA478C IECEx and ATEX certifications have identical intrinsic safety parameters and installation requirements. The ATEX system design requirements described in section 5 of this manual may therefore be used for IECEx installations in gas atmospheres, but the local code of practice should also be consulted.

A1.3 Special conditions for Zone 0 installations
The IECEx certificate has an 'X' suffix which indicates that the transmitter is subject to special conditions for safe use, which are:

CAUTION
The BA478C Indicating Temperature Transmitter when installed in a Zone 0 potentially explosive atmosphere shall be installed such that even in the event of rare incidents, an ignition source due to impact or friction between the aluminium enclosure at the rear of the instrument mounting panel and iron/steel is excluded.

These special conditions only apply in the very unlikely event that the transmitter is installed in a Zone 0 hazardous area. The special conditions result from the aluminium enclosure and mean that in a Zone 0 installation the rear of the instrument, behind the panel, should be protected from impact.

APPENDIX 2

EU Declaration of Conformity

This certificate is issued for electrical apparatus BA478C

Description
BA478C is a panel mounting, intrinsically safe Indicating Temperature Transmitter

Manufactured by
BEKA associates Ltd, Old Charlton Road, Hitchin, Herts. UK. SG5 2DA

Council Directives this equipment complies with:

2014/34/EU (ATEX Directive)

Relating to equipment and protective systems intended for use in potentially explosive atmospheres.

Provisions of the Directive fulfilled by the equipment:

Group II Category 1G Ex ia IIC T5 Ga -40°C ≤ Ta ≤ +70°C

Notified Body for EU-Type Examination and production
INTERTEK ITALIA SPA 2575 Via Guido Miglioli, 2/A 20063 Cernusco sul Naviglio (MI) Italy

EU-Type Examination Certificate
ITS09ATEX26156X revision 1 issued 05/07/2022.

Standards used:
EN IEC 60079-0:2018 and EN 60079-11:2012 except in respect of those requirements referred to within item 16 of the Schedule.

2014/30/EU (EMC Directive)

Standards used:
EN 61326-1:2021

2011/65/EU (RoHS Directive) relating to hazardous substances in electronic and electrical equipment.

2015/863/EU additional substances added by amending Annex II to Directive 2011/65/EU as regards the list of restricted substances.

CE mark first affixed in 2009

Authorised Signatory:

Olivier Lebreton CEng
Managing Director

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