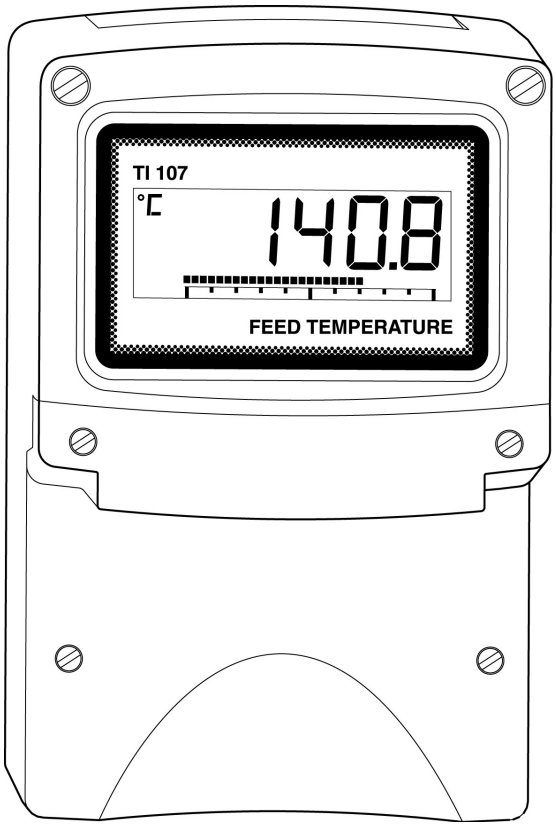
BA474D
Intrinsically safe field mounting indicating temperature transmitter

Issue 13



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Appendix 1
ATEX dust certification

Appendix 2
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Appendix 3
EU Declaration of Conformity

The BA474D 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 BA474D is a field 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 BA474D 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 BA474D has been certified intrinsically safe and as associated apparatus by European Notified Body Intertek ITALIA S.p.A. The transmitter complies with the ATEX Directive 2014/34/EU for use in explosive gas and combustible dust atmospheres. ATEX dust certification is an option - see Appendix 1.

The BA474D also has UKCA and IECEx intrinsic safety and associated apparatus certification for use in explosive gas and combustible dust atmospheres. IECEx dust certification is an option – see Appendix 2.

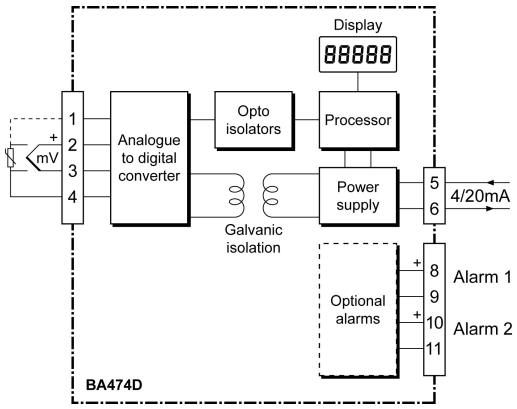


Fig 1 Simplified block diagram

2. DOCUMENTATION

This instruction manual describes the installation and configuration of the BA474D Indicating Temperature Transmitter for ATEX and UKCA intrinsically safe and associated apparatus applications.

System design information for IECEx and other non-ATEX certifications and for use in combustible dust atmospheres is contained in 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

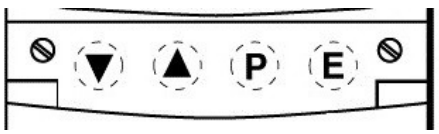
Fig 1 shows a simplified diagram of the BA474D Indicating Temperature Transmitter. The input, which may be from a resistance thermometer, thermocouple, or a dc voltage or resistance, is digitised and transferred to the instrument processor via an optical isolator. The processor linearises the input signal, 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 four push buttons which are located behind the removable switch cover – see Fig 7. For applications where frequent adjustments are required the BA474D transmitter is available with an optional external membrane keypad. 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 10.4.12
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 10.4.11



4. INTRINSIC SAFETY CERTIFICATION

The BA474D Indicating Temperature Transmitter is intrinsically safe allowing installation in Zone 0, 1 or 2 when protected by a safe area Zener barrier or galvanic isolator.

The transmitter is also certified as associated apparatus, which when mounted in a safe area, allows the input terminals to be directly connected to a sensor in Zone 0, 1 or 2 without the need for Zener barriers or galvanic isolators.

4.1 ATEX & UKCA certification

The BA474D has been awarded EU-Type Examination Certificate ITS09ATEX26155X and similar UK-Type Examination Certificate ITS21UKEX0308X. These state that the transmitter is intrinsically safe and complies with requirements for Group II, Category 1GD Ex ia IIC T5 equipment, and that it also complies with the requirements for intrinsically safe associated apparatus. 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 main section of the manual describes ATEX and UKCA installations in explosive gas atmospheres 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.

For use in the presence of combustible dust, please refer to Appendix 1, which describes ATEX and UKCA. Dust certification is an option that must be specified when the transmitter is ordered.

4.2 Zones, gas groups and T rating

The BA474D has been certified as Group II Category 1G Ex ia IIC T5 apparatus. When connected to a suitable certified system the BA474D may be installed in:

Zone 0	explosive gas air mixture continuously present. **Note:** Special conditions apply.
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 specified operating temperature of BA474D is -20°C.

This allows the BA474D to be installed in all Zones and to be used with most common industrial gases.

CAUTION

When used in a Zone 0 potentially explosive atmosphere, the BA474D Indicating Temperature Transmitter shall be installed such that even in the event of rare incidents, an ignition source due to impact or friction between the aluminium marking label and iron / steel is avoided.

4.3 Associated apparatus

The ATEX certificate also states that the BA474D Indicating Transmitter complies with the requirements for associated apparatus as it has a galvanically isolated intrinsically safe sensor input. When installed in a safe area this allows the transmitter sensor input, terminals 1, 2, 3 & 4, to be connected directly, without the need for Zener barriers or galvanic isolators, to a sensor 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.

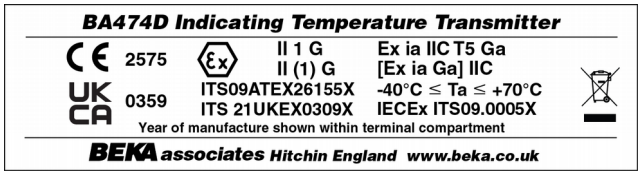
With a gas in groups:

Group A propane
Group B ethylene
Group C hydrogen

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 and UKCA certifications plus BEKA associates name and location. IECEx approval information is also included.

The instruments serial number and the year of manufacture are recorded on a separate label inside the terminal compartment.



4.5 Input terminals 1, 2, 3 and 4

When used as intrinsically safe or associated apparatus 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 BA474D 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	=	8µH

5. ELECTRICAL SYSTEM DESIGN

The BA474D is a smart HART® enabled loop powered 4/20mA Indicating Temperature Transmitter. It may be used as an intrinsically safe instrument in a hazardous area, or as associated apparatus in a safe area with it's input directly connected to a hazardous area sensor. The transmitter is available with an optional factory fitted display backlight that increases the transmitter's minimum operating voltage.

Operating voltage range between terminals 5 & 6:

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

5.1 Use as an intrinsically safe instrument

Intrinsic safety certification allows the transmitter and sensor to be installed in any hazardous Zone providing that the transmitter is protected by a certified safe area mounted Zener barrier or galvanic isolator. When the transmitter is fitted with an optional display backlight the increased minimum operating voltage usually precludes the use of Zener barriers.

5.1.1 With Zener barriers

There are three requirements when designing a BA474D 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 BA474D must be between 9 & 28V.
   Note: Zener barriers are not normally able to power a BA474D transmitter fitted with an optional display backlight which requires a minimum 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 BA474D is powered from an isolated (floating) power supply. Only one barrier is required, as the other wire is earthed at the barrier busbar.

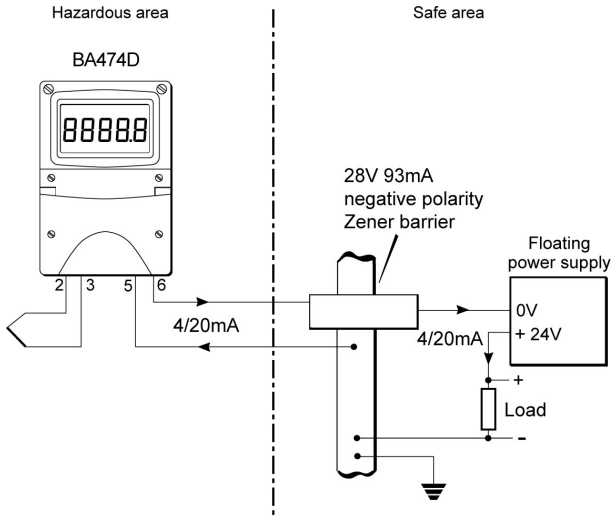


Fig 2 BA474D powered from floating supply

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.

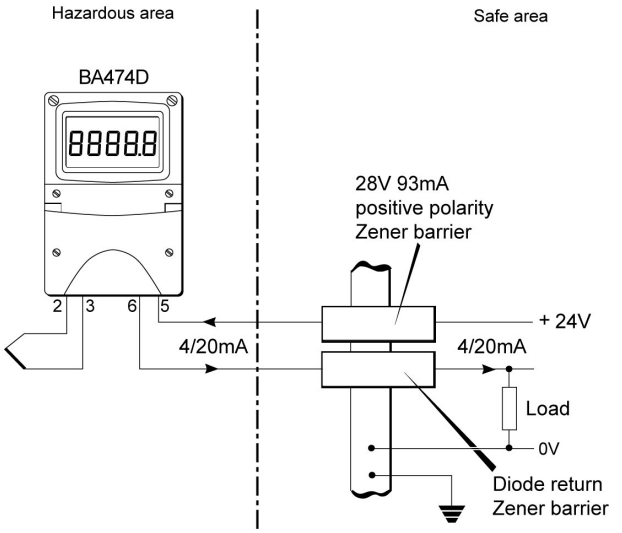


Fig 3 BA474D powered from a common supply

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 BA474D 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.

5.1.2 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 BA474D 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.

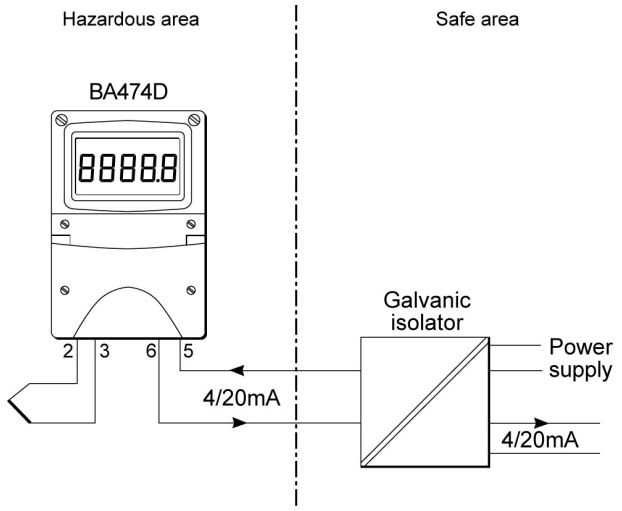


Fig 4 BA474D powered via galvanic isolator

Any ATEX certified 4/20mA repeater power supply or transmitter power supply galvanic isolator may be used. There are three requirements when designing a BA474D 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:

BA474D without backlight	9.0V
BA474D 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.

5.2 Use as associated apparatus

CAUTION

When used as associated apparatus without Zener barriers or galvanic isolators the BA474D transmitter must be installed in a safe, non-hazardous area.

When installed in a safe area, the associated apparatus certification allows the BA474D Indicating Temperature input terminals 1, 2, 3 & 4, to be directly connected to an earthed or floating sensor in a hazardous area without the need for Zener barriers or a galvanic isolator. Fig 5 shows a typical loop. The sensor may be a passive device such as a thermocouple or resistance thermometer complying with the requirements for simple apparatus, or a voltage source. See section 4.5 of this instruction manual for full details of what may be connected.

The 4/20mA loop must be designed such that the voltage between terminals 5 & 6 remains between the following limits at all currents.

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

To comply with the associated apparatus certification, terminals 5 & 6 should not be connected to any apparatus containing or generating a voltage greater than 250V rms or dc.

The intrinsically safe input wiring connected to terminals 1, 2, 3 & 4 must be segregated from the non intrinsically safe 4/20mA output wiring connected to terminals 5 & 6. See section 6.2

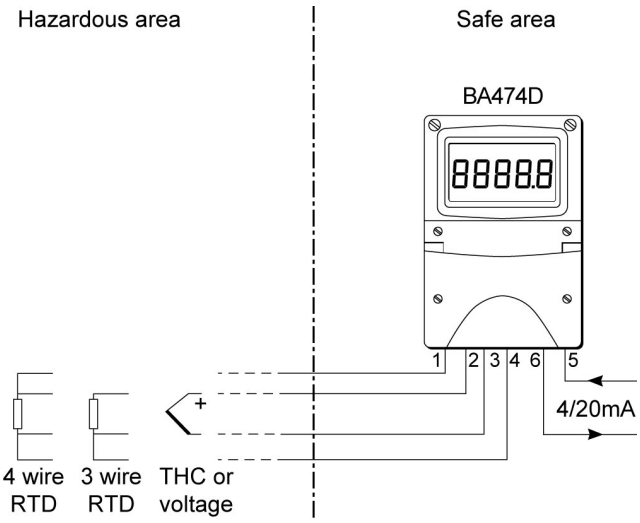


Fig 5 Use as Associated Apparatus

5.3 Use as a temperature indicator

The BA474D may also be used as just a temperature indicator by ignoring the instrument's 4/20mA output current. When installed in a hazardous area the same Zener barriers or galvanic isolators required for transmitter operation are required. When installed in a safe area as associated apparatus, the supply terminals 5 & 6 may be directly connect to a dc supply with an output voltage between 9 and 28V, or between 15.5 and 28V if the BA474D is fitted with an optional backlight. No load resistor is required.

6. INSTALLATION

6.1 Location

The BA474D Indicating Temperature Transmitter is housed in a robust IP66 glass reinforced polyester (GRP) enclosure incorporating an armoured glass window and stainless steel fittings. It is suitable for exterior mounting in most industrial environments, including offshore and wastewater treatment installations. Please consult BEKA associates if high vibration is anticipated.

The BA474D enclosure is surface mounting. Accessory kits described in sections 10 of this manual enable the instrument to be mounted onto a vertical or horizontal pipe.

The field terminals and the two mounting holes are located in a separate compartment with a sealed cover allowing the instrument to be installed without exposing the display assembly.

The BA474D earth terminal is connected to the carbon loaded GRP enclosure. If this enclosure is not bolted to an earthed post or structure, the earth terminal should be connected to a local earth.

The BA474D enclosure is supplied with a bonding plate to ensure electrical continuity between the three conduit / cable entries.

The BA474D liquid crystal display has maximum contrast when viewed from directly ahead and slightly below the centre line of the instrument. Without a backlight there is very little degradation of contrast when viewed from above the centre line, but slight degradation may be noticeable when the instrument is fitted with a backlight.

6.2 Installation Procedure

Fig 6 illustrates the instrument installation procedure.

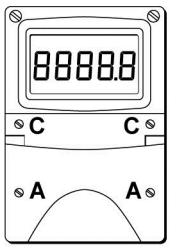
a. Remove the instrument terminal cover by unscrewing the two captive 'A' screws.

b. Mount the instrument on a flat surface and secure with two M6 screws through the 'B' holes. Alternatively use one of the mounting kits described in section 10.3

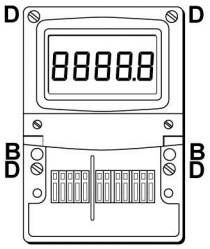
c. Remove the temporary hole plug and install an appropriate IP rated cable gland or conduit fitting. If more than one entry is required, one or both of the IP66 stopping plugs may be replaced with an appropriate IP rated cable gland or conduit fitting.
Cable glands, conduit fittings, blanking plugs and cables must be suitable for continuous use at the maximum operating temperature.

d. Connect the field wiring to the terminals as shown in Fig 7.

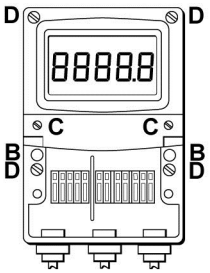
e. Replace the instrument terminal cover and evenly tighten the two 'A' screws.



Step a
Remove the terminal cover by unscrewing the two ‘A’ screws.



Step b
Secure the instrument to a flat surface with M6 screws through the two ‘B’ holes. Alternatively use a pipe mounting kit.



Step c, d and e
Remove the temporary hole plug and install an appropriately IP rated cable gland or conduit fitting. If more than one entry is required, one or both of the IP66 stopping plugs may be replaced by an appropriately IP rated cable gland or conduit fitting.

Fig 6 BA474D installation procedure

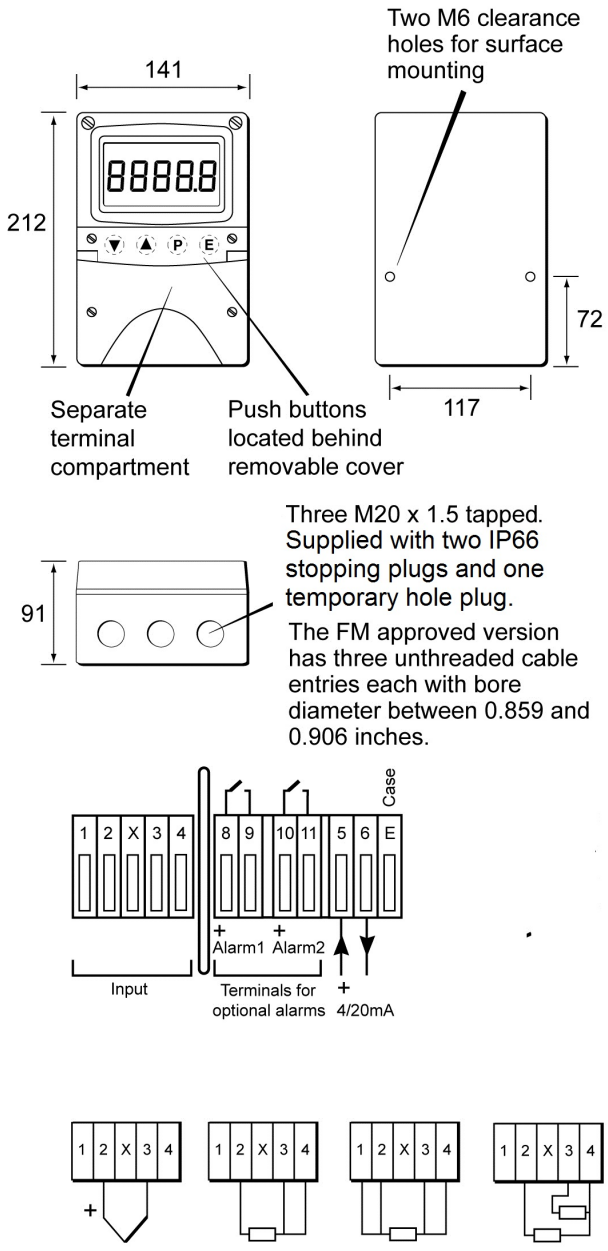


Fig 7 Dimensions and terminal connections

6.3 Associated apparatus installations

When used as associated apparatus the BA474D transmitter must be installed a safe area and the intrinsically safe input wiring, connected to terminals 1, 2, 3 & 4, must be segregated from the non-intrinsically safe 4/20mA output wiring connected to terminals 5 & 6.

An insulating partition separates the intrinsically safe and non-intrinsically safe terminals within the enclosure. Conductors of intrinsically safe circuits and non-intrinsically safe circuits should not be contained in the same cable and should enter the terminal compartment via separate glands or conduit entries. See EN 60079-14 section 12 for detailed cable requirements.

6.4 EMC

The BA474D 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 BA474D Indicating Temperature Transmitter may be configured and calibrated via HART® digital communication, or configuration may be performed using the menu accessed via the four push buttons located behind the instrument switch cover, see Fig 7. When frequent adjustments are required the transmitter can be supplied with a keypad mounted on the outside of this cover.

Configuration and calibration via HART® may be performed using a portable configurator connected to the BA474D test pillars located by terminals 5 & 6, or by connecting to the galvanic isolator powering the transmitter. Alternatively, proprietary configuration software installed 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. See the BA47X/67X Indicating Temperature Transmitter HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals

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7.1 Configuration menu

Throughout this manual the four BA474D 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 8, 9 & 10.

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 10.4.

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 BA47X/67X Indicating Temperature Transmitter 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 BA474D 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 have required input range.

Voltage and resistance inputs

The BA474D 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 have required 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 8, 9 and 10.

For Thermocouple Input – see Fig 8

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. Sensor fault analogue 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 9

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. Sensor fault analogue 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 10

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 8, 9 &10.

7.2.1 Transmitter input 'InPut'

This function enables the BA474D 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	BA474D 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 flashes. 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 BA474D 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	'inVAL' 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	'inVAL' 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.

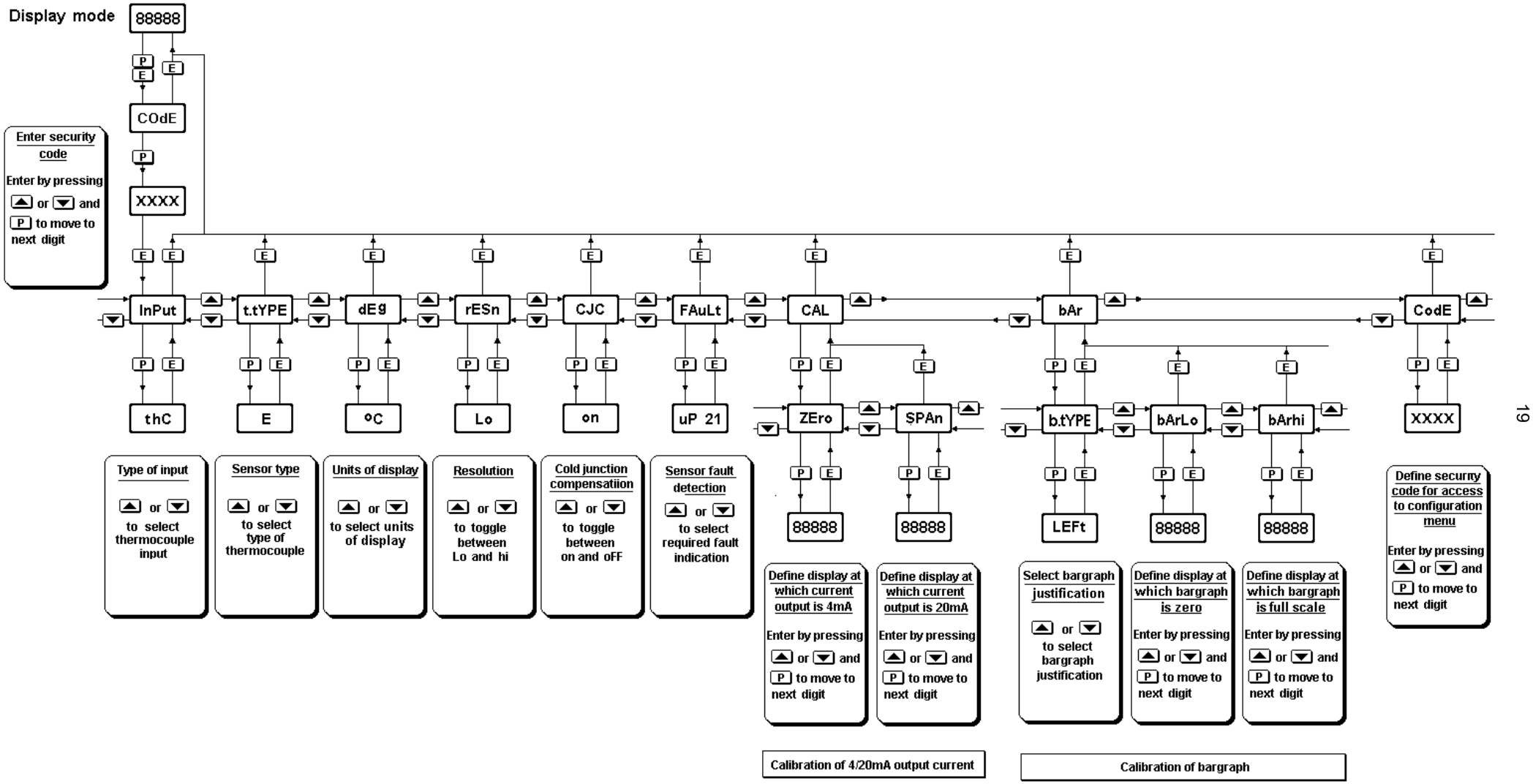


Fig 8 Thermocouple input configuration menu

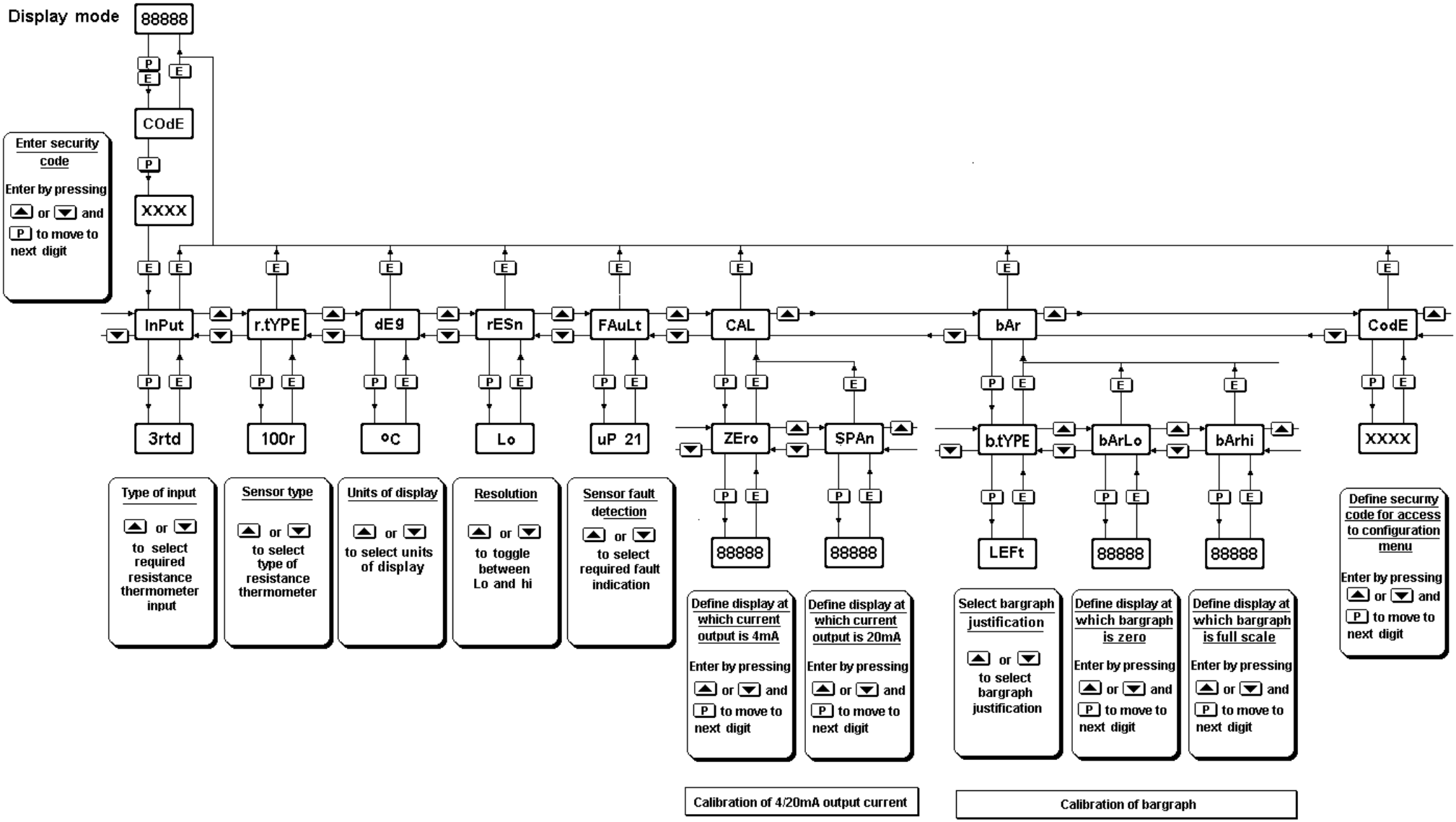


Fig 9 Resistance thermometer input configuration menu

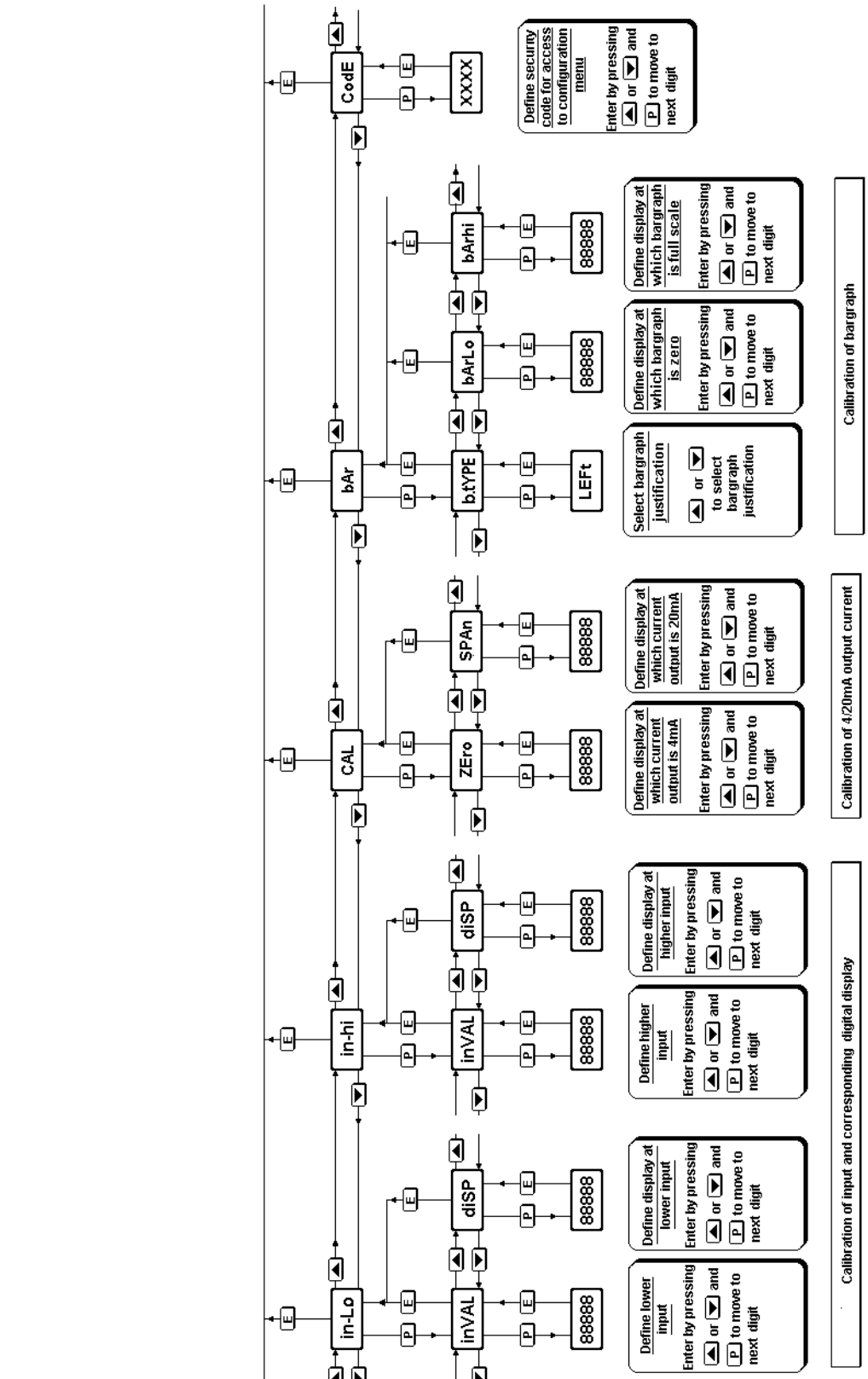


Fig 10 Voltage and resistance input configuration menu

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 BA474D 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 four push buttons which are located behind the removable switch cover below the digital display – see Fig 7. The BA474D 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 9 and section 7.2.1

New BA474D 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 9 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 9 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 9 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 9 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 9 and section 7.2.7

The BA474D 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 transmitter input 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 9 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 9 and section 7.2.9
This function defines the four digit code that must be entered to obtain access to the BA474D 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 BA474D to the display mode via the 'CodE prompt.

This completes the instrument configuration. The BA474D 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 BA474D indicating temperature transmitter should only be maintained by trained competent personnel.

9.1 Fault finding during commissioning

If a BA474D 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. Wiring and input configuration.
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

<u>Use as an intrinsically safe transmitter</u>

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.

<u>Use as an associated apparatus transmitter</u>

Mounted in a safe area with the transmitter input connected directly to a sensor in a hazardous area.

The BA474D input terminals, the sensor and the wiring between them are intrinsically safe. Live maintenance is permitted but only certified test equipment may be used unless a gas clearance certificate is available.

If a BA474D 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 BA474D 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 and tag marking
BA474D indicating temperature transmitters are fitted with a blank escutcheon around the liquid crystal display. If specified when the transmitter is ordered, this can be supplied printed with units of measurement and tag information, plus a scale for the horizontal bargraph. Alternatively, information may be added on-site via an embossed strip, dry transfer or a permanent marker.

To gain access to the display escutcheon remove the terminal cover by unscrewing the two 'A' screws which will reveal two concealed 'D' screws. Unscrew all four 'D' screws and carefully lift off the front of the instrument. The location of these screws is shown in Fig 6.

After adding the required legends, or fitting a new pre-printed self-adhesive escutcheon, ensure that the gasket is correctly positioned before reassembling the instrument enclosure.

10.2 Tag plate
The BA474D can be supplied with a blank or custom laser marked stainless steel plate secured by two screws to the front of the instrument enclosure. This plate can accommodate:

1 row of 9 alphanumeric characters 10mm high

or 1 row of 11 alphanumeric characters 7mm high

or 2 rows of 18 alphanumeric characters 5mm high

10.3 Pipe mounting kits
Two pipe mounting kits are available for securing the BA474D to a horizontal or vertical pipe.

BA392D Stainless steel bracket secured by two worm drive hose clips for 60 to 80mm outside diameter pipes.

BA393 Heavy-duty stainless steel bracket secured by a single 'V' bolt. Will clamp to any pipe with an outside diameter between 40 and 80mm.

10.4 Alarms

The BA474D 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 11 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.

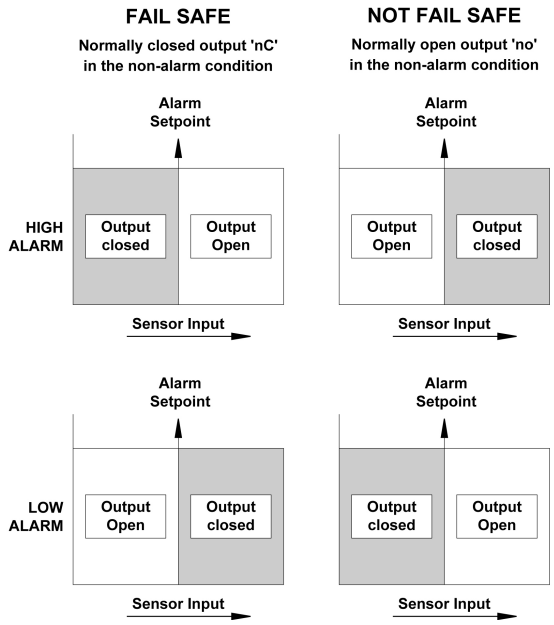


Fig 11 Alarm outputs

When an alarm is activated an annunciator appears on the left hand side of the BA474D 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.

10.4.1 Solid state output

Each alarm has a galvanically isolated single pole solid state switch output as shown in Fig 12. 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	=	8 ohms + 1.2V
Roff	=	greater than 180k

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

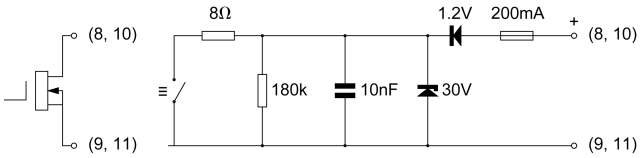


Fig 12 Equivalent circuit of each alarm output

WARNING

Connection of alarm output to a supply greater than 30V may rupture the internal encapsulated fuse.

10.4.2 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 EN60079-11. This allows each of the BA474D 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 13.

The maximum equivalent capacitance and inductance of each BA474D alarm output is:

Ci	=	40nF
Li	=	20µH

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.

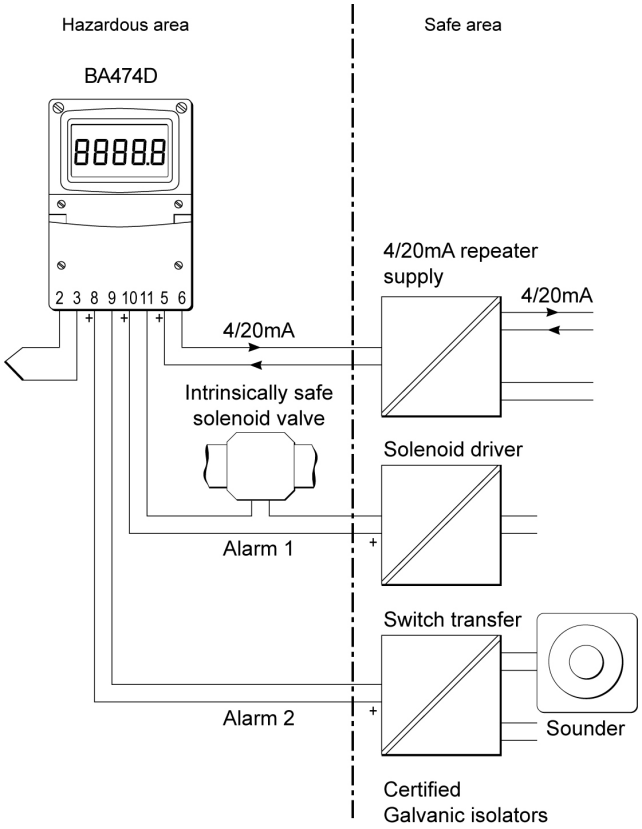


Fig 13 Typical alarm application

10.4.3 Alarm configuration

Alarm configuration may be performed via the HART® digital communication, see the BA47X/67X Indicating Temperature Transmitter HART® Interface Guide which may be downloaded from www.beka.co.uk/manuals, or using the configuration menu which is accessed via the four push buttons located behind the instrument switch cover, see Fig 7. When frequent adjustments are required the transmitter can be supplied with a keypad mounted on the outside of this cover.

When a BA474D indicating temperature transmitter is supplied with optional alarms the conditioning menu is extended as shown in Fig 14. The additional alarm functions appear between 'bAr' and 'CodE' in the configuration menu. For simplicity Fig 14 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 10.4.4 and Fig 14.
'EnbL'	**Alarm enable** Enables or disables the alarm function without changing the alarm parameters. See section 10.4.5
'SP1'	**Alarm setpoint 1** Adjusts the alarm setpoint. The alarm is activated when the indicator display equals the setpoint. See section 10.4.6
'Hi.Lo'	**Alarm function** Defines whether the alarm has a high or low function. See section 10.4.7
'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 10.4.8
'HStr'	**Hysteresis** Adjusts the alarm hysteresis. See section 10.4.9
'dELA'	**Alarm delay time** Adjusts the delay between the display equalling the setpoint and the alarm output being activated. See section 10.4.10
'SiL'	**Alarm silence time** Defines the time that the alarm output remains in the non-alarm condition following acceptance of an alarm. See section 10.4.11
'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 10.4.12

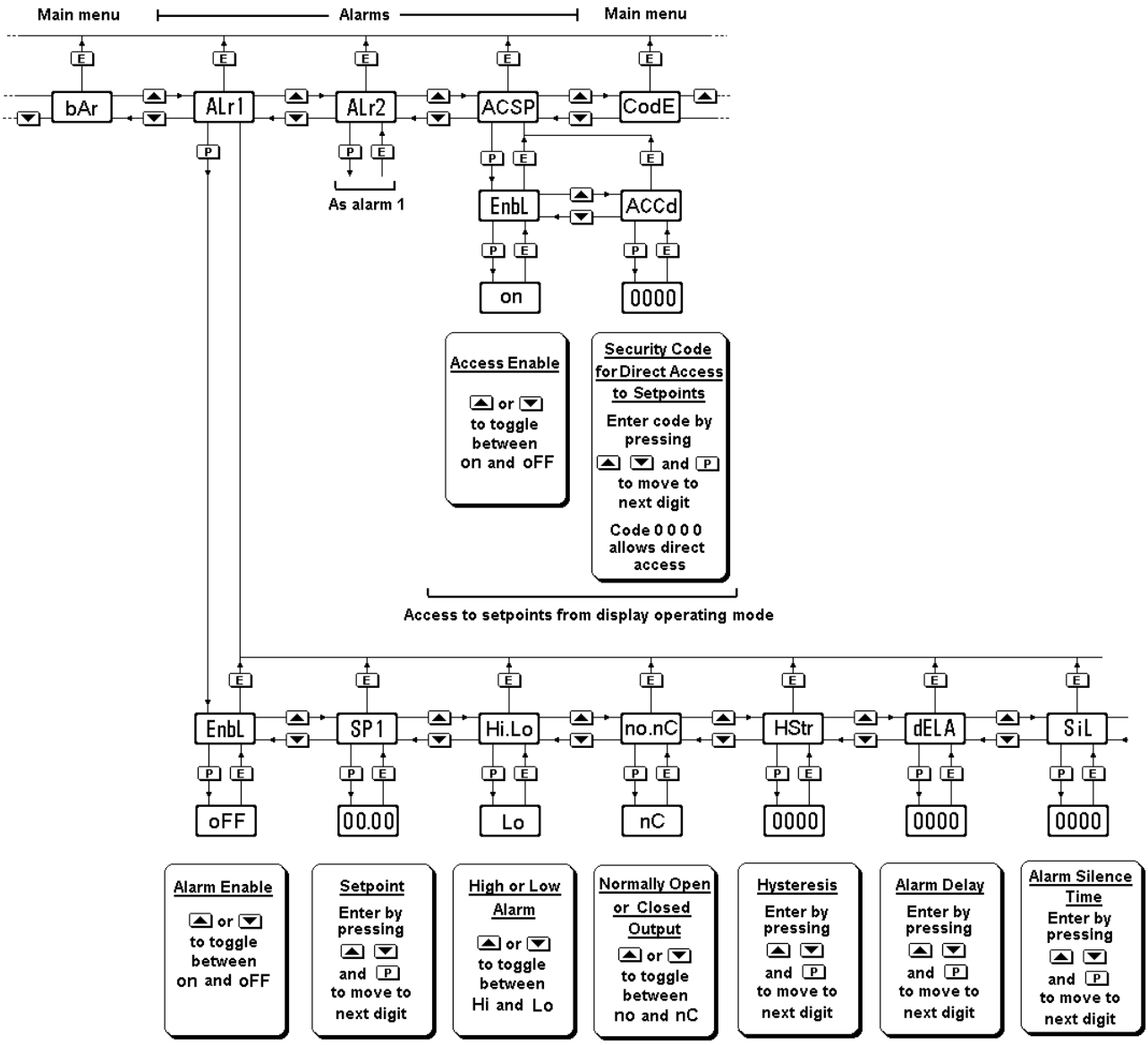


Fig 14 Alarm conditioning menu

10.4.4 Alarm selection: ALr1 or ALr2
As shown in Fig 14, 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 10.4.5 to 10.4.11 describe each of these sub-functions in detail

10.4.5 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.

10.4.6 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.

10.4.7 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.

10.4.8 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 11.

'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 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.

10.4.9 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 BA474D 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.

10.4.10 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.

10.4.11 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. Ideally the BA474D requires an optional external keypad for this function to be used.

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.

10.4.12 Access Setpoint: ACSP

This function controls a separate menu that provides direct access to the alarm setpoints when the BA474D 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 14. 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

10.4.13 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 15. 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.

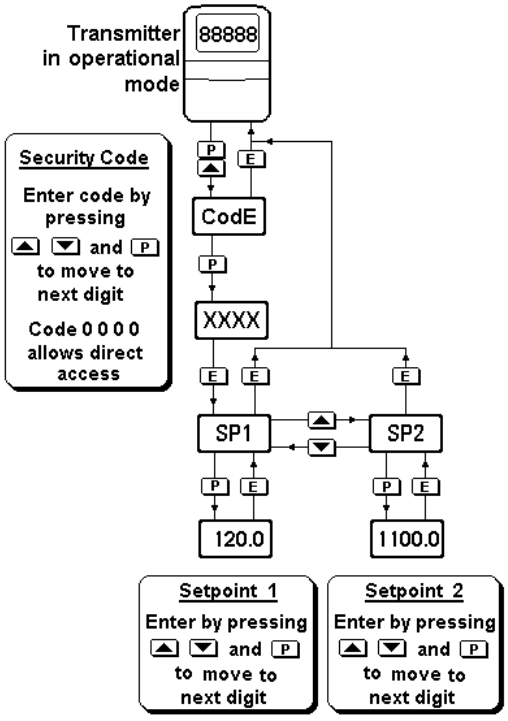


Fig 15 Setpoint adjustment from the display mode

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 10.4.12

APPENDIX 1
ATEX and UKCA dust certification

A2.0 ATEX dust certification
In addition to ATEX and UKCA certification permitting installation in explosive gas atmospheres which is described in the main section of this instruction manual, the BA474D is available with optional ATEX & UKCA certification permitting use in the presence of combustible dusts. If dust certification is required it must be requested when the BA474D Indicating Temperature Transmitter is purchased.

WARNING
Before installing a BA474D Indicating Temperature Transmitter in the presence of a combustible dust, ensure that the certification information label, which is located on the top of the instrument, specifies dust certification - see section A2.2

A2.1 Zones and Maximum Surface Temperature
The BA474D has been ATEX and UKCA certified as Group II, Category 2 Ex ia IIIC T80°C Db apparatus Tamb = -20 to 70ºC.
The Indicating Temperature Transmitter 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 dusts having a Minimum Ignition Temperature of:

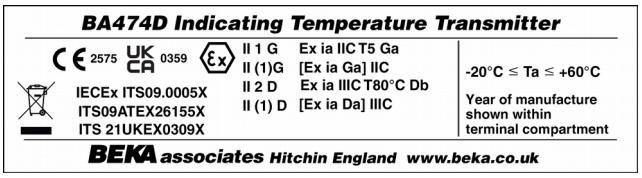
Dust cloud	120ºC
Dust layer on BA474D up to 5mm thick	155ºC
Dust layer on BA474D over 5mm thick.	Refer to EN 60079-14

At an ambient temperature between -20 and +60ºC

A2.2 Certification Label Information
The certification label is fitted in a recess on the top outer surface of the enclosure. It shows details of the ATEX dust certification including the maximum surface temperature and ingress protection,

Intrinsic safety dust certification.	II 2 D Ex ia IIIC T80ºC
Associated apparatus dust certification.	II (1) D [Ex ia Da]IIIC

ATEX gas and IECEx gas and dust certification information is also shown.



The instrument serial number and date of manufacture are recorded on a separate label inside the terminal compartment.

A2.3 Installation & maintenance
The ATEX dust certification relies on the BA474D Indicating Temperature Transmitter enclosure being dust-tight. Therefore the terminal cover should only be removed when dust can not enter the instrument enclosure. Before replacing the terminal cover ensure that the sealing gaskets are undamaged and are free from foreign bodies.

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 gas certification

The BA474D Indicating Temperature Transmitter has been issued with an IECEx Certificate of Conformity number IECEx ITS 09.0005 that specifies the following certification codes and marking for use in explosive gas atmospheres:

Intrinsic safety gas certification.	Ex ia IIC T5 Ga
Associated apparatus gas certification.	[Ex ia Ga] IIC

When connected to a certified IECEx system the BA474D may be installed in:

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 +70°C.

Minimum operating temperature of BA474D is -20°C.

When the transmitter is installed in a safe area, the associated apparatus IECEx certification allows input terminals 1, 2, 3 & 4 to be directly connected to a sensor in a hazardous area without the need for a Zener barrier or galvanic isolator. See sections 5.2 and 6.3 for system design and installation information.

A2.1.1 Installation in an explosive gas atmosphere

For installations in gas atmospheres the BA474D 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.

A2.2 IECEx dust certification

In addition to IECEx certification permitting installation in explosive gas atmospheres, the BA474D is available with optional IECEx certification permitting use in the presence of combustible dusts.

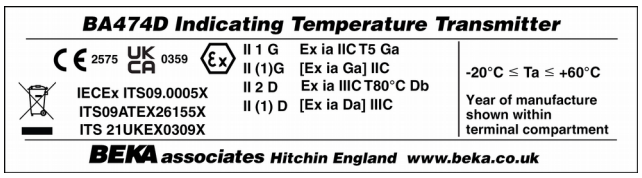
The IECEx Certificate of Conformity specifies the following certification codes and marking:

Intrinsic safety dust certification.	Ex ia IIIC T80°C Db
Associated apparatus dust certification.	[Ex ia Da] IIIC
	Ta -20 °C to +60 °C

If IECEx dust certification is required it must be requested when the BA474D Indicating Temperature Transmitter is purchased.

WARNING

Before installing a BA474D Indicating Temperature Transmitter in the presence of a combustible dust, ensure that the certification information label, which is located on the top of the instrument, specifies dust certification - see below.



When connected to a certified IECEx system the BA474D 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 dusts having a Minimum Ignition Temperature of:

Dust cloud	120°C
Dust layer on BA474D up to 5mm thick	155°C
Dust layer on BA474D over 5mm thick.	Refer to EN 61241-14

At an ambient temperature between -20 and +60°C

A2.4 Installation & maintenance

The IECEx dust certification relies on the BA474D Indicating Temperature Transmitter enclosure being dust-tight. Therefore the terminal cover should only be removed when dust can not enter the instrument enclosure. Before replacing the terminal cover ensure that the sealing gaskets are undamaged and are free from foreign bodies.

APPENDIX 3

EU Declaration of Conformity

This certificate is issued for electrical apparatus BA474D

Description
BA474D is a field 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
Group II Category (1)G [Ex ia Ga] IIC -40°C ≤ Ta ≤ +70°C
Group II Category 2D Ex ia IIIC T80°C Db -20°C ≤ Ta ≤ +60°C
Group II Category (1)D [Ex ia Da] IIIC -20°C ≤ Ta ≤ +60°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
ITS09ATEX26155X 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 MIET
Managing Director

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Issue 15	24th May 2023

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