

1. Description

The BA405C manual set point station enables the current flowing in a 4/20mA loop to be adjusted from within a hazardous process area. The instrument is loop powered and requires no additional power supply or batteries. The set point station has ATEX Group II Category 1G and FM Division 1 intrinsic safety approval allowing it to be installed in most gas hazardous areas. It also has FM non-incendive approval that permits installation in Division 2 without Zener barriers or galvanic isolators.



BA405C manual set point station

The BA405C setpoint station has a ten turn control knob for adjusting the loop current, plus a digital indicator which may be calibrated to displays the 4/20mA loop current in engineering units. With only a two wire connection this single instrument enables an operator to manually adjust a 4/20mA current and to monitor its value in engineering units.

The main application is the remote adjustment of control signals or setpoints from within a hazardous area. For example, the BA405C can remotely control the setpoint of a motor speed controller so that the required speed can be set from the hazardous process area.

Options include loop or separately powered display backlights and custom legends to show the function of the manual set point station.

For applications in non hazardous areas, the BA505C is an uncertified version of the BA405C which offers identical features, apart from the optional loop powered backlight.

2. Operation

The BA405C is a loop powered current sink that can be manually adjusted to pass any current between 3.5 and 21mA. Fig 1

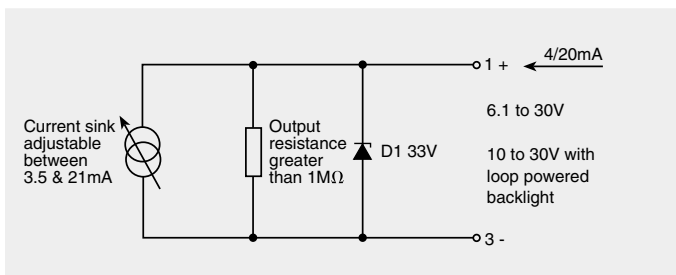


Fig 1 Equivalent circuit of manual set point station

shows the equivalent circuit. The output resistance of the sink is very high so that the loop current is virtually unaffected by changes in the supply voltage within the operating limits of the set point station. Zener diode D1 protects the manual setpoint station from damage caused by over-voltage and reverse connection. The minimum required supply voltage is 6.1V which increases to 10V when an optional loop powered backlight is fitted.

3. ATEX Intrinsic Safety Certification

Notified Body Intertek Testing and Certification Ltd have issued an EC-Type Examination Certificate confirming compliance with the European ATEX Directive 94/9/EC for Group II, Category 1G equipment, EEx ia IIC T5. The BA405C bears the Community Mark and subject to local codes of practice, it may be installed in any of the European Economic Area (EEA) member countries. ATEX certificates are also acceptable for installations in Switzerland.

This guide describes ATEX installations which conform with BS EN60079:Part14 Electrical Installation in Hazardous Areas. When designing systems for installation outside the UK, the local Code of Practice should be consulted.

The BA405C has been certified as Group II, Category 1G, EEx ia IIC T5 equipment, Tamb = -40 and 60°C. When connected to a suitable system the set point station and accessories may be installed in:

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

Be used with gases in groups:

| | |
|---------|----------|
| Group A | propane |
| Group B | ethylene |
| Group C | hydrogen |

Having a temperature classification of:

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

In an ambient temperature between -40 and +60°C.

Note: Although certified safe at -40°C, the BA405C is only guaranteed to operate between -20°C and +60°C

This allows the BA405C set point station to be installed in all Zones and to be used with most common industrial gases.

3.1 Safety parameters

The BA405C EC-Type Examination Certificate specifies the maximum input safety parameters for the 4/20mA terminals 1 and 3, and the equivalent internal capacitance and inductance that appears between the terminals. Using the entity concept and these safety parameters, suitable Zener barriers or galvanic isolators may be selected and the maximum permissible cable parameters calculated.

Terminals 1 & 3

Maximum input safety parameters:

| | | |
|-------|--------|----------|
| U_i | \leq | 30V dc |
| I_i | \leq | 200mA dc |
| P_i | \leq | 0.85W |

Equivalent capacitance and inductance:

| | | |
|-------|-----|--------|
| C_i | $=$ | 40nF |
| L_i | $=$ | 0.01mH |

With optional loop powered backlight.
(Terminals 1 & 13; terminals 3 & 12 connected together)

Maximum input safety parameters:

| | | |
|-------|--------|----------|
| U_i | \leq | 30V dc |
| I_i | \leq | 200mA dc |
| P_i | \leq | 0.85W |

Equivalent capacitance and inductance:

| | | |
|-------|-----|--------|
| C_i | $=$ | 40nF |
| L_i | $=$ | 0.03mH |

Separately powered display backlight: (Terminals 12 & 13)

Maximum input safety parameters:

| | | |
|-------|--------|----------|
| U_i | \leq | 28V dc |
| I_i | \leq | 159mA dc |
| P_i | \leq | 0.8W |

Equivalent capacitance and inductance:

| | | |
|-------|-----|--------|
| C_i | $=$ | 30nF |
| L_i | $=$ | 0.01mH |

4. FM Approval

4.1 Intrinsic safety

The FM intrinsic safety approval is similar to the ATEX approval described in section 3, with almost identical safety parameters, except the temperature rating is only T4. When installed as specified by the BEKA Control Drawing CI405-27 the BA405C set point station to be installed in:

- | | |
|------------|--|
| Division 1 | Ignitable concentrations of flammable gases, vapours or liquids can exist all of the time or some of the time under normal operating conditions. |
| Division 2 | Ignitable concentrations of flammable gases, vapours or liquids are not likely to exist under normal operating conditions. |

Be used with gases in groups:

| | |
|---------|-----------|
| Group A | Acetylene |
| Group B | Hydrogen |
| Group C | Ethylene |
| Group D | Propane |

Having a temperature classification of:

| | |
|----|-------|
| T1 | 450°C |
| T2 | 300°C |
| T3 | 200°C |
| T4 | 135°C |

In an ambient temperature between -40 and $+60$ °C.

Note: Although certified safe at -40 °C, the BA405C is only guaranteed to operate between -20 °C and $+60$ °C

This allows the BA405C set point station to be installed in all Divisions and to be used with most common industrial gases.

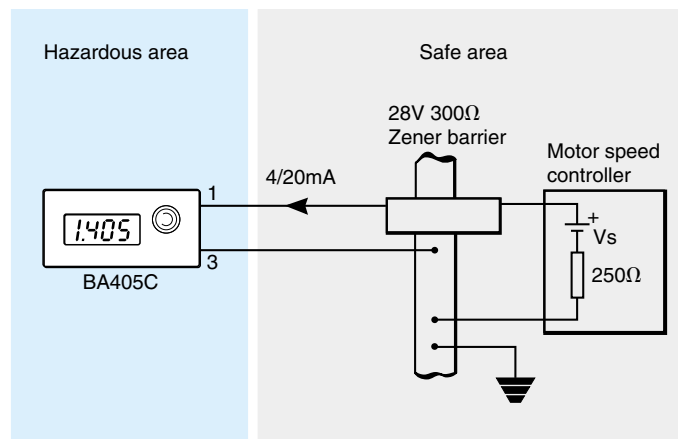


Fig 2 BA405C setting motor speed controller set point

Before installation reference should be made to the FM Approval listing, the BEKA Control Drawing and the instrument FM Certificate of Compliance that can be downloaded from the BEKA web site.

4.2 Nonincendive approval

The BA405C has also been certified as Nonincendive Field Wiring Apparatus allowing installation in Division 2 without the need for Zener barriers or galvanic isolators. Approval is for Class I, Groups A, B, C & D gases.

Detailed installation requirements are shown on sheets 3 and 4 of the BEKA Control Drawing CI405-27 that is appended to the FM Approval Certificate of Compliance, which may be downloaded from www.beka.co.uk.

The installation must be in accordance with the National Electrical Code ANSI/NFPA 70.

The BA405C may be connected to other FM certified Nonincendive Field Wiring Apparatus and Simple Apparatus in Division 2 subject to entity concept requirements.

The BA405C may be connected to FM certified Associated Nonincendive Field Wiring Apparatus located in an unclassified location subject to entity concept requirements.

Any wiring method permitted for unclassified locations may be used.

5. System design for ATEX and FM intrinsic safety hazardous area installations

Designing a loop incorporating a BA405C set point station is similar to designing a loop incorporating a 2-wire temperature or pressure transmitter.

There are three design steps:

- The output parameters of the Zener barrier or galvanic isolator powering the BA405C set point station must be equal to, or less than the maximum input parameters specified by the set point station certificate. Namely:

| | | |
|-------|--------|----------|
| U_o | \leq | 30V dc |
| I_o | \leq | 200mA dc |
| P_o | \leq | 0.85W |
- The maximum permitted cable parameters for the system should be calculated by subtracting C_i and L_i for the BA405C set point station from the maximum cable parameters specified for the barrier or isolator powering the set point station. These limits are not normally restrictive.
- The supply voltage at the set point station terminals must always be greater than the minimum operating voltages which are:

| | |
|---|-------|
| Without loop powered backlight (terminals 1 & 3) | 6.1V |
| With optional & loop powered backlight (terminals 1 & 13) | 10.0V |

5.1 Use with Zener barriers

Fig 2 illustrates how a BA405C set point station may be used to adjust the input to a speed controller.

The speed controller in Fig 2 is intended to operate with a 4/20mA current sink i.e. the controller has an output voltage. If the controller requires a 4/20mA input current source, then a separate power supply is required as shown in Fig 3. If the power supply or the input to the speed controller are floating only one Zener barrier is required, but if either is earthed, two Zener barriers or a galvanic isolator are required as shown in Fig 3.

Considering the total voltage drop around the loop shown in fig 3:

| | |
|---|--------------|
| Minimum operating voltage of BA405C | 6.1 |
| Maximum voltage drop caused by 28V 300Ω barrier (340Ω x 20mA) | 6.8 |
| Maximum voltage drop caused by 10V 50Ω barrier (85Ω x 20mA) | 1.7 |
| Maximum voltage drop caused by motor speed controller input (250Ω x 20mA) | 5.0 |
| Maximum voltage drop caused by cable resistance (10Ω x 20mA) | 0.2 |
| Total maximum voltage drop around loop | 19.8V |

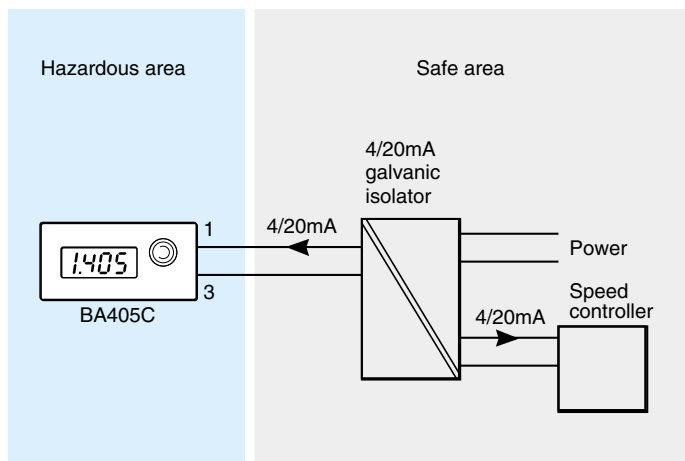


Fig 4 Use with galvanic isolator

The power supply output voltage must therefore be greater than 19.8V, but less than the maximum working voltage of the 28V 300Ω Zener barrier which is likely to be about 26V.

5.2 Use with galvanic isolators

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

The example shown in Fig 3 can be simplified by the use of a galvanic isolator as shown in Fig 4. Any certified isolator with output parameters equal to or less than the maximum input safety parameters of the set point station may be used. The isolator must be able to supply at least the minimum operating voltage to the set point station and to the load in the safe area.

6. Display backlight

Two alternative optional display backlights are available.

6.1 Loop powered backlight

The loop powered display backlight produces green background illumination enabling the display to be read at night and in poor lighting conditions. No additional power supply, Zener barrier, galvanic isolator or field wiring are required, but the BA405C voltage drop increases from 6.1 to 10V. Fig 5 shows the required connections when powered from a Zener barrier.

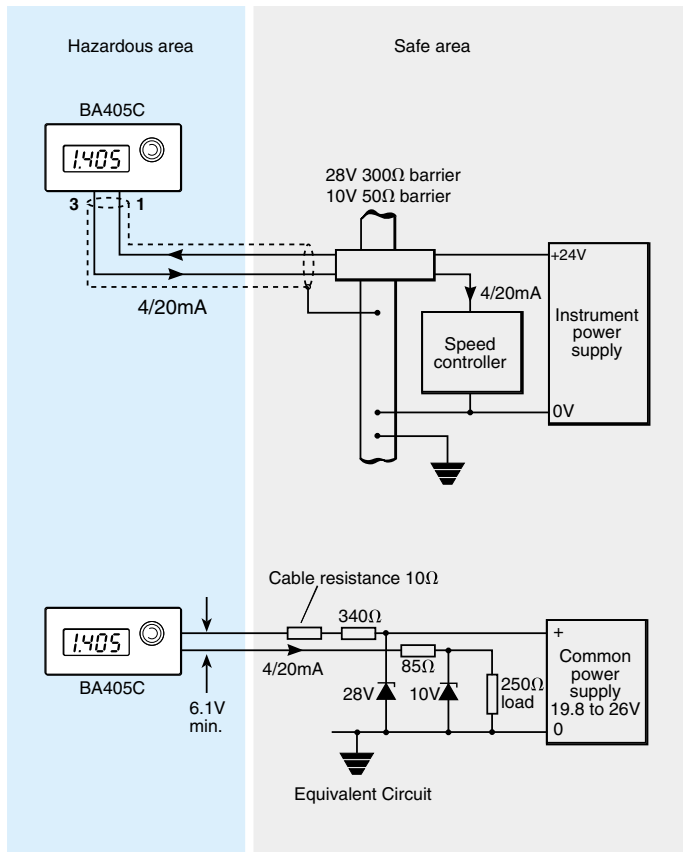


Fig 3 BA405C powered from common power supply

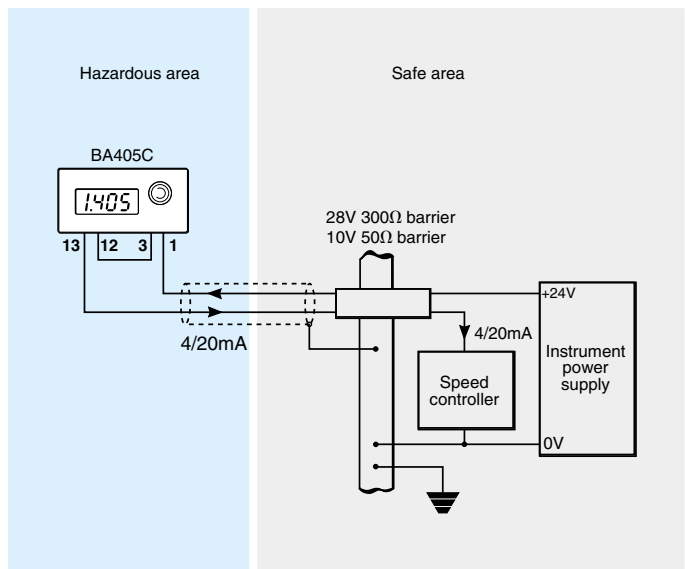


Fig 5 Loop powered backlight

6.2 Separately powered backlight

The separately powered display backlight has bright orange output which enhances daylight viewing, but an additional power supply, Zener barrier or galvanic isolator and field wiring are required as shown in Fig 6.

7. Location

The BA405C set point station has an IP65 sealed front panel and is supplied with a gasket to seal the joint between the instrument and the panel into which it is mounted. When correctly installed in an instrument panel or cubicle, the front of the instrument will have IP65 protection and may be cleaned with a low pressure hose. It is not recommended that the indicator front panel is permanently exposed to severe exterior environments unless additional protection is provided.

This ingress protection has been assessed by FM Approval and the resulting test report 3026080 may be downloaded from www.beka.co.uk. The report includes BEKA drawing CI100-04 that contains the following mounting recommendations:

Minimum panel thickness should be

| | |
|-----------|-------------------|
| Steel | 2mm (0.08 inches) |
| Aluminium | 3mm (0.12 inches) |

Outside panel finish should be smooth, free from particle inclusions, runs or build up of paint around cut-out.

Panel cut-out should be 43.5 x 90.0mm -0.0 +0.5
(1.71 x 3.54 inches -0.00 +0.02)

Edges of panel cut-out should be deburred and clean

Two panel mounting clips should be used and each should be tightened to between 20 and 22cNm (1.77 to 1.95 inLb)

The rear of the BA405C set point station has IP20 protection. If liquids or condensates are likely to be present, the panel or cubicle in which the set point station is mounted should be sealed.

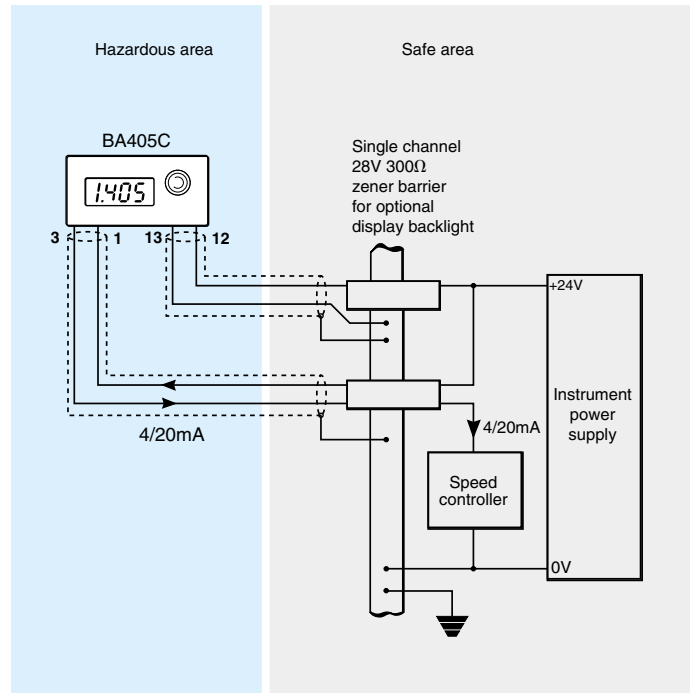


Fig 6 Separately powered backlight