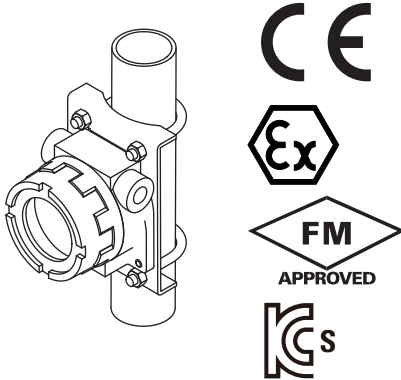


## Field-mounted Two-wire Signal Conditioners B6-UNIT SERIES

### 2-WIRE UNIVERSAL TEMPERATURE TRANSMITTER (HART communication, intrinsically safe/explosion-proof)

#### Functions & Features

- Universal input: mV, V, T/C, RTD, resistance and potentiometer
- High accuracy
- HART communication
- Intrinsically safe and explosion-proof approval
- Optional stainless steel enclosure
- Programming via hand-held communicator or via PC
- A wide variety of T/C and RTD types
- User's temperature table can be used
- Self diagnostics
- Input-output isolated



## MODEL: B6U-B-[1][2][3][4][5]

### ORDERING INFORMATION

- Code number: B6U-B-[1][2][3][4][5]
- Specify a code from below for each of [1] through [5].  
(e.g. B6U-B-4121)
- Use Ordering Information Sheet (No. ESU-7451). Factory standard setting will be used if not otherwise specified.  
Specify the country in which the product is to be used with the Safety Approval code 2 or 4.

### [1] SAFETY APPROVAL

- 0: None
  - 1: FM intrinsically safe
  - 2: IECEx/ATEX intrinsic safety
  - 3: FM explosion-proof
  - 4: IECEx/ATEX flameproof
  - 5: FM nonincendive
- Confirm selectable combinations of approval and wiring

conduit types in the table.

### [2] LCD DISPLAY

- 0: Without
- 1: With

### [3] WIRING CONDUIT

- 0: G 1/2
- 1: 1/2 NPT
- 2: M20 × 1.5
- 3: PG 13.5

Confirm selectable combinations of approval and wiring conduit types in the table.

### [4] MOUNTING BRACKET

- 0: Without
- 1: With

### [5] OPTIONS

#### Enclosure Materials

- Blank: Diecast aluminium enclosure
- /S: Stainless steel enclosure

#### ■ SELECTABLE WIRING CONDUITS SPECIFIC TO EACH APPROVAL 'N' marked combinations are not selectable.

WIRING CONDUIT	APPROVAL					
	0	1	2	3	4	5
0	Y	N	Y	N	N	N
1	Y	Y	Y	Y	Y	Y
2	Y	Y	Y	N	Y	Y
3	Y	N	Y	N	N	N

### RELATED PRODUCTS

- USB interface Bell202 modem (model: COP-HU)  
Usable in 'non-hazardous' area only.
- Hand-held communicator
- AMS (version 6.0 or higher)
- PC configurator software (model: B6UCFG)  
Downloadable at M-System's web site.
- LCD display (model: B6U-LCD) (non safety approval)
- Lightning Surge Protectors for Electronics Equipment (Model: MD6x-24)  
Refer to the specification of MD6x-24 for surge protection and safety approval.

## PACKAGE INCLUDES...

- **Mounting screws**
  - Bolt (M8 x 15): 4 pcs.
  - Spring washer for M8: 4 pcs.
- Material:** Stainless steel 304
- **Mounting bracket set (option)**
  - Mounting bracket: 1 pce.
  - M10 U-bolt: 2 pcs.
  - Nut for M10: 4 pcs.
  - Spring washer for M10: 4 pcs.
- Material:** Stainless steel 304
- Applicable pipe:** 1 1/2" min.; 2" max.
- **LCD Angle Change Adaptor (for optional LCD display):**
  - Adaptor plate: 1 pce.
  - Flat head screw (M4 x 10): 2 pcs.

## GENERAL SPECIFICATIONS

- Degree of protection:** NEMA 4X, IP66/IP67  
**Wiring conduit:** See 'Ordering information.'  
**Electrical connection:** M3.5 screw terminals (torque 0.8 N·m)  
**Materials**  
**Transmitter housing:** Flame-resistant resin (black)  
**Screw terminals:** Nickel-plated brass  
**Enclosure:** Diecast aluminium standard or stainless steel casting (equivalent to type 316); silver epoxy resin coating  
**Isolation:** Input to output to outdoor enclosure  
**Burnout (T/C, RTD, Potentiometer & Resistance):** Upscale, downscale or no burnout selectable (standard: upscale); Also detects wire breakdown and overrange input exceeding the electrical design limit for DC input.  
**Cold Junction Compensation (thermocouple input):** CJC sensor incorporated  
**User-configurable items:**
  - Input sensor type
  - Number of wires (RTD & resistance)
  - Input range
  - Inverted output
  - Burnout
  - Damping time (via HART only, standard: 0)
  - Sensor calibration (via HART only)
  - Output calibration
  - Special linearization data (via HART only)
  - HART communication mode

## HART COMMUNICATION

- Protocol:** HART communication protocol  
**HART address range:** 0 - 15 (factory set to 0)  
**Transmission speed:** 1200 bps  
**Digital current:** Approx. 1 mA<sub>p-p</sub> when communicating  
**Character format:** 1 Start Bit, 8 Data Bits, 1 Odd Parity Bit,

1 Stop Bit

**Distance:** 1.5 km (0.9 miles)

**HART communication mode:** Master-Slave Mode and Burst Mode (factory set to Master-Slave)

**HART network mode:** Point-to-Point Mode and Multi-drop Mode; automatically set to Multi-drop Mode when the address is set to other than 0.

## LCD DISPLAY (option)

**Features:**

- Setting and display of input signals, engineering units and the transmitter operating status, etc.
- Removable while the module is powered.

**Display size:** 36 × 20 mm (1.42" × 0.79")

**Characters**

**Color:** Black

**Format:**

- 2 rows of 5 alphanumeric characters:
    - Top row: 7.4 mm high;
    - Bottom row: 6.5 mm high,
  - Status indicators and engineering units
- For detail of the LCD panel indication, refer to the instruction manual.

**Display range:** -99999 to 99999

**Decimal point:** In top row

**Read rate:** 150 msec.

**Back light:** None

## INPUT SPECIFICATIONS

The input type is factory-set to K thermocouple, and the input range to 0 to 100°C.

See Table 1 for the available input type, the minimum span, and the maximum range.

■ **DC mV & V**

**Input resistance:** ≥ 1 MΩ

■ **Thermocouple**

**Input resistance:** ≥ 1 MΩ

**Burnout sensing:** 130 nA ±10 %

■ **RTD (2-wire, 3-wire or 4-wire)**

**Input resistance:** ≥ 1 MΩ

**Allowable leadwire resistance:** Max. 20 Ω per wire

■ **Resistance (2-wire, 3-wire or 4-wire)**

**Excitation:** 0.2 mA ±10 %

**Allowable leadwire resistance:** Max. 20 Ω per wire

■ **Potentiometer**

**Excitation:** 0.2 mA ±10%

**Allowable leadwire resistance:** Max. 20 Ω per wire

## OUTPUT SPECIFICATIONS

**Output range:** 4 - 20 mA DC

**Operational range:** 3.8 - 21.6 mA

**Load resistance vs. supply voltage:**

Load Resistance ( $\Omega$ ) = (Supply Voltage (V) - 12 (V))  
 $\div$  0.024 (A) (including leadwire resistance)

## INSTALLATION

**Supply voltage**

- 12 - 42 V DC (non-approved)
- 12 - 28 V DC (approved)

**Operating temperature:**

- Non-safety-approved unit: -40 to +85°C (-40 to +185°F)
- Safety-approved unit: See Safety Parameters for use in a hazardous location.
- LCD display (full visibility): -30 to +80°C (-22 to +176°F)

**Weight:**

- Unit
  - Approx. 1.3 kg (2.9 lb), aluminium
  - Approx. 4.0 kg (8.8 lb), stainless steel
- Mounting bracket set (option)
  - Approx. 0.78 kg (1.72 lb)

## PERFORMANCE

**Accuracy:** See Table 1 and 'Explanations of Terms.'

**Cold junction compensation error:**  $\pm 0.5^\circ\text{C}$  ( $\pm 0.9^\circ\text{F}$ )

**Temp. coefficient:**  $\pm 0.015\% / ^\circ\text{C}$  ( $\pm 0.008\% / ^\circ\text{F}$ ) of max. span at -5 to +55°C [23 to 131°F]

**Start-up time:** Approx. 8 sec.

**Response time:**  $\leq 2$  sec. (0 - 90 %) with damping time set to 0 and when not communicating via HART.

**Supply voltage effect:**  $\pm 0.003\% \times [\text{Output Span}] / 1\text{ V}$

**Insulation resistance:**  $\geq 100\text{ M}\Omega$  with 500 V DC

**Dielectric strength:** 1500 V AC @1 minute (input to output to outdoor enclosure)

**Safety integrity level:** Suitable for use in a safety instrumented system up to SIL1 or SIL2 if appropriate safety instructions are observed. Consult M-System.

## EXPLANATIONS OF TERMS

### ■ ACCURACY

This transmitter's accuracy is theoretically defined as the addition of A/D and D/A conversion errors:

$$\text{Accuracy} = \text{A/D Conversion Error} + \text{D/A Conversion Error}$$

The A/D conversion error means that measured as HART signal which is A/D converted from the analog input signal. The D/A conversion error of this transmitter is relatively very small so that it does not really affect the unit's overall performance.

The "Accuracies" given in Table 1 therefore equals the A/D conversion error.

The temperature drift (coefficient) or the cold junction compensation error is not included in the "Accuracy."

### ■ CALCULATION EXAMPLES OF OVERALL ACCURACY IN %

#### • DC Voltage

1) 0 - 200 mV

Absolute value accuracy (Table 1): 40  $\mu\text{V}$

$$40\ \mu\text{V} \div 200000\ \mu\text{V} \times 100 = 0.02\% < 0.1\%$$

➡ Overall accuracy =  $\pm 0.1\%$  of span

2) 0 - 4 mV

Absolute value accuracy (Table 1): 10  $\mu\text{V}$

$$10\ \mu\text{V} \div 4000\ \mu\text{V} \times 100 = 0.25\% > 0.1\%$$

➡ Overall accuracy =  $\pm 0.25\%$  of span

#### • Thermocouple

1) K thermocouple, 0 - 1000°C

Absolute value accuracy (Table 1): 0.25°C

$$0.1\% \times 1000^\circ\text{C} = 1^\circ\text{C} > 0.25^\circ\text{C}$$

CJC error (0.5°C) added: 1 + 0.5 = 1.5°C

$$1.5^\circ\text{C} \div 1000^\circ\text{C} \times 100 = 0.15\%$$

➡ Overall accuracy including CJC error =  $\pm 0.15\%$  of span

2) K thermocouple, 50 - 150°C

Absolute value accuracy (Table 1): 0.25°C

$$0.1\% \times (150 - 50)^\circ\text{C} = 0.1^\circ\text{C} < 0.25^\circ\text{C}$$

CJC error (0.5°C) added: 0.25 + 0.5 = 0.75°C

$$0.75^\circ\text{C} \div (150 - 50)^\circ\text{C} \times 100 = 0.75\%$$

➡ Overall accuracy including CJC error =  $\pm 0.75\%$  of span

#### • RTD

1) Pt 100, -200 - 800°C

Absolute value accuracy (Table 1): 0.15°C

$$0.15^\circ\text{C} \div (800 - -200)^\circ\text{C} \times 100 = 0.015\% < 0.1\%$$

➡ Overall accuracy =  $\pm 0.1\%$  of span

2) Pt 100, 0 - 100°C

Absolute value accuracy (Table 1): 0.15°C

$$0.15^\circ\text{C} \div 100^\circ\text{C} \times 100 = 0.15\% > 0.1\%$$

➡ Overall accuracy =  $\pm 0.15\%$  of span

## STANDARDS & APPROVALS

**EU conformity:**

ATEX Directive

Ex ia EN 60079-11 (for ATEX intrinsic safety)

Ex db EN 60079-1 (for ATEX flameproof)

EMC Directive

EMI EN 61000-6-4

EMS EN 61000-6-2

Immunity Test Item and Criteria

IMMUNITY TEST ITEM	STANDARD NUMBER	CRITERIA
Electrostatic discharge	EN/IEC 61000-4-2	$\pm 8\text{kV}$ air, $\pm 4\text{kV}$ contact
Electromagnetic fields	EN/IEC 61000-4-3	10V/m at 0.08 to 1 GHz
Electrical fast transient / burst immunity	EN/IEC 61000-4-4	Signal: $\pm 1\text{kV}$
Surge	EN/IEC 61000-4-5	Signal: $\pm 1\text{kV}$ line-ground
Conducted RF	EN/IEC 61000-4-6	10Vrms at 0.15 to 80 MHz

RoHS Directive

**Safety approval:**

FM: Intrinsically safe

Class I, Division 1, Groups A, B, C and D

Class II, Division 1, Groups E, F and G

Class III, Division 1

Class I, Zone 0, AEx ia IIC

T4, T5 and T6

(Class 3600)

(Class 3610)

(ANSI/ISA 60079-0)

(ANSI/ISA 60079-11)

FM: Explosion-proof and Dust-ignition proof

Class I, Division 1, Groups B, C and D

Class II, Division 1, Groups E, F and G

Class III, Division 1

T6

(Class 3600)

(Class 3615)

FM: Nonincendive

Class I, Division 2, Groups A, B, C, and D

Class II, Division 2, Groups F and G

Class III, Division 1

Class I, Zone 2, Group IIC

T4, T5 and T6

(Class 3600)

(Class 3611)

IECEX intrinsic safety

Ex ia IIC T4, T5 and T6 Ga

(IEC 60079-0)

(IEC 60079-11)

IECEX flameproof

Ex db IIC T4, T5 and T6 Gb

(IEC 60079-0)

(IEC 60079-1)

KOSHA: flameproof (Occupational Safety and Health Act)

Ex d IIC T6

(Only available for Model: B6U-B-41\*\*\*\*)

ATEX Intrinsic safety

Ⓔ II 1G, Ex ia IIC, T4, T5 and T6 Ga

(EN 60079-0)

(EN 60079-11)

ATEX Flameproof

Ⓔ II 2G, Ex db IIC, T4, T5 and T6 Gb

(EN 60079-0)

(EN 60079-1)

Functional safety

(IEC 61508-1)

(IEC 61508-2)

(IEC 61511-1)

## SAFETY PARAMETERS

### Operating temperature

For IECEX, ATEX and FM:

T4: -40 to +80°C

T5: -40 to +65°C

T6: -40 to +50°C (-40 to +80°C for FM explosion-proof)

### Ex-data:

- Output circuit

Ui (Vmax): 30 V

Ii (Imax): 96 mA

Pi (Pmax): 720 mW

Ci: 0 µF

Li: 0 mH

- Sensor circuit

Uo (Voc): 6.4 V

Io (Isc): 30 mA

Po: 48 mW

Co (Ca): 20 µF

Lo (La): 10 mH

**INPUT TYPE, RANGE & ACCURACY**

■ INPUT TYPE, RANGE & ACCURACY

Table 1

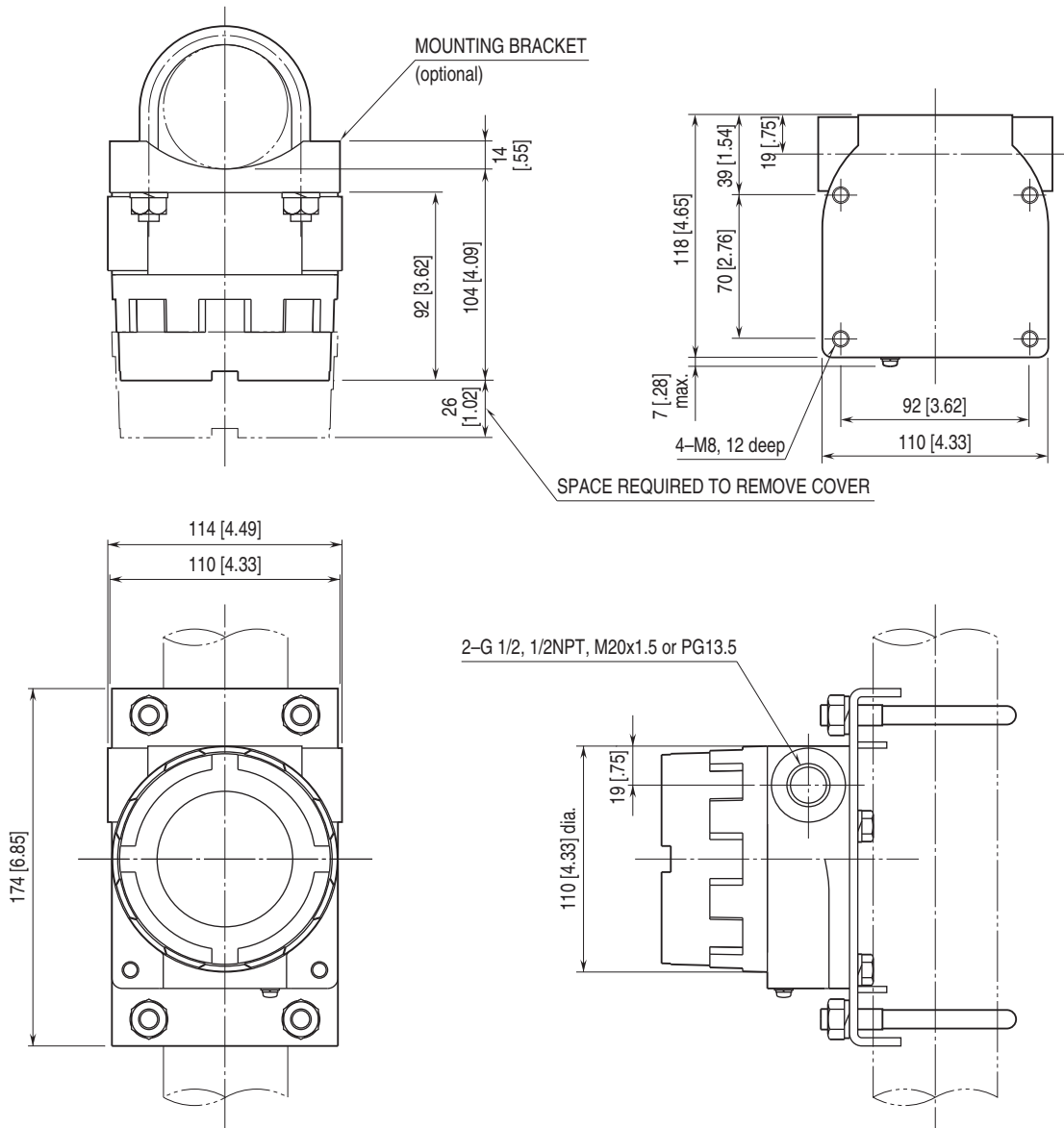
INPUT TYPE	MIN. SPAN	MAXIMUM RANGE		ACCURACY				
DC mV & V	4 mV	-50 to +1000 mV		±0.1 % or ±10μV, whichever is greater (F.S. input 50 mV) ±0.1 % or ±40μV, whichever is greater (F.S. input 200 mV) ±0.1 % or ±60μV, whichever is greater (F.S. input 500 mV) ±0.1 % or ±80μV, whichever is greater (F.S. input >500 mV)				
Potentiometer	2%	Total resistance 80 to 4000Ω		±0.1 %				
Resistance	10Ω	0 to 4000Ω		±0.1 % or ±0.1Ω, whichever is greater.*2				
THERMOCOUPLE	°C				°F			
	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1
(PR)	20	0 to 1760	0 to 1760	±1.00	36	32 to 3200	32 to 3200	±1.80
K (CA)	20	-270 to +1370	-150 to +1370	±0.25	36	-454 to +2498	-238 to +2498	±0.45
E (CRC)	20	-270 to +1000	-170 to +1000	±0.20	36	-454 to +1832	-274 to +1832	±0.36
J (IC)	20	-210 to +1200	-180 to +1200	±0.25	36	-346 to +2192	-292 to +2192	±0.45
T (CC)	20	-270 to +400	-170 to +400	±0.25	36	-454 to +752	-274 to +752	±0.45
B (RH)	20	100 to 1820	400 to 1760	±0.75	36	212 to 3308	752 to 3200	±1.35
R	20	-50 to +1760	200 to 1760	±0.50	36	-58 to +3200	392 to 3200	±0.90
S	20	-50 to +1760	0 to 1760	±0.50	36	-58 to +3200	32 to 3200	±0.90
C (WRe 5-26)	20	0 to 2315	0 to 2315	±0.25	36	32 to 4199	32 to 4199	±0.45
N	20	-270 to +1300	-130 to +1300	±0.30	36	-454 to +2372	-202 to +2372	±0.54
U	20	-200 to +600	-200 to +600	±0.20	36	-328 to +1112	-328 to +1112	±0.36
L	20	-200 to +900	-200 to +900	±0.25	36	-328 to +1652	-328 to +1652	±0.45
P (Platinel II)	20	0 to 1395	0 to 1395	±0.25	36	32 to 2543	32 to 2543	±0.45
RTD	°C				°F			
	MIN. SPAN	MAXIMUM RANGE		ACCURACY *2	MIN. SPAN	MAXIMUM RANGE		ACCURACY *2
Pt 100 (JIS '97, IEC)	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 200	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 300	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 400	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 500	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 1000	20	-200 to +850		±0.15	36	-328 to +1562		±0.27
Pt 50 Ω (JIS '81)	20	-200 to +649		±0.15	36	-328 to +1200		±0.27
JPt 100 (JIS '89)	20	-200 to +510		±0.15	36	-328 to +950		±0.27
Ni 100	20	-80 to +260		±0.15	36	-112 to +500		±0.27
Ni 120	20	-80 to +260		±0.15	36	-112 to +500		±0.27
Ni 508.4 Ω	20	-50 to +200		±0.15	36	-58 to +392		±0.27
Ni-Fe 604	20	-200 to +200		±0.15	36	-328 to +392		±0.27
Cu 10 @25°C	20	-50 to +250		±0.50	36	-58 to +482		±0.90

\*1. [Accuracy or ±0.1 % of span, whichever is greater] + Cold Junction Compensation Error

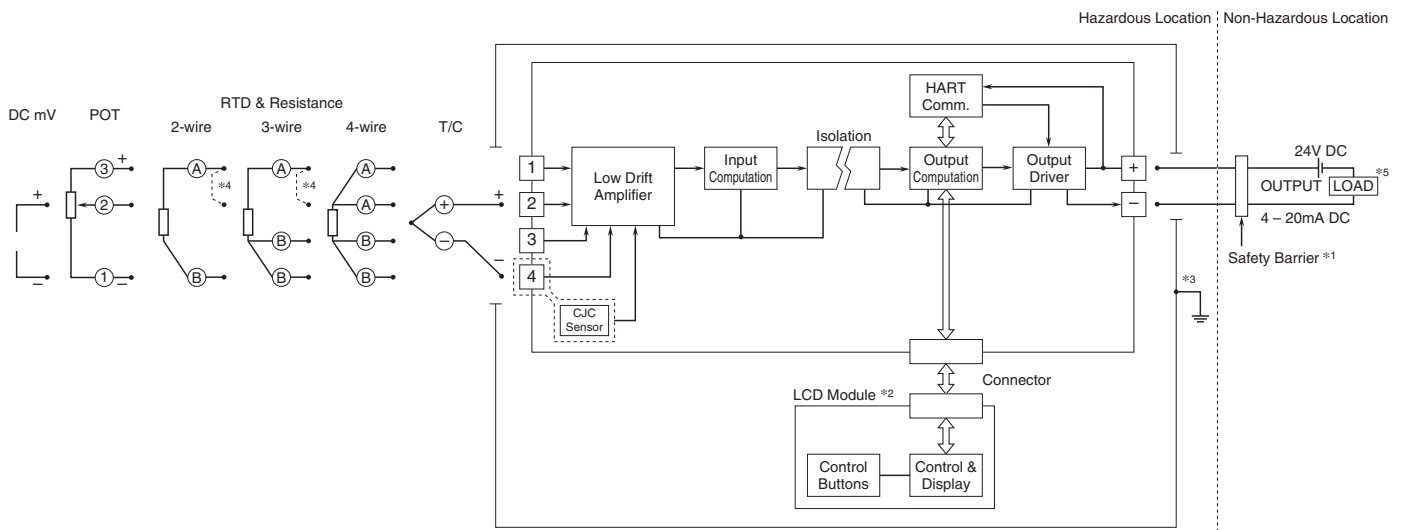
\*2. Or ±0.1% of span, whichever is greater.

(For 2- or 3-wire resistance or RTD, the value is valid by the sensor calibration after the wiring is done.)

**EXTERNAL DIMENSIONS** unit: mm [inch]



## SCHEMATIC CIRCUITRY & CONNECTION DIAGRAM



- \*1. A safety barrier must be installed for the intrinsic safety.  
The safety barrier must meet the Ex-data of this unit and must be approved for the hazardous location.
- \*2. Optional
- \*3. Be sure to earth the unit's enclosure to meet the intrinsically safe or explosion-proof (flameproof) requirements.
- \*4. Close across the terminals 1 & 2 for a resistance or RTD input.
- \*5. Limited to 250 – 1100Ω for HART communication.



Specifications are subject to change without notice.