

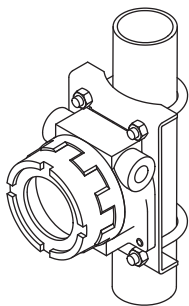
### Field-mounted Two-wire Signal Conditioners

#### 2-WIRE UNIVERSAL TEMPERATURE TRANSMITTER

(HART communication, intrinsically safe/explosion-proof)

##### Functions & Features

- Universal input: mV, V, T/C and RTD
- 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
- Self diagnostics
- Input-output isolated
- CE marking (conforms to ATEX and EMC)



### MODEL: FRC[1][2][3][4]A[5]

#### ORDERING INFORMATION

- Code number: FRC[1][2][3][4]A[5]

Specify a code from below for each of [1] through [5].  
(e.g. FRC1E11A/N/L/1)

#### [1] ENCLOSURE

0: None (Choose the suffix code 0 for 'Wiring Conduit.')

- 1: Diecast aluminium
- 2: Stainless steel casting

#### [2] SAFETY APPROVAL

- A: None
- C: IECEx/ATEX flameproof
- E: ATEX intrinsically safe

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

#### [3] LCD DISPLAY

- 0: Without
- 1: With

#### [4] WIRING CONDUIT

- 0: None
- 1: 1/2 NPT
- 2: M20 × 1.5
- 3: PG 13.5

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

#### [5] OPTIONS (multiple selections)

##### Knockdown

blank: None

/H: Knockdown product (Following option codes are not applicable.)

##### Mounting Bracket

(Not applicable with Enclosure code of "0")

blank: With

/N: Without

##### Mounting direction of transmitter

(Not applicable with Enclosure code of "0")

blank: Upright

/L: Left

/R: Right

##### LCD Display firmware

(Not applicable with LCD Display code of "0")

blank: Standard

/1: Write protection

Note

Option codes, except /H, do not appear on the product's marking.

However, in case of code /1 of LCD Display firmware, "FRCLCD/1" is marked on backside of the LCD Display module.

#### ■ SELECTABLE WIRING CONDUITS SPECIFIC TO EACH APPROVAL

'N' marked combinations are not selectable.

CONDUIT \ APPROVAL	A	C	E
0	Y	N	Y
1	Y	Y	Y
2	Y	Y	Y
3	Y	N	Y

#### RELATED PRODUCTS

- HART modem  
MACTek VIATOR RS232 HART IF recommended
- Hand-held communicator
- PC configurator software

#### 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)

**Enclosure color**

**Body:** Silver (epoxy resin)

**Cover:** Blue (equivalent to Munsell GPB3.5/10.5, polyurethane)

Silver for stainless steel (epoxy resin)

**Mounting bracket assembly:** Stainless steel 304 (FRC1) or 316 (FRC2)

**Applicable pipe:** 1 1/2" min.; 2" max.

**Isolation:** Input to output to outdoor enclosure

**Burnout (T/C & RTD):** 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 parameters:**

- Input sensor type
- Number of wires (RTD)
- Input range
- Damping time: 0 to 30 sec. (standard: 0)
- Output range (via HART only)
- Output calibration
- HART communication mode
- HART network 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 is factory set for use with 3-wire Pt 100, 0 to 150°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

## OUTPUT SPECIFICATIONS

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

**Zero adjustment:** 3.8 - 7.2 mA (standard: 4 mA)

**Span adjustment:** 12.8 - 17.6 mA (standard: 16 mA)

**Operational range:** 3.8 - 21.6 mA

**Load resistance vs. supply voltage:**

Load Resistance (Ω) = (Supply Voltage (V) - 12 (V)) ÷ 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)

**Operating humidity:** 0 to 95 %RH (non-condensing)

**Weight**

**FRC0:** Approx. 150 g including the LCD

**FRC1:** Approx. 1.3 kg

**FRC2:** Approx. 4.0 kg

## 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:**  $\pm 0.015\% / ^{\circ}\text{C}$  of max. range at  $-5$  to  $+55^{\circ}\text{C}$

**T/C and DC mV:**  $\pm 0.015\% / ^{\circ}\text{C}$  at  $-40$  to  $+85^{\circ}\text{C}$

**Pt 100, span  $\geq 100^{\circ}\text{C}$ :**  $\pm 0.015\% / ^{\circ}\text{C}$  at  $-40$  to  $+55^{\circ}\text{C}$   
 $\pm 0.03\% / ^{\circ}\text{C}$  at  $55$  to  $85^{\circ}\text{C}$

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

**Response time:** 1 second (0 - 63 %) 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)

## 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):  $40\text{ }\mu\text{V}$

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

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

2) 0 - 4 mV

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

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

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

#### • Thermocouple

1) K thermocouple, 0 -  $1000^{\circ}\text{C}$

Absolute value accuracy (Table 1):  $0.25^{\circ}\text{C}$

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

CJC error ( $0.5^{\circ}\text{C}$ ) added:  $1 + 0.5 = 1.5^{\circ}\text{C}$

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

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

2) K thermocouple, 50 -  $150^{\circ}\text{C}$

Absolute value accuracy (Table 1):  $0.25^{\circ}\text{C}$

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

CJC error ( $0.5^{\circ}\text{C}$ ) added:  $0.25 + 0.5 = 0.75^{\circ}\text{C}$

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

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

#### • RTD

1) Pt 100,  $-200$  -  $800^{\circ}\text{C}$

Absolute value accuracy (Table 1):  $0.15^{\circ}\text{C}$

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

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

2) Pt 100, 0 -  $100^{\circ}\text{C}$

Absolute value accuracy (Table 1):  $0.15^{\circ}\text{C}$

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

➡ 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

RoHS Directive

### Safety approval:

IECEx flameproof

Ex db IIC T4, T5 and T6 Gb

(IEC 60079-0)

(IEC 60079-1)

ATEX Intrinsic safety

Ex II 1G, Ex ia IIC, T4, T5 and T6 Ga

(EN 60079-0)

(EN 60079-11)

ATEX: Flameproof\*

Ex II 2G, Ex db IIC, T4, T5 and T6 Gb

(EN 60079-0)

(EN 60079-1)

\*FRC1 or FRC2

## SAFETY PARAMETERS

### Operating temperature

For ATEX :

**T4:**  $-40$  to  $+80^{\circ}\text{C}$

**T5:**  $-40$  to  $+65^{\circ}\text{C}$

**T6:**  $-40$  to  $+50^{\circ}\text{C}$

### Ex-data

**Ui:** 30 V DC

**Ii:** 96 mA DC

**Pi:** 0.72 W

**Ci:** 0  $\mu\text{F}$

**Li:** 0 mH

**Uo:** 6.4 V DC

Io: 30 mA DC  
 Po: 48 mW  
 Co: 20 μF  
 Lo: 10 mH

## INPUT TYPE, RANGE & ACCURACY

### ■ INPUT TYPE, RANGE & ACCURACY

Table 1

INPUT TYPE	MIN. SPAN	MAXIMUM RANGE	ACCURACY					
DC mV & V	4mV	-50 to +1000mV	±0.1% or ±10μV, whichever is greater (F.S. input ≤50mV) ±0.1% or ±40μV, whichever is greater (F.S. input ≤200mV) ±0.1% or ±60μV, whichever is greater (F.S. input ≤500mV) ±0.1% or ±80μV, whichever is greater (F.S. input >500mV)					
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
W	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

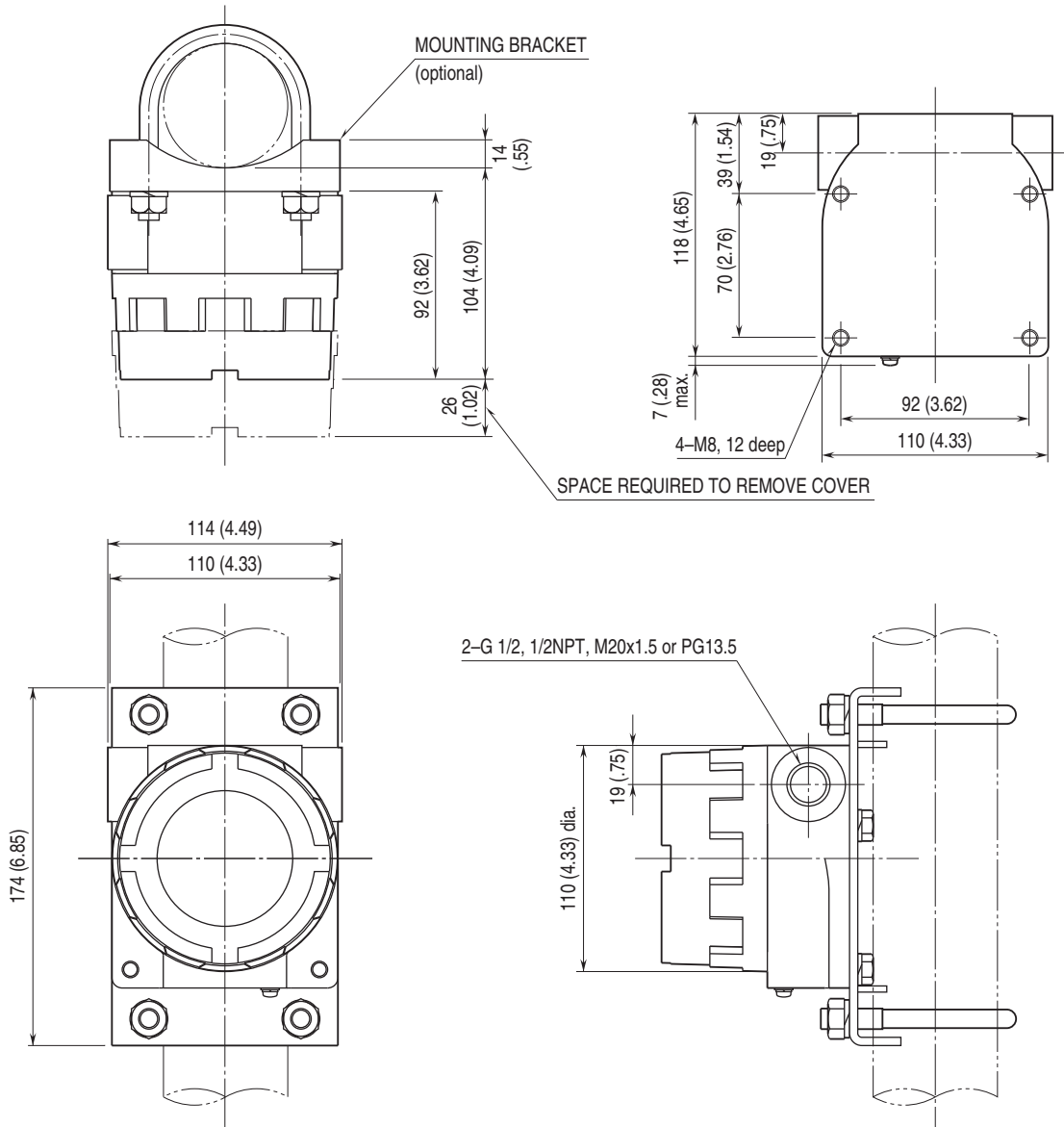
\*1. [Accuracy or ±0.1% of span, whichever is greater] + Cold Junction Compensation Error 0.5°C

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

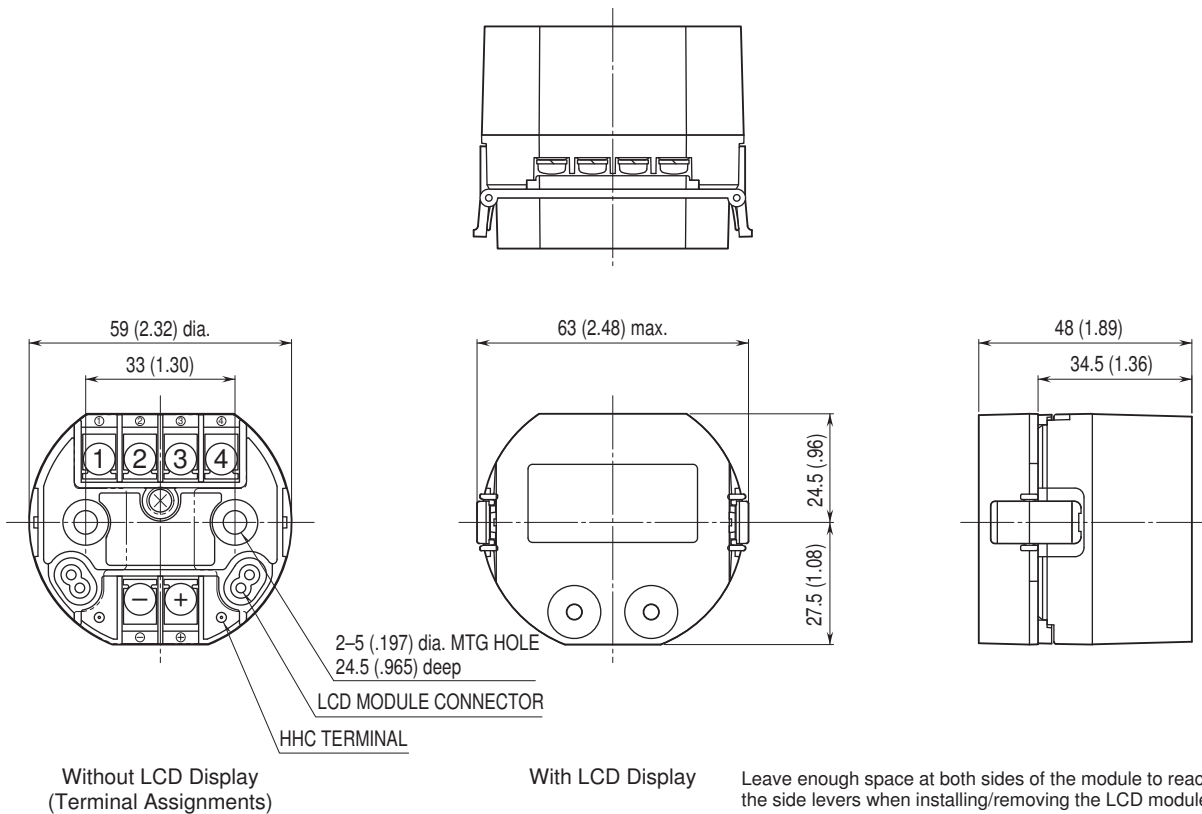
(For 2- or 3-wire RTD, the value is valid by the sensor calibration after the wiring is done.)

**DIMENSIONS unit: mm (inch)**

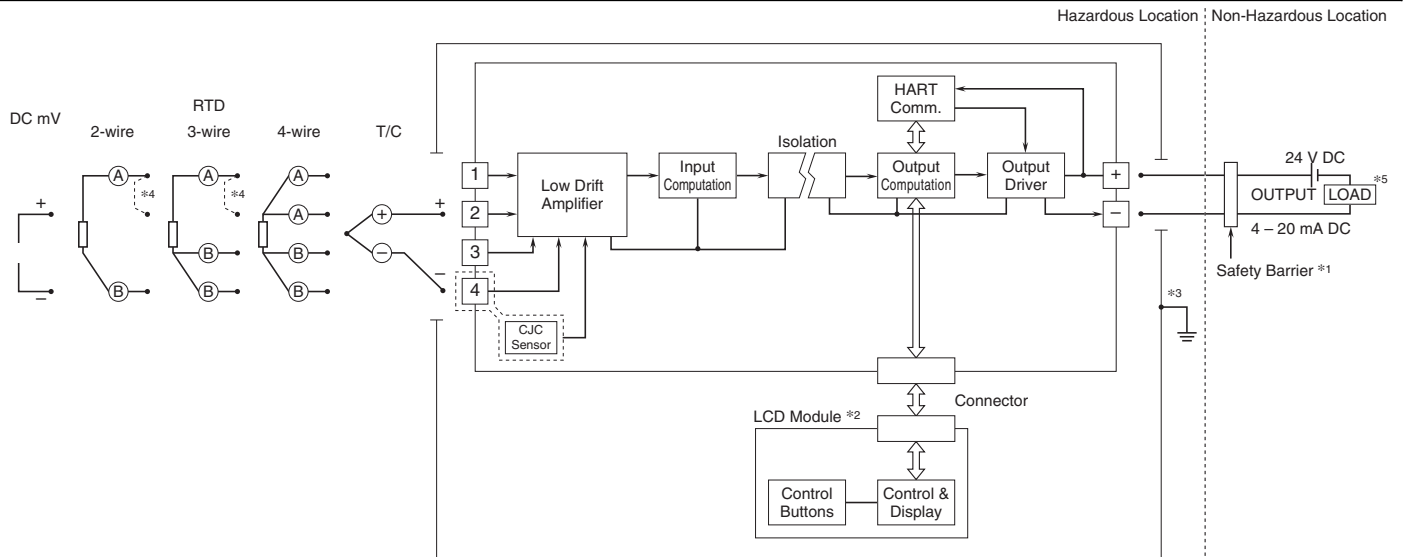
**OUTDOOR ENCLOSURE**



## ■ TRANSMITTER



## 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 2-wire or 3-wire RTD input.
- \*5. Limited to 250 - 1100Ω for HART communication.



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