Field-mounted Two-wire Signal Conditioners

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

MODEL **FRC**

MODEL & SUFFIX CODE SELECTION

1 C 1 1
FRC□□□□A

MODEL

ENCLOSURE
0 : None *1
1 : Diecast aluminium
2 : Stainless steel casting

SAFETY APPROVAL
A : None
C : CENELEC flameproof (ATEX)
E : CENELEC intrinsically safe (ATEX)

LCD DISPLAY
0 : Without
1 : With

WIRING CONDUIT *2
0 : None
1 : 1/2 NPT
2 : M20 × 1.5
3 : PG 13.5

*1. Choose the suffix code 0 for “Wiring Conduit”
*2. Confirm selectable combinations of approval and wiring conduit types in the table below.

■ **SELECTABLE WIRING CONDUITS SPECIFIC TO EACH APPROVAL**
‘N’ marked combinations are not selectable.

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

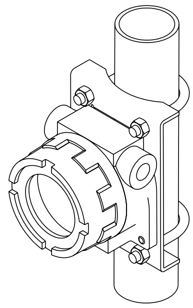
RELATED PRODUCTS

- PC Configurator Software
- HART modem*
  MACTek VIATOR RS232 HART® IF recommended
- Hand-held communicator*

* Consult HART® Communication Foundation (HCF) web site : www.hartcomm.org

GENERAL SPECIFICATIONS

Degree of protection : NEMA 4X, IP66/IP67
Wiring conduit : See “Model & Suffix Code”.
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 (polyurethane coated) or stainless steel casting (equivalent to type 316, epoxy resin coated).



Functions & Features

- Universal input: mV, V, T/C and RTD
- High accuracy
- HART communication
- Intrinsically safe and explosion-proof approval
- CE marking (conforms to ATEX and EMC)
- 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

Enclosure color :
Body : Silver
Cover : Blue (equivalent to Munsell GPB3.5/10.5)
Silver for stainless steel
Mounting bracket assembly :
Stainless steel 304
Applicable pipe :
1” 1/2 min.; 2” max.
Isolation :
Input to output to outdoor enclosure
User-configurable parameters :
· Input sensor type
· Number of wires (RTD)
· Input range
· Output range (via HART® only)
· Output calibration
· HART communication mode
· HART network mode
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 (T/C) :
CJC sensor incorporated
Damping time :
0 to 30 sec. (standard : 0)

LCD DISPLAY (option)

Features: · Indicates and setts input signal, engineering unit and transmitter status.
· Removable while the module is powered.

Display size : 36 × 20 mm (1.41” × 0.79”)

Characters :

Color : Black

Format : 2 rows of 5 alphanumeric characters;
Top: 7.4 mm high
Bottom: 6.5 mm high
6 status characters, 1.9 mm high

Display range :
-99999 to 99999

Decimal point :
Top row only; positioned between two characters

Read rate : 150 msec.

Back light : None

HART® COMMUNICATION

Protocol :
HART® communication protocol

HART® address range :
0 – 15 (standard: 0)

Transmission speed : 1200 bps

Digital current :
Approx. 1mA p-p when communicating

Character format :
1 Start Bit, 8 Data Bits, 1 Odd Parity Bit, 1 Stop Bit

Distance :
1.5 kilometers (0.9 mile)

HART® communication mode :
Master-Slave Mode and Burst Mode (standard: 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.

INPUT

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 : 1MΩ minimum

■ **THERMOCOUPLE**

Input resistance : 1MΩ minimum
Burnout sensing : 130nA ±10%

■ **RTD** (2-wire, 3-wire or 4-wire)

Input resistance : 1MΩ minimum
Excitation : 0.2mA ±10%
Allowable leadwire resistance : Max. 20Ω per wire

OUTPUT

Output range : 4 – 20mA DC
Zero adjustment : 3.8 – 7.2mA (standard: 4mA)
Span adjustment : 12.8 – 17.6mA (standard: 16mA)
Operational range : 3.8 – 21.6mA
Load resistance vs. supply voltage:

$$\text{Load Resistance } (\Omega) = \frac{\text{Supply Voltage (V)} - 12\text{ (V)}}{0.024\text{ (A)}}$$

(including leadwire resistance)

INSTALLATION

Supply voltage :
12 – 42V DC (non-approved)
12 – 28V DC (approved)

Operating temperature:
-40 to +85°C Electronics
(See Safety Parameters for use in a hazardous location.)
-30 to +80°C Display (full visibility)

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

Dimensions :
See External Dimensions.

Weight :

FRC0 : Approx. 150 g including the LCD
FRC1 : Approx. 1.3 kg
FRC2 : Approx. 4.0 kg

PERFORMANCE

Accuracy :
See Table 1 and “Explanation of Terms”

Cold junction compensation error : ≤ ±0.5°C

Temperature coefficient :
±0.015%/°C of max. range at -5 to +55°C
T/C and DC mV : ±0.015%/°C at -40 to +85°C
Pt 100, span ≥ 100°C : ±0.015%/°C at -40 to +55°C
±0.03%/°C at 55 to 85°C

Start-up time : Approx. 8 seconds

Response time :
1 second (0 – 63%) with damping time set to 0 and when not communicating via HART®.

Supply voltage effect :
±0.003% x [Output Span] / 1V

Insulation resistance :
≥100MΩ with 500V DC (input to output)

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

STANDARDS & APPROVALS

CE conformity: ATEX Directive (94/9/EC)
Ex ia EN 50020
Ex d EN 60079-1
EMC Directive (2004/108/EC)
EMI EN 61000-6-4
EMS EN 61000-6-2

Safety approval
CENELEC: Intrinsically safe (ATEX)
Ⓔx II 1G, Ex ia IIC; T4, T5 and T6
(EN 50020 : 2002)
CENELEC: Flameproof (ATEX) **
Ⓔx II 2G, Ex d IIC; T4, T5 and T6
(EN 60079-1 : 2007)
**FRC1 or FRC2

SAFETY PARAMETERS

Operating temperature for CENELEC (ATEX):
T4 -40 to +80°C
T5 -40 to +65°C
T6 -40 to +50°C

Ex-data:

Ui	30V DC	Uo	6.4V DC
Ii	96mA DC	Io	30mA DC
Pi	0.72W	Po	48mW
Ci	0 µF	Co	20 µF
Li	0 mH	Lo	10 mH

EXPLANATIONS OF TERMS

■ ACCURACY

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

Accuracy = A/D Conversion Error + 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 – 200mV
   Absolute value accuracy (Table 1): 40μV
   40μV / 200000μV × 100 = 0.02 % < 0.1%
   ➠ Overall accuracy = ±0.1% of span
2) 0 – 4mV
   Absolute value accuracy (Table 1): 10μV
   10μV / 4000μV × 100 = 0.25 % > 0.1%
   ➠ Overall accuracy = ±0.25% of span

• Thermocouple

1) K thermocouple, 0 – 1000°C
   Absolute value accuracy (Table 1): 0.25°C
   0.1% × 1000°C = 1°C > 0.25°C
   CJC error (0.5°C) added: 1 + 0.5 = 1.5°C
   1.5°C / 1000°C × 100 = 0.15 %
   ➠ Overall accuracy including CJC error = ±0.15% of span
2) K thermocouple, 50 – 150°C
   Absolute value accuracy (Table 1): 0.25°C
   0.1% × (150 – 50)°C = 0.1°C < 0.25°C
   CJC error (0.5°C) added: 0.25 + 0.5 = 0.75°C
   0.75°C / (150 – 50)°C × 100 = 0.75 %
   ➠ Overall accuracy including CJC error = ±0.75% of span

• RTD

1) Pt 100, -200 – 800°C
   Absolute value accuracy (Table 1): 0.15°C
   0.15°C / (800 – -200)°C × 100 = 0.015 % < 0.1%
   ➠ Overall accuracy = ±0.1% of span
2) Pt 100, 0 – 100°C
   Absolute value accuracy (Table 1): 0.15°C
   0.15°C / 100°C × 100 = 0.15 % > 0.1%
   ➠ Overall accuracy = ±0.15% of span

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)

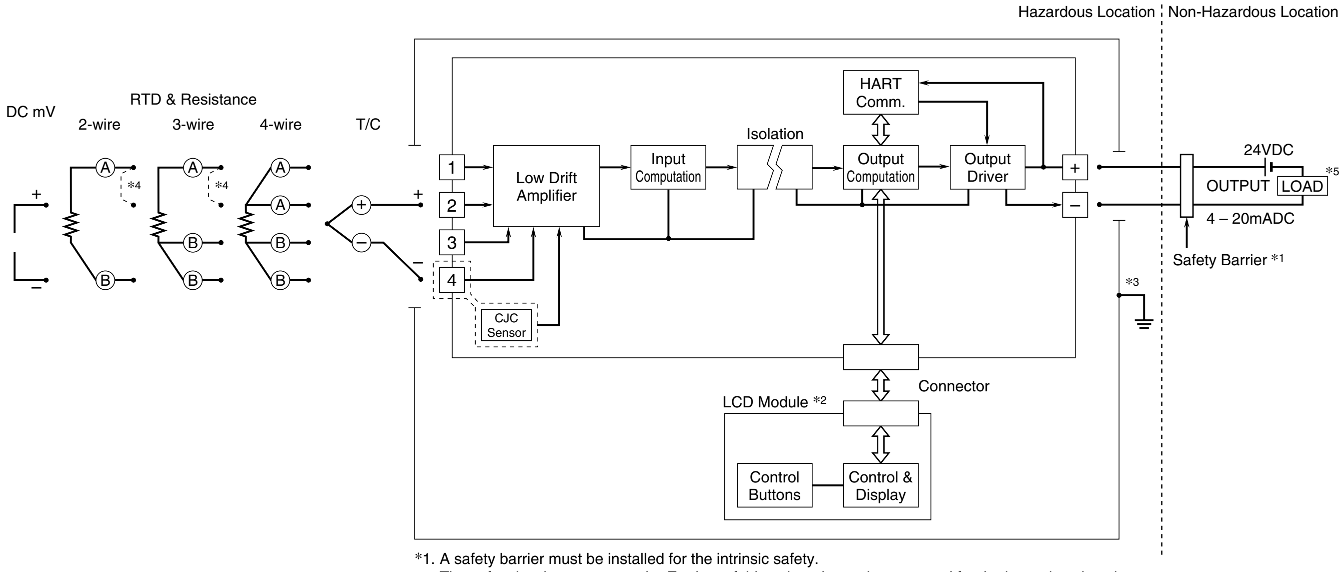
Thermocouple	°C				°F			
	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1	MIN. SPAN	MAXIMUM RANGE	CONFORMANCE RANGE	ACCURACY *1
(PR)	20	0 to 1760	0 to 1760	±1.00	36	32 to 3200	32 to 3200	±1.80
K (CA)	20	-270 to +1370	-150 to +1370	±0.25	36	-454 to +2498	-238 to +2498	±0.45
E (CRC)	20	-270 to +1000	-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.)

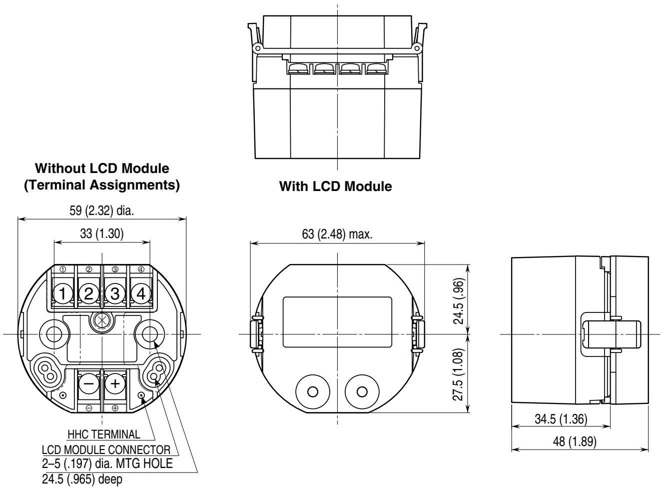
SCHEMATIC CIRCUITRY & CONNECTION DIAGRAM



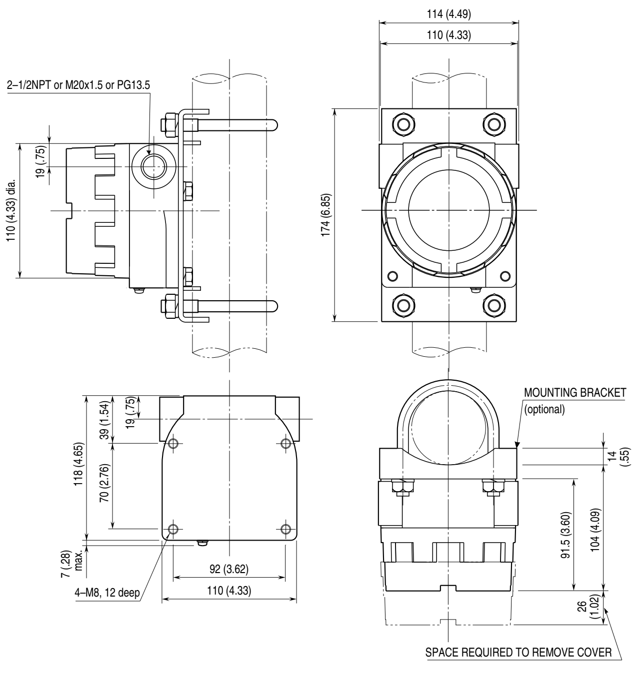
*1. A safety barrier must be installed for the intrinsic safety.
The safety barrier must meet the Ex-data of this unit and must be approved for the hazardous location.
*2. Optional
*3. Be sure to earth the unit s enclosure to meet the intrinsic safe or explosion-proof (flameproof) requirements.
*4. Close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

EXTERNAL DIMENSIONS & MOUNTING REQUIREMENTS unit: mm (inch)

■ FRC0



■ FRC1, FRC2



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