

TEMPERATURE TRANSMITTER (HART communication, intrinsically safe/flameproof)

MODEL

FRC

BEFORE USE

Thank you very much for your purchase of the Fuji FRC Transmitter. Before use, please check contents of the package you received as outlined below.

If you have any problems or questions with the product, please contact Fuji's Sales Office or representatives.

■ PACKAGE INCLUDES:

Transmitter	(1)
Short bar	(1)
Outdoor enclosure (FRC1)	(1)
Mounting screws (FRC1)	(4)
2-inch pipe mounting bracket (FRC1)	(1) set

■ MODEL NO.

Check that model No. described on the specification label is exactly what you ordered.

■ SAFETY PRECAUTIONS

This manual describes necessary points of caution when you use this product, including installation, connection and basic maintenance procedures.

Information that potentially raises safety issues is indicated by a warning symbol (Δ). Please refer to the following safety messages before performing an operation preceded by this symbol.

Δ POINTS OF CAUTION

The following are general precautions when using this unit. The safety features and precautions specific to the hazardous locations are explained in Page 10.

■ POWER INPUT RATING

- Use a stable power source. The FRC restarts with a power interruption for longer than 1 millisecond.

■ ENVIRONMENT

- The model FRC0 is for indoor use.
- When heavy dust or metal particles are present in the air, install the unit inside an outdoor enclosure.
- Environmental (non-hazardous location) temperature must be within -40 to $+85^{\circ}\text{C}$ (-40 to 185°F) in order to ensure adequate life span and operation.
- For installing the FRC0 in an environment with a high relative humidity exceeding 0 to 95% RH or in a condensing atmosphere, install the unit inside an outdoor enclosure.
- Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
- For use in a hazardous location, be sure that the environmental temperature is within the temperature class required for the area.

■ WIRING

- Do not install cables (input and output) close to noise sources (relay drive cable, high frequency line, etc.).
- Do not bind the unit's cables together with cables where high noise levels are present. Do not install them in the same duct.

■ AND

- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.

COMPONENT IDENTIFICATION

Figure 1. FRC0 exploded view and component identification

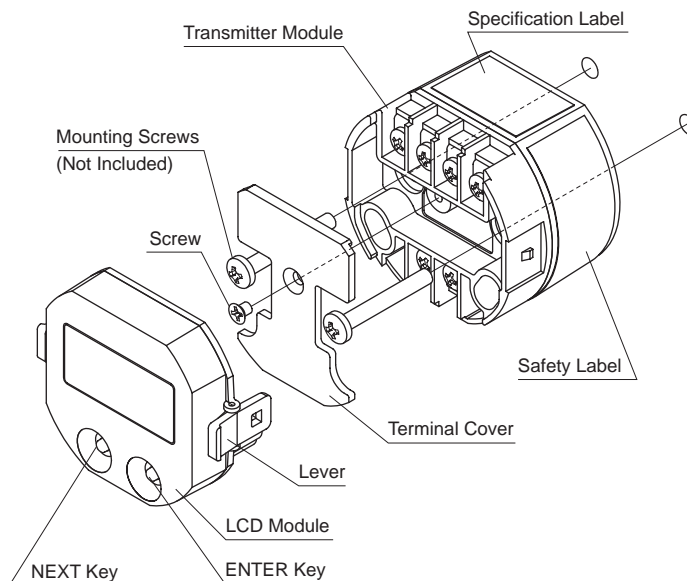
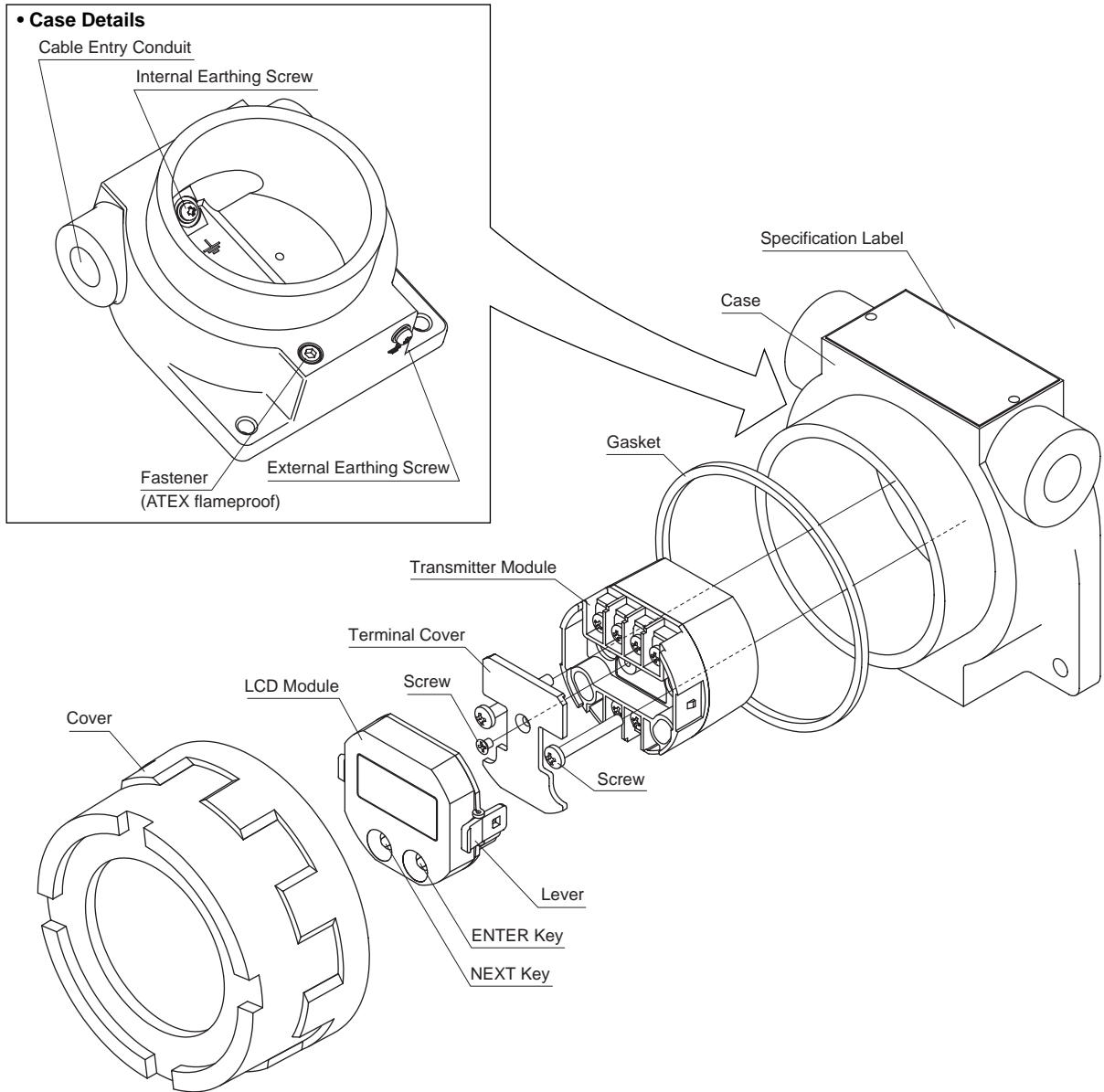


Figure 2. FRC1 exploded view component identification



EXTERNAL DIMENSIONS mm (inch)

Figure 3. FRC0 external dimensions

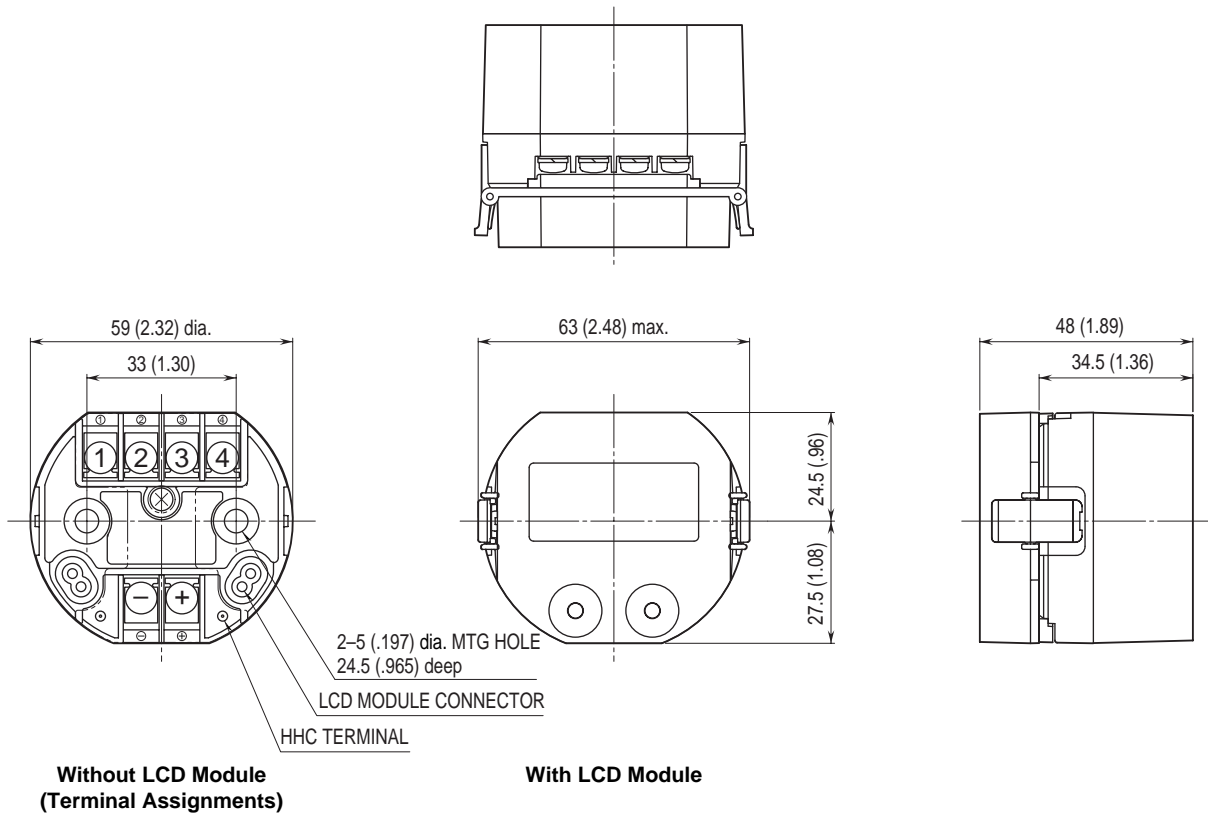
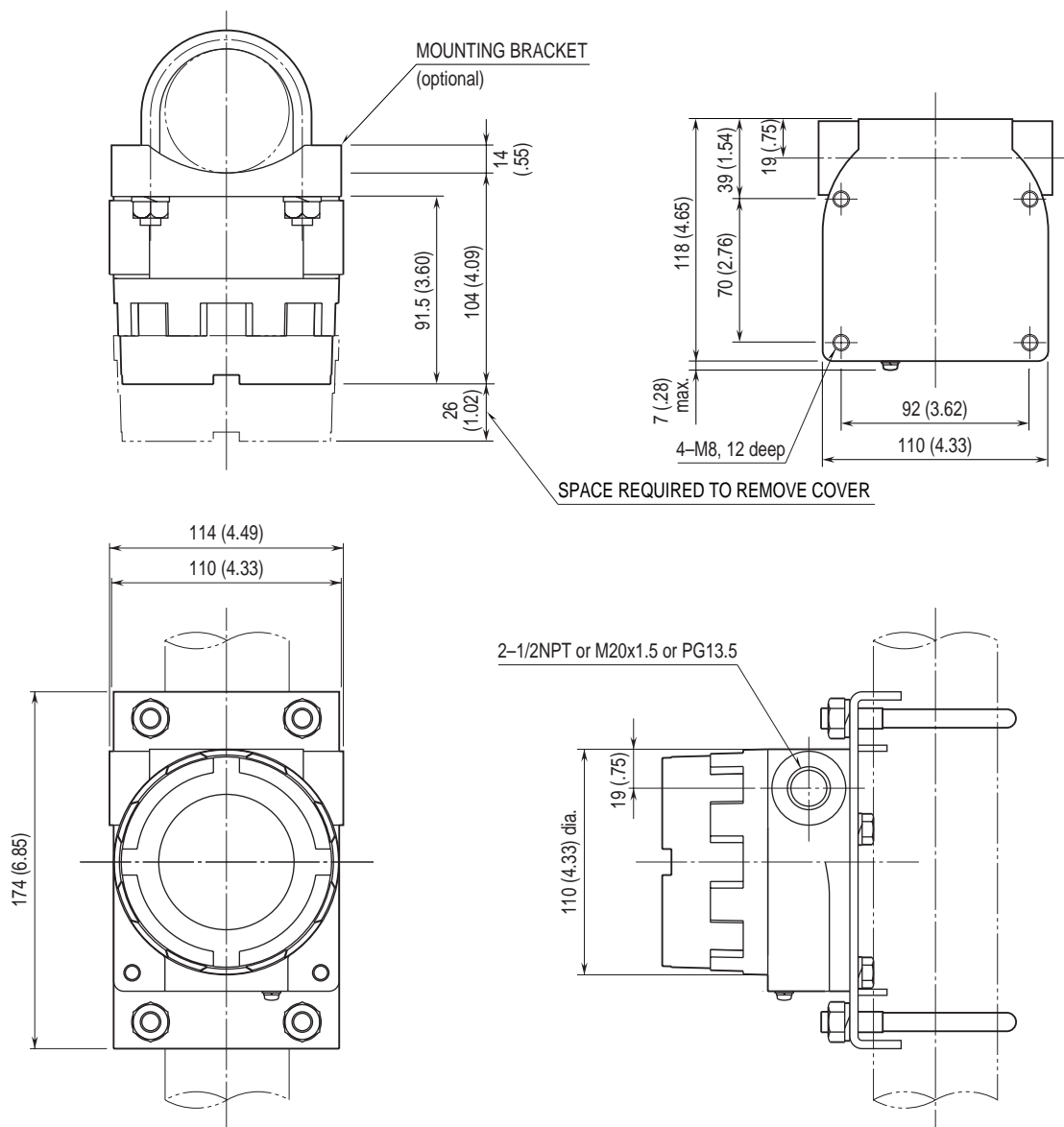


Figure 4. FRC1 external dimensions



INSTALLATION

■ LCD MODULE

- For attaching the LCD module, hold the levers at the side and push into the connectors on top of the transmitter module.
- When removing the module, hold the levers in the same manner and pull.

■ WALL MOUNTING

Refer to Figures 1 and 3.

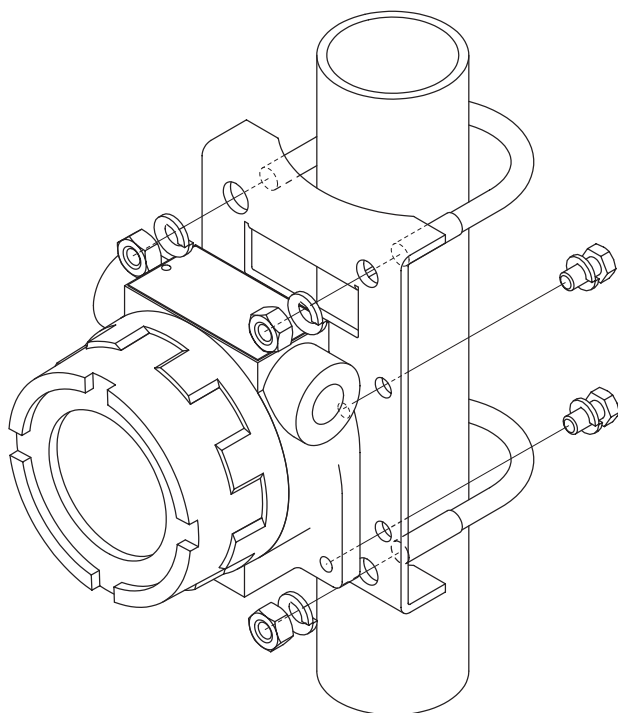
■ OUTDOOR INSTALLATION

For mounting the transmitter module inside the outdoor enclosure, refer to Figure 2.

■ MOUNTING THE ENCLOSURE ON A PIPE

See Figures 5 below.

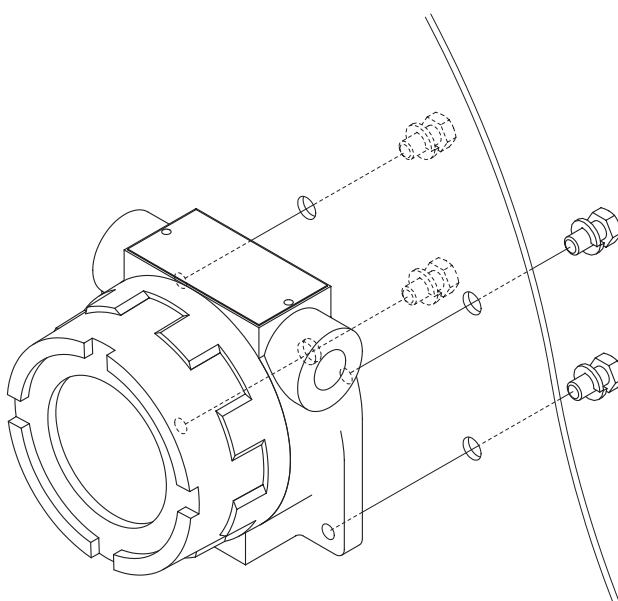
Figure 5. Pipe mounting



■ MOUNTING THE ENCLOSURE ON A WALL

See Figures 4 and 6 (below).

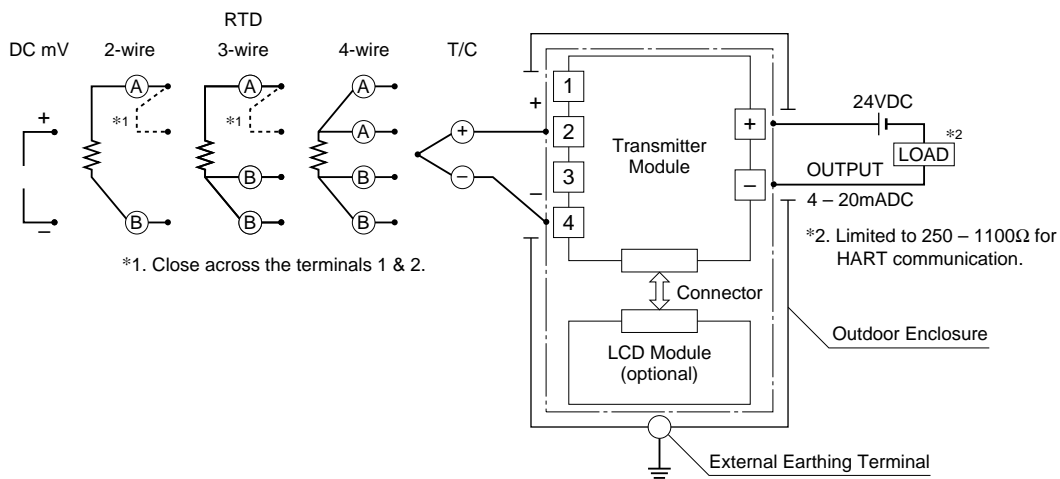
Figure 6. Wall mounting



TERMINAL CONNECTIONS

Connect the unit as in the diagram below. For use in a hazardous location, refer to "Installation Diagram" attached at the end of this manual.

Figure 7. Connection diagram



CHECKING

⚠ Warning! Whenever you need to measure voltage across the terminals or apply a simulated input signal to the terminals, make sure that there is no danger of explosion in the atmosphere.

- 1) Terminal wiring: Check that all cables are correctly connected according to the connection diagram.
- 2) Input type and range setting: Check that the input type and range are correctly set.
- 3) Input: Check that the input signal is within 0 – 100% of the full-scale.

If the thermocouple/RTD or its extension wires are broken, the output goes over 100% (below 0% with downscale) due to the burnout function. Check leadwires in such a case.

- 4) Output: Check that the load is within the permissible limit including wiring resistance.

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

(including leadwire resistance)

ADJUSTMENT PROCEDURE

■ USING THE HART COMMUNICATION

Refer to the HART Setup Manual (EM-7451-FIC-B). For operating an HHC (Hand-Held Communicator), refer to its instruction manual.

■ USING THE LCD MODULE

Figure 8 shows the display panel configuration of the LCD module, and Figure 9 shows the basic operation flow chart for programming the transmitter.

• How to Input Numerical Figures on the LCD

Numerical figures (numbers) can be set by combining NEXT and ENTER key operations.

Pressing the NEXT key increases the value from 0 to 9 and back to 0 again. Pressing the ENTER key when a desired value is shown sets the value and then moves to the next less significant digit. Pressing the ENTER key at the least significant digit completes the input.

For the most significant digit, numbers change from 0, 1, 2 through 9, then -0, -1, -2, through -9, and then back to 0.

• Basic Operation

When the power supply is turned on, the "RUN" indicator on the LCD module flashes until communication with the transmitter module is established. Once established, the "RUN" indicator remains on.

The LCD starts up in the Display Mode.

The upper (first) row on the display indicates numerical figures, and the lower (second) row indicates messages.

Pressing the NEXT key one or more times switches the module between the Configuration Mode, Calibration Mode and Display Mode.

Pressing the ENTER key in the Configuration Mode or Calibration Mode calls up the first programming item (step). In this state, every time the NEXT key is pressed, the next item and current setting is displayed until it returns to the Display Mode after the last programming item.

Whenever the type/value within a particular programming step can be changed, "PGM" is shown on the LCD. When each step is complete, the "PGM" indicator is turned off.

• LCD Panel Indication in the Display Mode

"Burnout State" includes not only a temperature sensor's wire breakdown but also an overrange input outside the physically set range for thermocouples or RTDs.

"Saturation State" is when an overrange input is applied outside the physically set range and proportional to the output smaller than 3.8mA or exceeding 21.6mA.

Normal State	
Top row	Numerical figures
Bottom row	HART address* ¹
BO	OFF
ERR	OFF
asterisk	OFF
Eng. unit	ON* ¹
Saturation State	
Top row	Numerical figures
Bottom row	HART address* ¹
BO	OFF
ERR	OFF
asterisk	ON
Eng. unit	ON* ¹
Burnout State	
Top row	Blank
Bottom row	HART address* ¹
BO	ON
ERR	OFF
asterisk	ON
Eng. unit	ON* ¹

*1. When an appropriate unit symbol is not available among the selections on the LCD, the bottom row indicates the unit and HART address alternately.

• Programming Procedure in the Configuration Mode

1) Input Type (SelectInput)

First choose the input type. Pressing the NEXT key one or more times switches between each of the available input types. Press ENTER to set a desired input type.

When Thermocouple, RTD or potentiometer is selected, the display goes to the sensor type list. Use the NEXT and ENTER keys to choose a sensor type.

See Table 1 through 3 for available input types.

Table 1. Input types

Input type	LCD bottom row
Thermocouple	TC
2-wire RTD	2-RTD
3-wire RTD	3-RTD
4-wire RTD	4-RTD
mV	MV

Table 2. Thermocouples

Sensor type	Bottom row	Sensor type	Bottom row
B	TC/B	T	TC/T
E	TC/E	W	TC/W5
J	TC/J	U	TC/U
K	TC/K	L	TC/L
N	TC/N	P	TC/P
R	TC/R	PR	TC/PR
S	TC/S		

Table 3. RTDs

RTD type	Top row	Bottom row*2
IEC Pt 100	100	n-IPT

*2. n = 2 : 2-wire, 3 : 3-wire, 4 : 4-wire

2) Temperature Unit (SelectUnit)

For a thermocouple or RTD input, the Temperature Unit can be specified.

At the initial state, the LCD shows the current setting. Pressing the NEXT key one or more times switches between the available temperature units. Stop when a desired selection is displayed, and press ENTER.

For mV, resistance and potentiometer inputs, settings other than "mV", "Ω" and "%" respectively cannot be selected.

See Table 4.

Table 4. Temperature units

Temperature unit	LCD bottom row
Degree Celcius	DEG C
Degree Fahrenheit	DEG F
Degree Rankine	DEG R
Degree Kelvin	DEG K

3) Burnout (BurnoutDirection)

At the initial state, the LCD shows the current setting. Pressing the NEXT key one or more times switches between "High" (upscale), "Low" (downscale), and "Off" (no burnout). Stop when a desired selection is displayed, and press ENTER.

4) Lower Range Input (InputLowerRange)

Lower and Upper Input ranges can be specified.

At the initial state, the LCD shows the current 0%* setting.

Values are indicated in the selected temperature unit (T/C and RTD) or mV (DC mV).

Set an actual value on the top row of the LCD.

*For potentiometer input, enter the percentage of the total resistance for both the lower and upper ranges.

5) Upper Range Input (InputUpperRange)

Refer to the Lower Range Input.

6) Display Item (SelectDisplay)

Specifies the item to be monitored on the LCD in the Display Mode.

At the initial state, the LCD shows the current setting.

Pressing the NEXT key one or more times switches between available selection items. Stop when a desired selection is displayed, and press ENTER.

See Table 5 for available display items.

Table 5. Display items

Item	Bottom row
Input (unit as selected in SelectUnit)	I ENG
Input in %	I PER
Output in %	O PER
Output in mA	O ENG
Cold junction temperature (T/C only)	CJM

• Programming Procedure in the Calibration Mode

1) Output Zero Adjustment (TrimOutput4mA)

Used to fine tune 4mA output.

At the initial state, the unit outputs 4mA regardless of actual input value.

Set an actual measured value on the top row of the LCD.

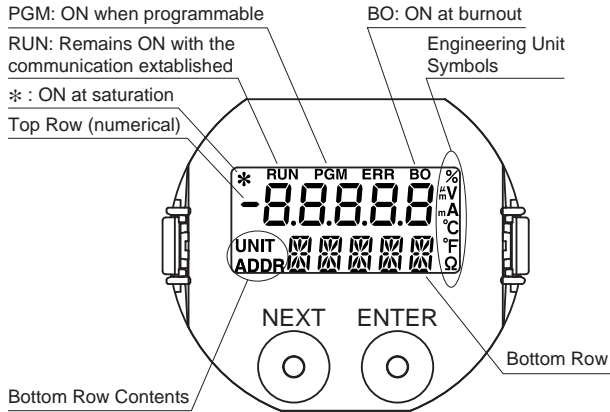
2) Output Span Adjustment (TrimOutput20mA)

Used to fine tune 20mA output.

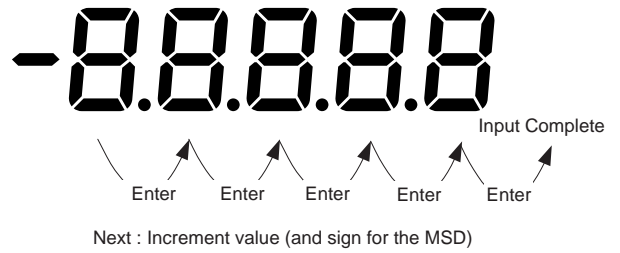
At the initial state, the unit outputs 20mA regardless of actual input value.

Set an actual measured value on the top row of the LCD.

Figure 8. LCD display panel configuration

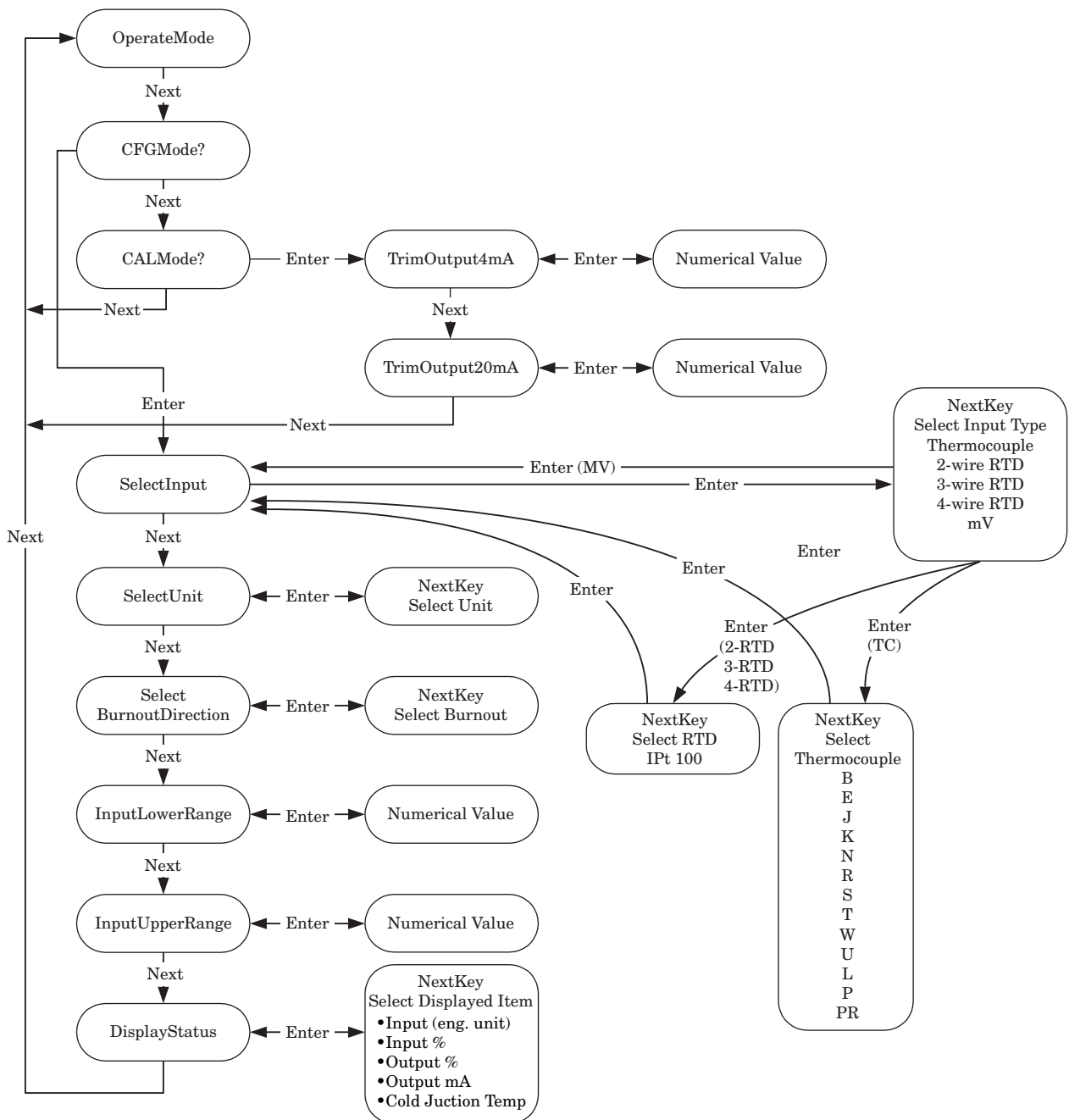


•Key Operations in Entering Numerical Value



Unexplained symbols are unused for the B6U and B6U-B.

Figure 9. Programming operation flowchart



TEMPERATURE TRANSMITTER (HART communication, intrinsically safe/flameproof)

MODEL

FRC

BEFORE USE

■ SAFETY PRECAUTIONS

This manual describes important points of caution for safe use of this product in potentially explosive atmosphere. Please read this manual carefully before installing and operating the product.

■ SPECIAL CONDITIONS FOR SAFE USE

- If the model FRC0 is mounted in an area where category 1 equipment is required, precautions have to be taken that the enclosure can not be charged by static electricity.
- If the model FRC1 is mounted in an area where category 1 equipment is required, it must be installed such that even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.
- When the model FRC0 is installed in environment requiring a higher ingress protection than IP20, it must be additionally protected by an enclosure suitable for the environment.

■ MANUFACTURED DATE CODE IDENTIFICATION

The manufactured year can be identified by the serial number described on the specification label.

Serial No. x Y xxxxxxT

YEAR _____

Indicates the least significant digit of the year.

■ MODEL NUMBER IDENTIFICATION

- Model No. FRC _____ 1
- 1) OUTDOOR CASE _____
 - 0 : None (module only)
 - 1 : Yes
 - 2) SAFETY APPROVAL _____
 - A : None
 - B : FM flame-proof (for FRC1)
 - C : ATEX flameproof (for FRC1)
 - D : FM intrinsically safe
 - E : ATEX intrinsically safe
 - 3) DISPLAY _____
 - 0 : None
 - 1 : LCD
 - 4) WIRING CONDUIT _____
 - 0 : None (for FRC0)
 - 1 : 1/2 NPT
 - 2 : M20 x 1.5
 - 3 : PG 13.5

⚠ WARNING

Explosions could result in death or serious injury:

- The enclosure cover must be fully engaged to meet flameproof requirements.
- Do not remove the enclosure cover in explosive atmospheres when the circuit is alive (except IS models).
- Do not connect or disconnect the LCD module in explosive atmosphere when the circuit is alive.
- When the LCD is not installed, covers shall instead be fitted at the open connectors.
- Before you remove the unit or mount it, or before you connect or disconnect the wiring, turn off the power supply and the input signal for safety. Do not disconnect unless the area is known to be non-explosive.
- Whenever you need to measure voltage across the terminals or apply a simulated input signal to the terminals, make sure that there is no danger of explosion in the atmosphere.
- Before connecting a HART communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices.
- Verify the certification of the product described on the specification label on the product.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Verify that the environmental temperature is within the temperature class required for the area.

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

⚠ SAFETY FEATURES & CAUTIONS

■ INTRINSICALLY SAFE APPROVAL

• CENELEC / ATEX

EC-Type Examination Certificate: KEMA 02ATEX1179 X

⊕ II 1G EEx ia IIC T4 through T6

Zone 0

• IS Data

$U_i = 30V$ DC $U_o = 6.4V$ DC

$I_i = 96mA$ DC $I_o = 30mA$ DC

$P_i = 720mW$ $P_o = 48mW$

$C_i = 0 \mu F$ $C_o = 20 \mu F$

$L_i = 0 mH$ $L_o = 10 mH$

• Prior to installation, check that the safety class of this unit satisfies the system requirements.

• A safety barrier must be installed between the unit and its power supply. Refer to "Installation Diagram" attached at the end of this manual when selecting a safety barrier.

• The power supply and the safety barrier must be located in a non-hazardous area.

• Environmental temperature must be within the following ranges depending upon the required temperature class.

T4 : $-40^{\circ}C \leq T_a \leq +80^{\circ}C$

T5 : $-40^{\circ}C \leq T_a \leq +65^{\circ}C$

T6 : $-40^{\circ}C \leq T_a \leq +50^{\circ}C$

• **DO NOT RUB** the surface of the plastic enclosure with a dry cloth. Electrostatic charge generated by the friction may cause an explosion.

• **DO NOT APPLY** physical impact or friction onto the FRC1 enclosure.

• Be sure to secure the terminal cover after wiring (model FRC0).

• The wiring method must be in accordance with the electrical parameters described in this manual.

• Be sure to earth the unit (model: FRC1).

• The intrinsic safety approval of the model FRC1 is applied to the combination of the outdoor enclosure and the transmitter. The transmitter must not be separated or replaced.

• Substitution of components may impair suitability for the hazardous location and may cause an explosion.

• When metal particles are present in the air, install the model FRC0 inside an outdoor enclosure.

• For installing the FRC0 in an environment with a high relative humidity exceeding 0 to 95% RH or in a condensing atmosphere, install the unit inside an outdoor enclosure.

■ Model FRC1 FLAMEPROOF APPROVAL (Pending)

• CENELEC / ATEX

EC-Type Examination Certificate: KEMA XXXXXX

⊕ II 2G EEx d IIC T4 through T6

Zone 1

• Prior to installation, check that the safety class of this unit satisfies the system requirements.

• Environmental temperature must be within the following ranges depending upon the required temperature class.

T4 : $-40^{\circ}C \leq T_a \leq +80^{\circ}C$

T5 : $-40^{\circ}C \leq T_a \leq +65^{\circ}C$

T6 : $-40^{\circ}C \leq T_a \leq +50^{\circ}C$

• Use suitable heat resistant cable for ambient temperatures $\geq 70^{\circ}C$

• Before wiring, make sure there is no danger of explosion in the atmosphere.

• Before opening the enclosure, wait at least for 60 seconds after the power is removed.

• The cable entry device and stopping plugs for unused apertures shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

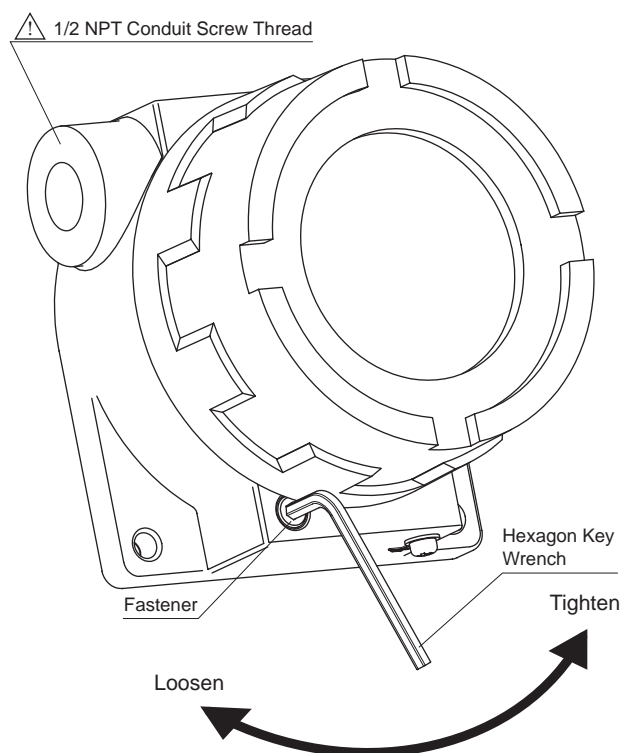
• The cable entry conduit is 1/2 NPT threaded and with the \triangle mark, or M20 \times 1.5 threaded with no marking.

• Six or more cable entry threads must be engaged.

• Squeeze the cable entry and stopping plug into the conduit with the proper tool.

• Before turning the power supply on, be sure to close the enclosure cover tightly and tighten the fastener as shown in Figure 1 using a hexagon key wrench. When opening the enclosure, loosen the fastener first.

Figure 1. Enclosure fastener



• **DO NOT RUB** the surface of the plastic enclosure with a dry cloth. Electrostatic charge generated by the friction may cause an explosion.

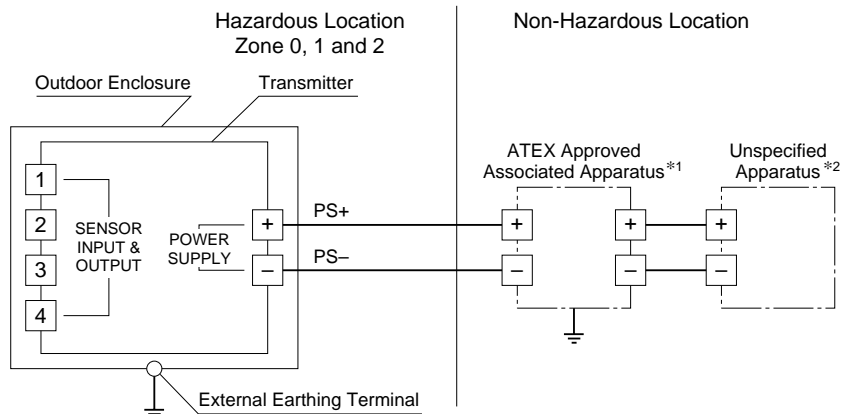
• Be sure to earth the unit.

• For external earthing or bonding connection a cable lug shall be used so that the conductor is secured against loosening and twisting and that contact pressure is maintained.

• The flameproof approval of this unit is applied to the combination of the outdoor enclosure and the transmitter. The transmitter must not be separated or replaced.

• Substitution of components may impair suitability for the hazardous location and may cause an explosion.

INSTALLATION DIAGRAM for ATEX INTRINSICALLY SAFE MODEL



ELECTRICAL DATA

Power Supply (+ and -)

Maximum Input Voltage U_i : 30 V
 Maximum Input Current I_i : 96 mA
 Maximum Input Power P_i : 0.72 W
 Maximum Internal Capacitance C_i : 0 μ F
 Maximum Internal Inductance L_i : 0 mH

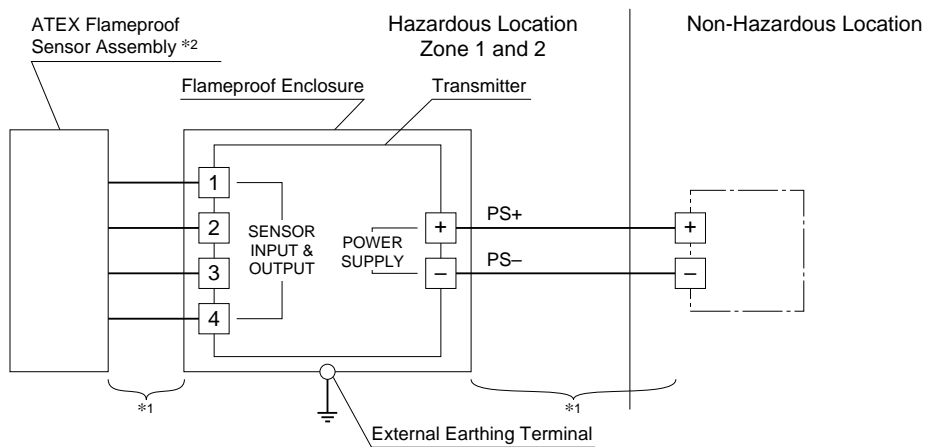
Sensor Circuit (1 to 4)

Maximum Output Voltage U_o : 6.4 V
 Maximum Output Current I_o : 30 mA
 Maximum Output Power P_o : 48 mW
 Maximum External Capacitance C_o : 20 μ F
 Maximum External Inductance L_o : 10 mH

NOTES

- *1 : In any safety barrier, the output current of the barrier must be limited by a resistor 'R' such that $I_o = U_o / R$.
 The safety barrier must be certified by an EEC approved certification body to EEx ia IIC.
 In case of isolated barrier, the earth is not required.
- *2 : Apparatus which is unspecified except that it must not be supplied from nor contain under normal or abnormal conditions a source of potential with respect to earth in excess of 250 Volts RMS.

INSTALLATION DIAGRAM for ATEX FLAMEPROOF MODEL



ELECTRICAL DATA

Power Supply (+ and -)

Supply Voltage : 12 to 28 V
 Output Current : 4 to 20 mA
 (Burnout Current : 24 mA)

Sensor Circuit (1 to 4)

Input Signal : 1.0 V max

NOTES

- *1 : Install per local installation codes.
ATEX approved cable entries or stopping plugs required.
- *2 : Sensor assembly must be ATEX approved for appropriate hazardous location.

Using the HART Communicator

The FRC can be programmed using a HART Communicator. If your communicator is not equipped with the Device Description for the FRC, you need to update it with the FRC DD. The FRC DD is available on the HART Foundation's Device Driver Library Release Jun 2002 and later.

This section contains the instructions for programming the FRC temperature transmitter using a HART Communicator that has been loaded with the FRC DD.

Fig 1 shows a tree view of the programming menus for the configuration process.

A. Online Menu

The Online Menu displays the current process value (PV), the actual output current (AO), the lower and upper range values (LRV, URV). Use the Device Setup to configure the FRC.

B. Configuring the Input Sensor

In the "Select Snsr" Menu, the type of input sensor (millivolt, TC, RTD, Ohm Resistance, Potentiometer) including the number of input wires can be configured.

C. Configuring the Input Properties

In the "Basic Setup" Menu, you can configure the Input Sensor Type, the sensor's upper and lower range values, the units and damping time. Damping smooths the input fluctuations and output the averaged values. The damping time can be set between 0 and 30 seconds.

In the "Signal Condition" Menu, you can configure the sensor's upper and lower range values, the units, and the damping time.

D. Configuring the Analog Output Properties

In the "Analog Output" Menu, you can perform the output D/A trimming, output loop test and set the burnout (Upscale, Downscale and None).

E. Configuring the HART Output

In the "HART Output" menu, you can configure a polling address between 0 and 15, turn burst mode ON/OFF, and change the burst option.

F. Configuring the Device Information

In the "Device Information" Menu, you can display the current device information and configure a tag, descriptor, date, a message and final assembly numbers for the transmitter.

G. Calibrating the Input Sensor

In the "Calibration" Menu, you can perform the zero and span calibrations for a non-calibrated sensor. "Snsr Zero Cal." adjusts the offset value at the zero point. "Snsr Span Cal." adjusts the gain value against the zero point. The Zero and Span calibration can be applied to any particular point within the measurable range. Conduct the calibration in order of Zero and Span.

In the "Reset Cal." menu, you can reset the transmitter to the factory settings. Once the reset calibration is complete, the input sensor calibrated values are erased. When the sensor type has been changed, the calibrated values applied to the previous sensor are erased, too.

H. Changing the Terminal Temperature Units and the CJ Compensation

In the "Term Temp Sensor" menu, you can change the units of the terminal temperature and turn the CJ (Cold Junction) Compensation ON/OFF. When you configured the input sensor to a TC, the CJ Compensation is always set to ON.

I. Changing Loop Current to a Fixed Value

In the "Loop Test" Menu, you can change the loop current to a fixed output. The FRC must be removed from automatic control in order to execute the loop test.

J. Performing the Diagnostics

In the "Test Device" Menu, you can perform the Master reset, the Self Test and display the additional device status.

K. Checking on the Transmitter's Settings

In the "Review" Menu, you can check on the transmitter's settings. In the menu, you cannot change the value of the transmitter's settings.

Figure 1. FRC HART Communicator Menu Tree

