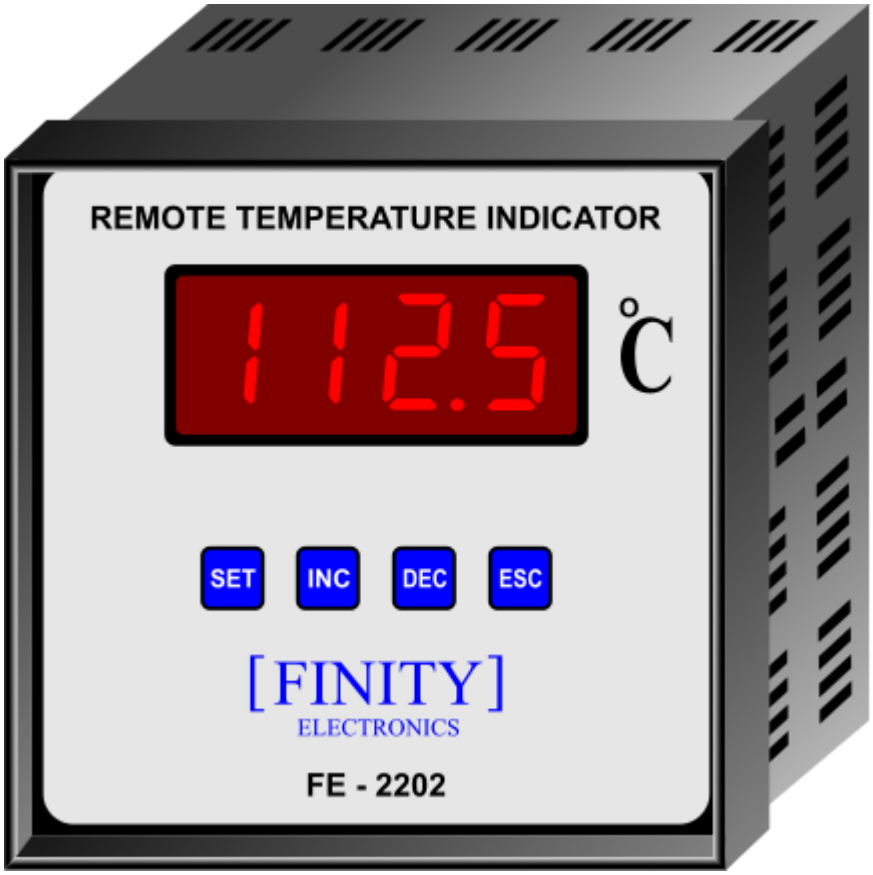


Remote Temperature Indicator

Model : FE-2202

User Manual

To know more about us and our products, visit finityelectronics.com.

Brief Description:

Every transformer consists of a primary and secondary winding through which voltage is either stepped up at generation side or is stepped down at distribution side. During its operation the transformer windings heat up while delivering the load. So, to cool the transformer and to get a subsequent protection from internal sparking within windings, oil is filled in transformer. The oil transfers heat from the windings to outside air with help of radiators and fans attached to transformers.

While in operation, the windings and oil are at different temperatures. If the temperatures are not maintained low, then it might result an electrical hazard. So to get the temperatures of windings and oil separate measuring pockets are built in transformer. In these pockets thermo sensors are placed (generally a PT 100 sensor for digital systems and a sensing bulb with Pt-100 embedded for analog or dial based systems). Through these sensors temperature is read out and subsequent action is took to cool the oil down.

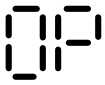
Function:

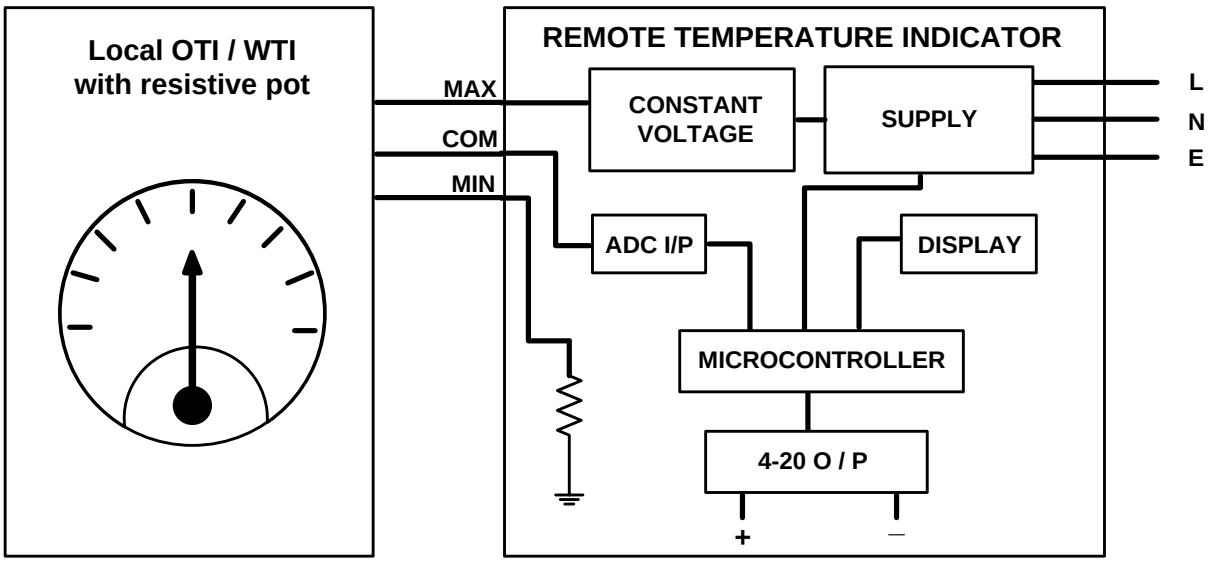
RTI's (Remote Temperature Indicator) purpose is to read, indicate and transmit the present temperature which transformer winding or oil at. From the Local WTI or OTI three output terminals are extended up to RTI named as Max, Com and Min. To read present temperature, the RTI measures the resistance between its Com and Min terminals. It also measures the total resistance across the full-scale range offered.

In other models direct PT-100 sensor is connected to C, B, A terminals of RTI. Here RTI uses whetstone bridge for measuring the resistance. Other model includes 4-20 mA input from local OTI-WTI and 4-20 mA input from LOTI/LWTI through CCU.

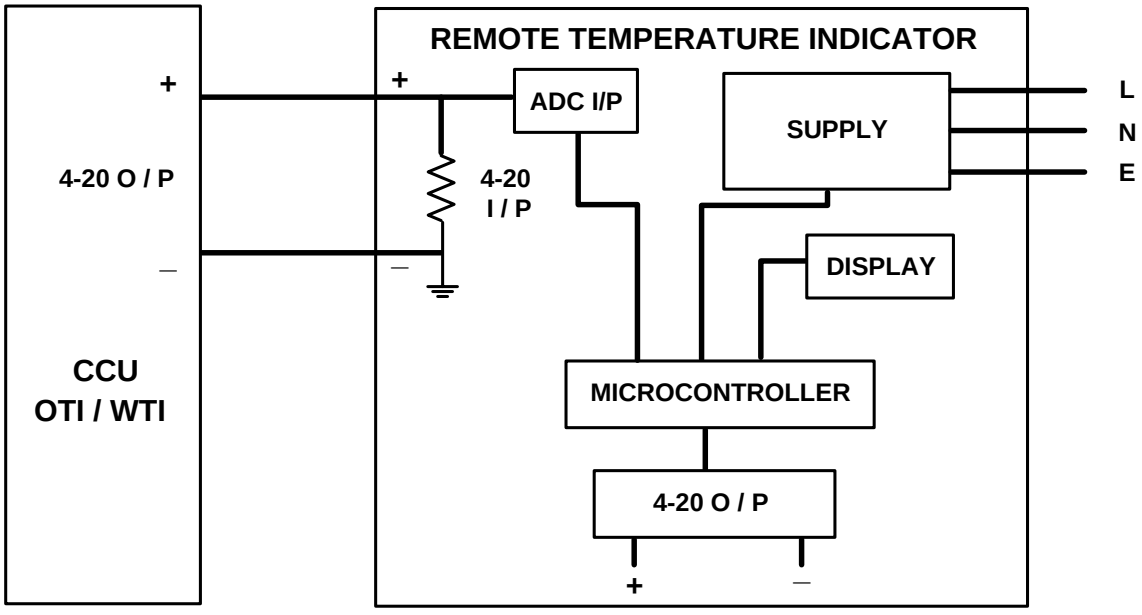
After measuring the resistance, RTI processes them as per user the type of input available and displays the present temperature on display. To transmit the temperature to other indicators at RTUs, RTI has 4-20 mA current loop outputs and RS-485 communication working on MODBUS Protocol for SCADA based systems.

The FE-2202 displays the present temperature after powered up. As the temperature changes in oil pocket, it is reflected on RTI.

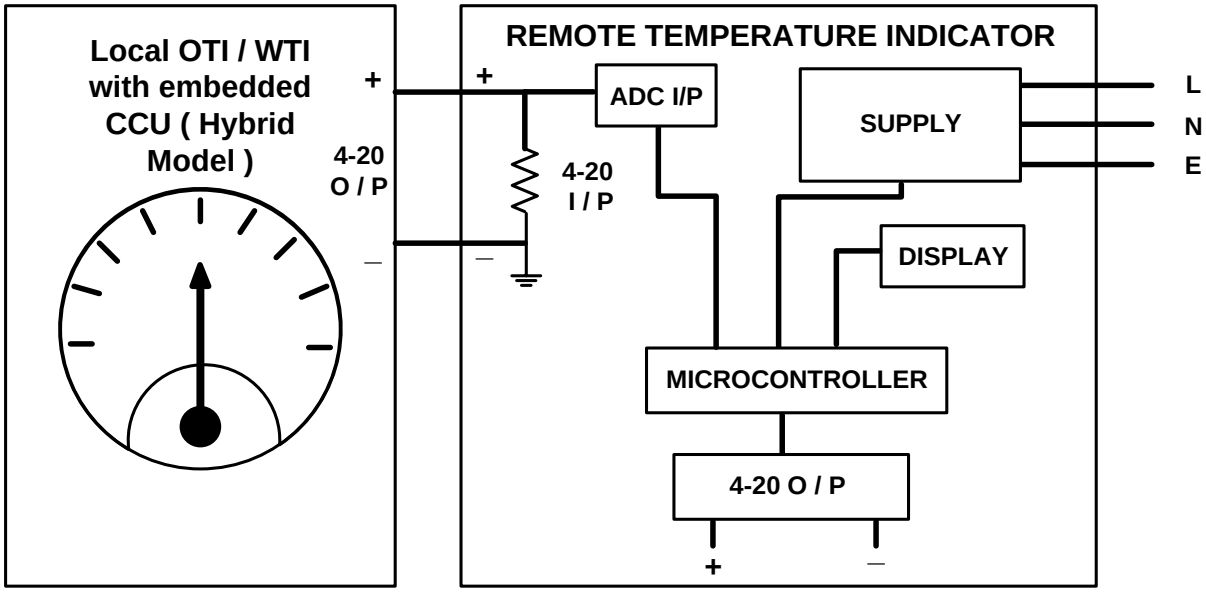
When the input terminals are open the display will indicate  at the display.



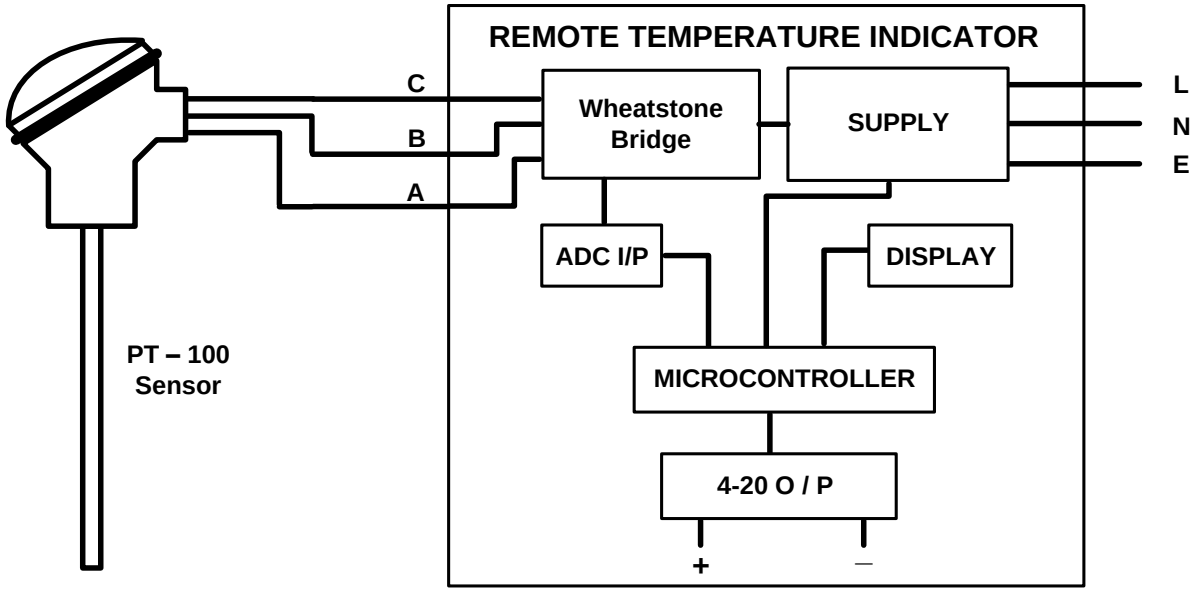
Block diagram of RTI with Resistive Potentiometer as Input



Block diagram of RTI with 4-20 mA output from CCU as Input



Block diagram of RTI with 4-20 mA output from CCU of LWTI/LOTI as Input and self-powered loop at 24V



Block diagram of RTI with PT-100 sensor directly as Input

Features:

- Accurate temperature sensing across wide range with 0.1°C resolution.
- In-built compatibility for different resistive potentiometers be it 0 to 440Ω or 2,8kΩ or as specified by user.
- Bright red 0.56-inch 4-character 7 segment LED display.
- User settable Temperature range 0 to 180.0°C, settable in control settings.
- Up to 4 opto-isolated 4-20 mA outputs. The outputs are fully programable for digital calibration of zero and span settings. The outputs are calibrated in the control settings.
- Reverse polarity protected outputs with ESD and EFT protection.
- Digital Calibration for the input to RTI. The calibration can be done in control settings. This calibration will result change in the temperature displayed.
- I/P protected from static discharge and EFT surge by TVS diode.
- Embedded with a powerful microcontroller for fast & enhanced processing.
- Easy and flawless control settings for setting parameters by user.

Technicalities:

- Input type : 1) Resistive Potentiometer I/P
  2) 4-20 mA current loop I/P (not powered)
  3) 4-20 mA current loop I/P self-powered at 24V
  4) Pt-100 Sensor I/P
- Resistive Potentiometer : Compatible for 440Ω to 2.8kΩ, or user specified
- Display : 4-character, 0.56-inch, 7 Segment LED Display
- Display Resolution : 0.1°C
- Display Temperature Range : 0 to 180.0°C
- Supply : Universal Supply, 85-265V AC/DC
- Power consumption : 5W
- Number of Outputs : 4 / 2 / None, 4-20mA O/P, optically isolated from measurement system, 700 ohms max burden.
- RS 485 Output : Available as per user need.
- Panel Cut-Out : 90 X 90 mm
- Enclosure Dimensions : 96 X 96 X 85 mm
- Working Temperature : 0 - 60° C
- Weight : 300 grams approx.

Control Settings:

To enter the control settings first press **SET** button. After that you enter the parameter selection menu. The menu consists of three fields as follows:

- Input Parameter Menu : 
- Output Parameter Menu : 
- Tap Calibration Menu : 

To change between different menus, press **INC** or **DEC** buttons to move forward or backward. To enter a menu press **SET**. To escape a menu press **ESC**. Press **ESC** again to escape control settings.

Note: In case of inactivity for more than 10 seconds the RTI will escape control settings automatically with saved parameters.

Input Parameter Menu:

In this menu the parameters and their values will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape input parameter menu.

- **<u>Highest Temperature Limit Selection</u> :** 

  This parameter indicates the highest limit of temperature range a user can set. The output and display temperature will be automatically calibrated for the selected range by RTI. User can set this parameter between lowest temperature limit to 180.0°C.

- **<u>Lowest Temperature Limit Selection</u> :** 

  This parameter indicates the lowest limit of temperature range a user can set. The output and display temperature will be automatically calibrated for the selected range by RTI. User can set this parameter from 0.0°C to highest temperature limit.

- **Device ID Selection :** 

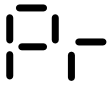
  This parameter is only available in RS485 enabled model. Here user can set the slave ID of the RTI used in communication from 01 to 99.

- **Baud Rate Selection :** 

  This parameter is only available in RS485 enabled model. Here user can set the baud rate for MODBUS communication. The respective code for different baud rates is shown below which the user can select as per his need.

Code	Baud Rate
01	2400
02	4800
03	9600
04	19200
05	38400
06	57600
07	115200

Note : After changing the Baud Rate it is mandatory to restart the RTI. Only then communication will proceed at selected baud rate.

- **Parity Bit Selection** : 

  This parameter is only available in RS485 enabled model. Here user can set the parity bit for MODBUS communication. The respective code for different parity bits is shown below which the user can select as per his need.

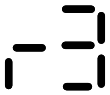
Code	Parity Bit
1	Even
2	Odd
3	No bit

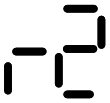
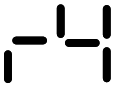
Output Parameter Menu:

This menu is only available for models having 2 or 4 4-20 mA outputs. In this menu the parameters and their values will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape output parameter menu.

Note : To set the parameters here, user is instructed to use multimeter in mA mode and connect it across the + and – terminals of the particular output he wishes to calibrate. For good calibration it is mandatory to set the **zero before span** for an output.

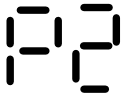
- **Zero Setting :**
  Entering this setting, the particular selected output will be at **4 mA** ideally. But if it is not then user can calibrate it by himself. When user will increase or decrease the value associated to parameter, then corresponding change in output current will be seen. The parameter value can be changed from 0 to 40. Calibrating the current at **4 mA** will set the zero correctly.

  Zero for Output 1 : 
  Zero for Output 3 : 

  Zero for Output 2 : 
  Zero for Output 4 : 

- **Span Setting :**
  Entering this setting, the particular selected output will be at **20 mA** ideally. But if it is not then user can calibrate it by himself. When user will increase or decrease the value associated to parameter, then corresponding change in output current will be seen. The parameter value can be changed from 0 to 40. Calibrating the current at **20 mA** will set the span correctly.

  Span for Output 1 : 
  Span for Output 3 : 

  Span for Output 2 : 
  Span for Output 4 : 

If the zero and span are set for exact 4mA and 20mA current output, then the 4-20mA output will be precise as per displayed temperature value.

Input Calibration Menu:

Generally, the RTI is well temperature calibrated and is rarely needed to calibrate. But sometimes due to in-accurate pot resistances or due interference the present temperature may vary by ± 2% of the actual value. To solve the above issue this menu is provided.

In this menu the temperature and its corresponding calibration value will blink synchronously. To increase or decrease the respective value of a parameter press **INC** or **DEC.** Press **SET** to save and move on to next parameter. Press **ESC** to escape tap calibration menu.

Input Calibration : 

In this user can alter the displayed temperature by increasing or decreasing the corresponding value for the parameter using **INC** and **DEC** buttons. User should change the values until the actual value to be displayed is reached. That value will be selected as the ideal value of calibration for present temperature.

RS-485 (Modbus RTU) Output :

RTI FE-2201 supports RS-485 Modbus RTU **2-wire** output. The RTI contains communication line terminated **120 Ω** load and TVS protection diodes for ESD and EFT surges. The communication line requires opposite end to be terminated at 120 Ω too. For connection use twisted pair shielded cable daisy chained together. The permissible slave address range for RTI is from **1-99**. Broadcast Mode (0 Address) is not allowed.

Here the messages start with a silent interval of at least **3.5-character** times. The allowable character transmitted for all fields are **0-9**, **A-F**. Networked devices should monitor the bus continuously. When the address is received in the bus, RTI begins matching its slave address. To mark the end of a message, the master should observe a silent interval of **3.5-character** times.

If a silent interval of more than **1.5-character** times occurs within a frame then RTI will flush the earlier frame and will start receiving new frame with assuming coming byte as an address byte. The received bytes is then **parity** checked as selected by user and then the whole frame is **CRC** checked for any errors and then request is processed.

To enable data transmission at **16 bits** hex, the temperature transmitted is not in floating-point value. Rather actual displayed temperature is **multiplied** by **10** and then transmitted. User is advised to **divide** the received value by **10** to get the RTI displayed result in floating point. Similarly, while pre-setting the temperature limits user should **multiply** the desired floating-point temperature by **10** and then enter the value.

Byte Format :

1 start bit	8 data bits (LSB 1st)	1 bit for odd or even parity.1st stop bit if no parity used	1 stop bit if parity used. 2nd stop bit if no parity used

Data Format : 2 bytes (16 bits) per parameter, Hexadecimal, MSB first

Function Codes supported by RTI :

03	Read Holding Registers	Read content of read/write location 4X
04	Read Input Registers	Read content of read only location 3X
06	Pre-set Single Register	Set single register of read/write location 4X
16(10 Hex)	Pre-set Multiple Registers	Set Multiple registers of read/write location 4X

Exception Codes :

01	Illicit Function	Requested function not supported by RTI
02	Illicit Data Address	Attempt to read/write at an illicit data address
03	Illicit Data Value	Attempt to set data register with an out of range value

Function code 04 (Read Input Register 3X) Example:

Query : Get Display Temperature

01(Hex)	04(Hex)	00(Hex)	00(Hex)	00(Hex)	01(Hex)	31(Hex)	CA(Hex)
Device Address	Function Code	Start Address(H)	Start Address(L)	No. of Registers requested (H)	No. of Registers requested (L)	CRC (L)	CRC (H)

Response : Temperature : 1125 (user should divide by 10 to get 112.5°C)

01(Hex)	04(Hex)	02(Hex)	04(Hex)	65(Hex)	7B(Hex)	DB(Hex)
Device Address	Function Code	Byte Count	Data Reg. 1 (H)	Data Reg. 1 (L)	CRC (L)	CRC (H)

Note : The temperature returned in query is resulting of displayed temperature **multiplied** by **10**. This is done to transfer the data in 16 bits hex format. The user should **divide** the received value by **10** at his end to get the RTI displayed temperature.

Function code 03 (Read Holding Register 4X) Example:

Query : Get Maximum Temperature Limit, Lowest Temperature Limit

01(Hex)	03(Hex)	00(Hex)	00(Hex)	00(Hex)	02(Hex)	C4(Hex)	0B(Hex)
Device Address	Function Code	Start Address(H)	Start Address(L)	No. of Registers requested (H)	No. of Registers requested (L)	CRC (L)	CRC (H)

Response : Get Maximum Temperature Limit-1500, Lowest Temperature Limit-0

01(Hex)	03(Hex)	04(Hex)	05(Hex)	DC(Hex)	00(Hex)	00(Hex)	3B(Hex)	05(Hex)
Device Address	Function Code	Byte Count	Data Reg. 1 (H)	Data Reg. 1 (L)	Data Reg. 2 (H)	Data Reg. 2 (L)	CRC (L)	CRC (H)

Note : The temperature limit returned in query is resulting of displayed temperature **multiplied** by **10**. This is done to transfer the data in 16 bits hex format. The user should **divide** the received value by **10** at his end to get RTI range limit temperature.

Function code 06 (Pre-Set Holding Register 4X) Example:

Query : Pre-set Maximum Temperature Limit to 1600 **(160.0°C X 10)**.

01(Hex)	06(Hex)	00(Hex)	00(Hex)	06(Hex)	40(Hex)	8B(Hex)	9A(Hex)
Device Address	Function Code	Register Address(H)	Register Address(L)	Pre-Set Data (H)	Pre-Set Data (L)	CRC (L)	CRC (H)

Response : Response is echoed just same as query shown above.

Function code 10(Hex) (Multiple-Set Holding Register 4X) Example:

Query: Pre-Set Maximum Temperature Limit to 1500 (**150.0°C X 10**) and Lowest Temperature Limit to 500 (**50.0°C X 10**).

Device Address : 01
Function : 10
Start Address High : 00
Start Address Low : 00
Number of Registers High : 00
Number of Registers Low : 02
Byte Count : 04
Data Register 1 High : 05
Data Register 1 Low : DC
Data Register 2 High : 01
Data Register 2 Low : F4
CRC Low : 32
CRC High : 8E

Response : Pre-Set Step Resistance to code 2, Pre-set Time Delay to 6 seconds.

01(Hex)	10(Hex)	00(Hex)	00(Hex)	00(Hex)	02(Hex)	41(Hex)	C8(Hex)
Device Address	Function Code	Register Address(H)	Register Address(L)	No. of Registers Pre-Set (H)	No. of Registers Pre-Set (L)	CRC (L)	CRC (H)

3X Register Addresses :

Address	Parameter	Start Address High Byte	Start Address Low Byte
30001	Present Temperature	00	00

Note: When RTI input terminals are open then parameter will show **2000** as value.

4X Register Addresses :

Important : After writing registers it is mandatory to set register 4000C to 1, to save values in EEPROM of the microcontroller, else values will be flushed if restarted. Also, EEPROM has 100000 write/erase cycles. So, load EEPROM wisely.

4 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max. Temp. Limit (HT)	LT-1800	00	00
2	40002	Lowest Temp. Limit (LT)	0-HT	00	01
3	40003	O/P 1 zero calibration	0-40	00	03
4	40004	O/P 1 span calibration	0-40	00	04
5	40005	O/P 2 zero calibration	0-40	00	05
6	40006	O/P 2 span calibration	0-40	00	06
7	40007	O/P 3 zero calibration	0-40	00	07
8	40008	O/P 3 span calibration	0-40	00	08
9	40009	O/P 4 zero calibration	0-40	00	09
10	4000A	O/P 4 span calibration	0-40	00	0A
11	4000B	Disp. Temp. Calibration	0-60	00	0B
12	4000C	EEPROM Load	0 or 1	00	0C

2 (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max. Temp. Limit (HT)	LT-1800	00	00
2	40002	Lowest Temp. Limit (LT)	0-HT	00	01
3	40003	O/P 1 zero calibration	0-40	00	03
4	40004	O/P 1 span calibration	0-40	00	04
5	40005	O/P 2 zero calibration	0-40	00	05
6	40006	O/P 2 span calibration	0-40	00	06
7	4000B	Disp. Temp. Calibration	0-60	00	0B
8	4000C	EEPROM Load	0 or 1	00	0C

No (4-20 mA) Output 4X Addresses

Sr. No.	Address	Parameter	Range	Start Address (H)	Start Address (L)
1	40001	Max. Temp. Limit (HT)	LT-1800	00	00
2	40002	Lowest Temp. Limit (LT)	0-HT	00	01
3	4000B	Disp. Temp. Calibration	0-60	00	0B
4	4000C	EEPROM Load	0 or 1	00	0C

Connection Diagram :

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Max	Com	Min	O/p 1 (+)	O/p 1 (-)	O/p 2 (+)	O/p 2 (-)	A	B

10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
L	N	E	O/p 3 (+)	O/p 3 (-)	O/p 4 (+)	O/p 4 (-)		Gnd

Connection Diagram for Resistive Potentiometer Input to RTI

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	I/P (+)	I/P (-)	O/p 1 (+)	O/p 1 (-)	O/p 2 (+)	O/p 2 (-)	A	B

10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
L	N	E	O/p 3 (+)	O/p 3 (-)	O/p 4 (+)	O/p 4 (-)		Gnd

Connection Diagram for 4-20 mA Current Loop Input (both un-powered and self-powered current loop at 24V options) to RTI

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
C	B	A	O/p 1 (+)	O/p 1 (-)	O/p 2 (+)	O/p 2 (-)	A	B

10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
L	N	E	O/p 3 (+)	O/p 3 (-)	O/p 4 (+)	O/p 4 (-)		Gnd

Connection Diagram for PT-100 Input to RTI

Warranty :

On this purchase of RTI FE-2202 from FINITY ELECTRONICS you get a warranty against defects in materials or technical abnormalities found in the product for a period of 12 months from the date of dispatch to the consumer. If in warranty period FINITY ELECTRONICS will repair or replace the product, provided that product was used with care and in accordance with user manuals provided.

This warranty will not be applied for defects from transit resulting from mishandling or misuse by carrier agencies. Any malfunctioning by modifications or repairs done in other vicinity will not be covered in this warranty. Also damages due to in-appropriate site conditions, electrical parameters, or any abnormal accident from user end will not be covered in this warranty. Warranty period will not extend if product is replaced or repaired while in warranty.

For warranty repair or replacement, product must be returned to FINITY ELECTRONICS with good packing and freight paid with product purchase documents, company note for replacement, product failure details and fault conditions. Return of product can be arranged on payment of packing and delivery charges and any other miscellaneous expenses incurred. In case the product fails outside the warranty period, the user can send the product for repair and the expenses must be fully paid.

As we develop and improve our products consistently, we have the right to change any product parameters or details in this user manual without any prior notice. User should communicate us before making any purchase after reading this manual.