RTD Module

M/N 61C544A

Instruction Manual J2-3003-3

RELIANCE ELECTRIC

The information in this user's manual is subject to change without notice.

DANGER

THIS UNIT AND ITS ASSOCIATED EQUIPMENT MUST BE INSTALLED, ADJUSTED, AND MAINTAINED BY QUALIFIED PERSONNEL WHO ARE FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE SYSTEM AND THE POTENTIAL HAZARDS INVOLVED. READ AND UNDERSTAND THIS MANUAL AND OTHER MANUALS APPLICABLE TO THE EQUIPMENT IN YOUR INSTALLATION. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

INSERTING OR REMOVING THIS MODULE OR ITS CONNECTING CABLES MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE OR ITS CONNECTING CABLES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

CAUTION

THIS MODULE CONTAINS STATIC-SENSITIVE COMPONENTS. CARELESS HANDLING CAN CAUSE SEVERE DAMAGE. DO NOT TOUCH THE CONNECTORS ON THE BACK OF THE MODULE. WHEN NOT IN USE, THE MODULE SHOULD BE STORED IN AN ANTI-STATIC BAG. THE PLASTIC COVER SHOULD NOT BE REMOVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

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1.0 INTRODUCTION

The products described in this manual are manufactured or distributed by Reliance Electric Industrial Company.

The Multibus®-compatible RTD input module (M/N 61C544A) allows you to connect 16 RTD input signals to AutoMate®, AutoMax®, and DCS 5000 systems.

Resistance temperature detectors (RTDs) are accurate temperature measurement devices which monitor temperature changes. The RTD module takes the RTD signals and converts them into equivalent temperature (Fahrenheit or Celsius) values. The module can be used in both local and remote racks. An external power supply is not required.

The module provides 16 channels of RTD data at 0.1ºC or 0.1ºF resolution. RTD calibration is automatic. Parameters such as alarm limits and number of samples are user-configurable. Default configuration values are provided at power-up.

Designed to provide the most resolution and accuracy when used with 4-wire RTDs, the module is also compatible with 2- and 3-wire RTDs.

This manual describes the functions and specifications of the RTD module M/N 61C544A and earlier. The information in this manual is applicable to all versions of the module unless noted otherwise. This manual also includes installation and troubleshooting procedures, as well as configuration and programming information.

1.1 Related Publications

Related publications that may be of interest:

- J-2611 DCS 5000 PRODUCT SUMMARY
- J-3031 AutoMate 30 HARDWARE INSTRUCTION MANUAL
- J-3063 AutoMate PROGRAMMING EXECUTIVE INSTRUCTION MANUAL
- J-3141 AutoMate 40 HARDWARE INSTRUCTION MANUAL
- J-3150 AutoMate 30/40 SOFTWARE REFERENCE MANUAL
- J-3606 AutoMax REMOTE I/O INSTRUCTION MANUAL
- J-3649 AutoMax CONFIGURATION TASK INSTRUCTION MANUAL
- J-3650 AutoMax PROCESSOR MODULE INSTRUCTION MANUAL
- J-3675 AutoMax ENHANCED BASIC LANGUAGE INSTRUCTION MANUAL
- J-3676 AutoMax CONTROL BLOCK LANGUAGE INSTRUCTION MANUAL
- J-3677 AutoMax LADDER LOGIC LANGUAGE INSTRUCTION MANUAL
- J-3684 AutoMax PROGRAMMING EXECUTIVE V2.0 INSTRUCTION MANUAL

- J-3750 AutoMax PROGRAMMING EXECUTIVE V3.0 INSTRUCTION MANUAL
- IEEE 518 GUIDE FOR THE INSTALLATION OF ELECTRICAL EQUIPMENT TO MINIMIZE ELECTRICAL NOISE INPUTS TO CONTROLLERS FROM EXTERNAL SOURCES

1.2 Related Hardware and Software

The RTD module, M/N 61C544A, contains the following:

1. One RTD module

The following items must be purchased separately:

- Panel mount terminal board and cable assembly, M/N 61C545. One is required for each set of eight channels (2 per module).

  or

- DIN rail mount terminal board and cable assembly, M/N 61C546. One is required for each set of eight channels (2 per module).

The RTD module can be configured with the hardware (purchased separately) listed in figure 1.1.

Host	Model Number
AutoMate 30, 30E	M/N 45C301, 45C305, 45C307
AutoMate 40X, 40, 40E	M/N 45C409, 45C410, 45C411
DCS 5000	M/N 57C407
AutoMax	M/N 57C430A, 57C431, 57C435
AutoMate Remote I/O Processor	M/N 45C201B
DCS 5000/AutoMax Remote I/O Communication Module	M/N 57C416

Figure 1.1 - RTD Module Hardware Configuration

2.0 MECHANICAL/ELECTRICAL DESCRIPTION

The following is a description of the faceplate LED, field termination connectors, and electrical characteristics of the field connections.

2.1 Mechanical Description

The input module is a Multibus-compatible printed circuit board assembly that plugs into the backplane of the DCS 5000/AutoMax or AutoMate rack.

It consists of a printed circuit board, a faceplate, and a protective enclosure. The faceplate contains tabs at the top and bottom to simplify removing the module from the rack. On the back of the module are two edge connectors that attach to the system backplane. Module dimensions are given in Appendix A.

The faceplate of the module contains two 37-pin female D-shell connector sockets labeled "Ch.0-7" and "Ch.8-15". See figure 2.1.

RTD input signals are brought into the module via two 5-foot multi-conductor cable assemblies. The 37-pin male D-shell connector end of the cable attaches to the faceplate connector, while the 37-pin female D-shell connector end of the cable attaches to the male connector on the terminal board assembly (M/N 61C545 or M/N 61C546). Screw-type connectors on the terminal board assembly provide for easy field wiring.

The module faceplate also contains a green LED labeled "OK". This LED is on when the module has passed its power-up diagnostics and is operating properly.

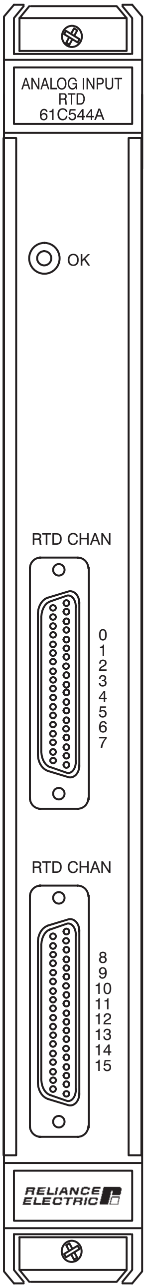

Figure 2.1 - Module Faceplate

2.2 Electrical Description

The module provides sixteen channels of precise RTD temperature information to AutoMax and AutoMate systems. Each channel consists of a constant current source and a pair of high impedance measurement inputs. See figure 2.2. The current sources are powered by an on-board supply that is isolated from the system common. No external user-supplied power supplies are required. The sixteen RTD inputs share the same common. This analog common has 2500 VAC of isolation from the system common.

The sixteen pairs of measurement inputs are multiplexed to an instrumentation amplifier which drives a fourteen-bit A/D converter. This configuration measures the voltage drop across the selected RTD element.

The data register (registers 0 to 15) of a configured channel is updated when the processor converts and averages channel input samples over 16.6 ms for a 60 Hz line or 20 ms for a 50 Hz line. In this manner, line frequency noise at the input of the A/D converter is integrated out of the result that is provided to the system. This over-sampling of the analog inputs also simplifies the filter requirements. A single pole analog filter is located on each measurement input line.

The module also contains positive and zero references for A/D converter calibration. These references are checked at the end of each scan of the configured channels and the calibration coefficients are updated accordingly. All non-zero references are derived from the A/D converter's buried-zener reference. The reference for the constant current sources is likewise derived from the A/D converter. This provides a ratiometric style of conversion. No potentiometer adjustments are required to maintain the specified accuracy.

The on-board processor averages the raw A/D converter data, linearizes the average using the calibration coefficients, and then performs a table look-up based upon the specified alpha value of the RTD. This value will then either be written to the appropriate channel data register (registers 0-15) or will become part of the running average specified in register 26. The running average value is stored in 0.1°C or 0.1°F units in the appropriate channel data register.

A broken wire from the RTD is indicated through an out of range status bit in register 20. The module also provides high and low limit registers which can be set by the user. Status registers then indicate when the desired low/high values have been exceeded.

All read operations on the module's memory by the on-board processor include a parity test. Failure of the parity test results in a module shutdown. Processor modules can read all locations within the slot address but can only write to registers 23 through 31.

The module will execute a full set of power-up diagnostics which must execute successfully before the module can go into the run mode.

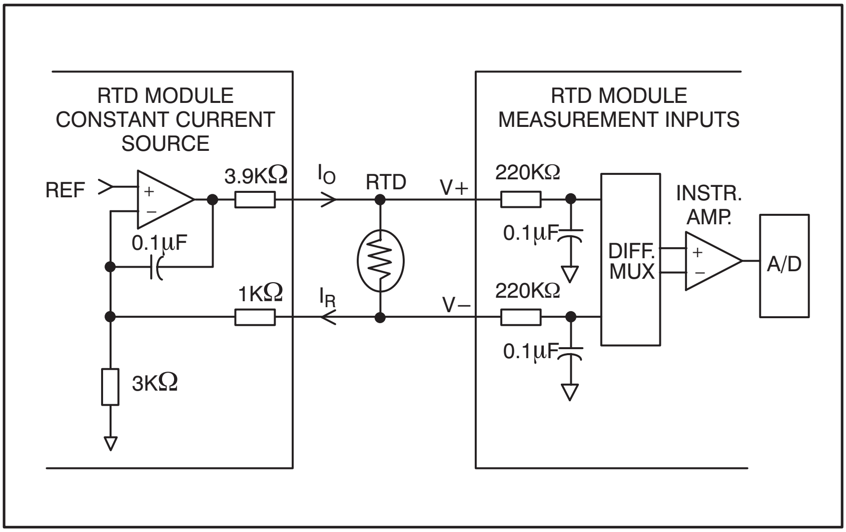

Figure 2.2 – Typical RTD Channel

3.0 INSTALLATION

This section describes how to install and remove the module and its cable assemblies.

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DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH ALL APPLICABLE LOCAL, NATIONAL, AND INTERNATIONAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

3.1 Wiring

To reduce the possibility of electrical noise interfering with the proper operation of the control system, exercise care when installing the wiring from the system to the external devices. For more detailed recommendations, refer to IEEE 518.

3.2 Initial Installation

Use the following procedure to install the module:

Step 1. Turn off power to the system. All power to the rack as well as all power to the wiring leading to the module should be off.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Step 2. Mount the terminal board assemblies (M/N 61C545) on a flat panel or a DIN rail (M/N 61C546).

The terminal boards should be mounted to allow easy access to the screw terminals. Be sure the terminal board assemblies are close enough to the rack so that the cables (M/N 61C545 or M/N 61C546) will reach between them and the RTD module in the rack. The cables are five feet long. See figure 3.1.

Step 3. Fasten the wires from the RTDs to the screw-type connectors on the terminal board assemblies. Use shielded dual twisted-pair cable, such as Belden 9502 or equivalent. Typical RTD wiring connections are shown in figure 3.2. Refer to Appendix C for a listing of the terminal board connections. See Appendix G for a listing of module faceplate connections.

Be sure that all of the RTD field wire connections are tight. Note that all 4 wires must be connected to the RTD.

The RTD module is designed to provide optimum performance when used with 4-wire RTDs. When used with 2- or 3-wire RTDs as shown in figure 3.2, the module will still provide accuracy that is superior to that of bridge-measurement techniques. See Appendix E for additional information on 2- and 3-wire RTDs.

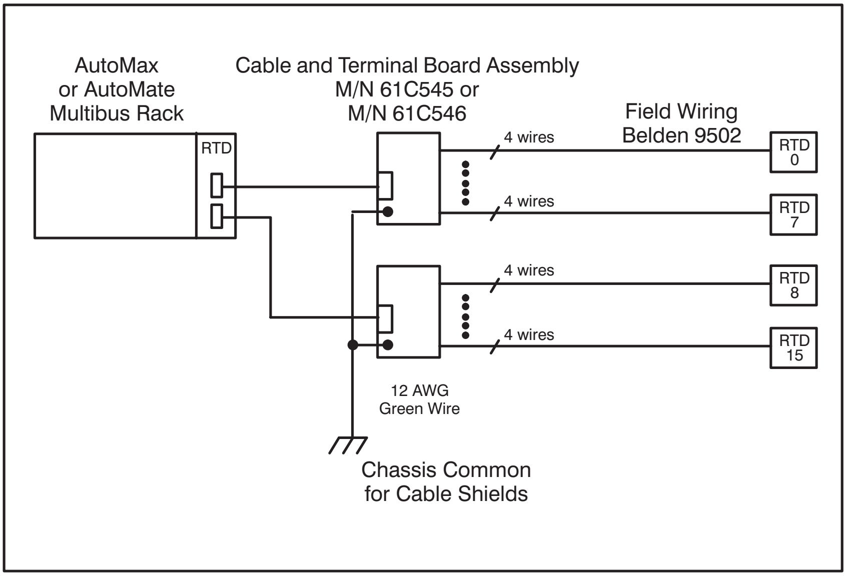

Figure 3.1 - RTD Module Connections

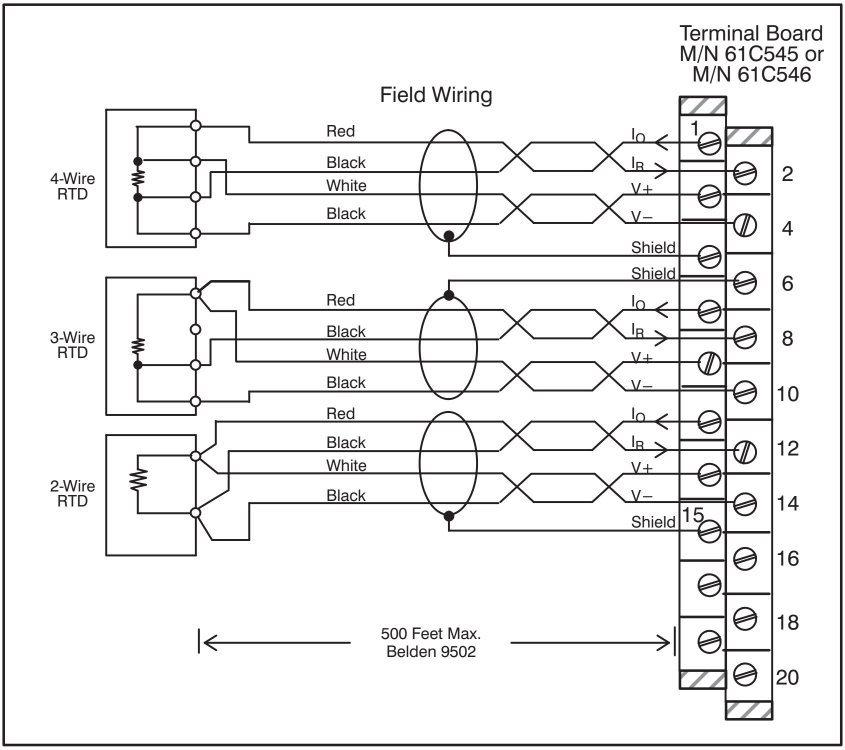

Figure 3.2 - RTD Wiring Connections

Step 4. Take the RTD module out of its shipping container. Take it out of its anti-static bag. Be careful not to touch the connectors on the back of the module.

Step 5. Insert the module into the desired slot in the rack. Use a screwdriver to secure the module into the slot.

Step 6. Attach the cables between the terminal board assemblies and the module. Be sure that the D-shell connectors are oriented properly. Use a screwdriver to secure the D-shell connectors to the terminal board assemblies and the module.

Step 7. Turn on power to the system.

Step 8. Connect the programming terminal to the system and run the ReSource Programming Executive Software.

Stop all programs that may be running.

Configure the RTD channels you are using by following the procedure in section 4.2. You cannot monitor the registers on the module until you have configured the channels. When you are done configuring, read the channels' default values to verify that the installation is correct. Refer to sections 4.1.1 to 4.1.15 for the default values.

3.3 Module Replacement

Use the following procedure to replace a module:

Step 1. Turn off power to the rack and all external devices.

DANGER

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Step 2. Use a screwdriver to loosen the screws holding the D-shell connectors to the module. Remove the D-shell connectors.

Step 3. Loosen the screws that hold the module in the rack. Remove the module from the rack.

Step 4. Place the module in the anti-static bag that it came in. Do not touch the connectors on the back of the module. Place the module in the cardboard shipping container.

Step 5. Take the new module out of the anti-static bag. Do not touch the connectors on the back of the module.

Step 6. Insert the module into the proper slot in the rack. Use a screwdriver to secure the module to the rack.

Step 7. Attach the D-shell connectors to the module. Use a screwdriver to secure the connectors to the module.

Step 8. Turn on power to the rack and external devices.

Step 9. Connect the programming terminal to the system and run the ReSource Software.

Stop all programs that may be running.

Configure the RTD channels you are using by following the procedure in section 4.2. You cannot monitor the registers on the module until you have configured the channels. When you are done configuring, read the channels' default values to verify that the installation is correct. Refer to sections 4.1.1 to 4.1.15 for the default values.

4.0 PROGRAMMING

This section describes how the data is organized in the module and provides examples of how the module is accessed by application programs.

For DCS 5000 and AutoMax version 2.1 and earlier, you must assign variable names to registers by writing a configuration task. For AutoMax version 3.0 and later, you define registers using the ReSource™ AutoMax Programming Executive. After these variables are defined, you can generate the configuration file automatically, which eliminates the requirement to write a configuration task for the rack. If you are using AutoMax version 2.1 or earlier, refer to Appendix F for a sample RTD configuration task. If you are using AutoMax version 3.0 or later, refer to the AutoMax Programming Executive Instruction Manual (J-3750) for more information. Note that AutoMate systems require no special configuration procedure to use the RTD module.

For additional programming information refer to the AutoMate 30/40 Software Instruction Manual (J-3150), the DCS 5000/AutoMax Configuration Task Instruction Manual (J-3649), or the AutoMax Programming Executive Manual (J-3750).

4.1 Register Organization

The RTD module uses 32 registers to store and organize its data. The same registers are used whether the module is in a local rack or a remote rack. See Table 4.1 for a list of the registers. Table 4.2 contains a list of the registers' default values. When the module is used in a DCS 5000/AutoMax system and a Stop All command is received, the module will be placed in a power up state which will reset all 32 registers to their default values.

Table 4.1 - Register Organization

Register #	Register Name	Accessibility
0	Channel 0 A/D Data	Read Only
1	Channel 1 A/D Data	Read Only
2	Channel 2 A/D Data	Read Only
3	Channel 3 A/D Data	Read Only
4	Channel 4 A/D Data	Read Only
5	Channel 5 A/D Data	Read Only
6	Channel 6 A/D Data	Read Only
7	Channel 7 A/D Data	Read Only
8	Channel 8 A/D Data	Read Only
9	Channel 9 A/D Data	Read Only
10	Channel 10 A/D Data	Read Only
11	Channel 11 A/D Data	Read Only
12	Channel 12 A/D Data	Read Only
13	Channel 13 A/D Data	Read Only
14	Channel 14 A/D Data	Read Only
15	Channel 15 A/D Data	Read Only
16	High High Alarm Status	Read Only
17	High Alarm Status	Read Only
18	Low Alarm Status	Read Only
19	Low Low Alarm Status	Read Only
20	Out of Range Status	Read Only
21	Channel Configuration Status	Read Only
22	Configuration Status	Read Only
23	Channel Number	Read/Write
24	Reserved	
25	Reserved	
26	Number of Samples	Read/Write
27	High High Alarm	Read/Write
28	High Alarm	Read/Write
29	Low Alarm	Read/Write
30	Low Low Alarm	Read/Write
31	Configure Command	Read/Write

Table 4.2 - Register Default Values

Register Number and Name		Default Value
0	Channel 0 A/D Data	0
1	Channel 1 A/D Data	0
2	Channel 2 A/D Data	0
3	Channel 3 A/D Data	0
4	Channel 4 A/D Data	0
5	Channel 5 A/D Data	0
6	Channel 6 A/D Data	0
7	Channel 7 A/D Data	0
8	Channel 8 A/D Data	0
9	Channel 9 A/D Data	0
10	Channel 10 A/D Data	0
11	Channel 11 A/D Data	0
12	Channel 12 A/D Data	0
13	Channel 13 A/D Data	0
14	Channel 14 A/D Data	0
15	Channel 15 A/D Data	0
16	High High Alarm Status	0
17	High Alarm Status	0
18	Low Alarm Status	0
19	Low Low Alarm Status	0
20	Out of Range Status	0
21	Channel Configuration Status	0
22	Configuration Status	0
23	Channel Number	0
24	Reserved	0
25	Reserved	0
26	Number of Samples	1
27	High High Alarm	4000 = 400°C
28	High Alarm	1000 = 100°C
29	Low Alarm	−1000 = −100°C
30	Low Low Alarm	−1500 = −150°C
31	Configure Command	
	Bits 1 and 0	Retain old input value
	Bit 2	Celsius temperature units
	Bits 3	European platinum RTD
	Bits 5 to 4	Reserved
	Bit 6	Enable line frequency averaging
	Bits 11 to 7	Reserved
	Bits 15 to 12	READY command

4.1.1 A/D Data Registers (Registers 0 to 15)

Registers 0 to 15 hold the latest numeric data from RTD analog channels 0 to 15. This data has been filtered (50 or 60 Hz filters) and averaged together. See figure 4.1. The data is in a 15-bit plus a sign-bit integer format. The data is displayed in units of 0.1 degrees (either Celsius or Fahrenheit). If a channel is not configured, its data is held at zero.

Register 0 = A/D Data from Channel 0
Register 1 = A/D Data from Channel 1
Register 2 = A/D Data from Channel 2
•
•
•
Register 14 = A/D Data from Channel 14
Register 15 = A/D Data from Channel 15

Figure 4.1 - A/D Data Register Assignments

4.1.2 High High Alarm Status Register (Register 16)

Register 16 indicates the current status of each configured channel's High High alarm. See figure 4.2. A bit is set in this register whenever a channel's input value exceeds the configured High High alarm limit. The bit is reset when the input value returns to a level below the configured limit.

Register 16

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0
Bit 1 = Channel 1
Bit 2 = Channel 2
Bit 3 = Channel 3
Bit 4 = Channel 4
Bit 5 = Channel 5
Bit 6 = Channel 6
Bit 7 = Channel 7
Bit 8 = Channel 8
Bit 9 = Channel 9
Bit 10 = Channel 10
Bit 11 = Channel 11
Bit 12 = Channel 12
Bit 13 = Channel 13
Bit 14 = Channel 14
Bit 15 = Channel 15

Figure 4.2 - High High Alarm Status Register

4.1.3 High Alarm Status Register (Register 17)

Register 17 indicates the current status of each configured channel's High alarm. See figure 4.3. A bit is set in this register whenever a channel's input value exceeds the configured High alarm limit. The bit is reset when the input value returns to a level below the configured limit.

Register 17

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0	Bit 5 = Channel 5	Bit 10 = Channel 10
Bit 1 = Channel 1	Bit 6 = Channel 6	Bit 11 = Channel 11
Bit 2 = Channel 2	Bit 7 = Channel 7	Bit 12 = Channel 12
Bit 3 = Channel 3	Bit 8 = Channel 8	Bit 13 = Channel 13
Bit 4 = Channel 4	Bit 9 = Channel 9	Bit 14 = Channel 14
		Bit 15 = Channel 15

Figure 4.3 - High Alarm Status Register

4.1.4 Low Alarm Status Register (Register 18)

Register 18 indicates the current status of each configured channel's Low alarm. See figure 4.4. A bit is set in this register whenever a channel's input value is less than the configured Low alarm limit. The bit is reset when the input value returns to a level above the configured limit.

Register 18

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0	Bit 5 = Channel 5	Bit 10 = Channel 10
Bit 1 = Channel 1	Bit 6 = Channel 6	Bit 11 = Channel 11
Bit 2 = Channel 2	Bit 7 = Channel 7	Bit 12 = Channel 12
Bit 3 = Channel 3	Bit 8 = Channel 8	Bit 13 = Channel 13
Bit 4 = Channel 4	Bit 9 = Channel 9	Bit 14 = Channel 14
		Bit 15 = Channel 15

Figure 4.4 - Low Alarm Status Register

4.1.5 Low Low Alarm Status Register (Register 19)

Register 19 indicates the current status of each configured channel's Low Low alarm. See figure 4.5. A bit is set in this register whenever a channel's input value is less than the configured Low Low alarm limit. The bit is reset when the input value returns to a level above the configured limit.

Register 19

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0	Bit 5 = Channel 5	Bit 10 = Channel 10
Bit 1 = Channel 1	Bit 6 = Channel 6	Bit 11 = Channel 11
Bit 2 = Channel 2	Bit 7 = Channel 7	Bit 12 = Channel 12
Bit 3 = Channel 3	Bit 8 = Channel 8	Bit 13 = Channel 13
Bit 4 = Channel 4	Bit 9 = Channel 9	Bit 14 = Channel 14
		Bit 15 = Channel 15

Figure 4.5 - Low Low Alarm Status Register

4.1.6 Out of Range Status Register (Register 20)

Register 20 indicates the current status of each configured channel's Out of Range alarm. See figure 4.6. A bit is set in this register whenever a channel's A/D input value exceeds the physical limitations of the A/D converter. These limits are -200^oC to 500^oC. The bits in this register are not latched automatically. If you want a bit to be latched the first time a value goes out of range, you must latch it through the application program.

If an input is identified as being out of range, the most probable cause is that a wire between the module and the RTD has either not been connected or has been broken.

Register 20

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0	Bit 5 = Channel 5	Bit 10 = Channel 10
Bit 1 = Channel 1	Bit 6 = Channel 6	Bit 11 = Channel 11
Bit 2 = Channel 2	Bit 7 = Channel 7	Bit 12 = Channel 12
Bit 3 = Channel 3	Bit 8 = Channel 8	Bit 13 = Channel 13
Bit 4 = Channel 4	Bit 9 = Channel 9	Bit 14 = Channel 14
		Bit 15 = Channel 15

Figure 4.6 - Out of Range Status Register

4.1.7 Channel Configuration Status Register (Register 21)

Register 21 indicates whether or not a channel has been configured. See figure 4.7. A bit is set in this register when a channel receives a correct write configuration command. The bit remains set until it is cleared by a reset configuration command from register 31.

Register 21

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Bit 0 = Channel 0	Bit 5 = Channel 5	Bit 10 = Channel 10
Bit 1 = Channel 1	Bit 6 = Channel 6	Bit 11 = Channel 11
Bit 2 = Channel 2	Bit 7 = Channel 7	Bit 12 = Channel 12
Bit 3 = Channel 3	Bit 8 = Channel 8	Bit 13 = Channel 13
Bit 4 = Channel 4	Bit 9 = Channel 9	Bit 14 = Channel 14
		Bit 15 = Channel 15

Figure 4.7 - Channel Configuration Status Register

4.1.8 Configuration Status Register (Register 22)

Register 22 provides the status of the configuration command issued by register 31. See figure 4.8. Bit 15 is set in this register whenever a channel receives a configuration command. Error bit 14 will be set if an incorrect configuration command is detected.

Register 22

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	R	–	–	–	–	–	–	R	R	R	R	R	R	R	R

Bit 0 = Channel Number Error
Bit 1 = Illegal Running Average Error
Bit 2 = Low Low Alarm Value Is Not The Lowest
Bit 3 = High Alarm Value Is Not Larger Than The Low Alarm Value
Bit 4 = High High Alarm Value Is Not The Highest
Bit 5 = Alarm Value Is Out Of Range Of the Hardware Limits
Bit 6 = Illegal Configuration Command
Bit 7 = READY State Must Be Enabled
Bits 8 to 13 = Not Used
Bit 14 = Configuration Error
Bit 15 = Configuration Is Complete

Figure 4.8 - Configuration Status Register

Bit 15 will remain set after a configuration command is received until bits 12 to 15 of the Configuration Command Register (register 31) are reset to zero. When bits 12 to 15 of register 31 are reset to zero, the RTD module resets bit 15 of register 22, which allows you to enter another configuration command. If you try to enter another configuration command before bit 15 of register 22 is reset, error bits 7 and 14 in register 22 will be set.

4.1.9 Channel Number Register (Register 23)

Register 23 contains the number of the channel to be configured, read, or reset. Channel numbers can range from 0 to 15. A channel number outside of this range will be flagged as an error.

4.1.10 Number of Samples Register (Register 26)

Register 26 specifies the number of input data samples that will be averaged together. The module maintains a running average of "x" number of input data samples. The value in the register is a 15-bit plus a sign-bit integer. The default value is one. The maximum allowable value is 60.

If the register contains a value of zero or one, no input data will be averaged together. If the register contains a negative number, a configuration error will result.

As the number of input samples increases, the time span of averaging increases, which results in a less current input value for use in the application program. See figure 4.9 for an equation to determine the amount of time needed to calculate an average input value for registers 0 to 15.

$$\left(\text{\# of configured channels} * \text{cycle frequency time} + \text{system overhead} \right) * \text{\# of samples} = \text{time the value in reg. 0-15 was averaged over}$$

Where:

# of configured channels = 0 to 16

cycle frequency time = 20 msec for 50 Hz
16.6 msec for 60 Hz

system overhead = 5 msec

# of samples = 1 to 60

averaged time = time in seconds

Figure 4.9 - Equation for Determining the Input Value Averaging Time

4.1.11 High High Alarm Register (Register 27)

Register 27 defines the High High alarm limit. If a channel's input value exceeds this limit, the channel's corresponding bit in register 16 is set to one. The value in register 27 is a 15-bit plus a sign-bit integer. This value is in units of 0.1 degrees.

If register 27 does not contain the largest alarm value, a configuration error will result. At power-up, the register is set to a default value of 4000 (4000 x 0.1°C = 400°C).

4.1.12 High Alarm Register (Register 28)

Register 28 defines the High alarm limit. If a channel's input value exceeds this limit, the channel's corresponding bit in register 17 is set to one. The value in register 28 is a 15-bit plus a sign-bit integer. This value is in units of 0.1 degrees.

If register 28 does not contain an alarm value greater than the Low alarm value, a configuration error will result. At power-up, the register is set to a default value of 1000 (1000 x 0.1°C = 100°C).

4.1.13 Low Alarm Register (Register 29)

Register 29 defines the Low alarm limit. If a channel's input value is less than this limit, the channel's corresponding bit in register 18 is set to one. The value in register 29 is a 15-bit plus a sign-bit integer. This value is in units of 0.1 degrees.

If register 29 does not contain an alarm value less than the High alarm value, a configuration error will result. At power-up, the register is set to a default value of −1000 (−1000 x 0.1°C = −100°C).

4.1.14 Low Low Alarm Register (Register 30)

Register 30 defines the Low Low alarm limit. If a channel's input value is less than this limit, the channel's corresponding bit in register 19 is set to one. The value in register 30 is a 15-bit plus a sign-bit integer. This value is in units of 0.1 degrees.

If register 30 does not contain the lowest alarm value, a configuration error will result. At power-up, the register is set to a default value of −1500 (−1500 x 0.1°C = −150°C).

4.1.15 Configuration Command Register (Register 31)

Register 31 defines what action should be taken if an input value is out of range, what temperature units should be used, what type of RTD is used, and the average A-C line frequency. The register also contains the Configure Command Code. See figure 4.10.

Register 31

Bits 0-15

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RW	RW	RW	RW	–	–	–	–	–	RW	–	–	RW	RW	RW	RW

Bits 1 and 0 = When An Input Value Is Out of Range
- 0 0 = Retain Old Input Value
- 0 1 = Force Input Value to Low Low Alarm Value
- 1 0 = Force Input Value to High High Alarm Value
- 1 1 = Retain Old Input Value

Bit 2 = Temperature Unit
- 0 = Celsius
- 1 = Fahrenheit

Bit 3 = RTD Thermal Response
- 0 = European Curve: Alpha = 0.00385
- 1 = American Curve: Alpha = 0.00392

Bits 5 to 4 = Reserved for Future Use

Bit 6 = Cycle Frequency Averaging
- 0 = Enable
- 1 = Disable

Bits 11 to 7 = Reserved for Future Use

Bits 15 to 12 = Configure Command Code
- 0 0 0 0 = READY State
- 0 0 0 1 = Reset Configuration For This Channel
- 0 0 1 0 = Read Configuration For This Channel
- 0 0 1 1 = Write Configuration For This Channel
- 0 1 0 0 = 50 Hz A-C Line Frequency
- 0 1 0 1 = 60 Hz A-C Line Frequency

Figure 4.10 - Configuration Command Register

When configuring a channel, you must define values for registers 23 through 30 before writing a value to register 31. Register 31 must be the last register that you write to as you configure each channel.

When you are finished with register 31 for the channel you are configuring, and the module has processed the information, the module will set bit 15 of register 22 equal to one. You must then set bits 12 to 15 of register 31 equal to zero. This places the module in the READY state. The module then resets bit 15 of register 22 which indicates that it is ready to configure another channel via register 31. If you attempt to enter another command before resetting bits 12 to 15 of register 31, a configuration error will result.

Bits 0 and 1 specify what action should occur when an input value is out of range. The default condition is to retain the old input value from the data registers (0 to 15).

Bit 2 specifies whether the input values are in degrees Fahrenheit or in degrees Centigrade. The default is degrees Centigrade.

Bit 3 defines the RTD Thermal Response Curve. A value of zero indicates a European curve. A value of one indicates an American curve. The default is a European curve.

Bits 4 to 5 are reserved for future use.

Bit 6 defines whether or not cycle averaging is enabled for the channel specified in register 23. The default condition (0) enables cycle averaging.

Bits 7 to 11 are reserved for future use.

Bits 12 to 15, when equal to 0, enable the READY state, which is the default condition. When the module is in the READY state, it is ready to receive a configuration command.

When bits 12 to 15 are set to a binary 1, 2, or 3, their operations refer to the channel specified in register 23:

- A binary 1 (RESET) resets the channel's configuration by clearing its data register (registers 0-15) and resetting its bit in the status registers (registers 16-21).
- A binary 2 (READ) locates the channel's current configuration information in memory and loads it into registers 26 to 30.
- A binary 3 (WRITE) transfers the channel's configuration information (registers 26 to 30) into the module's memory, configures the channel, and then sets its bit in the status registers (registers 16-21).

When bits 12 to 15 are set to a binary 4 or 5, they reflect the A-C power line frequency. The default is 60 Hz.

4.2 RTD Configuration Procedure

RTD configuration information is stored on-board the RTD module. At system power-up, default values are automatically placed in the module's memory. You can change these default values on a channel-by-channel basis. See figure 4.11.

To do this, you need to set bits 12 to 15 of register 31 equal to zero to make sure the RTD module is in the READY state and then place a value in register 23 and registers 26 through 30 for each RTD channel you wish to configure:

- Channel Number Register (Register 23)
- Number of Samples Register (Register 26)
- High High Alarm Register (Register 27)
- High Alarm Register (Register 28)
- Low Alarm Register (Register 29)
- Low Low Alarm Register (Register 30)
- Configure Command Register (Register 31)

After you have placed values in registers 26 through 30 and put the write Configuration Command Code into register 31, the system automatically transfers the new channel parameters to the appropriate locations in memory. To use these parameters on another unconfigured channel, simply change the channel number and put the write Configuration Command Code into register 31. If you want to configure a channel with the original power-up default values, you must first place the read Configuration Command Code in register 31 to restore these values to registers 26 through 30. Note that the channels on the RTD module must be configured from only one application program.

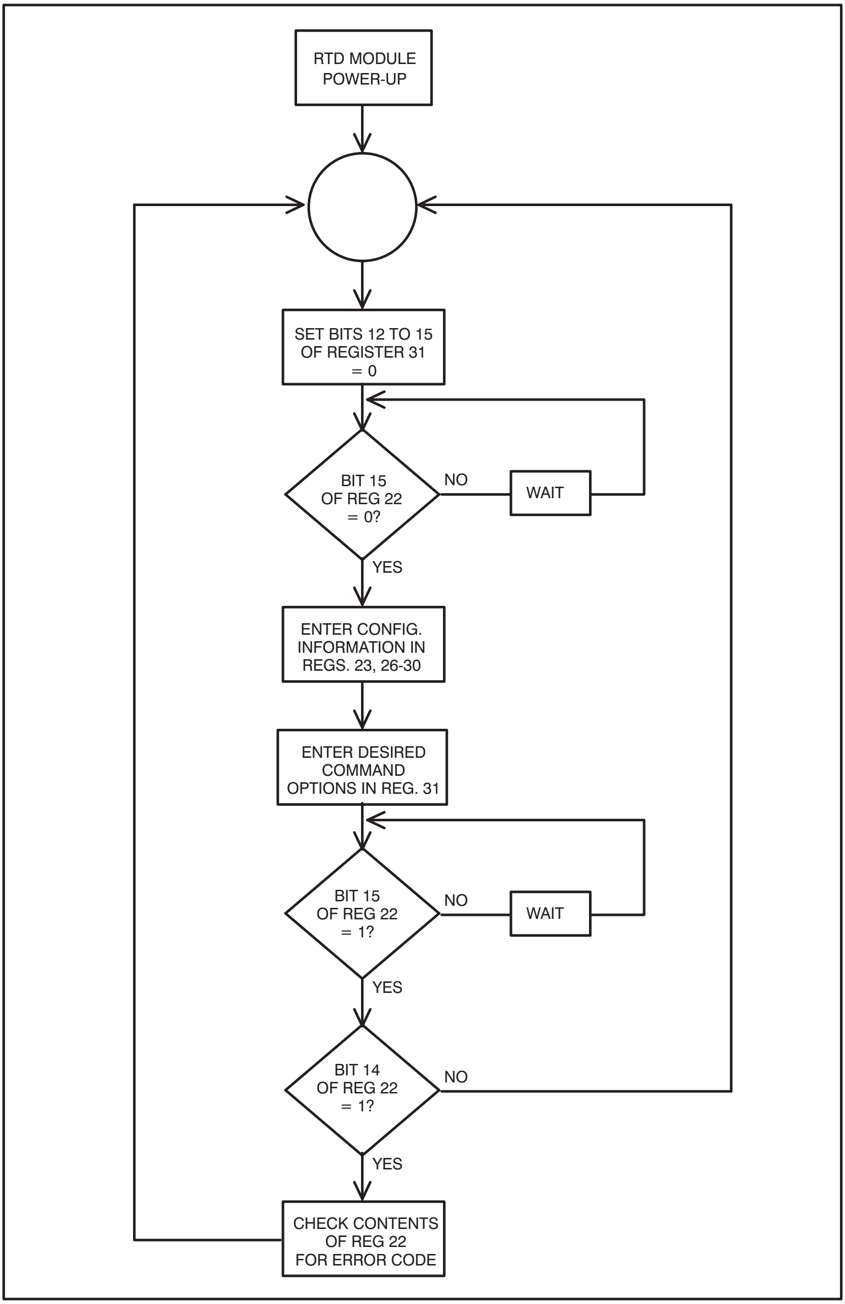


Figure 4.11 - Channel Configuration Flowchart

Use the following procedure to configure a channel:

Step 1. Set bits 12 to 15 of register 31 equal to zero. This resets bit 15 of register 22 and places the module in the READY state. When the READY state is enabled, the module is ready to process a configuration command.

Step 2. Select the channel to be configured by writing the appropriate number to the Channel Number Register (Register 23).

Step 3. Define the channel's High High alarm limit by writing the desired value to the High High Alarm Register (Register 27). This alarm value is a 15-bit plus a sign-bit integer that is in units of 0.1 degrees. See section 4.1.11 for more information.

Step 4. Define the channel's High alarm limit by writing the desired value to the High Alarm Register (Register 28). This alarm value is a 15-bit plus a sign-bit integer that is in units of 0.1 degrees. See section 4.1.12 for more information.

Step 5. Define the channel's Low alarm limit by writing the desired value to the Low Alarm Register (Register 29). This alarm value is a 15-bit plus a sign-bit integer that is in units of 0.1 degrees. See section 4.1.13 for more information.

Step 6. Define the channel's Low Low alarm limit by writing the desired value to the Low Low Alarm Register (Register 30). This alarm value is a 15-bit plus a sign-bit integer that is in units of 0.1 degrees. See section 4.1.14 for more information.

Step 7. Define the number of input data samples that are to be averaged together for the input running average value. Write the desired number to the Number of Samples Register (Register 26). See section 4.1.10 for more information.

Step 8. Enter the required information in the Configure Command Register (Register 31). See section 4.1.15 for more information. Set the Configure Command Code (bits 12 to 15) equal to three. This code transfers (writes) the channel's parameters into memory.

Step 9. When the module finishes processing the write configuration operation, it will set bit 15 of register 22 equal to one. To configure another channel repeat the procedure beginning with step 1.

4.3 Monitoring Data and Configuration Register Values

Run the ReSource Programming Executive Software. Use the MONITOR function in DCS 5000/ AutoMax systems or the POINT MONITOR function in AutoMate systems to check the contents of the registers. Note that you need to configure the channels before you can monitor their contents.

Status register values are in hexadecimal format. All other register values are in decimal.

4.4 Sample DCS 5000/AutoMax RTD Application Task

The sample DCS 5000/AutoMax RTD application task in figure 4.12 is written for an RTD module in slot 4 which is connected to a 4-wire RTD. In this example, three vats of solution are being monitored for the following temperatures:

- High High Alarm = 250°C
- High Alarm = 200°C
- Low Alarm = 100°C
- Low Low Alarm = 50°C.

If you are using AutoMax version 2.1 or earlier, you would need to define common (system-wide) variables in a configuration task before writing an application task. The configuration task in Appendix F defines the common variables in the sample task below.

If you are using DCS 5000/AutoMax version 3.0 or later, this information would be entered in the configuration form using the Programming Executive software.

Note that when RTD modules are placed in an AutoMax remote rack, the power-up default values in registers 23 to 31 are reset to zero. You must individually enter new values into these registers.

```
10      ! RTD Sample Task
20      ! April 22, 1991
30      !
40      ! This task checks for alarms once per second.
41      !    If the temperature is above 200 C or below 100 C, WARNING@ is set
42      !    If the temperature is above 250 C or below 50 C, SHUTDOWN@ is set
43      !    If the temperature is out of range, SHUTDOWN@ is set
44      ! If the configuration fails, SHUTDOWN@ is set
50      !
100     ! ************************** LOCAL VARIABLES ******************************
110     !
120     LOCAL I%
130     !
200     ! ************************** COMMON VARIABLES ***************************
210     !
220     COMMON VAT1_TEMP%      \! Temperature read by RTD card for vat one
230     COMMON VAT2_TEMP%      \! Temperature read by RTD card for vat two
240     COMMON VAT3_TEMP%      \! Temperature read by RTD card for vat three
245     !
300     COMMON VAT1_HH_ALARM@          \! High-high     alarm status for vat one
310     COMMON VAT1_H_ALARM@           \! High          alarm status for vat one
320     COMMON VAT1_L_ALARM@           \! Low           alarm status for vat one
330     COMMON VAT1_LL_ALARM@          \! Low-low       alarm status for vat one
340     !
400     COMMON VAT2_HH_ALARM@          \! High-high     alarm status for vat two
410     COMMON VAT2_H_ALARM@           \! High          alarm status for vat two
420     COMMON VAT2_L_ALARM@           \! Low           alarm status for vat two
430     COMMON VAT2_LL_ALARM@          \! Low-low       alarm status for vat two
440     !
500     COMMON VAT3_HH_ALARM@          \! High-high     alarm status for vat three
510     COMMON VAT3_H_ALARM@           \! High          alarm status for vat three
520     COMMON VAT3_L_ALARM@           \! Low           alarm status for vat three
530     COMMON VAT3_LL_ALARM@          \! Low-low       alarm status for vat three
540     !
590     COMMON CONF_AVE_SAMPLES%       \! Number of samples
600     COMMON CONF_HH_ALARM%          \! High-high     alarm value
610     COMMON CONF_H_ALARM%           \! High          alarm value
620     COMMON CONF_L_ALARM%           \! Low           alarm value
630     COMMON CONF_LL_ALARM%          \! Low-low       alarm value
640     COMMON CONF_COMMAND%           \! Configuration command
650     COMMON CONF_COMP@              \! Configuration complete
660     COMMON CONF_ERROR@             \! True if configuration error occurs
670     COMMON CONF_CHAN_NUM%          \! Channel number
700     COMMON WARNING@                \! True if any vat's temp above 200 or below 100
710     COMMON SHUTDOWN@               \! True if any vat's temp above 250 or below 50
720     COMMON OUT_OF_RANGE%           \! Non-zero if any channel is out of range
```

Figure 4.12 - Sample DCS 5000/AutoMax RTD Application Task (Continued)

```
990    !
1000   !   *************************** INITIALIZATION ***************************
1010   !
1020   ! Configure the first three channels using the data statements at 8000.
1030   !
1100   FOR I% = 0 TO 2
1110       !   Reset the configuration register
1120       CONF_COMMAND% = 0000H
1130       !   Wait for the config complete flag to be reset
1140       IF CONF_COMP@ = FALSE THEN GOTO 1180
1150           DELAY 10 TICKS
1160           GOTO 1140
1170       !   Specify the channel to be configured
1180       CONF_CHAN_NUM% = I%
1190       !   Specify number of samples, high-high, high, low, low-low alarm values
1200       READ CONF_AVE_SAMPLES%, CONF_HH_ALARM%, CONF_H_ALARM%, CONF_L_ALARM%,  &
               CONF_LL_ALARM%
1210       !   Send the WRITE configuration command with retaining old value for
1220       !   out of range mode, Celsius temperature unit, European 4-wire RTD
1230       CONF_COMMAND% = 3000H
1240       !   Wait for the config complete flag to be set
1250       IF CONF_COMP@ = TRUE THEN GOTO 1290
1260           DELAY 10 TICKS
1270           GOTO 1250
1280       !   Check for an error configuring the channel
1290       IF CONF_ERROR@ = TRUE THEN SHUTDOWN@ = TRUE
1300   NEXT I%
8000   !          Ave       High-high      High         Low        Low-low
8010   !        Samples
8020   !
8030   DATA       30          2500,        2000,        1000,         500
8040   DATA       40          2500,        2000,        1000,         500
8050   DATA       50          2500,        2000,        1000,         500
8060   !
9000   !
9010   !   *************************** MAIN LOOP *******************************
9990   !
9991   !   If any channels are out of range, then set shutdown flag
9992   !
10000  IF OUT_OF_RANGE% <> 0 THEN SHUTDOWN@ = TRUE
11000  !
11010  !   If vat 1, 2, or 3 has high or low alarm, set warning flag
11020  !
11030  IF VAT1_H_ALARM@ OR VAT2_H_ALARM@ OR VAT3_H_ALARM@ OR VAT1_L_ALARM@          &
           OR VAT2_L_ALARM@ OR VAT3_L_ALARM@ THEN WARNING@ = TRUE
12000  !
12010  !   If vat 1, 2, or 3 has high-high or low-low alarm, set shutdown flag
12020  !
12030  IF VAT1_HH_ALARM@ OR VAT2_HH_ALARM@ OR VAT3_HH_ALARM@ OR VAT1_LL_ALARM@   &
           OR VAT2_LL_ALARM@ OR VAT3_LL_ALARM@ THEN SHUTDOWN@ = TRUE
13010  !
13020  ! Wait one second then check again
13030  !
13040  DELAY 1 SECONDS
13050  GOTO 10000
```

Figure 4.12 - Sample DCS 5000/AutoMax RTD Application Task (Continued)

4.5 Sample AutoMate RTD Application Program

The sample AutoMate RTD application program in figure 4.13 is written for an RTD module in a remote rack that is controlled by an AutoMate 40 processor. If your system uses an AutoMate 30 processor, the addresses you would use must be changed accordingly. If the RTD module were in a local rack, LOCIN/LOCOUT commands would replace the REMIN/REMOUT commands. Refer to the A30/A40 Software Reference Manual (J-3150) for additional information.

The RTD module is connected to a 4-wire RTD in this example. Three vats of solution are being monitored for the following temperatures:

- High High Alarm = 250°C
- High Alarm = 200°C
- Low Alarm = 100°C
- Low Low Alarm = 50°C.

The sample program uses the following memory locations:

Bit 00.00 = Bit to be set by the user when a channel is to be configured.

Bit 1700.00 = Bit used to detect the rising edge of Bit 00.00.

Register 10 = Register contains the coils corresponding to the status of the RTD High High alarms.

Register 11 = Register contains the coils corresponding to the status of the RTD High alarms.

Register 12 = Register contains the coils corresponding to the status of the RTD Low alarms.

Register 13 = Register contains the coils corresponding to the status of the RTD Low Low alarms.

Register 1600 = Internal coils

Register 1601 = Internal coils

Register 1610 = The register's bits are used to indicate the status of operation.

Bit .00 represents state 0 which writes the READY command to the RTD module and then reads the module's configuration status. If the complete bit of the configuration status register is equal to zero, advance to state 1.

Bit .01 represents state 1 which reads channel configuration data from the AutoMate's memory and writes out to the RTD module. State 1 then reads the RTD module's configuration status. If the configuration is complete and there are no errors, go to state 2.

Bit .02 represents state 2. This state directs the program to continue with the configuration of the next channel (state 0), provided no errors have been detected.

Bit .16 is set when an error is detected and the configure operation is aborted.

Bit .17 is set when all of the RTD channels have been configured.

Register 1611 = Register is loaded by the REMIN instruction which contains the contents of the RTD Configuration Status Register (Register 22).

Register 3000 = Register contains the pointer to the data that is to be written to the RTD module.

Register 3001 = Register contains the RTD channel number that is being configured.

Register 3002 = Reserved for future use.

Register 3003 = Reserved for future use.

Register 3004 = Register contains the RTD channel's Number of Samples. This value is provided by the data table in the 5000-series registers.

Register 3005 = Register contains the RTD channel's High High alarm value. This value is provided by the data table in the 5000-series registers.

Register 3006 = Register contains the RTD channel's High alarm value. This value is provided by the data table in the 5000-series registers.

Register 3007 = Register contains the RTD channel's Low alarm value. This value is provided by the data table in the 5000-series registers.

Register 3010 = Register contains the RTD channel's Low Low alarm value. This value is provided by the data table in the 5000-series registers.

Register 3011 = Register contains the RTD channel's configuration command. This value is provided by the data table in the 5000-series registers.

Registers 3100 to 3137 = Registers contain the data read from the RTD module.

Registers 5000 to 5027 = Registers contain the data used to configure the RTD channels. Each channel uses six registers:

	Not Used		# of Samples	High High	High	Low	Low Low	Configure Command
Reg. 5000 =	0	0	20	2500	2000	1000	500	12288*
Reg. 5010 =	0	0	20	2500	2000	1000	500	12288
Reg. 5020 =	0	0	20	2500	2000	1000	500	12288

* 12288 = 3000 Hex

Note that you must use the POINT MONITOR function to enter these values into the 5000-series registers before you begin executing the program.

Register 5200 = Register contains the value (0) for the READY command.

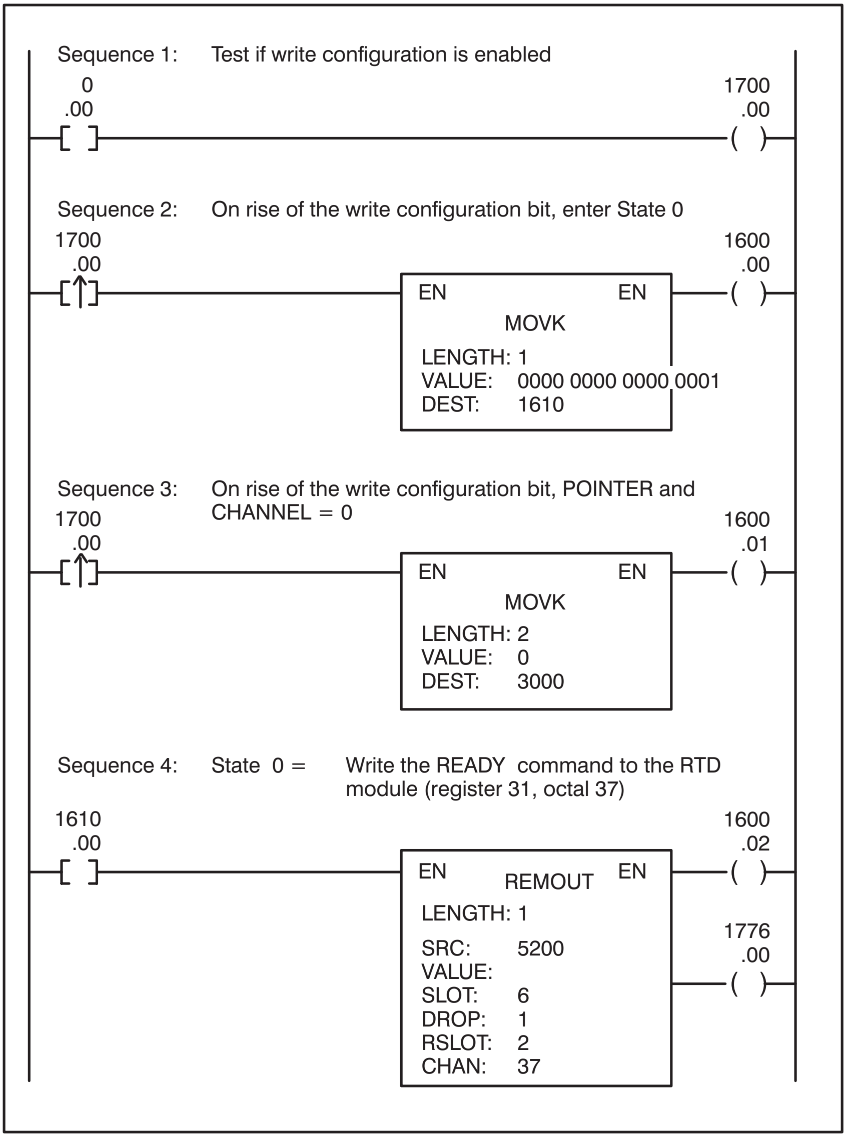


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

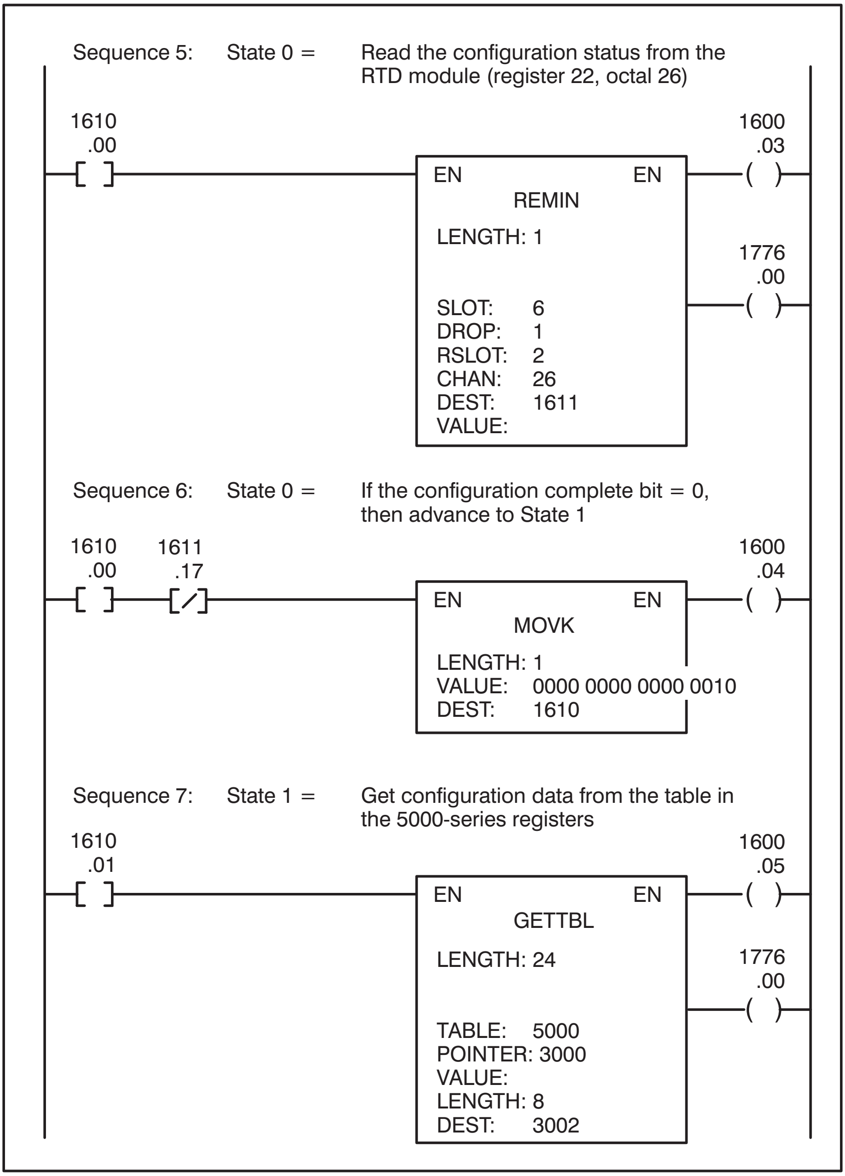


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

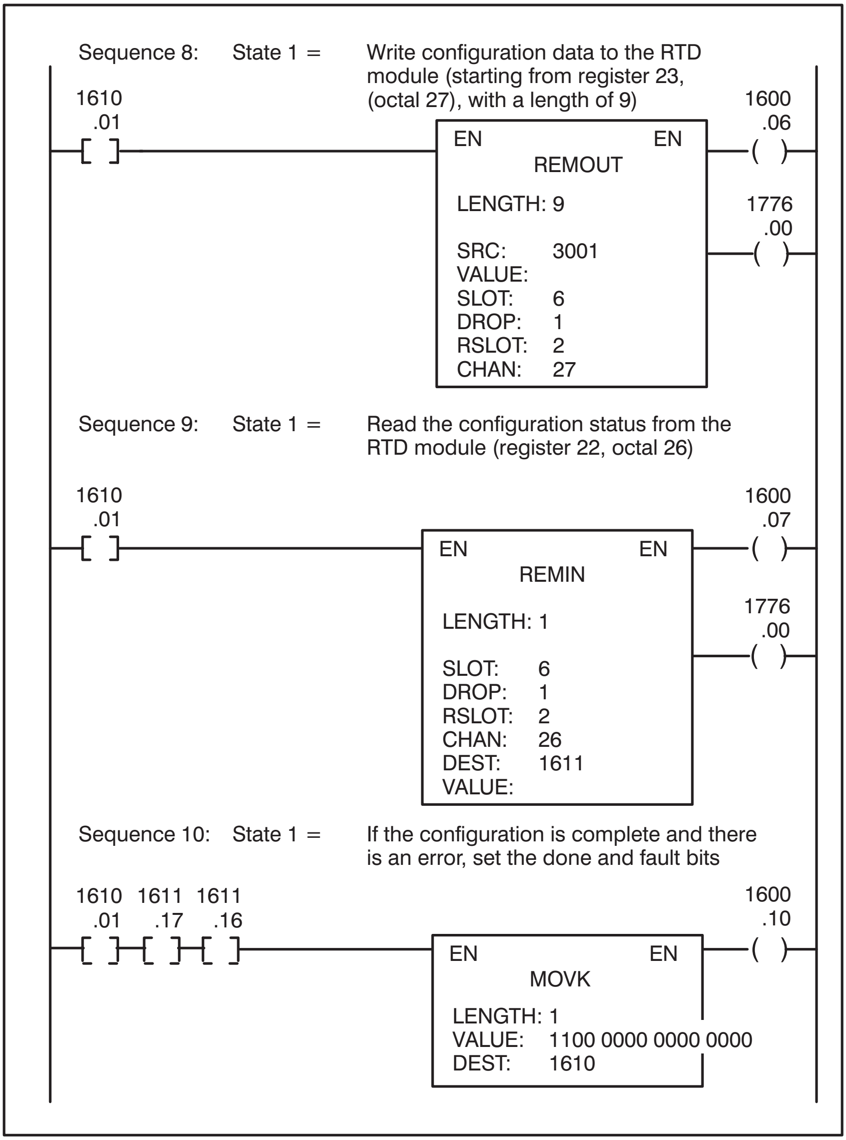


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

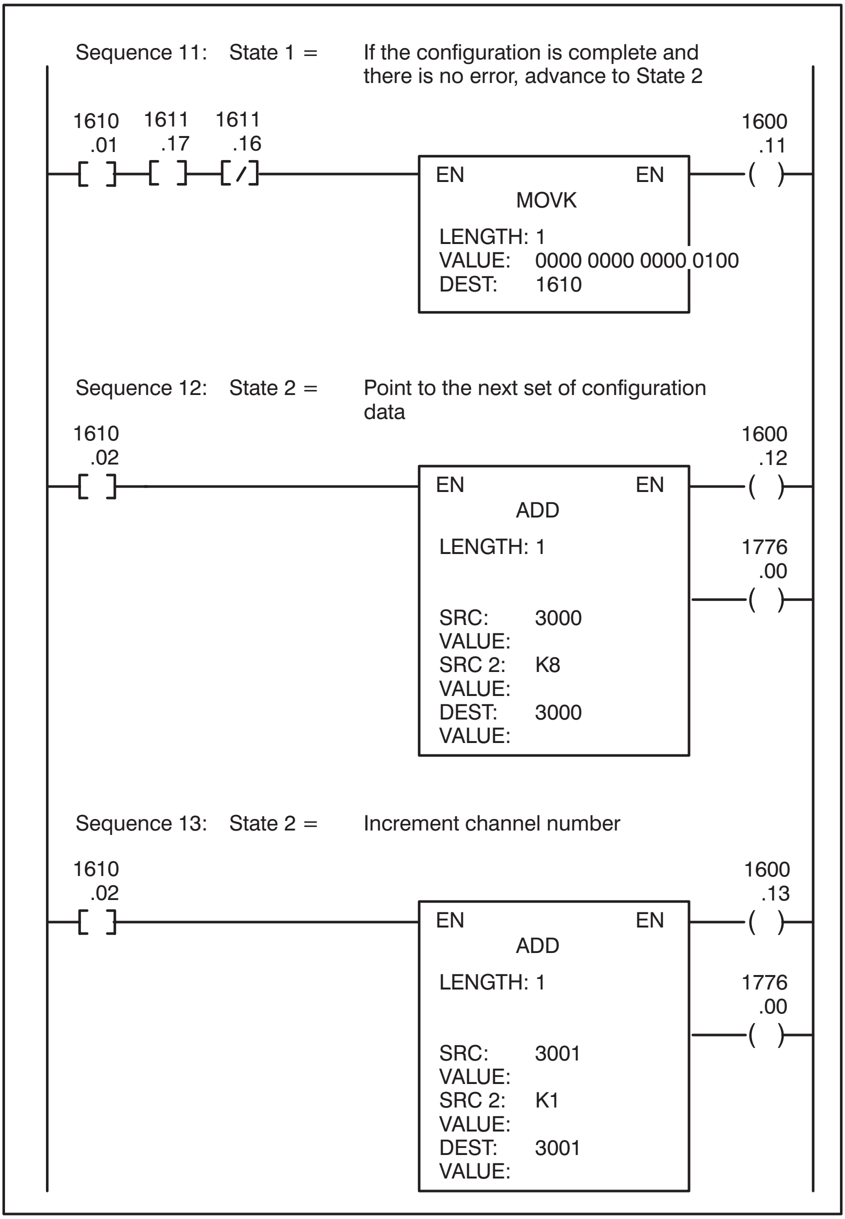


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

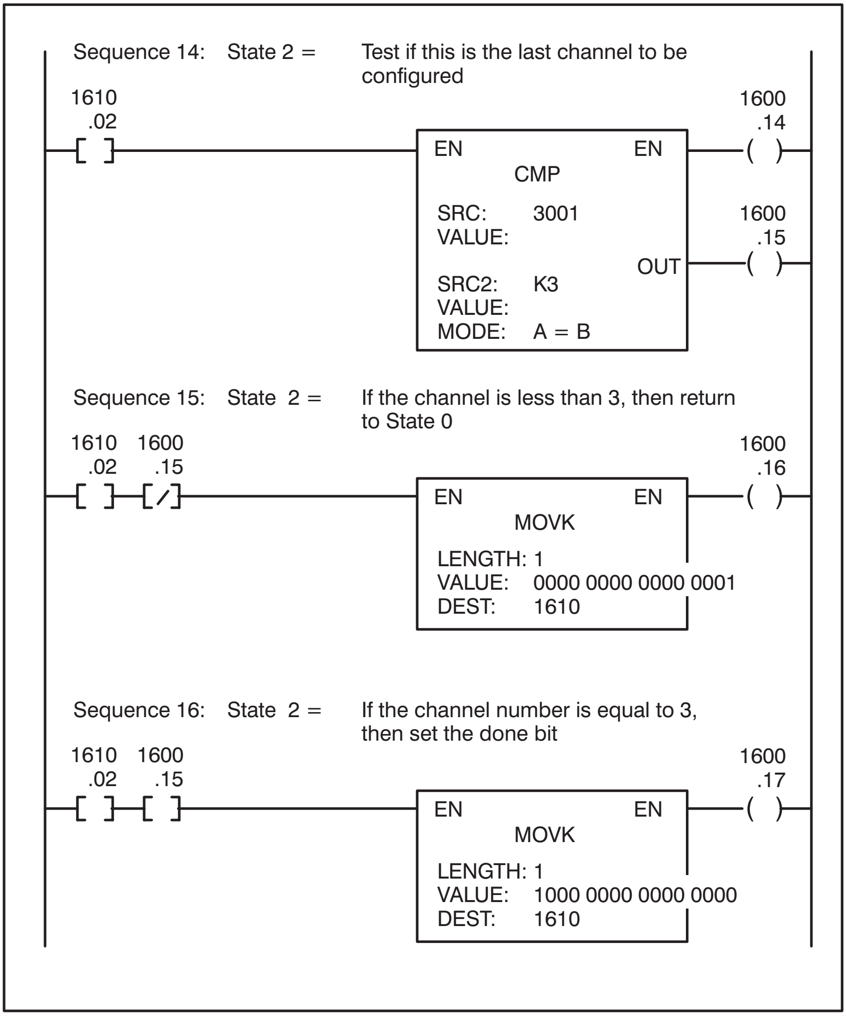


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

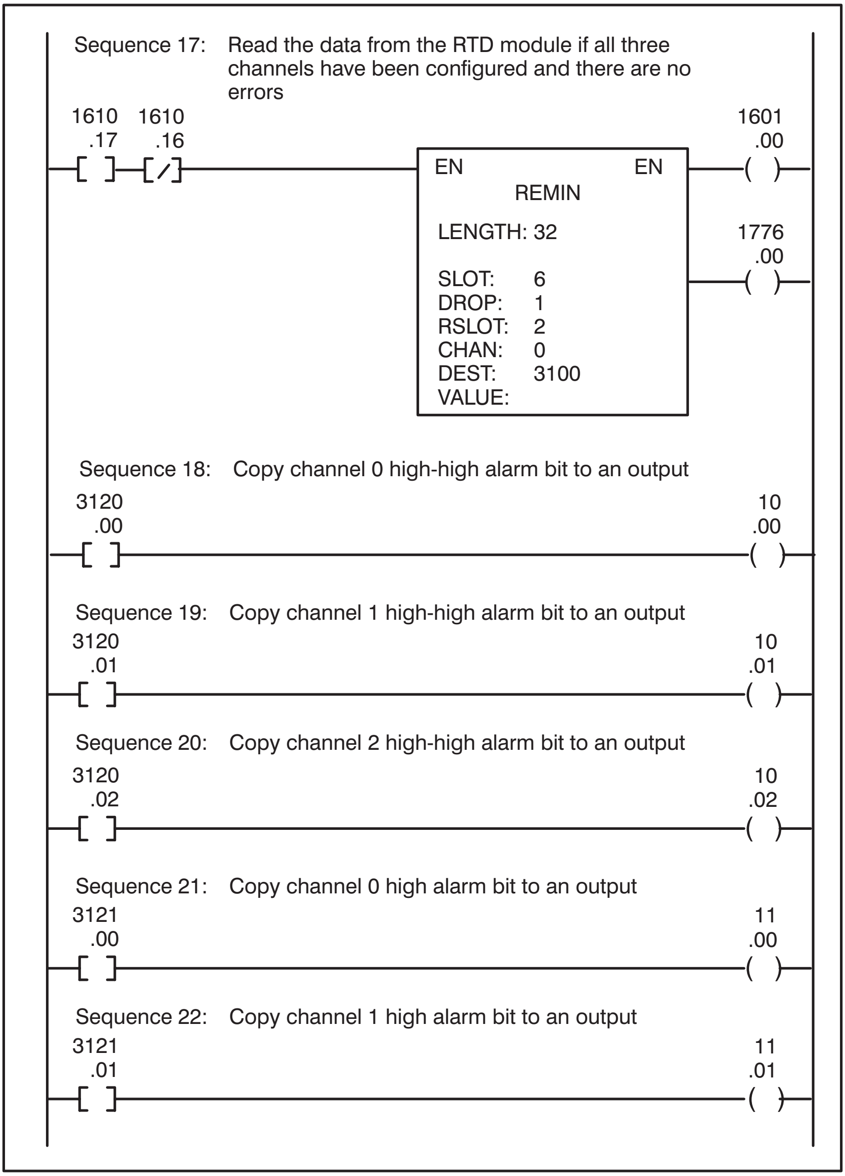


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

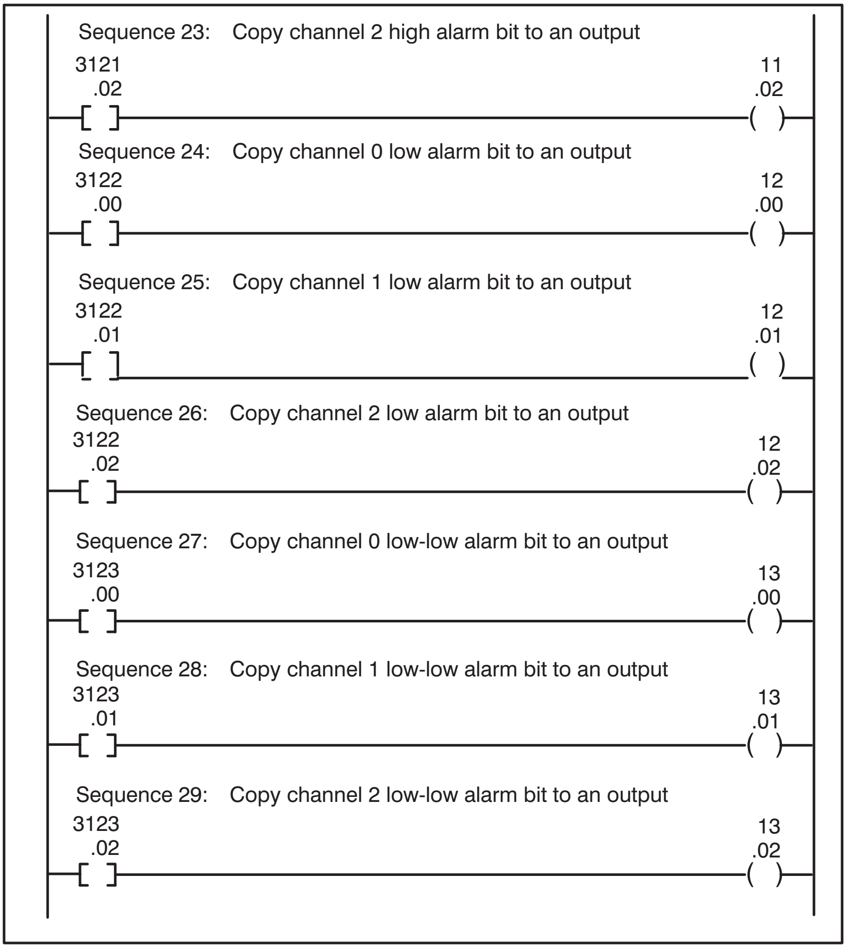


Figure 4.13 - Sample AutoMate RTD Application Program (Continued)

4.6 Restrictions on Use

The channels on the RTD module are to be configured from only one application task.

Do not configure a channel on the RTD module unless an RTD is connected to that channel. If you do, out-of-range input values may be generated.

If the RTD module is in an AutoMate remote rack, both the master Remote I/O Processor and the slave Remote I/O Processor must be M/N 45C201B or later. If either Processor is of an earlier version, the remote rack will not stay on-line with the master.

You can place up to 15 RTD modules in either a local or remote AutoMate rack when using a 50 Amp AutoMate Power Supply

(M/N45C322). When using a 20 Amp AutoMate Power Supply (M/N45C321) you are limited to:

- 8 RTD modules in a local rack with an AutoMate 30 Processor
- 5 RTD modules in a local rack with an AutoMate 40 Processor
- 10 RTD modules in a remote rack with a Remote I/O Processor

You can place up to 15 RTD modules in a local AutoMax rack. Note that you can only place up to five RTD modules in a remote AutoMax rack due to register transfer limitations. For additional information refer to the AutoMax Remote I/O Communications Instruction Manual (J-3606).

Note that when RTD modules are placed in an AutoMax remote rack:

- the power-up default values in registers 23 to 31 are reset to zero. You must individually enter new values into these registers.
- the Read Channel Configuration command (register 31, bits 12 to 15) will not update registers 26 to 31 and therefore cannot be used in a remote installation.

5.0 DIAGNOSTICS AND TROUBLESHOOTING

This section explains how to troubleshoot the module and field connections. If you cannot correct the problem using the instructions below, the module is not user-serviceable. If the procedure calls for a component to be swapped with a replacement part and the problem is not corrected, replace the original component and go on to the next step.

5.1 Incorrect Data

Problem: The data is always on, always off, or different than expected. The possible causes of this are a module in the wrong slot, a programming error, or a malfunctioning module. It is also possible that the RTD is either not wired or is wired incorrectly. Use the following procedure to isolate the problem:

Step 1. Connect the programming terminal to the system and run the ReSource Programming Executive Software. Determine whether the channel is configured by examining register 21. If it is not, use the procedure in section 4.2 to configure the channel.

Step 2. For DCS 5000/AutoMax systems, verify that the module configuration is correct. Verify that the RTD module is in the correct slot.

Verify that the slot number being referenced agrees with the slot number of the module.

For remote I/O installations, verify that the master slot and remote drop numbers are defined correctly.

Step 3. Verify that the field wiring is properly connected.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Turn off power to the module.

Confirm that all terminal board connections are tight.

Check the cables for continuity between the faceplate connector and the terminal board assembly.

Turn on power to the module.

Step 4. Check for an RTD out of range condition.

Monitor register 20. Use the MONITOR function in DCS 5000/AutoMax systems or the POINT MONITOR function in AutoMate systems.

DANGER
THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Turn off power to the module.

If an out of range condition exists, check for an open or shorted wire between the terminal board assembly and the RTD.

Turn on power to the module.

Step 5. Verify that the user application program is correct.

For DCS 5000/AutoMax systems, verify that the application program that references the symbolic names associated with the module has declared those names COMMON in the application tasks.

Verify that the symbolic name in question is being referenced in the application program. This can be done indirectly by monitoring the symbolic name with the MONITOR function in the ReSource Software.

For both DCS 5000/AutoMax and AutoMate systems, verify that the application program is executing fast enough to catch all of the input changes.

Step 6. Verify that the hardware is working correctly.

DANGER
THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Verify hardware functionality by systematically swapping out modules in the rack. Make certain power is off before removing any module from the rack. After each swap, if the problem is not corrected, replace the original module before swapping out the next one.

5.2 The “OK” LED is Off

Problem: The “OK” LED on the RTD module faceplate is off. This LED is on when the module passes its power-up diagnostics and is operating properly. The LED is off when the module fails its power-up diagnostics, when the calibration voltage is out of range, or when a watchdog timeout error occurs. If the LED remains off after system power-up, replace the module as described in section 3.3.

Appendix A

Technical Specifications

Ambient Conditions

- Storage Temperature: −40 to 85ºC
  −40 to 185ºF
- Operating Temperature: 0 to 60ºC
  32 to 140ºF
- Humidity: 5 to 90% non-condensing

Dimensions

- Height: 11.75 inches (29.8 cm)
- Width: 1.25 inches (3.2 cm)
- Depth: 7.375 inches (18.7 cm)
- Weight: 2 pounds (0.9 kg)

System Power Requirements

- + 5 volts: 1.5 A
- + 12 volts: 30 mA

Maximum Module Power Dissipation

- 7.5 Watts

Recommended RTD Cable

- Belden 9502 or Equivalent
- Maximum RTD Field Wiring Length: 500 Feet

Input Channels

- Number of Channels (RTDs): 16
- Commons: one analog common shared by 16 RTD channels
- Isolation: 2500V from analog common to digital ground

RTD Elements

- RTD Sensor Type: 100 ohm platinum
  alpha = 0.00385 ohm/ohm/ºC (European Curve)
  or 0.00392 ohm/ohm/ºC (American Curve)
  4-wire, 3-wire, or 2-wire terminations
- RTD Excitation Current: 1 mA, 0.2% across the operating temperature range
- RTD Excitation Current Loading: 0 to 500 ohms
- RTD Temperature Range: −200 to 500ºC
  −328 to 932ºF

Appendix A

(Continued)

Input Circuit

- Resolution: 0.1ºC
- Accuracy: 0.2% across the operating temperature range
- Input Impedance: 1000 Meg Ohms typical at 0 Hz
- Input Filter: first order, lowpass, 7 Hz breakpoint
- Input Overvoltage Protection: 115 V (rms) continuous

System Accuracy

- 4-Wire RTD Elements: RTD element tolerance + 0.4%
  3-Wire and 2-Wire RTD Elements: RTD element tolerance + 0.4% + error term (from Appendix E)

Noise Rejection

- Line Frequency Filter (Software Selectable): 60 Hz (default) or 50 Hz
- Averaging Filter (Software Selectable): 1 (default) to 60 samples per average
- Common Mode Rejection: −60dB min (worst case value with the averaging filter = 1)
- Normal Mode Rejection: −40dB min (worst case value with the averaging filter = 1)

Timing

- Update Time per Channel: 18.5 msec at 60 Hz
  22.0 msec at 50 Hz
- Channel Scan Time (16 Channels Configured): 335 msec at 60 Hz
  400 msec at 50 Hz
- Integration Period (60 Hz): 16.67 msec per temperature conversion per channel
  (50 Hz): 20.00 msec per temperature conversion per channel

Appendix A

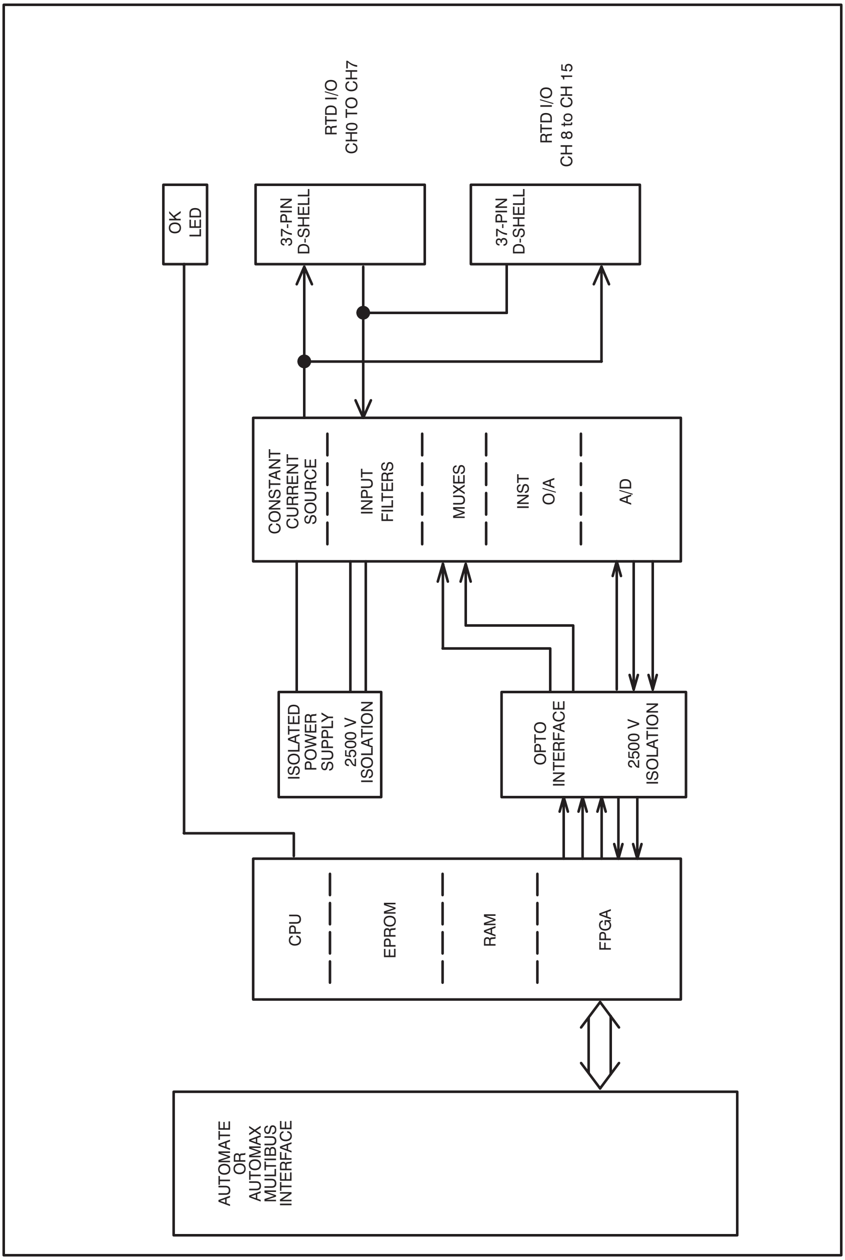
(Continued)

Input Channel Update Times (All times are in milli-seconds)

	Number of Configured Channels	Celsius	Fahrenheit	Running Average of 60 Samples
60 Hz Line Freq. Filter Enabled	One	18.3	18.4	18.5
	Each Added	17.5	17.6	17.7
	Sixteen	281	282	283
Line Freq. Filters Disabled	One	2.0	2.1	2.2
	Each Added	1.0	1.1	1.2
	Sixteen	17	18.6	20.2
50 Hz Line Freq. Filter Enabled	One	21.8	21.9	22
	Each Added	21	21.1	21.2
	Sixteen	336	337	339

Appendix B

Module Block Diagram



Appendix C

Field Connections

Terminal Block Pin Number	RTD Function Ch. 0-7 D-Shell	RTD Function Ch. 8-15 D-Shell
1	Current Out Ch. 0	Current Out Ch. 8
2	Current Return Ch. 0	Current Return Ch. 8
3	RTD Voltage (+) Ch. 0	RTD Voltage (+) Ch. 8
4	RTD Voltage (–) Ch. 0	RTD Voltage (–) Ch. 8
5	Shield	Shield
6	Shield	Shield
7	Current Out Ch. 1	Current Out Ch. 9
8	Current Return Ch. 1	Current Return Ch. 9
9	RTD Voltage (+) Ch. 1	RTD Voltage (+) Ch. 9
10	RTD Voltage (–) Ch. 1	RTD Voltage (–) Ch. 9
11	Current Out Ch. 2	Current Out Ch. 10
12	Current Return Ch. 2	Current Return Ch. 10
13	RTD Voltage (+) Ch. 2	RTD Voltage (+) Ch. 10
14	RTD Voltage (–) Ch. 2	RTD Voltage (–) Ch. 10
15	Shield	Shield
16	Shield	Shield
17	Current Out Ch. 3	Current Out Ch. 11
18	Current Return Ch. 3	Current Return Ch. 11
19	RTD Voltage (+) Ch. 3	RTD Voltage (+) Ch. 11
20	RTD Voltage (–) Ch. 3	RTD Voltage (–) Ch. 11
21	Current Out Ch. 4	Current Out Ch. 12
22	Current Return Ch. 4	Current Return Ch. 12
23	RTD Voltage (+) Ch. 4	RTD Voltage (+) Ch. 12
24	RTD Voltage (–) Ch. 4	RTD Voltage (–) Ch. 12
25	Shield	Shield
26	Shield	Shield
27	Current Out Ch. 5	Current Out Ch. 13
28	Current Return Ch. 5	Current Return Ch. 13
29	RTD Voltage (+) Ch. 5	RTD Voltage (+) Ch. 13
30	RTD Voltage (–) Ch. 5	RTD Voltage (–) Ch. 13
31	Current Out Ch. 6	Current Out Ch. 14
32	Current Return Ch. 6	Current Return Ch. 14
33	RTD Voltage (+) Ch. 6	RTD Voltage (+) Ch. 14
34	RTD Voltage (–) Ch. 6	RTD Voltage (–) Ch. 14
35	Shield	Shield
36	Shield	Shield
37	Current Out Ch. 7	Current Out Ch. 15
38	Current Return Ch. 7	Current Return Ch. 15
39	RTD Voltage (+) Ch. 7	RTD Voltage (+) Ch. 15
40	RTD Voltage (–) Ch. 7	RTD Voltage (–) Ch. 15

Appendix D

Related Components

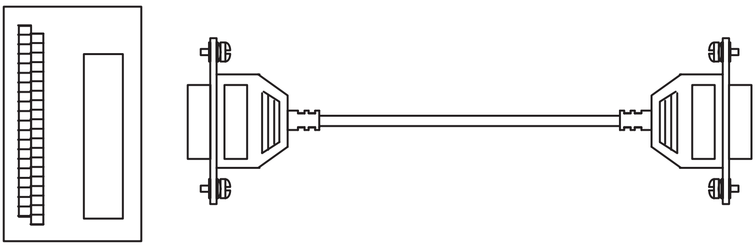
M/N 61C545 Panel Mount Terminal Board and Cable Assembly

The panel mount terminal board assembly provides terminals on a flat panel mounting surface for connecting the field wires coming from the RTDs. Also included is a cable to connect the terminals with the RTD module. The cable is five feet long. One assembly for each set of eight channels is required (2 per module).

M/N 61C546 DIN Rail Mount Terminal Board and Cable Assembly

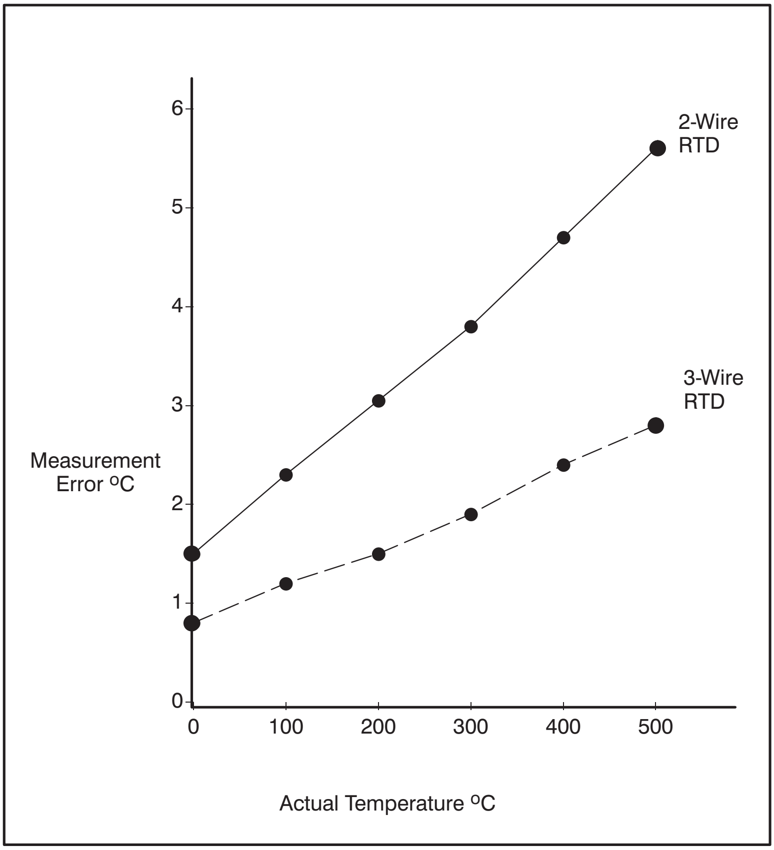
The DIN rail terminal board assembly provides terminals on a DIN rail mounting surface for connecting the field wires coming from the RTDs. Also included is a cable to connect the terminals with the RTD module. The cable is five feet long. One assembly for each set of eight channels is required (2 per module).

M/N 61C545 Terminal Board and Cable Assembly
(M/N 61C546 is similar)



Appendix E

Typical 2-Wire and 3-Wire RTD Measurement Error



Appendix F

Configuration Task

The following configuration task is intended as a guide to help you in defining your system-wide RTD variables when using DCS 5000 and AutoMax version 2.1 and earlier. This task defines the common variables used in the sample application task in section 4.4.

```
10   ! RTD Sample Configuration Task
20   ! April 22, 1991
30   !
100  TASK RTD[ TYPE=BASIC, PRIORITY=7, SLOT=0, CRITICAL=FALSE ]
110  !
220  IODEF VAT1_TEMP%[            SLOT=4, REGISTER=0 ]
230  IODEF VAT2_TEMP%[            SLOT=4, REGISTER=1 ]
240  IODEF VAT3_TEMP%[            SLOT=4, REGISTER=2 ]
245  !
300  IODEF VAT1_HH_ALARM@[        SLOT=4, REGISTER=16, BIT=0 ]
310  IODEF VAT1_H_ALARM@[         SLOT=4, REGISTER=17, BIT=0 ]
320  IODEF VAT1_L_ALARM@[         SLOT=4, REGISTER=18, BIT=0 ]
330  IODEF VAT1_LL_ALARM@[        SLOT=4, REGISTER=19, BIT=0 ]
340  !
400  IODEF VAT2_HH_ALARM@[        SLOT=4, REGISTER=16, BIT=1 ]
410  IODEF VAT2_H_ALARM@[         SLOT=4, REGISTER=17, BIT=1 ]
420  IODEF VAT2_L_ALARM@[         SLOT=4, REGISTER=18, BIT=1 ]
430  IODEF VAT2_LL_ALARM@[        SLOT=4, REGISTER=19, BIT=1 ]
440  !
500  IODEF VAT3_HH_ALARM@[        SLOT=4, REGISTER=16, BIT=2 ]
510  IODEF VAT3_H_ALARM@[         SLOT=4, REGISTER=17, BIT=2 ]
520  IODEF VAT3_L_ALARM@[         SLOT=4, REGISTER=18, BIT=2 ]
530  IODEF VAT3_LL_ALARM@[        SLOT=4, REGISTER=19, BIT=2 ]
540  !
590  IODEF CONF_AVE_SAMPLES% [              SLOT = 4, REGISTER = 26]
600  IODEF CONF_HH_ALARM%[        SLOT=4, REGISTER=27 ]
610  IODEF CONF_H_ALARM%[         SLOT=4, REGISTER=28 ]
620  IODEF CONF_L_ALARM%[         SLOT=4, REGISTER=29 ]
630  IODEF CONF_LL_ALARM%[        SLOT=4, REGISTER=30 ]
640  IODEF CONF_COMMAND%[         SLOT=4, REGISTER=31 ]
650  IODEF CONF_COMP@[            SLOT=4, REGISTER=22, BIT=15 ]
660  IODEF CONF_ERROR@[           SLOT=4, REGISTER=22, BIT=14 ]
670  IODEF CONF_CHAN_NUM%[        SLOT=4, REGISTER=23 ]
720  IODEF OUT_OF_RANGE%[         SLOT=4, REGISTER=20 ]
900  !
910  MEMDEF WARNING@
920  MEMDEF SHUTDOWN@
```

Appendix G

Module Faceplate Connections

Module Faceplate Connector Pin # (RTD Chan 0-7)	Function	
1	Channel 7	V+
2	Channel 7	I_{OUT}
3	Isolated Common*	
4	Channel 6	V+
5	Channel 6	I_{OUT}
6	Channel 5	V+
7	Channel 5	I_{OUT}
8	Channel 4	V+
9	Channel 4	I_{OUT}
10	Isolated Common*	
11	Channel 3	V+
12	Channel 3	I_{OUT}
13	Channel 2	V+
14	Channel 2	I_{OUT}
15	Channel 1	V+
16	Channel 1	I_{OUT}
17	Isolated Common*	
18	Channel 0	V+
19	Channel 0	I_{OUT}
20	Channel 7	I_{RET}
21	Channel 7	V−
22	Channel 6	I_{RET}
23	Channel 6	V−
24	Channel 5	I_{RET}
25	Channel 5	V−
26	Isolated Common*	
27	Channel 4	I_{RET}
28	Channel 4	V−
29	Channel 3	I_{RET}
30	Channel 3	V−
31	Channel 2	I_{RET}
32	Channel 2	V−
33	Isolated Common*	
34	Channel 1	I_{RET}
35	Channel 1	V−
36	Channel 0	I_{RET}
37	Channel 0	V−

*All commons are internally connected
I_{OUT} - I_{RET} are the current sources per channel.
V+ to V− are the measurement points per channel.

Appendix G

(Continued)

Module Faceplate Connector Pin # (RTD Chan 8-15)	Function	
1	Channel 15	V+
2	Channel 15	I_{OUT}
3	Isolated Common*	
4	Channel 14	V+
5	Channel 14	I_{OUT}
6	Channel 13	V+
7	Channel 13	I_{OUT}
8	Channel 12	V+
9	Channel 12	I_{OUT}
10	Isolated Common*	
11	Channel 11	V+
12	Channel 11	I_{OUT}
13	Channel 10	V+
14	Channel 10	I_{OUT}
15	Channel 9	V+
16	Channel 9	I_{OUT}
17	Isolated Common*	
18	Channel 8	V+
19	Channel 8	I_{OUT}
20	Channel 15	I_{RET}
21	Channel 15	V−
22	Channel 14	I_{RET}
23	Channel 14	V−
24	Channel 13	I_{RET}
25	Channel 13	V−
26	Isolated Common*	
27	Channel 12	I_{RET}
28	Channel 12	V−
29	Channel 11	I_{RET}
30	Channel 11	V−
31	Channel 10	I_{RET}
32	Channel 10	V−
33	Isolated Common*	
34	Channel 9	I_{RET}
35	Channel 9	V−
36	Channel 8	I_{RET}
37	Channel 8	V−

*All commons are internally connected

. I_{OUT} - I_{RET} are the current sources per channel.

V+ to V− are the measurement points per channel.

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