

Current Input Module

(M/N 61C540A)

Industrial --- **CONTROLS** ---

Instruction Manual J2-3002-2



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 MUST 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 Current Analog Input module (M/N 61C540A) allows you to connect sixteen 4-20mA current input signals to AutoMate®, AutoMax®, and DCS 5000 systems. The current input signals may be generated from process control sensors, transmitters, transducers, or drive controllers.

The module converts the input signals into digital values which are then available for use by the application program. Input circuit calibration is automatic. Parameters such as alarm limits and number of samples are user-configurable. Default configuration values are provided at power-up.

The module can be used in both local and remote racks. An external power supply is required for the current input transmitters.

This manual describes the functions and specifications of the Current Input module M/N 61C540A or earlier. The information in this manual is applicable to all versions of the module unless noted otherwise. See Appendix F. 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 Current Input module, M/N 61C540A, contains the following:

1. One Current Input module

The following items must be purchased separately:

- Panel mount terminal board and cable assembly, M/N 61C549.
One is required per module.

or

- DIN rail mount terminal board and cable assembly, M/N 61C550.
One is required per module.

The Current Input 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, 45C11 |
| DCS 5000 | M/N 57C407 |
| AutoMax | M/N 57C430, 57C431, 57C435 |
| AutoMate Remote I/O Processor | M/N 45C201B |
| DCS 5000/AutoMax Remote I/O Communication Module | M/N 45C416 |

Figure 1.1 - Current Input 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 Current 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 one 37-pin female D-shell connector socket labeled "Ch.0-15". See figure 2.1.

Analog input signals are brought into the module via a 5-foot multi-conductor cable assembly. 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 61C549 or M/N 61C550). 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.

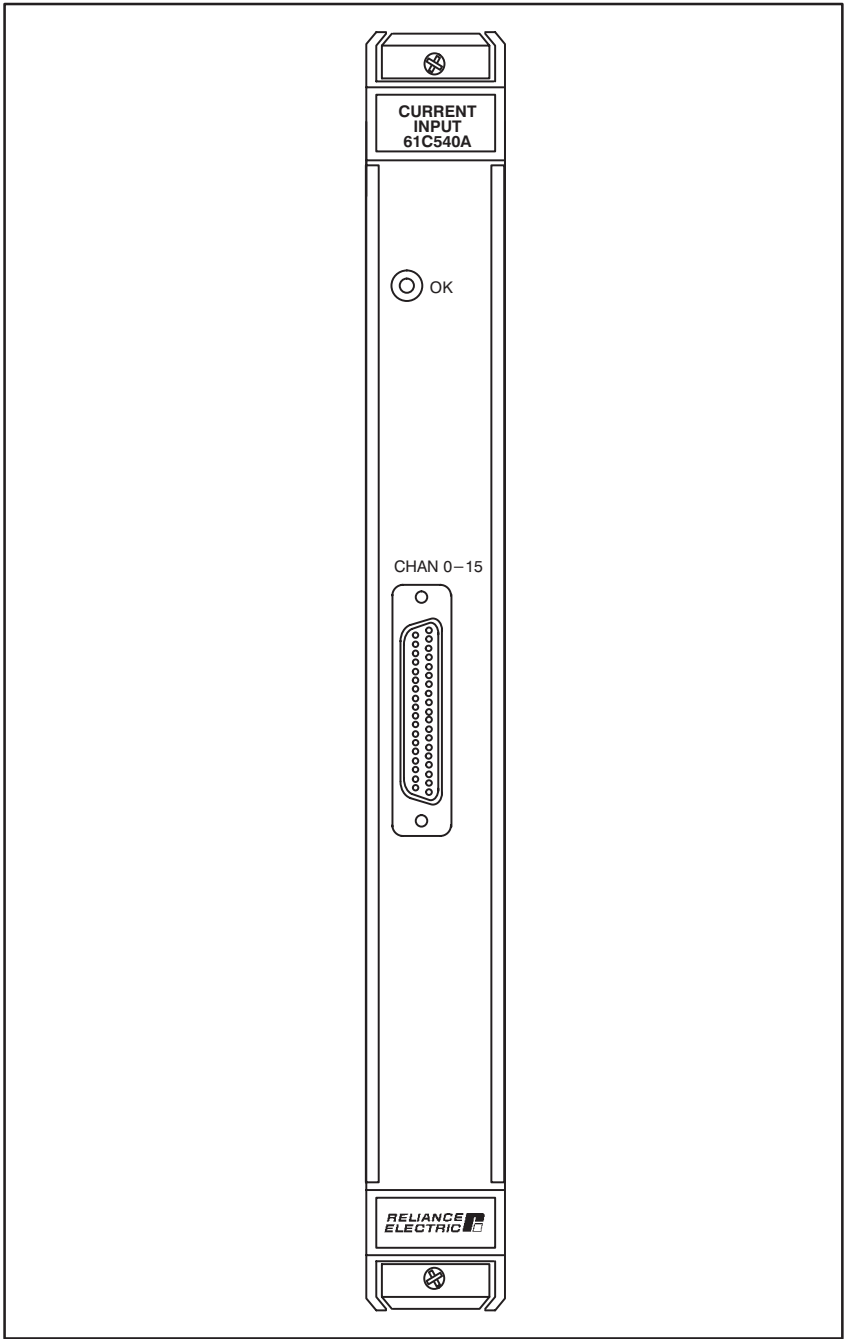


Figure 2.1 - Module Faceplate

2.2 Electrical Description

The module provides sixteen channels of 4-20 mA analog current information to AutoMax and AutoMate systems. Each channel consists of a pair of high impedance measurement inputs. The sixteen current inputs share the same common. This analog common has 2500 VAC of isolation from the system common. See figure 2.2. An external user-supplied power supply is required for the 4-20 mA transmitters. Terminal board assemblies (M/N 61C549 and 61C550) have terminals available for both a primary power supply and a backup power supply. The backup supply is optional. The two power supplies are diode-isolated as shown in figure 2.2.

The sixteen pairs of inputs are multiplexed to an instrumentation amplifier which drives a thirteen-bit plus sign bit A/D converter.

The data register (registers 0 to 15) of a configured channel is updated when the on-board processor converts and averages together approximately 166 samples (60 Hz) or 200 samples (50 Hz) of the channel input. 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 line frequency filter can be disabled on a per-channel basis via register 31 for a faster response time.

The module also contains three voltage references for A/D converter calibration. These references are checked prior to 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. 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 adjusts the reported output value per the user-selectable scaling values. If scaling values are not used, the reported output value will be in the range 0 to 4095. This value will then either be written to the appropriate channel data register (registers 0-15), or it will become part of the running average specified in register 26. If a running average is specified in register 26, the reported output value in the channel data register is the averaged data value.

The module can also be configured, on a per-channel basis, to provide square root extraction on the input signal. This provides flow information directly from differential pressure inputs.

A broken wire from a transmitter 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 high/low values have been exceeded.

All read operations on the module's memory include a parity test. Failure of the parity test results in a system 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.

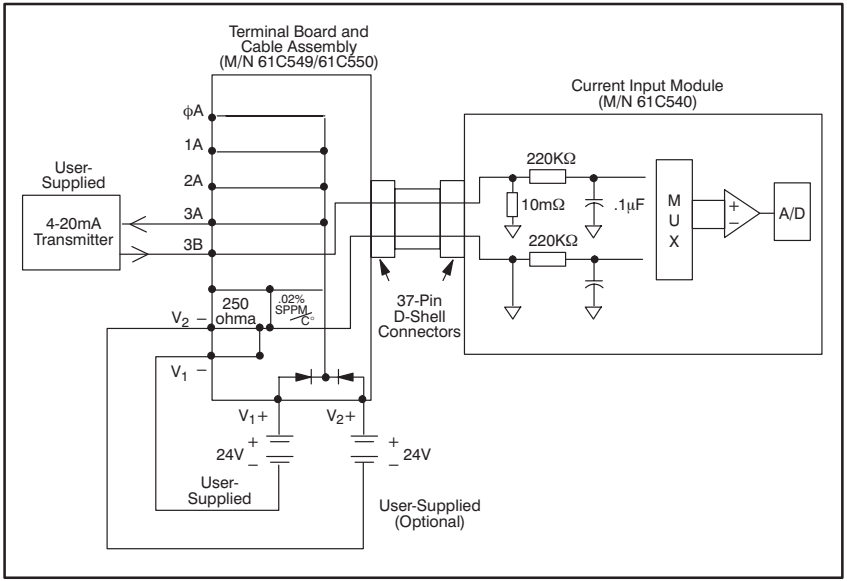


Figure 2.2 - Typical Current Input Channel

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 on a flat panel (M/N 61C549) or a DIN rail (M/N 61C550). See figure 3.1.
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 61C549 or M/N 61C550) will reach between them and the Current Input module in the rack. The cables are five feet long. See figure 3.2.

- Step 3. Fasten the wires from the transmitters to the screw-type connectors on the terminal board assemblies. Use shielded twisted-pair cable, such as Belden 9501 or equivalent. Maximum field wiring length is dependent upon the transmitters. Typical transmitter wiring connections are shown in figure 3.3. 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 transmitter field wire connections are tight.

Connect the shields of the shielded twisted-pair wires to the screw-type connectors on the terminal boards that are labeled "S". All "S" terminals are connected to the metal header labelled SHIELD. A lugged 12 AWG green wire connected from the metal header to a chassis ground will shield all of the cables including the cable assembly attached to the module faceplate. See figure 3.2.

The shields must be connected at one end only. Do not connect the shields to the transmitters. Cut the drain wire and remove the foil shielding at the transmitter end. Insulate the shield conductors at the transmitter end with heat-shrink tubing or electrical tape.

- Step 4. Take the Current Input 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 cable between the terminal board assembly 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 assembly and the module.
- Step 7. Turn on power to the system.
- Step 8. Connect the programming terminal to the system and run the ReSource Software.

Stop all programs that may be running.

Configure the current input channels you are using by following the procedure in section 4.2. You cannot monitor 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 4.1.17 for the default values.

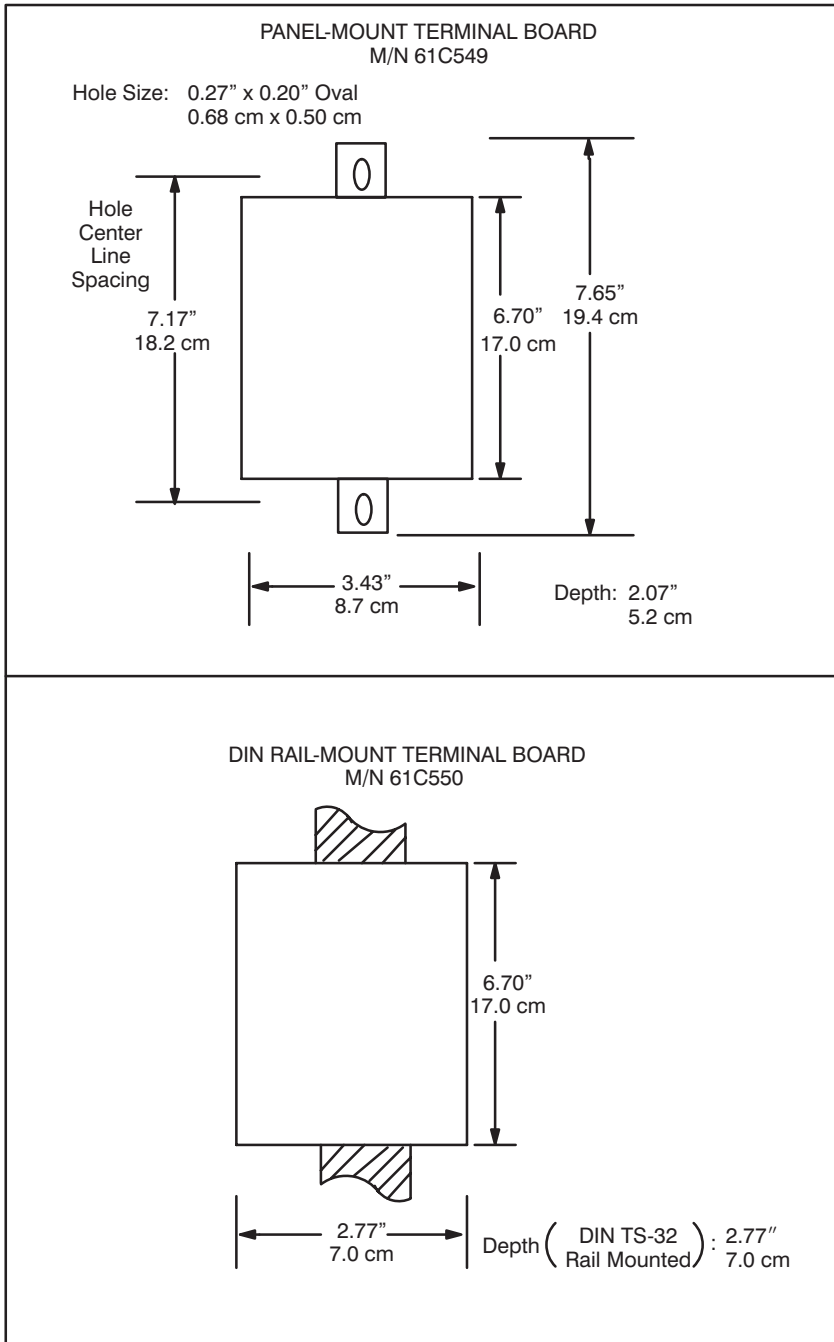


Figure 3.1 - Terminal Board Assembly Mounting Dimensions

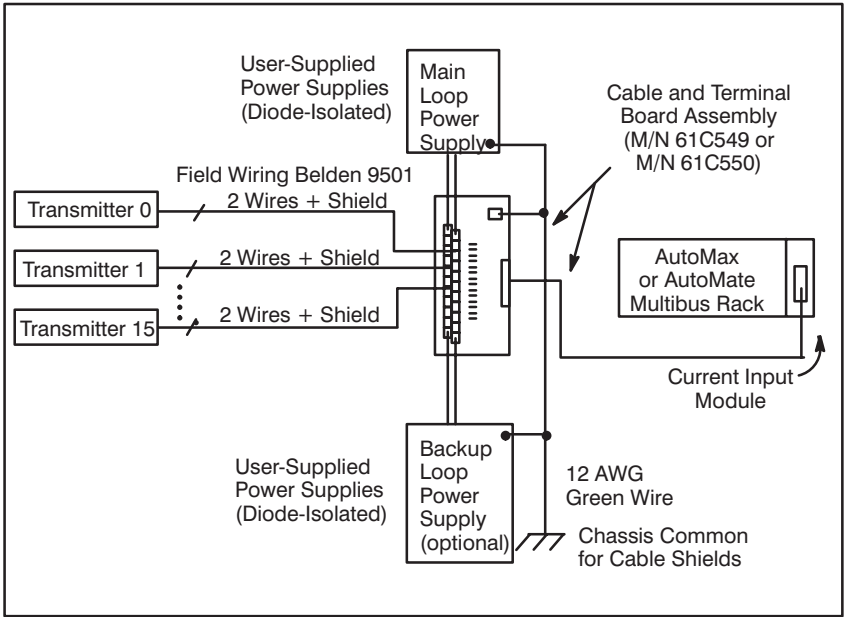


Figure 3.2 - Current Input Module Connections

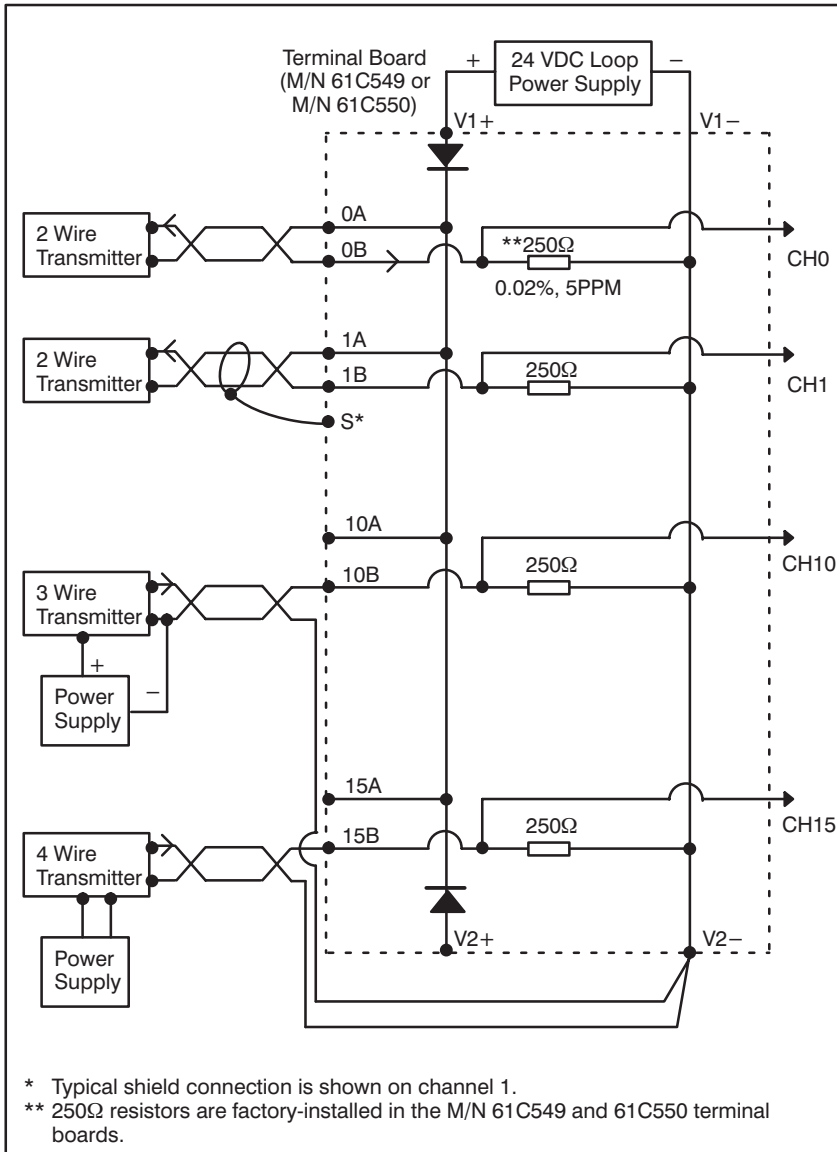


Figure 3.3 - Transmitter Wiring Connections

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

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN AC 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. Use a screwdriver to loosen the screws holding the D-shell connector to the module. Remove the D-shell connector.
- 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 connector to the module. Use a screwdriver to secure the connector 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 current input channels you are using by following the procedure in section 4.2. You cannot monitor 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 4.1.17 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 current input 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 current input 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 Current Input 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. Note that writing to a "read only" register will result in an I/O error. Table 4.2 contains a list of register 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 | Maximum Scaling Value | Read/Write |
| 25 | Minimum Scaling Value | Read/Write |
| 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 | Configuration 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 Maximum Scaling Value | 4095 |
| 25 Minimum Scaling Value | 0 |
| 26 Number of Samples | 1 |
| 27 High High Alarm | 4094 |
| 28 High Alarm | 4085 |
| 29 Low Alarm | 10 |
| 30 Low Low Alarm | 1 |
| 31 Configuration Command | |
| Bits 1 and 0 | Retain old input value |
| Bits 5 to 2 | Reserved |
| Bit 6 | Enable line frequency averaging |
| Bit 7 | Disable square root extraction |
| Bits 11 to 8 | 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 configured analog current input channels 0 to 15. This data has been filtered (50 or 60 Hz filters) and, if the cycle averaging option has been enabled, averaged together. See figure 4.1. The data is in 15-bit signed integer format. The data is displayed in engineering units specified by the Maximum Scaling Value (register 24) and Minimum Scaling Value (register 25). Unscaled values will range from 0 to 4095. If a channel is not configured, its data is held at zero.

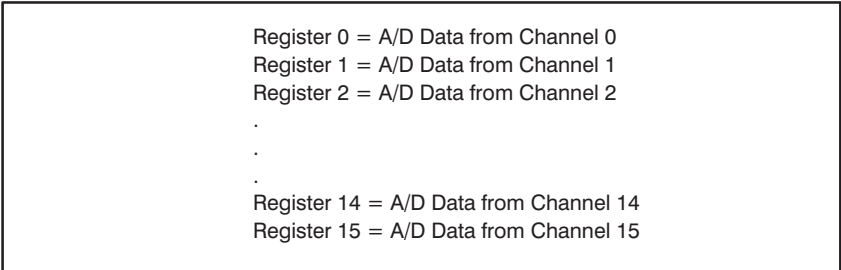


Figure 4.1 - A/D Data Register Assignments

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 or equal to the configured limit.

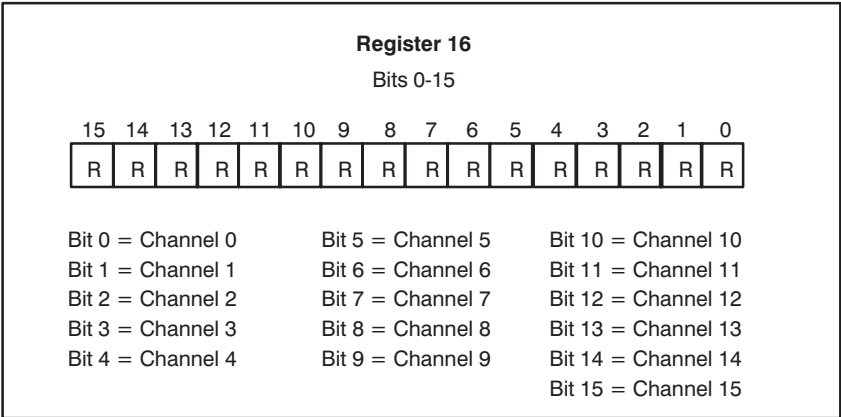


Figure 4.2 - High High Alarm Status Register

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 or equal to the configured limit.

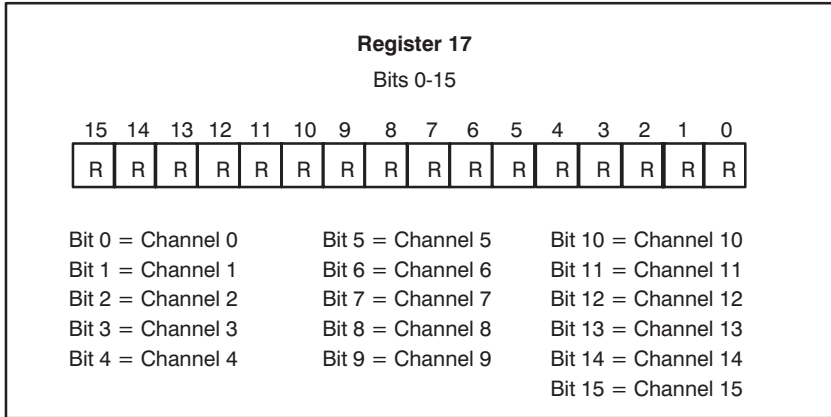


Figure 4.3 - High Alarm Status Register

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 equal to or above the configured limit.

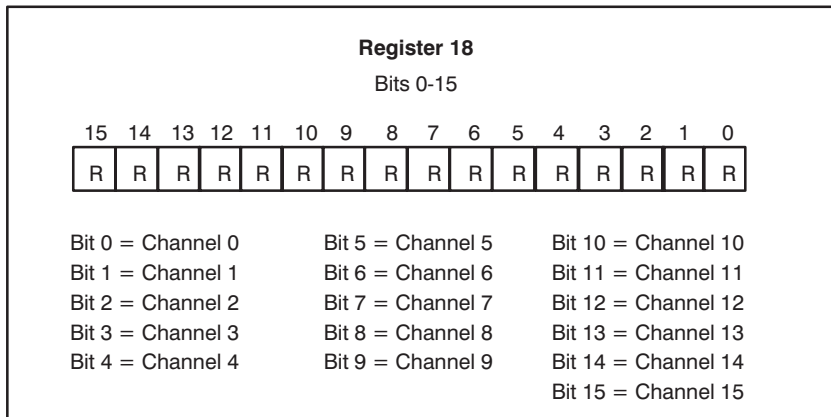


Figure 4.4 - Low Alarm Status Register

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 equal to or above the configured limit.

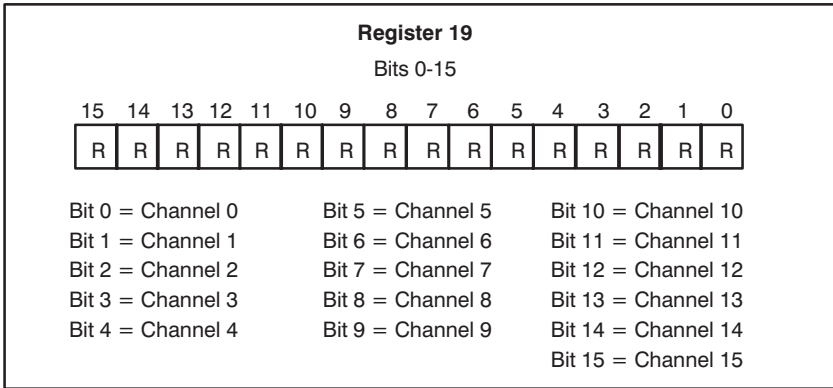


Figure 4.5 - Low Low Alarm Status Register

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 is outside of the range of 3.7 mA to 20.3 mA. 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 transmitter and the module has either not been properly connected or has been broken.

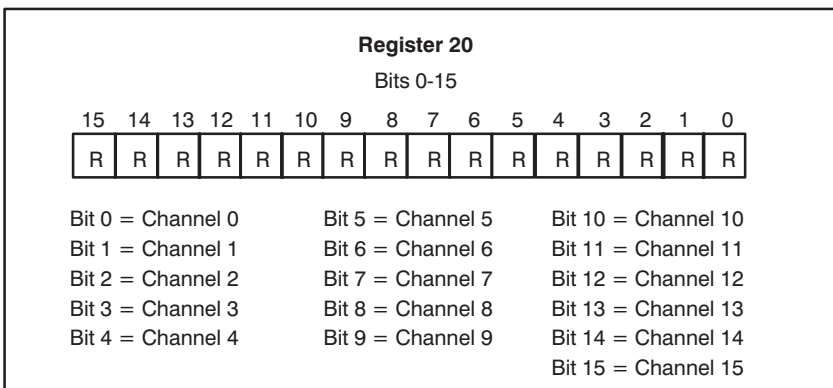


Figure 4.6 - Out of Range Status Register

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.

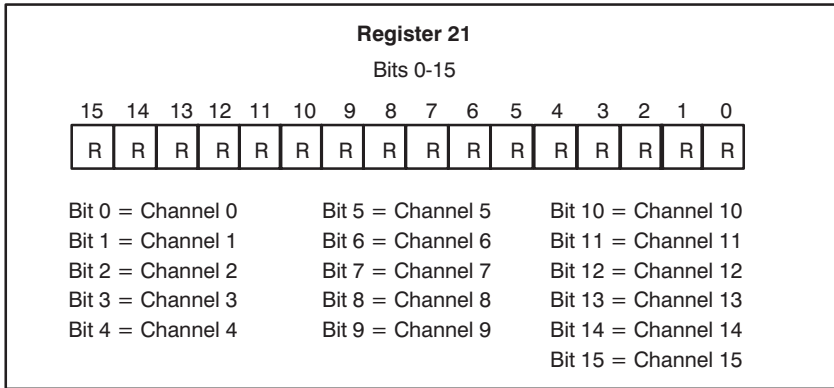


Figure 4.7 - Channel Configuration Status Register

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.

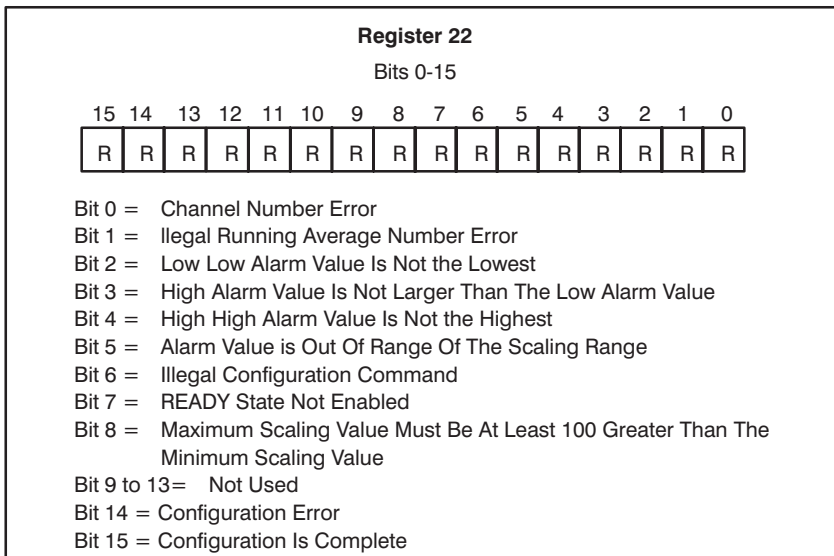


Figure 4.8 - Configuration Status Register

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 Current Input 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 in register 22.

4.1.10 Maximum Scaling Value Register (Register 24)

Register 24 defines the upper limit value of the input data. The module uses this value to perform a linear conversion of the input data (in an unscaled range of 0 to 4095) into engineering units. The value in register 24 must be at least 100 greater than the value in register 25 or a configuration error will result in register 22.

The value in register 24 is a 15-bit signed integer (–32768 to 32767). At system power-up, register 24 is set to a value of 4095. If you want the input value to be in a scaled format, you can change the value in either registers 24 or 25, or both. If you do not change the values in registers 24 and 25, the input value is sent to the appropriate configured channel data register (0 to 15) in an unscaled format.

4.1.11 Minimum Scaling Value Register (Register 25)

Register 25 defines the lower limit value of the input data. The module uses this value to perform a linear conversion of the input data (in an unscaled range of 0 to 4095) into engineering units. The value in register 25 must be at least 100 less than the value in register 24 or a configuration error will result in register 22.

The value in register 25 is a 15-bit signed integer (-32768 to 32767). At system power-up, register 25 is set to a value of 0. If you want the input value to be in a scaled format, you can change the value in either registers 24 or 25, or both. If you do not change the values in registers 24 and 25, the input value is sent to the appropriate configured channel data register (0 to 15) in an unscaled format.

4.1.12 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 signed 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 or a number greater than 60, a configuration error will result in register 22.

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.

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

Where:

of configured channels that have cycle averaging enabled = 1-16

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

system overhead = 5 msec

of samples = 1-60

averaged time = time in seconds

Figure 4.9 - Equation for Determining the Input Value Averaging Time

4.1.13 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 signed integer. This value must be in engineering units if scaling is used. If scaling is used, this value must be equal to or smaller than the Maximum Scaling Value (register 24) and larger than the Minimum Scaling Value (register 25). Unscaled data can range from 0 to 4095.

If register 27 does not contain an alarm value greater than or equal to the High alarm value, a configuration error will result in register 22. At power-up, the register is set to a default value of 4094.

4.1.14 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 signed integer. This value must be in engineering units if scaling is used. If scaling is used, this value must be equal to or smaller than the Maximum Scaling Value (register 24) and larger than the Minimum Scaling Value (register 25). Unscaled data can range from 0 to 4095.

If register 28 does not contain an alarm value greater than the Low alarm value, a configuration error will result in register 22. At power-up, the register is set to a default value of 4085.

4.1.15 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 signed integer. This value must be in engineering units if scaling is used. If scaling is used, this value must be smaller than the Maximum Scaling Value (register 24) and equal to or larger than the Minimum Scaling Value (register 25). Unscaled data can range from 0 to 4095.

If register 29 does not contain an alarm value less than the High alarm value, a configuration error will result in register 22. At power-up, the register is set to a default value of 10.

4.1.16 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 signed integer. This value must be in engineering units if scaling is used. If scaling is used, this value must be smaller than the Maximum Scaling Value (register 24) and equal to or larger than the Minimum Scaling Value (register 25). Unscaled data can range from 0 to 4095.

If register 30 does not contain an alarm value lower than or equal to the Low alarm value, a configuration error will result in register 22. At power-up, the register is set to a default value of 1.

4.1.17 Configuration Command Register (Register 31)

Register 31 defines what action should be taken if an input value is out of range, line frequency averaging, the average A-C line frequency, and square root extraction. The register also contains the Configuration Command Code. See figure 4.10.

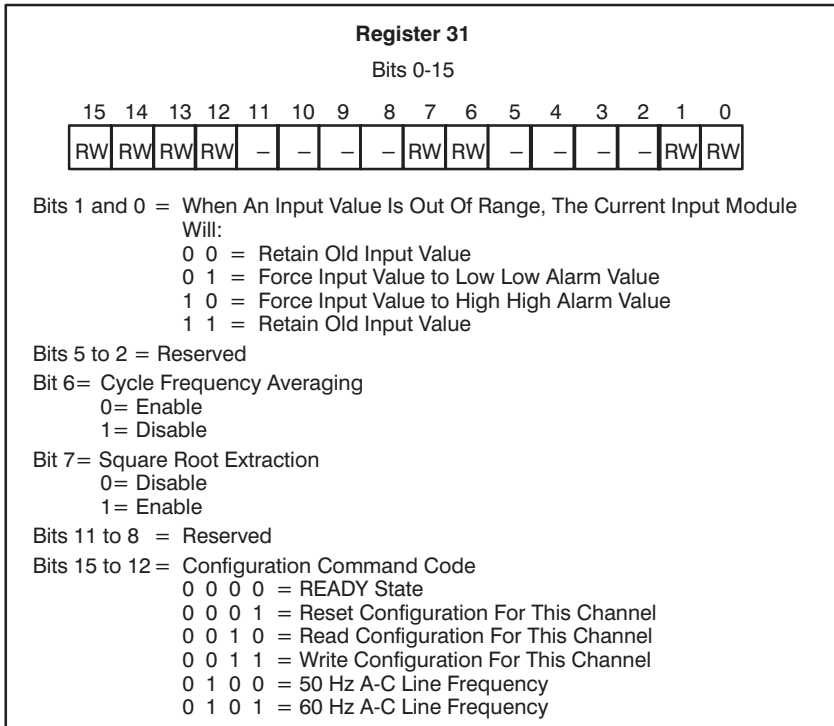


Figure 4.10 - Configuration Command Register

When configuring a channel, you must define values for registers 23 through 30 before placing a value in register 31. Register 31 must be the last register that you place a value in 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 receive another command. If you attempt to enter another command before resetting bits 12 to 15 of register 31, a configuration error will result in register 22.

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 channel data registers (0 to 15).

Bits 2 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.

Bit 7 defines whether or not square root extraction is enabled for the channel specified in register 23. The default condition (0) disables square root extraction. The square root function provides flow information directly from a differential pressure input.

If the specified channel has square root extraction enabled and does not use engineering units, the flow information provided is in the range of 0 to 4095. The data returned represents the following ratio:

$$\frac{\text{Data}}{4095} = \frac{\text{Flow}}{\text{Flow (Maximum)}}$$

Set the Maximum Scaling Register (register 24) to 10000 in order to read the flow information in steps of 0.01%:

$$\frac{\text{Data}}{10000} = \frac{\text{Flow}}{\text{Flow (Maximum)}}$$

You can also set register 24 to the maximum flow value which will allow a direct indication of flow.

Bits 8 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 value of 1, 2, or 3, their operations refer to the channel specified in register 23:

- A binary value of 1 (RESET) resets the channel's configuration by clearing its corresponding data register (registers 0-15) and resetting its bit in the status registers (registers 16-21).
- A binary value of 2 (READ) locates the channel's current configuration information in memory and loads it into registers 24 to 31.
- A binary value of 3 (WRITE) transfers the channel's configuration information (registers 24 to 31) 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 value of 4 or 5, they reflect the A-C power line frequency. The default is 60 Hz.

4.2 Analog Input Channel Configuration Procedure

Analog input channel configuration information is stored on-board the Current Input 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 Current Input module is in the READY state and then place a value in registers 23 through 31 for each analog input channel you wish to configure:

- Channel Number Register (Register 23)
- Maximum Scaling Value (Register 24)
- Minimum Scaling Value (Register 25)
- 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)
- Configuration Command Register (Register 31)

After you have placed values in registers 23 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 23 through 30. Note that the channels on the Current Input module must be configured from only one application program.

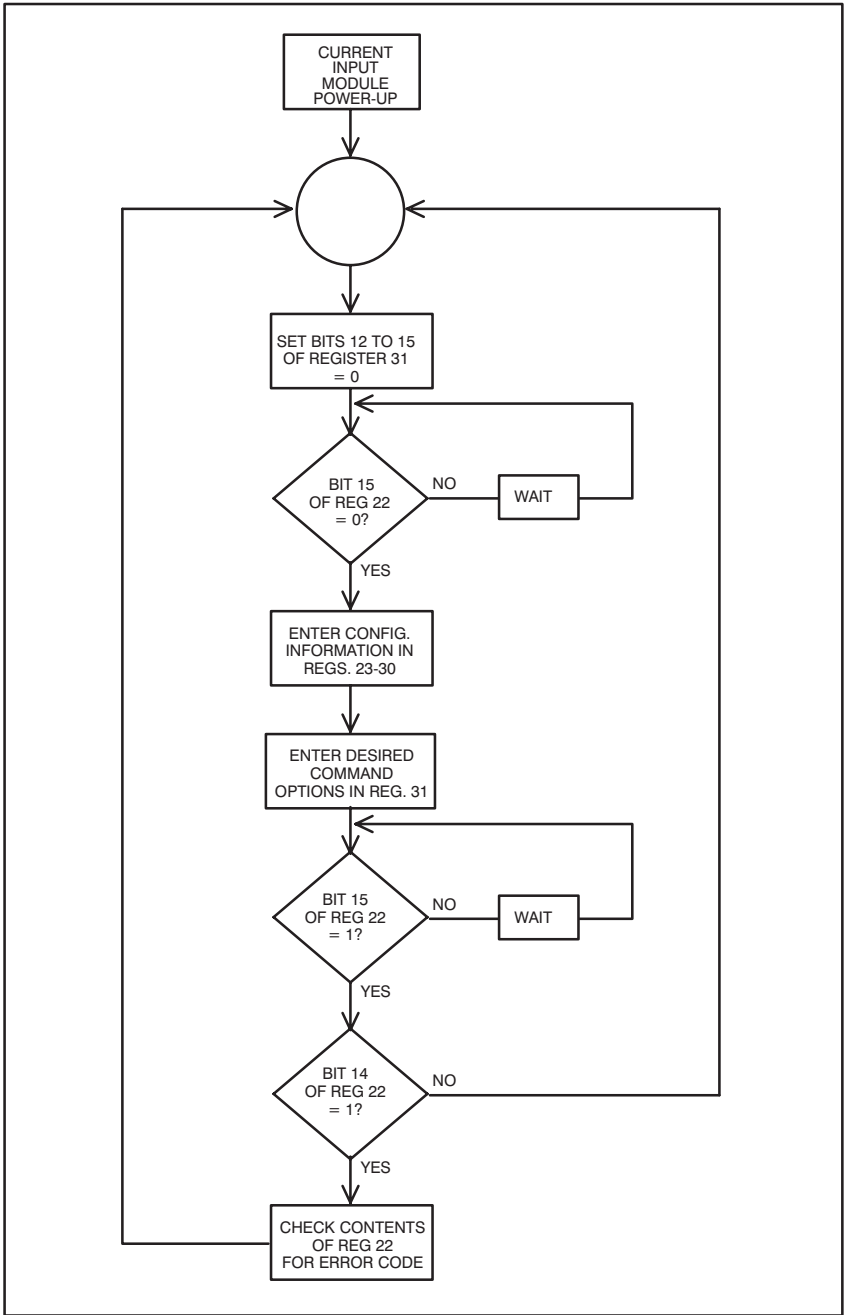


Figure 4.11 - Channel Configuration Flowchart

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. Monitor bit 15 until it is equal to zero before continuing with Step 2.
- Step 2. Select the channel to be configured by placing the appropriate number in the Channel Number Register (Register 23). This value is a 15-bit signed integer. See section 4.1.9 for more information.
- Step 3. Define the channel's Maximum Scaling Value by placing the desired value in the Maximum Scaling Value Register (Register 24). This value is a 15-bit signed integer. See section 4.1.10 for more information.
- Step 4. Define the channel's Minimum Scaling Value by placing the desired value in the Minimum Scaling Value Register (Register 25). This value is a 15-bit signed integer. See section 4.1.11 for more information.
- Step 5. Define the number of input data samples that are to be averaged together for the input running average value. Place the desired number in the Number of Samples Register (Register 26). This value is a 15-bit signed integer. See section 4.1.12 for more information.
- Step 6. Define the channel's High High alarm limit by placing the desired value in the High High Alarm Register (Register 27). This alarm value is a 15-bit signed integer. See section 4.1.13 for more information.
- Step 7. Define the channel's High alarm limit by placing the desired value in the High Alarm Register (Register 28). This alarm value is a 15-bit signed integer. See section 4.1.14 for more information.
- Step 8. Define the channel's Low alarm limit by placing the desired value in the Low Alarm Register (Register 29). This alarm value is a 15-bit signed integer. See section 4.1.15 for more information.
- Step 9. Define the channel's Low Low alarm limit by placing the desired value in the Low Low Alarm Register (Register 30). This alarm value is a 15-bit signed integer. See section 4.1.16 for more information.
- Step 10. Enter the required information in the Configuration Command Register (Register 31). See section 4.1.17 for more information. Set the Configuration Command Code (bits 12 to 15) equal to three. This code transfers (writes) the channel's parameters into memory.
- Step 11. When the module finishes processing the write configuration operation, it will set bit 15 of register 22 equal to one. Monitor bit 15 until it is set to one.
- Step 12. Monitor bit 14 of register 22. If this bit is equal to zero the module is ready to configure another channel. To configure another channel repeat the procedure beginning with step 1. If bit 14 is equal to one, check the error code in register 22.

4.3 Monitoring Data and Configuration Register Values

Run the ReSource 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 Current Input Application Task

The sample DCS 5000/AutoMax current input application task in figure 4.12 is written for a Current Input module in slot 2 which is connected to three 4-20 mA transmitters which are wired into a pressure polymerization process.

One transmitter is used to sense the level of the material in the reactor. The second transmitter has its span calibrated for 0 to 3000 psig (gauge pounds-per-square inch) and is used during startup operation. The third transmitter has its span calibrated for 1940 to 1960 psig and is used for process control.

Channel 0: Material Level

Process Parameters

- Maximum = 20 feet
- Minimum = - 1 feet
- High High Alarm = 18 feet
- High Alarm = 16 feet
- Low Alarm = 4 feet
- Low Low Alarm = 0 feet

Configuration Values

- Reg. 24 = 2000 (Scaled in 0.01 Ft)
- Reg. 25 = -100
- Reg. 27 = 1800
- Reg. 28 = 1600
- Reg. 29 = 400
- Reg. 30 = 0

Channel 1: Startup Pressure

Process Parameters

- Maximum = 3000 psig
- Minimum = 0 psig
- High High Alarm = 2500 psig
- High Alarm = 2000 psig
- Low Alarm = 500 psig
- Low Low Alarm = 250 psig

Configuration Values

- Reg. 24 = 3000 (Scaled directly in psig)
- Reg. 25 = 0
- Reg. 27 = 2500
- Reg. 28 = 2000
- Reg. 29 = 500
- Reg. 30 = 250

Channel 2: Operating Pressure

Process Parameters

- Maximum = 1960 psig
- Minimum = 1940 psig
- High High Alarm = 1958 psig
- High Alarm = 1955 psig
- Low Alarm = 1945 psig
- Low Low Alarm = 1942 psig

Configuration Values

- Reg. 24 = 10000 (Scaled in 0.01% of span)
- Reg. 25 = 0
- Reg. 27 = 9000
- Reg. 28 = 7500
- Reg. 29 = 2500
- Reg. 30 = 1000

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

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

```

10 ! September 20, 1991
20 !
30 ! This task configures three channels:
40 ! Channel 0 monitors the level of a liquid in a tank
45 ! Channel 1 monitors the startup pressure of a process
50 ! Channel 2 monitors the operating pressure of a process
55 ! If any configuration fails, SHUTDOWN@ is set
60 !
65 ! This task checks for alarms once per second.
70 ! If any channel has an out of range status condition, &
! SHUTDOWN@ is set
75 ! If any channel has a high or low alarm, WARNING@ is set
80 ! If any channel has a high-high or low-low alarm, &
! SHUTDOWN@ is set
90 !
100 ! ***** LOCAL VARIABLES *****
110 !
120 LOCAL CHANNEL%
130 !
200 ! ***** COMMON VARIABLES *****
210 !
220 COMMON TANK_LEVEL%          \! Tank level read by the CIM card
230 COMMON START_PROCESS%      \! Pressure read by the CIM card &
!                               \! during the startup process
240 COMMON OP_PROCESS%        \! Pressure read by the CIM card &
!                               \! during the operation process
245 !
300 COMMON TANK_HH_ALARM@     \! Tank high-high alarm status
310 COMMON TANK_H_ALARM@      \! Tank high alarm status
320 COMMON TANK_L_ALARM@      \! Tank low alarm status
330 COMMON TANK_LL_ALARM@     \! Tank low-low alarm status
340 !
400 COMMON START_HH_ALARM@    \! High-high alarm status during the &
!                               \! startup process
410 COMMON START_H_ALARM@     \! High alarm status during the &
!                               \! startup process
420 COMMON START_L_ALARM@     \! Low alarm status during the &
!                               \! startup process
430 COMMON START_LL_ALARM@    \! Low-low alarm status during the &
!                               \! startup process
440 !
500 COMMON OP_HH_ALARM@       \! High-high alarm status during &
!                               \! the operation process
510 COMMON OP_H_ALARM@        \! High alarm status during the &
!                               \! operation process
520 COMMON OP_L_ALARM@        \! Low alarm status during the &
!                               \! operation process
530 COMMON OP_LL_ALARM@       \! Low-low alarm status during the &
!                               \! operation process
540 !
600 COMMON CNF_CHAN_NUM%      \! Channel number (Register 23)
610 COMMON CNF_MAX%           \! Maximum scaling value (Register 24)
620 COMMON CNF_MIN%           \! Minimum scaling value (Register 25)
630 COMMON CNF_AVE_SAMPLE%    \! Number of running average samples (Register 26)
640 COMMON CNF_HH_ALARM%      \! High-high alarm value (Register 27)
650 COMMON CNF_H_ALARM%       \! High alarm value (Register 28)
660 COMMON CNF_L_ALARM%       \! Low alarm value (Register 29)
670 COMMON CNF_LL_ALARM%      \! Low-low alarm value (Register 30)
680 COMMON CNF_COMMAND%       \! Configuration command (Register 31)
690 COMMON CNF_COMP@          \! Configuration complete (Register 22, bit 15)
700 COMMON CNF_ERROR@         \! True if configuration error occurs (Register 22, bit 14)
710 COMMON WARNING@           \! True if any channel has a high or &
!                               \! low alarm
720 COMMON SHUTDOWN@          \! True if any channel has a low-low &
!                               \! or high-high alarm or an out-of- &
!                               \! range or configuration error
730 COMMON OUT_OF_RANGE%      \! Non-zero if any channel output &
!                               \! value is out of range

```

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

```

990 !
1000 ! ***** INITIALIZATION *****
1010 !
1020 ! Configure the first three channels using the data          &
! statements at 8000.
1030 !
1100 FOR CHANNEL% = 0 TO 2
! Reset the configuration register
1110 CNF_COMMAND% = 0000H
1120 ! Wait for the config complete flag to be reset
1130 IF CNF_COMP@ = FALSE THEN GOTO 1180
1140 DELAY 10 TICKS
1150 GOTO 1140
1160 ! Specify the channel to be configured
1170 CNF_CHAN_NUM% = CHANNEL%
1180 ! Specify the max scaling, min scaling, high-high, high,    &
! low, low-low alarm values
1190 READ CNF_MAX%, CNF_MIN%, CNF_AVE_SAMPLE%, CNF_HH_ALARM%,    &
CNF_H_ALARM%, CNF_L_ALARM%, CNF_LL_ALARM%
1200 ! Send the WRITE configuration command that specifies        &
! retaining the old value for the out of range mode and        &
! enabling cycle averaging, and disabling square root extraction &
1210 CNF_COMMAND% = 3000H
1220 ! Wait for the config complete flag to be set
1230 IF CNF_COMP@ = TRUE THEN GOTO 1290
1240 DELAY 10 TICKS
1250 GOTO 1250
1260 ! Check for an error configuring the channel
1270 IF CNF_ERROR@ = TRUE THEN SHUTDOWN@ = TRUE
1280 NEXT CHANNEL%
1290
8000 !
8010 ! Max Min Run High High Low Low
8020 ! Scaling Scaling Aver High High Low Low
8030 DATA 2000, -100, 20, 1800, 1600, 400, 0
8040 DATA 3000, 0, 20, 2500, 2000, 500, 250
8050 DATA 10000, 0, 20, 9000, 7500, 2500, 1000
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 tank or startup process or operation process has    &
! high or low alarm, set warning flag
11030 !
11040 IF TANK_H_ALARM@ OR START_H_ALARM@ OR OP_H_ALARM@ OR    &
TANK_L_ALARM@ OR START_L_ALARM@ OR OP_L_ALARM@ THEN & WARNING@ = TRUE
12000 !
12010 ! If tank or startup process or operation process has a    &
! high-high or low-low alarm, set the shutdown flag
12030 !
12040 IF TANK_HH_ALARM@ OR START_HH_ALARM@ OR OP_HH_ALARM@ OR    &
TANK_LL_ALARM@ OR START_LL_ALARM@ OR OP_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 Current Input Application Task
(Continued)

4.5 Sample AutoMate Current Input Application Program

The sample AutoMate current input application program in figure 4.13 is written for a Current Input 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 Current Input module is in a local rack, LOCIN/LOCOUT commands would replace the REMIN/REMOU commands. Refer to the A30/A40 Software Reference Manual (J-3150) for additional information.

In the sample AutoMate program, the Current Input module is connected to three 4-20 mA transmitters which are wired into a pressure polymerization process.

One transmitter is used to sense the level of the material in the reactor. The second transmitter has its span calibrated for 0 to 3000 psig (gauge pounds-per-square inch) and is used during startup operation. The third transmitter has its span calibrated for 1940 to 1960 psig and is used for process control.

Channel 0: Material Level

| <u>Process Parameters</u> | <u>Configuration Values</u> |
|-----------------------------|------------------------------------|
| ● Maximum = 20 feet | Reg. 24 = 2000 (Scaled in 0.01 Ft) |
| ● Minimum = - 1 feet | Reg. 25 = -100 |
| ● High High Alarm = 18 feet | Reg. 27 = 1800 |
| ● High Alarm = 16 feet | Reg. 28 = 1600 |
| ● Low Alarm = 4 feet | Reg. 29 = 400 |
| ● Low Low Alarm = 0 feet | Reg. 30 = 0 |

Channel 1: Startup Pressure

| <u>Process Parameters</u> | <u>Configuration Values</u> |
|-------------------------------|--|
| ● Maximum = 3000 psig | Reg. 24 = 3000 (Scaled directly in psig) |
| ● Minimum = 0 psig | Reg. 25 = 0 |
| ● High High Alarm = 2500 psig | Reg. 27 = 2500 |
| ● High Alarm = 2000 psig | Reg. 28 = 2000 |
| ● Low Alarm = 500 psig | Reg. 29 = 500 |
| ● Low Low Alarm = 250 psig | Reg. 30 = 250 |

Channel 2: Operating Pressure

| <u>Process Parameters</u> | <u>Configuration Values</u> |
|-------------------------------|---|
| ● Maximum = 1960 psig | Reg. 24 = 10000 (Scaled in 0.01% of span) |
| ● Minimum = 1940 psig | Reg. 25 = 0 |
| ● High High Alarm = 1958 psig | Reg. 27 = 9000 |
| ● High Alarm = 1955 psig | Reg. 28 = 7500 |
| ● Low Alarm = 1945 psig | Reg. 29 = 2500 |
| ● Low Low Alarm = 1942 psig | Reg. 30 = 1000 |

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 current input High High alarms
- Register 11 = Register contains the coils corresponding to the status of the current input High alarms
- Register 12 = Register contains the coils corresponding to the status of the current input Low alarms
- Register 13 = Register contains the coils corresponding to the status of the current input Low Low alarms
- Register 1600 = Internal coils
- Register 1601 = Internal coils
- Register 1610 = The register's bits are used to indicate the current state of operation.
 - Bit .00 represents state 0 which writes the READY command to the Current Input 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 it out to the Current Input module. State 1 then reads the Current Input 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 three of the current input channels have been configured.
- Register 1611 = Register is loaded by the REMIN instruction which contains the contents of the Configuration Status Register (Register 22).
- Register 3000 = Register contains the pointer to the data that is to be written to the Current Input module.
- Register 3001 = Register contains the current input channel number that is being configured.
- Register 3002 = Register contains the current input channel's Maximum Scaling Value. This value is provided by the data table in the 5000-series registers.
- Register 3003 = Register contains the current input channel's Minimum Scaling Value. This value is provided by the data table in the 5000-series registers.
- Register 3004 = Register contains the current input channel's Number of Samples. This value is provided by the data table in the 5000-series registers.

- Register 3005 = Register contains the current input channel's High High alarm value. This value is provided by the data table in the 5000-series registers.
- Register 3006 = Register contains the current input channel's High alarm value. This value is provided by the data table in the 5000-series registers.
- Register 3007 = Register contains the current input channel's Low alarm value. This value is provided by the data table in the 5000-series registers.
- Register 3010 = Register contains the current input channel's Low Low alarm value. This value is provided by the data table in the 5000-series registers.
- Register 3011 = Register contains the current input 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 Current Input module.
- Registers 5000 to 5027 = Registers contain the data used to configure the current input channels. Each channel uses eight registers:

| | Max. Scale | Min. Scale | Average Samples | High High | High | Low | Low Low | Config. Command |
|-------------|-------------------|-------------------|------------------------|------------------|-------------|------------|----------------|------------------------|
| Reg. 5000 = | 2000 | -100 | 20 | 1800 | 1600 | 400 | 0 | 12288* |
| Reg. 5010 = | 3000 | 0 | 20 | 2500 | 2000 | 500 | 250 | 12288 |
| Reg. 5020 = | 10000 | 0 | 20 | 9000 | 7500 | 2500 | 1000 | 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.

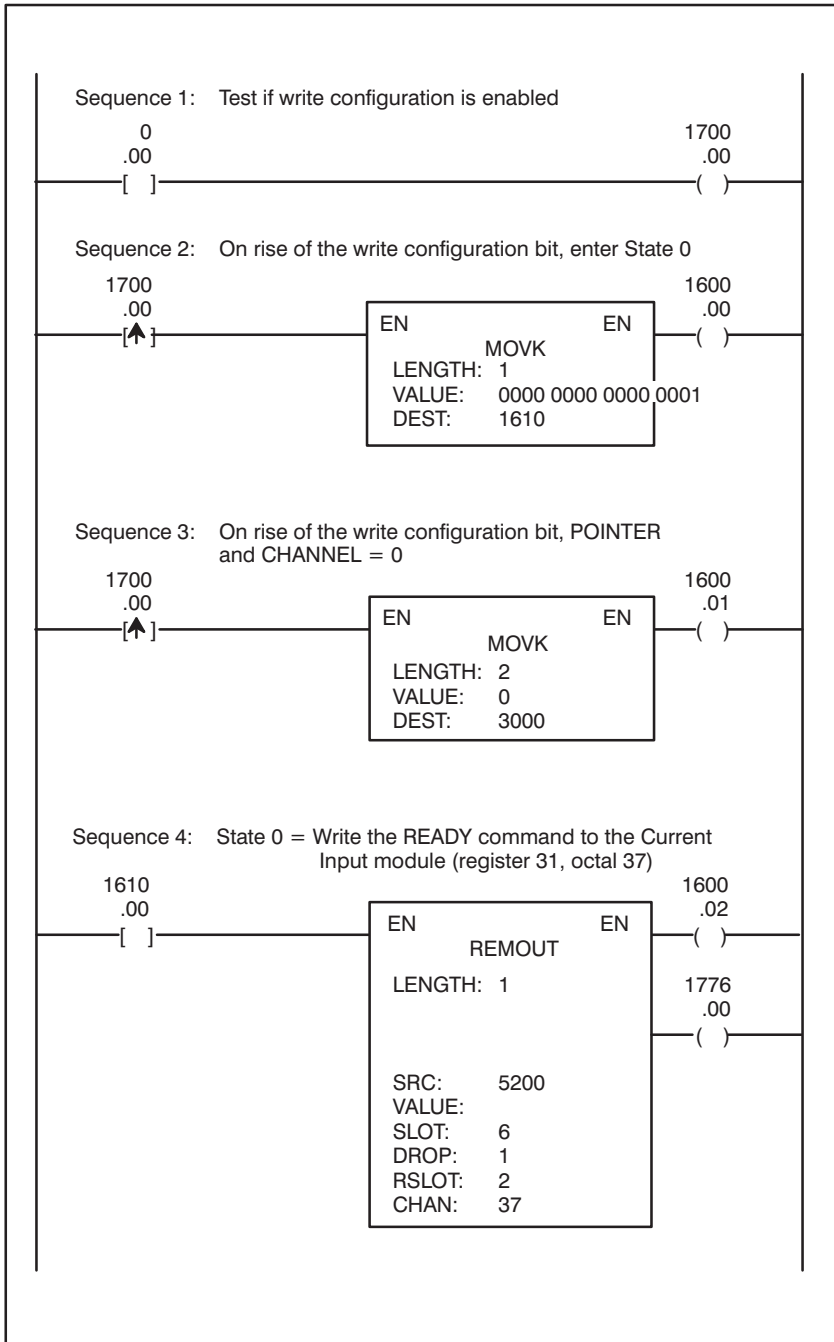


Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

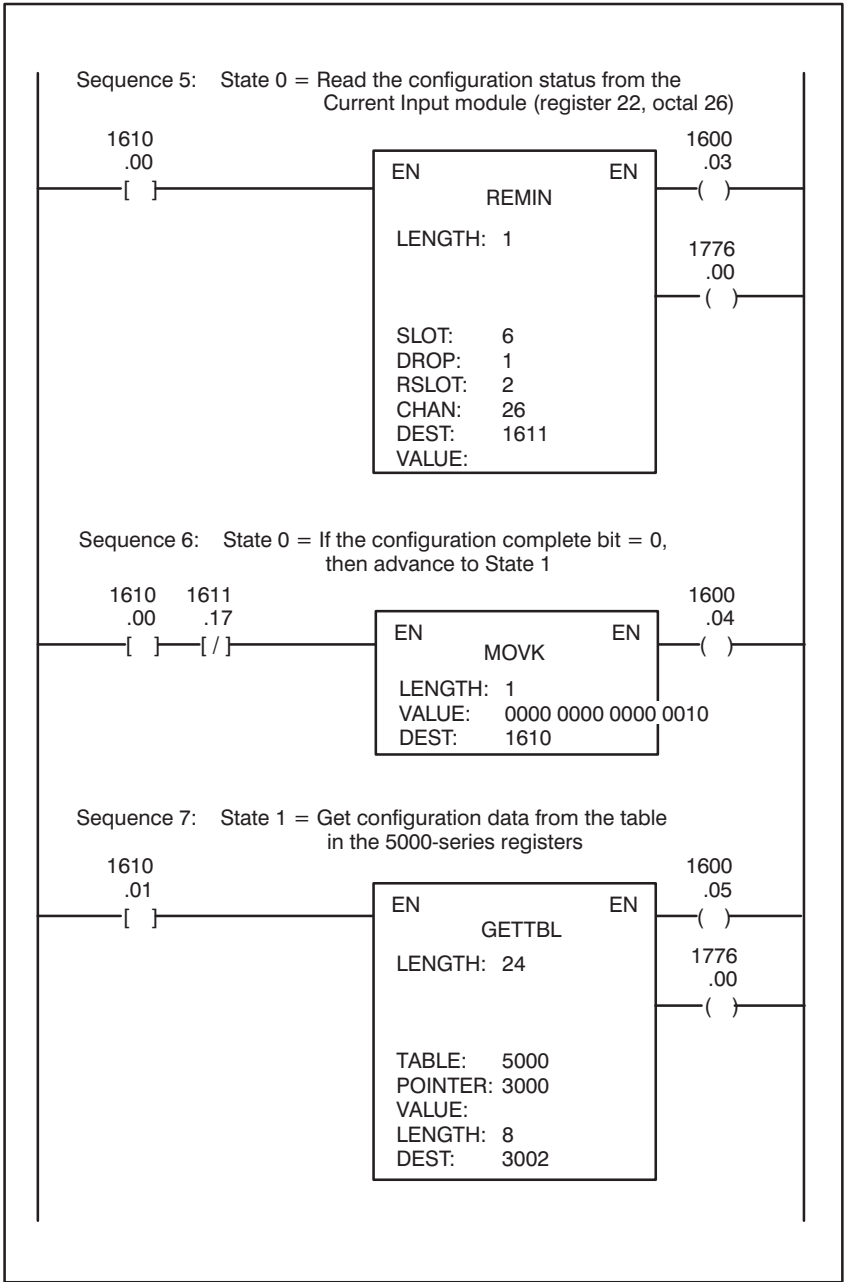


Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

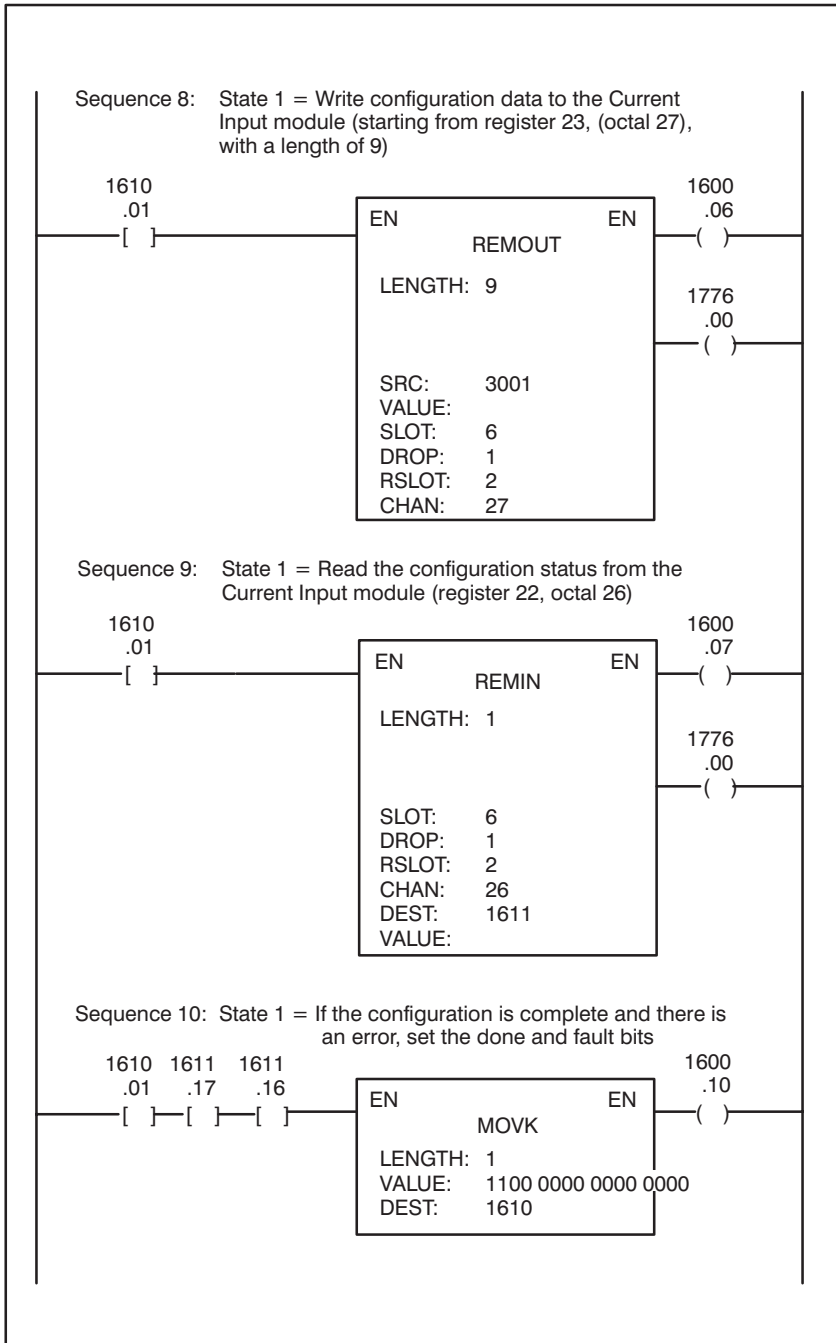
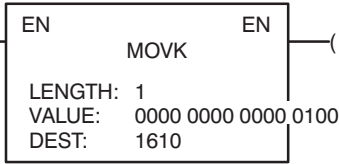


Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

Sequence 11: State 1 = If the configuration is complete and there is no error, advance to State 2

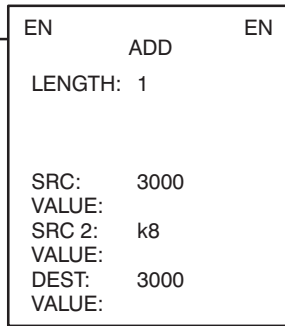
1610 .01 []
 1611 .17 []
 1611 .16 [/]



1600 .11 ()

Sequence 12: State 2 = Point to the next set of configuration data

1610 .02 []

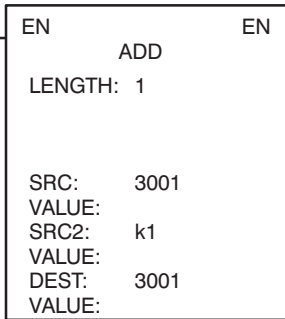


1600 .12 ()

1776 .00 ()

Sequence 13: State 2 = Increment channel number

1610 .02 []



1600 .13 ()

1776 .00 ()

Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

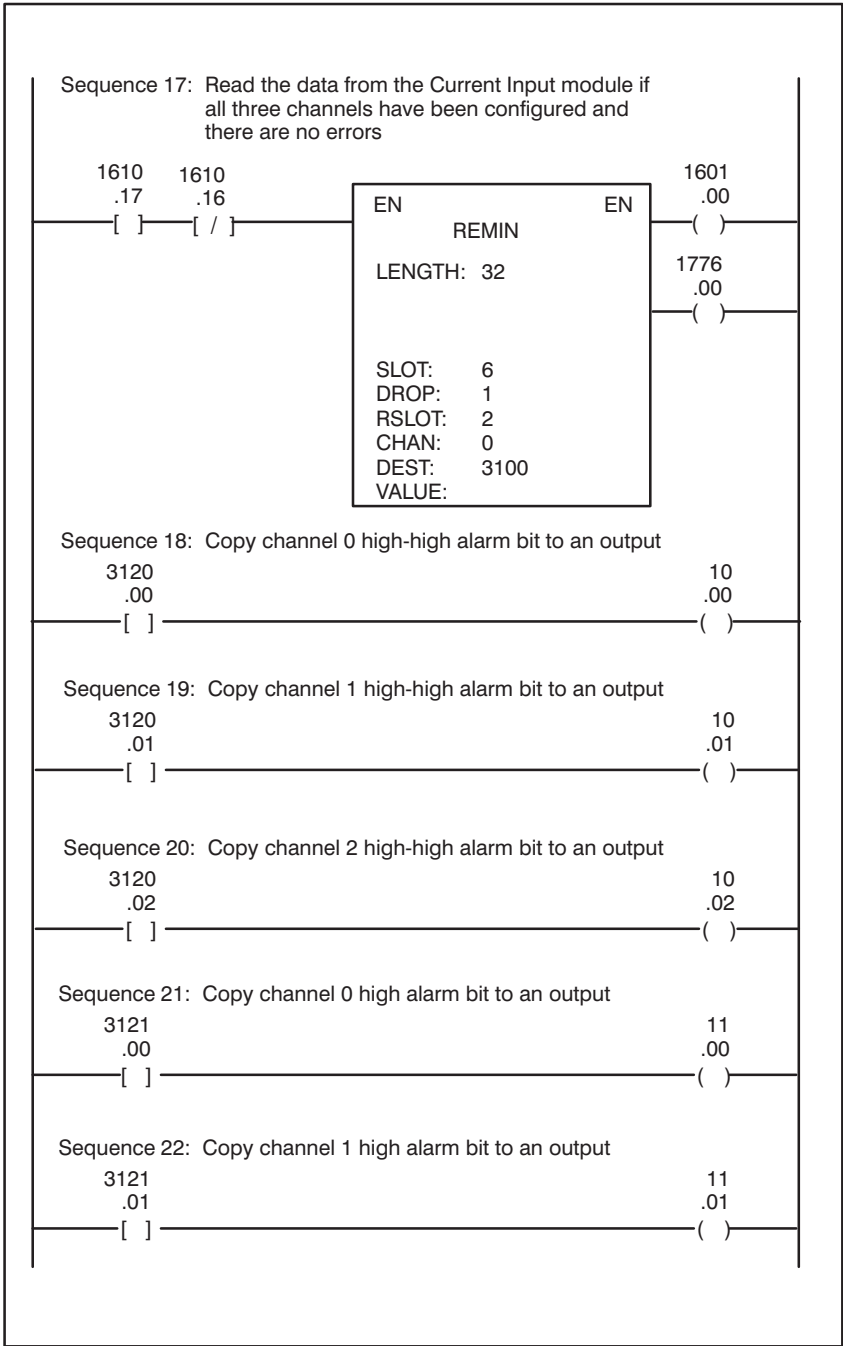


Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

| | |
|--|-----|
| Sequence 23: Copy channel 2 high alarm bit to an output | |
| 3121 | 11 |
| .02 | .02 |
| [] | () |
| Sequence 24: Copy channel 0 low alarm bit to an output | |
| 3122 | 12 |
| .00 | .00 |
| [] | () |
| Sequence 25: Copy channel 1 low alarm bit to an output | |
| 3122 | 12 |
| .01 | .01 |
| [] | () |
| Sequence 26: Copy channel 2 low alarm bit to an output | |
| 3122 | 12 |
| .02 | .02 |
| [] | () |
| Sequence 27: Copy channel 0 low-low alarm bit to an output | |
| 3123 | 13 |
| .00 | .00 |
| [] | () |
| Sequence 28: Copy channel 1 low-low alarm bit to an output | |
| 3123 | 13 |
| .01 | .01 |
| [] | () |
| Sequence 29: Copy channel 2 low-low alarm bit to an output | |
| 3123 | 13 |
| .02 | .02 |
| [] | () |

Figure 4.13 - Sample AutoMate Current Input Application Program (Continued)

4.6 Restrictions on Use

The channels on a Current Input module in an AutoMax/DCS 5000 system are to be configured from only one application task.

Do not configure a channel on the Current Input module unless a transmitter or transducer is connected to that channel. If you do, out-of-range input values will be generated.

If the Current Input 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 Current Input modules in either a local or remote AutoMate rack when using a 50 Amp AutoMate Power Supply (M/N 45C322). When using a 20 Amp AutoMate Power Supply (M/N 45C321) you are limited to:

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

You can place up to 15 Current Input modules in a local AutoMax rack. Note that you can only place up to five Current Input 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 Current Input 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 24 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 transmitter 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 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 Current Input 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 input 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 transmitter.

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 program reading the module 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 Current Input 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 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 85°C
-40 to 185°F
- Operating Temperature: 0 to 60°C
32 to 140°F
- 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 From The Backplane

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

Maximum Module Power Dissipation

- 7.5 Watts

Recommended Loop Power Supply (User-Supplied)

- 12–24 VDC; 500 mA minimum
- Actual requirements are dependent upon transmitter specifications

Recommended Field Wiring Cable

- Belden 9501 or Equivalent
- Maximum Recommended Field Wiring Length is dependent upon the transmitters

Terminal Board and Cable Assemblies

- M/N 61C549: Panel Mount
- M/N61C550: DIN-Rail Mount

Channels

- Number of Input Channels: 16
- Commons: one analog common shared by all 16 current input channels
- Isolation: 2500V from analog common to digital ground
2500V rms for 1 minute

Appendix A

(Continued)

Input Circuit

- Input Current Range: 4–20 mA
- Resolution: 4 μ A per count (4–20 mA = 0–4095 counts)
- Accuracy: 0.2% across the operating temperature range
- Input Filter: first order, lowpass, 7 Hz breakpoint
- Out of Range Threshold Voltages): below 3.7 mA or above 20.3 mA
- Input Impedance: 10M ohms typical at 0 Hz at faceplate connector
: 250 ohms with Terminal Board
M/N 61C549 or 61C550 attached

Noise Rejection

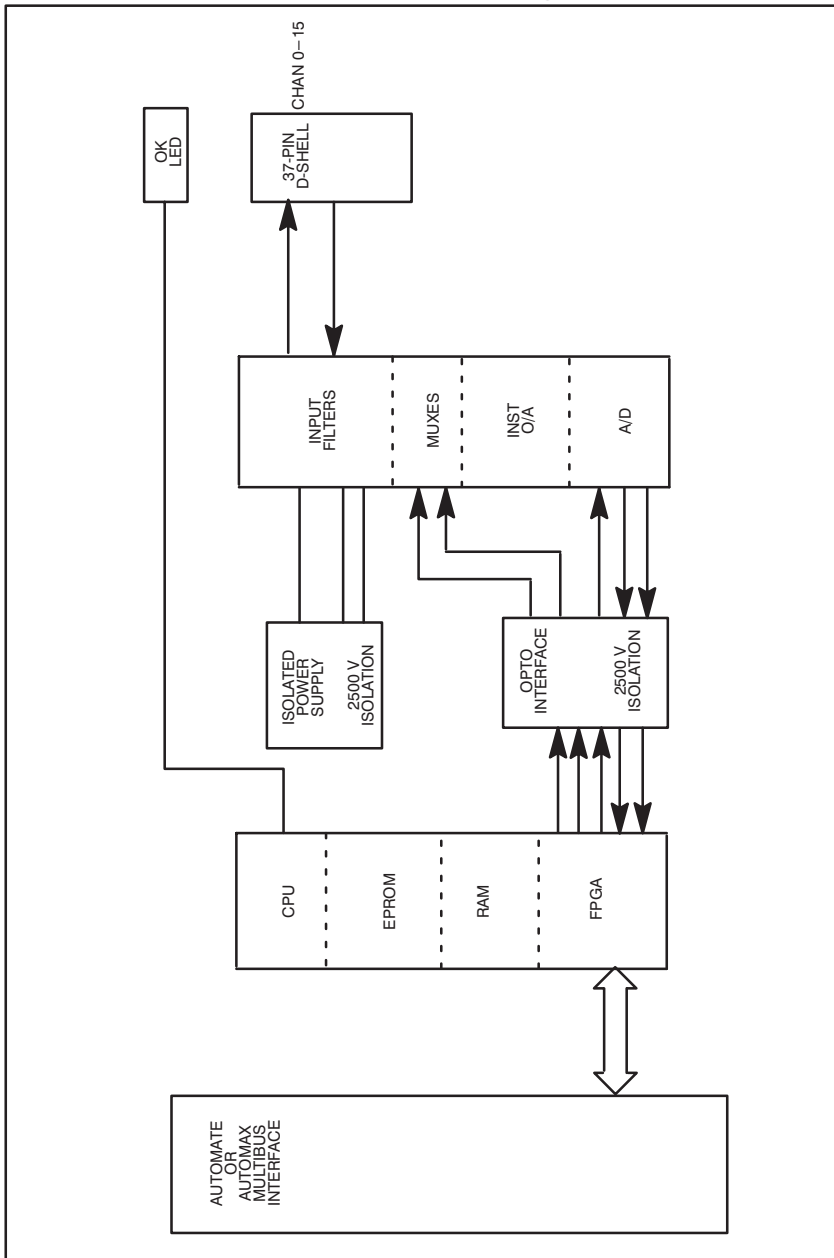
- Line Frequency Filter (Software Selectable): 60 Hz (default) or 50 Hz
- Averaging Filter (Software Selectable): 1 (default) to 60 samples per average
- Common Mode Rejection: -60dB min (averaging filter = 1 and line filter enabled)
- Normal Mode Rejection: -40dB min (averaging filter = 1 and line filter enabled)

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

| | Number of Configured Channels | Unscaled Data | Scaled Data | Square Root of Scaled Data | Running Average of Square Root of Scaled Data |
|----------------------------------|-------------------------------|---------------|-------------|----------------------------|---|
| 60 Hz. Line Freq. Filter Enabled | One | 18.4 | 18.5 | 18.7 | 18.8 |
| | Each Added | 17.6 | 17.7 | 17.9 | 18 |
| | Sixteen | 282 | 283 | 286 | 288 |
| Line Freq. Filters Disabled | One | 2.0 | 2.1 | 2.3 | 2.4 |
| | Each Added | 1.0 | 1.1 | 1.3 | 1.4 |
| | Sixteen | 17 | 18.6 | 21.8 | 23.4 |
| 50 Hz. Line Freq. Filter Enabled | One | 21.6 | 21.7 | 21.9 | 22 |
| | Each Added | 20.8 | 20.9 | 21.0 | 21.1 |
| | Sixteen | 333 | 334 | 337 | 339 |

Appendix B

Module Block Diagram



Appendix C

Field Connections

| Terminal Block Label | Current Input Function |
|----------------------|---|
| V1 G1 | Primary Power Source for Current Loops Primary Power Source Return |
| 0A 0B S | Current Loop 0: Power Current Loop 0: 4–20 mA Input Current Loop 0: Cable Shield |
| S 1A 1B | Current Loop 1: Cable Shield Current Loop 1: Power Current Loop 1: 4–20 mA Input |
| 2A 2B S | Current Loop 2: Power Current Loop 2: 4–20 mA Input Current Loop 2: Cable Shield |
| S 3A 3B | Current Loop 3: Cable Shield Current Loop 3: Power Current Loop 3: 4–20 mA Input |
| 4A 4B S | Current Loop 4: Power Current Loop 4: 4–20 mA Input Current Loop 4: Cable Shield |
| S 5A 5B | Current Loop 5: Cable Shield Current Loop 5: Power Current Loop 5: 4–20 mA Input |
| 6A 6B S | Current Loop 6: Power Current Loop 6: 4–20 mA Input Current Loop 6: Cable Shield |
| S 7A 7B | Current Loop 7: Cable Shield Current Loop 7: Power Current Loop 7: 4–20 mA Input |
| 8A 8B S | Current Loop 8: Power Current Loop 8: 4–20mA Input Current Loop 8: Cable Shield |
| S 9A 9B | Current Loop 9: Cable Shield Current Loop 9: Power Current Loop 9: 4–20 mA Input |
| 10A 10B S | Current Loop 10: Power Current Loop 10: 4–20 mA Input Current Loop 10: Cable Shield |
| S 11A 11B | Current Loop 11: Cable Shield Current Loop 11: Power Current Loop 11: 4–20 mA Input |

Appendix C

(Continued)

| Terminal Block Label | Current Input Function |
|----------------------|---|
| 12A 12B S | Current Loop 12: Power Current Loop 12: 4–20 mA Input Current Loop 12: Cable Shield |
| S 13A 13B | Current Loop 13: Cable Shield Current Loop 13: Power Current Loop 13: 4–20 mA Input |
| 14A 14B S | Current Loop 14: Power Current Loop 14: 4–20 mA Input Current Loop 14: Cable Shield |
| S 15A 15B | Current Loop 15: Cable Shield Current Loop 15: Power Current Loop 15: 4–20 mA Input |
| V2 G2 | Back–up Power Source for Current Loops Back–up Power Source Return |

Appendix D

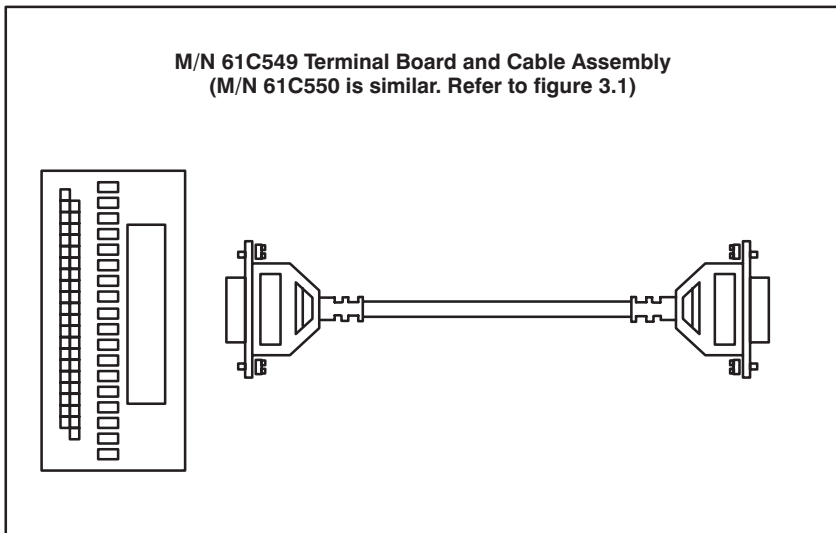
Related Components

M/N 61C549 Panel Mount Terminal Board and Cable Assembly

The terminal board assembly provides terminals on a flat panel mounting surface for connecting the field wires coming from the transmitters. Also included is a cable to connect the terminals with the Current Input module. The cable is five feet long. One assembly is required per module.

M/N 61C550 DIN Rail Mount Terminal Board and Cable Assembly

The terminal board assembly provides terminals on a DIN rail mounting surface for connecting the field wires coming from the transmitters. Also included is a cable to connect the terminals with the Current Input module. The cable is five feet long. One assembly is required per module.



Appendix E

Configuration Task

The following configuration task is intended as a guide to help you in defining your system-wide 4-20 mA transmitter 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 ! CIM Sample Configuration Task
20 ! September 20, 1991
30 !
100 TASK CIM[ TYPE=BASIC, PRIORITY=7, SLOT=0, CRITICAL=FALSE ]
110 !
220 IODEF TANK_LEVEL%[SLOT=2, REGISTER=0 ]
230 IODEF START_PROCESS%[SLOT=2, REGISTER=1 ]
240 IODEF OP_PROCESS%[ SLOT=2, REGISTER=2 ]
245 !
300 IODEF TANK_HH_ALARM@[ SLOT=2, REGISTER=16, BIT=0 ]
310 IODEF TANK_H_ALARM@[ SLOT=2, REGISTER=17, BIT=0 ]
320 IODEF TANK_L_ALARM@[ SLOT=2, REGISTER=18, BIT=0 ]
330 IODEF TANK_LL_ALARM@[ SLOT=2, REGISTER=19, BIT=0 ]
340 !
400 IODEF START_HH_ALARM@[ SLOT=2, REGISTER=16, BIT=1 ]
410 IODEF START_H_ALARM@[SLOT=2, REGISTER=17, BIT=1 ]
420 IODEF START_L_ALARM@[ SLOT=2, REGISTER=18, BIT=1 ]
430 IODEF START_LL_ALARM@[SLOT=2, REGISTER=19, BIT=1 ]
440 !
500 IODEF OP_HH_ALARM@[ SLOT=2, REGISTER=16, BIT=2 ]
510 IODEF OP_H_ALARM@[SLOT=2, REGISTER=17, BIT=2 ]
520 IODEF OP_L_ALARM@[ SLOT=2, REGISTER=18, BIT=2 ]
530 IODEF OP_LL_ALARM@[ SLOT=2, REGISTER=19, BIT=2 ]
540 !
600 IODEF CNF_MAX%[SLOT=2, REGISTER=24 ]
610 IODEF CNF_MIN%[ SLOT=2, REGISTER=25 ]
615 IODEF CNF_AVE_SAMPLE%[SLOT=2, REGISTER=26]
620 IODEF CNF_HH_ALARM%[SLOT=2, REGISTER=27 ]
630 IODEF CNF_H_ALARM%[SLOT=2, REGISTER=28 ]
640 IODEF CNF_L_ALARM%[SLOT=2, REGISTER=29 ]
650 IODEF CNF_LL_ALARM%[ SLOT=2, REGISTER=30 ]
660 IODEF CNF_COMMAND%[SLOT=2, REGISTER=31 ]
670 IODEF CNF_COMP@[SLOT=2, REGISTER=22, BIT=15 ]
680 IODEF CNF_ERROR@[ SLOT=2, REGISTER=22, BIT=14 ]
690 IODEF CNF_CHAN_NUM%[ SLOT=2, REGISTER=23 ]
700 IODEF OUT_OF_RANGE%[ SLOT=2, REGISTER=20 ]
900 !
910 MEMDEF WARNING@
920 MEMDEF SHUTDOWN@
```


Appendix F

Compatibility with Earlier Versions

Version 61C540 modules are similar in operation to 61C540A modules except for the input channel update times listed below:

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

| | Number of Configured Channels | Unscaled Data | Scaled Data | Square Root of Scaled Data |
|----------------------------------|-------------------------------|---------------|-------------|----------------------------|
| 60 Hz. Line Freq. Filter Enabled | One | 24.5 | 25.5 | 27.5 |
| | Each Added | 19.5 | 20.5 | 22.5 |
| | Sixteen | 317 | 333 | 365 |
| Line Freq. Filters Disabled | One | 7.5 | 8 | 10 |
| | Each Added | 2.5 | 3 | 5 |
| | Sixteen | 45 | 53 | 85 |
| 50 Hz. Line Freq. Filter Enabled | One | 28.5 | 29.5 | 31.5 |
| | Each Added | 23.5 | 24.5 | 26.5 |
| | Sixteen | 381 | 397 | 429 |

Appendix G

Module Faceplate Connections

| Module Faceplate Connector Pin # | Function |
|--|-------------------|
| 1 | Channel 14 |
| 2 | Channel 15 |
| 3 | Isolated Common * |
| 4 | Channel 12 |
| 5 | Channel 13 |
| 6 | Channel 10 |
| 7 | Channel 11 |
| 8 | Channel 8 |
| 9 | Channel 9 |
| 10 | Isolated Common * |
| 11 | Channel 6 |
| 12 | Channel 7 |
| 13 | Channel 4 |
| 14 | Channel 5 |
| 15 | Channel 2 |
| 16 | Channel 3 |
| 17 | Isolated Common * |
| 18 | Channel 0 |
| 19 | Channel 1 |
| 20 to 37 | Isolated Common * |
| *All commons are internally connected. | |

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