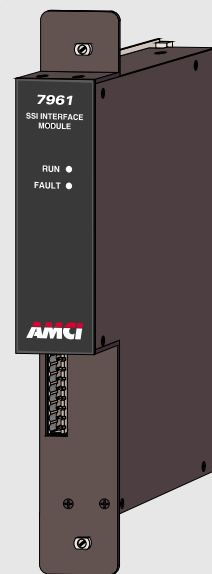


7961 SSI Interface Module

User Manual



GE-Fanuc 90-70 I/O Module



GENERAL INFORMATION

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein.

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Throughout this manual the following two notices are used to highlight important points.



WARNINGS tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.



CAUTIONS tell you when equipment may be damaged if the procedure is not followed properly.

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ADVANCED MICRO CONTROLS, INC. warrants that all equipment manufactured by it will be free from defects, under normal use, in materials and workmanship for a period of [1] year. Within this warranty period, AMCI shall, at its option, repair or replace, free of charge, any equipment covered by this warranty which is returned, shipping charges prepaid, within one year from date of invoice, and which upon examination proves to be defective in material or workmanship and not caused by accident, misuse, neglect, alteration, improper installation or improper testing.

The provisions of the "STANDARD WARRANTY" are the sole obligations of AMCI and excludes all other warranties expressed or implied. In no event shall AMCI be liable for incidental or consequential damages or for delay in performance of this warranty.

Returns Policy

All equipment being returned to AMCI for repair or replacement, regardless of warranty status, must have a Return Merchandise Authorization number issued by AMCI. Call (860) 585-1254 with the model number and serial number (if applicable) along with a description of the problem. A "RMA" number will be issued. Equipment must be shipped to AMCI with transportation charges prepaid. Title and risk of loss or damage remains with the customer until shipment is received by AMCI.

24 Hour Technical Support Number

24 Hour technical support is available on this product. For technical support, call (860) 583-7271. Your call will be answered by the factory during regular business hours, Monday through Friday, 8AM - 5PM EST. During non-business hours an automated system will ask you to enter the telephone number you can be reached at. Please remember to include your area code. The system will page one of two engineers on call. Please have your product model number and a description of the problem ready before you call.

ABOUT THIS MANUAL

Introduction

This manual explains the operation, installation, and programming of the 7961 SSI Interface Module for the GE Fanuc Series 90™-70 programmable controller systems. Designed specifically for transducers that use the SSI protocol, the programmable features of the 7961 make it an efficient interface between any SSI transducer and the 90-70 processors.

It is strongly recommended that you read the following instructions. If there are any unanswered questions after reading this manual, call the factory. An applications engineer will be available to assist you.

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Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual and the information it contains are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, 20 Gear Drive, Plymouth Industrial Park, Terryville CT 06786, or fax us at (860) 584-1973.

Revision Record

The following is the revision history for this manual. In addition to the information listed here, revisions will fix any known typographical errors and clarification notes may be added.

This manual, 940-09010, is the initial release of the manual. It corresponds to hardware revision B, and software revision 0, checksum CC02.

7961 SPECIFICATIONS

Module Interface

Third party VME module. Fully compatible with GE Fanuc's Industrialized VMEbus (VME-I).

Compatible Transducers

Any transducer that outputs data in single word SSI format. Number of bits transferred is programmable from 1 to 32. Multi-word transfers are not supported.

Transducer Input Isolation

Optically Isolated (1500 Vac)

Programmable Parameters

SSI Setup Parameters –

- SSI Clock Frequency
- Number of SSI Bits
- Number of Data Bits
- MSB Number
- Data Type
- Data Logic

Data Setup Parameters –

- Scalar Multiplier
- Scalar Divisor
- Preset Value
- Count Direction
- Rate Update Time

Data Value (position) Range

±268,435,455 counts max.

Data Value (position) Preset

Data Value can be preset to any value within the range of ±268,435,455.

Rate of Change (velocity) Range

±268,435,455 counts per second max.

Rate of Change (velocity) Resolution

Determined by, and identical to, the Data Value resolution.

Rate of Change (velocity) Update Time

Programmable from 1 millisecond to 1,000 milliseconds with 1 millisecond resolution.

Data Transfer

Programmed with a sixteen byte VME WRT BYTE instruction.

Data available with a sixteen byte VME RD BYTE instruction.

Data Available to Processor

Data Value, Rate of Change, status bits, and raw SSI data.

Program Storage

Non-volatile RAM. Integrated lithium battery is rated for ten years.

Backplane Power Requirements

+5 Vdc @ 0.550A (2.75 Watts)

Transducer Power Supply

External +24 Vdc supply needed for transducer operation.

Modules +5 Vdc Supply Fuse

3.5A Fast Blow (Littelfuse 22503.5)

Environmental Conditions

Operating Temperature: 0 to 60° C

Relative Humidity: 5 to 95%
(non-condensing)

Storage Temperature: -40 to 85° C

CHAPTER 1

7961 INTRODUCTION

Overview

The single slot 7961 SSI Interface Module accepts a single transducer input and plugs directly into the GE Fanuc 90-70 rack. The 7961 module reads and scales the data from any SSI transducer and also calculates the data's rate of change. The meaning of the Data Value and Rate Of Change information depends on the type of transducer attached to the 7961. A SSI pressure sensor reports a pressure value and the 7961 calculates the pressure change per second. A SSI position sensor reports a position value and the 7961 calculates the position change per second, which is the velocity, of the moving part.

Communicating with eight word, (sixteen byte) VME READ BYTE and VME WRITE BYTE instructions, the 7961 reports the Data Value, Rate Of Change, and actual SSI data to the 90-70 CPU. The Data Value has a range of $\pm 268,435,455$ counts, which is twenty-eight bits plus sign. The Rate of Change has a range of $\pm 268,435,455$ counts per second, with the value negative when the Data Value is decreasing.

One type of SSI transducer the 7961 can interface with is the linear displacement transducer (LDT). LDTs are non-contact, absolute linear measurement devices that offer high resolution and accuracy. The transducer tracks the absolute position of a magnet along its waveguide. LDTs can be manufactured with a waveguide length from 2 to 300 inches. There are two major manufacturers of SSI linear displacement transducers, Balluff and MTS. Presently, Balluff BTL-5 transducers offer a resolution and repeatability of up to $5 \mu\text{m}$ (0.0002") and an accuracy of up to $\pm 30 \mu\text{m}$ (± 0.0012 "). MTS Temposonics III transducers offer a resolution and repeatability of up to $5 \mu\text{m}$ (0.0002") and an accuracy of up to $50 \mu\text{m}$ (0.002").

The formal SSI protocol defines a twenty-five bit serial data stream from the transducer that is synchronized to clock pulses generated by the controller. However, AMCI is aware of some transducers that do not transmit twenty-five bits. To accommodate these devices, AMCI has made the number of bits that the module accepts programmable from one to thirty-two.

Physically, the 7961 module is a single slot module that accepts a single SSI transducer, and requires an external 24 Vdc power supply. In addition to the eight pin Transducer Input Connector, the front panel has two LED's that show the modules' status.

The 7961's *Programmable Parameters* are used to define where the SSI data is embedded in the bit stream and gives you the ability to scale this data. For example, assume that you are using a Balluff LDT that gives you one count per $20 \mu\text{m}$. You can use the 7961 to scale this value to one count per 0.001 inch. The calculated Rate of Change is scaled to the same units as the Data Value. To continue the example, the Rate of Change (velocity) is scaled thousandths of an inch per second. All parameter values are stored in non-volatile nvRAM memory.

Along with the scaled Data Value and Rate of Change information, the 7961 reports the actual SSI data to the 90-70 processor. This gives you the ability to use ladder logic to check the SSI data for any additional information that it may contain, such as error bits.

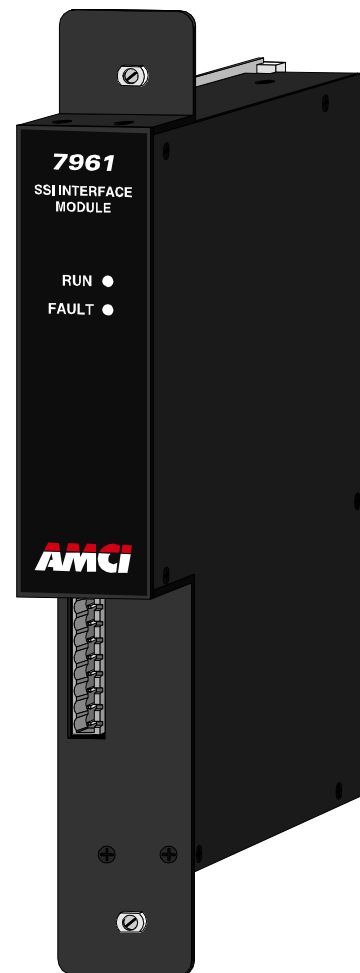
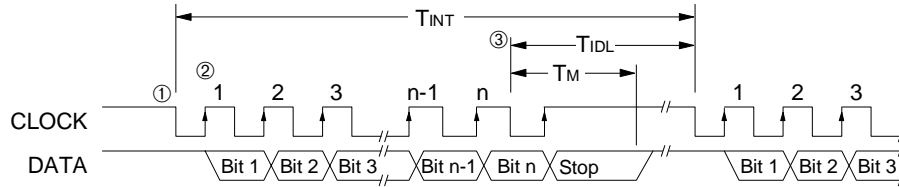


Figure 1.1 7961 Module

SSI Protocol

Figure 1.2 shows how a 7961 module reads data from a SSI transducer. Note that the formal SSI definition allows for twenty-four bits of data and a twenty-fifth stop bit. However, AMCI is aware of some transducers that transmit more or less than twenty-five bits. To accommodate these transducers, the 7961 can be programmed to accept up to thirty-two bits in the SSI bit stream.



“n” = Number of bits in SSI data. Range of 1 to 32. Default of 24.

- ① The first falling edge of the clock signal latches the SSI data. Note: Some transducers latch the data at the end of the previous interrogation.
- ② The next “n” rising edges of the clock shift out the “n” data bits.
- ③ T_{INT} is the time between interrogations and is fixed by the module at 500 μ S. T_M is the time that the Stop bit is valid, which is typically 12 to 20 μ S. T_{IDL} is the time between the end of the last interrogation and the start of the next. The transducer must have new data available within the T_{IDL} time period if the system is to work properly. The table below gives the values of T_{IDL} for twenty-four and thirty-two bit SSI data transfers at the four different clock frequencies available with the module.

ClockFRQ	T_{IDL} @ 24 bits	T_{IDL} @ 32 bits
125 KHz	308 μ S	244 μ S
250 KHz	404 μ S	372 μ S
500 KHz	452 μ S	436 μ S
1.00 MHz	476 μ S	468 μ S

Figure 1.2 SSI Data Stream Format



The formal SSI protocol definition includes a multi-word transfer capability. This is accomplished by holding the clock signal low for the T_M time period and restarting the clock. This signals the transducer to transfer additional bits of data instead of restarting at bit 1. The 7961 does not support multi-word transfers.

Programmable Parameters

The 7961 module is setup by programming its Programmable Parameters. These parameters are broken down into two groups.

- **SSI Setup Parameters** – Six parameters that are used to extract the SSI data from the twenty-five bit stream. These parameters define the clock speed of the data transfer, the position and length of the SSI data within the bit stream, and the format of the data.
- **Data Setup Parameters** – Five parameters that affect the Data Value and Rate of Change information. These parameters allow you to scale the Data Value, preset it to a programmable count, and set the update time of the Rate of Change information.

SSI Setup Parameters

SSI Clock Frequency

This parameter allows you to set the SSI clock frequency to one of four values: 125 KHz, 250 KHz, 500 KHz, or 1.000 MHz.



The default value of 125 KHz will work in all applications. Setting the clock frequency to 1 MHz yields the longest idle times between interrogations. However, your transducer may not be able to operate at 1 MHz. Consult your transducer documentation to determine its maximum operating frequency. Remember that the maximum SSI clock frequency is also dependent on the length of the transducer cable.

Number of SSI Bits

This value sets the number of bits that the 7961 will read from the SSI transducer per interrogation. The parameters default value of twenty-four will work in most cases. You can set this parameter to any value between 1 and 32.

Number of Data Bits & MSB Number Parameters

As the examples show in figure 1.3, these two parameters tell the 7961 where the SSI data is embedded in the SSI data stream. The Number of Data Bits parameter specifies the length of the data and the MSB Number parameter specifies the bit that starts the SSI data. The default value for the Number of Data Bits parameter is twenty-four. The default value of the MSB Number parameter is one.

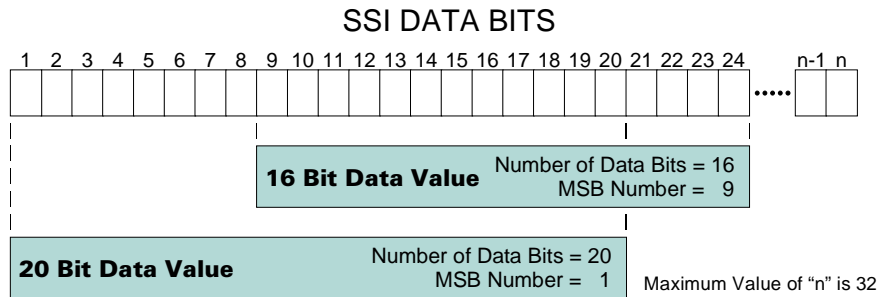


Figure 1.3 Embedded Data Value

Refer to the documentation that came with your transducer to determine where the SSI data is located in the SSI data stream. If you are using a Balluff LDT, the default values should work correctly. If you are using a MTS LDT, Set the Number of Data Bits equal to the LDT's number of bits and the MSB Number to one.

Data Type

This parameter tells the 7961 to interpret the SSI data as a binary number or a gray code number. The default value is Binary.

Data Logic

This parameter is included to handle situations where the SSI data is reported with negative logic. If this parameter is set, the 7961 will assume the SSI data is reported with negative logic and will invert the data bits before performing any scaling. The default value is positive logic. When this parameter is left at its default value, the 7961 will use the SSI data as it is from the transducer.

Data Setup Parameters

Once the 7961 has extracted the SSI data from the SSI data stream, it uses the Data Setup Parameters to convert the raw SSI data into the Data Value reported to the processor. The formula for determining the Data Value is:

$$\text{Data Value} = \text{SSI Data} * (\text{MUL} / \text{DIV}) + \text{LO}$$

where: **MUL** = Scalar Multiplier

DIV = Scalar Divisor

LO = Linear Offset. The Linear Offset is an internal parameter that normally equals zero. The Linear Offset is changed when you preset the Data Value.

Scalar Multiplier & Scalar Divisor

These two parameters are used to scale the SSI data. Both parameters have a default value of one and can range in value from 1 to 32,767. The Scalar Multiplier must be less than or equal to the Scalar Divisor. In other words, the ratio of Multiplier to Divisor cannot be greater than one.

Linear displacement transducers from Balluff and MTS have resolutions measured in $\mu\text{m}/\text{count}$. The 7961 can easily convert to a more familiar inch measurement system. The figure below shows the Multiplier and Divisor values needed to convert from various metric resolutions to inch resolutions. For example, to convert data from a LDT with $5\mu\text{m}/\text{count}$ resolution to $0.0005"/\text{count}$ resolution, use a Multiplier of 50 and a Divisor of 127.

		Desired Resolution				
		0.0002"	0.0005"	0.001"	0.002"	0.005"
LDT Resolution	5 μm	$\frac{125}{127}$	$\frac{50}{127}$	$\frac{25}{127}$	$\frac{25}{254}$	$\frac{5}{127}$
	10 μm		$\frac{100}{127}$	$\frac{50}{127}$	$\frac{25}{127}$	$\frac{10}{127}$
	20 μm			$\frac{100}{127}$	$\frac{50}{127}$	$\frac{20}{127}$
	40 μm				$\frac{100}{127}$	$\frac{40}{127}$

= Desired resolution exceeds resolution of LDT.

Figure 1.4 Scalar Values for Linear Measurement Conversion

Preset Value

The Preset Value parameter gives you the ability to offset the Data Value. When you preset the Data Value, the 7961 calculates an internal parameter called the Linear Offset. The Linear Offset is the value needed to make the Data Value equal to the Preset Value. The default Preset Value is zero. Its range is $\pm 268,435,455$.

NOTE

- 1) Programming this parameter does not change the Data Value. There is a separate command for presetting the Data Value to the Preset Value.
- 2) The 7961 will issue a Preset Error message if you attempt to program a Preset Value that is outside its range of $\pm 268,435,455$.
- 3) Presetting the Data Value generates a linear offset. If you are using a rotary encoder and wish to preset the position, contact AMCI for assistance in developing the ladder logic needed to offset the Data Value in the PLC.



Data Setup Parameters (continued)

Count Direction

This parameter is useful if your Data Value represents a linear position. It gives you the ability to reverse the direction of motion needed to increase the position count. For simplicity's sake, the two values for this parameter are called Positive Direction and Negative Direction. When this parameter is set to its default of Positive, the Data Value is not changed. When this parameter is set to Negative, the Data Value is changed to: $(2^n - (\text{Data Value}))$, where 'n' is the programmed value of the Number of Data Bits parameter.

If your Data Value represents a rotary position, you can change the count direction with this parameter only if the number of counts in your Data Value is a power of two. If it is not, you can easily reverse the count direction with ladder logic.

- 1) Subtract the Data Value from the number of encoder counts and store it in a temporary register.
- 2) If the Data Value equals zero, then move zero into your temporary register.

Rate Update Time

The Rate Update time sets the amount of time between Rate of Change information updates to the processor. Its range of values is 1 to 1,000 mS, with a default of 100 mS. Decrease the time between updates for fast response to changes in this value. Increase the time between updates for better averaging of this value.



Notes

CHAPTER 2

INSTALLATION

Power Requirements

The 7961 draws its power from the I/O rack +5Vdc supply. The maximum current draw is 0.550 amps. Therefore, the maximum power draw is 2.75 watts. Add this to the power requirements of all the other modules in the chassis when sizing the power supply.

AM Code Configuration

Every 7961 is factory configured to respond to the address modifier (AM) code of 29h. This AM code stands for Short (16 bit address) Non-Privileged VME access and is the default used by GE-Fanuc Series 90-70 systems. For GE-Fanuc installations, you need only set the slot number (address range) with DIP switches located on the back of the module.

Memory Address Allocation

The DIP switch block on the back of the module, (see figure 2.1), sets the memory addresses that the 7961 responds to. GE Fanuc assigns default memory locations for each slot in an I/O rack that should be used in most applications. However, GE Fanuc has also set aside a User Defined Memory Area from address 5000h to FFFFh in each rack. This memory area can be used by the 7961 if another module in the rack is using the memory addresses that are normally assigned to the 7961's slot. All 7961 module ship from the factory configured for use in slot 2 of the I/O rack.

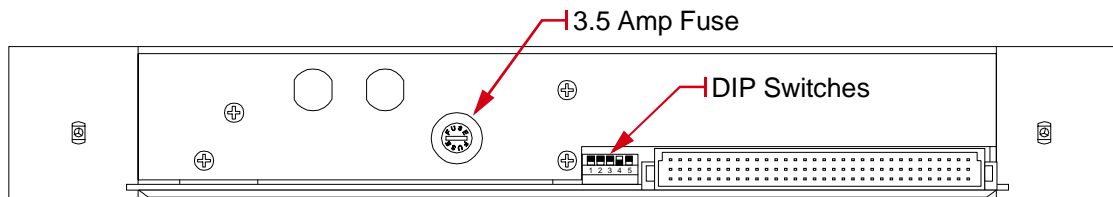


Figure 2.1 DIP Switch and Fuse Location

The five DIP switches correspond to address lines A15 through A11 on the backplane. If you are configuring the module to respond to the default memory locations, the DIP switches also represent the slot number of the module in binary.

The starting memory location of the 7961 in binary is:

XXXX X000 0000 0000b, where: XXXX X are the values specified by the DIP switches.

Table 2.1 on the following page gives the DIP switch setting for all of the memory locations that the 7961 can be configured for. The GE Fanuc slot numbers associated with the memory locations are also listed.



Memory Address Allocation (continued)

Setting the switch lever towards the PC board sets the address bit to a “0”. Setting the switch lever toward the metal case sets the address bit to a “1”.



Memory Locations	GE Slot #	DIP Switch	Memory Locations	GE Slot #	DIP Switch
0000h - 07FFh	None		8000h - 87FFh	User Def.	
0800h - 0FFFh	None		8800h - 8FFFh	User Def.	
1000h - 17FFh	2		9000h - 97FFh	User Def.	
1800h - 1FFFh	3		9800h - 9FFFh	User Def.	
2000h - 27FFh	4		A000h - A7FFh	User Def.	
2800h - 2FFFh	5		A800h - AFFFh	User Def.	
3000h - 37FFh	6		B000h - B7FFh	User Def.	
3800h - 3FFFh	7		B800h - BFFFh	User Def.	
4000h - 47FFh	8		C000h - C7FFh	User Def.	
4800h - 4FFFh	9		C800h - CFFFh	User Def.	
5000h - 57FFh	User Def.		D000h - D7FFh	User Def.	
5800h - 5FFFh	User Def.		D800h - DFFFh	User Def.	
6000h - 67FFh	User Def.		E000h - E7FFh	User Def.	
6800h - 6FFFh	User Def.		E800h - EFFFh	User Def.	
7000h - 77FFh	User Def.		F000h - F7FFh	User Def.	
7800h - 7FFFh	User Def.		F800h - FFFFh	User Def.	

Table 2.1 DIP Switch Settings

Installing the Module



WARNING

Remove system power before removing or installing any module in an I/O chassis. Failure to observe this warning may result in damage to the module's circuitry and/or undesired operation with possible injury to personnel.

After selecting the proper addresses with the DIP switches, the module is ready to be installed in the I/O rack. Insert the P.C. board into the card guides and gently seat the P1 connector into the backplane. Seating the connector does not require a great amount of force. Applying too much pressure on a mis-aligned connector may damage the module or backplane.

After seating the module in the backplane, secure the module to the rack with the two mounting screws.



NOTE

The two mounting screws that secure the module are also the grounding points for the 7961. These two screws *must* be tightly screwed into the rack for proper operation.

Front Panel Description

The front panel of the 7961 has the eight pin Transducer Input Connector and the two status LED's. The mate to the Transducer Input Connector is a Phoenix Contact MSTB2.5/8-ST-5.08, AMCI part number MS-8, which is included with the module.

Status LED's

The green and red LED's show the modules' operating status.

- **RUN** - This green LED is on when the module is operational.
- **FAULT** - This red LED is on if the module fails its initialization routines. If this occurs, remove the transducer connector and cycle power to the module. If the fault remains, check the VME READ BYTE data to see if there is a nvRAM error. If there is, clear the error with a VME WRITE BYTE instruction. If the error remains, the module needs to be repaired. See the inside front cover for information on contacting AMCI.



The 7961 considers all of the SSI bits as potential data. Therefore, the 7961 cannot determine if there is a transducer error. If your SSI transducer has error bits embedded in the SSI data, your ladder logic should check these bits. They are available in the raw SSI data the 7961 transmits to the processor. If the transducer is not attached to the 7961, the SSI data will be all 1's. If you know that your SSI data can never be all 1's, use this as a check to see if the transducer is attached and working.

Compatible Transducers

The 7961 module is compatible with any transducer that outputs serial data using the SSI protocol. The 7961 has been tested with Balluff BTL-3 and MTS Temposonics III linear displacement transducers, Stegmann optical encoders, and SICK optical distance sensors. Note that the 7961 does not support multi-word SSI transfers. Even though the SSI definition includes the multi-word transfer, it is rarely used in actual applications.

Transducer Mounting

Follow the mounting instruction you received with your SSI compatible transducer.

Transducer Power Supply

An external, isolated +24 Vdc supply is needed to power the SSI interface. The supply outputs must be isolate from chassis ground to eliminate the potential of ground loops. The 7961 draws a maximum of 0.030 amps to power its opto-couplers. Add this to the current requirements of the transducer when sizing the +24 Vdc supply.




Transducer Cable Installation

Follow the transducer manufacturers suggestions when specifying the transducer cable. Pre-assembled and tested cables are usually offered by the transducer manufacturer. When installing the transducer cable, follow these general guidelines.

- SSI signals are low voltage, low power signals. Cabling from the SSI transducer to the 7961 can be installed in conduit along with other low power cabling such as communication cables and low power ac/dc I/O lines. It cannot be installed in conduit with ac power lines or high power ac/dc I/O lines.
- The shields of the transducer cable must be grounded at the 7961 module only! When installing the cable, treat the shield as a signal carrying conductor. Do not connect the shield to ground at any junction box or the transducer. This will eliminate ground loops that could damage the module or PLC.

Figure 2.2 shows the wiring of the 7961 Transducer Input Connector. The diagram shows pin assignments and how to connect the external +24 Vdc supply to the module. The color codes for transducer cables specified by Balluff and MTS are also shown.

NOTE  The two mounting screws that secure the 7961 to the rack are also the grounding points for the module. These two screws *must* be tightly screwed into the rack to guarantee a low impedance path to ground for any EMI radiation that may be induced into the cable.

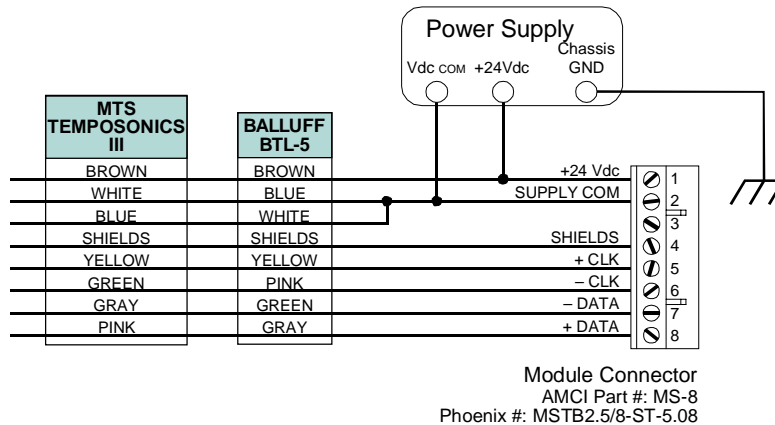


Figure 2.2 7961 Connector Wiring

CHAPTER 3

VME READ/WRITE FUNCTIONS

You will use the VME READ BYTE and VME WRITE BYTE functions to communicate with the 7961. Acknowledging that you may not be familiar with the VME_RD_BYTE and VME_WRT_BYTE functions, this chapter introduces both of them. This chapter also contains information on transfer lengths and addressing specific to the 7961 so you will need to look over this chapter even if you are familiar with the two instructions.

VME READ BYTE Function

The VME READ BYTE (VME_RD_BYTE) function is used to read the Data Value, Rate of Change, and raw SSI data from the 7961 to the 90-70 processor. Figure 3.1 is an example of a VME_RD_BYTE function. The highlighted sections contain information that you must supply when entering the function.

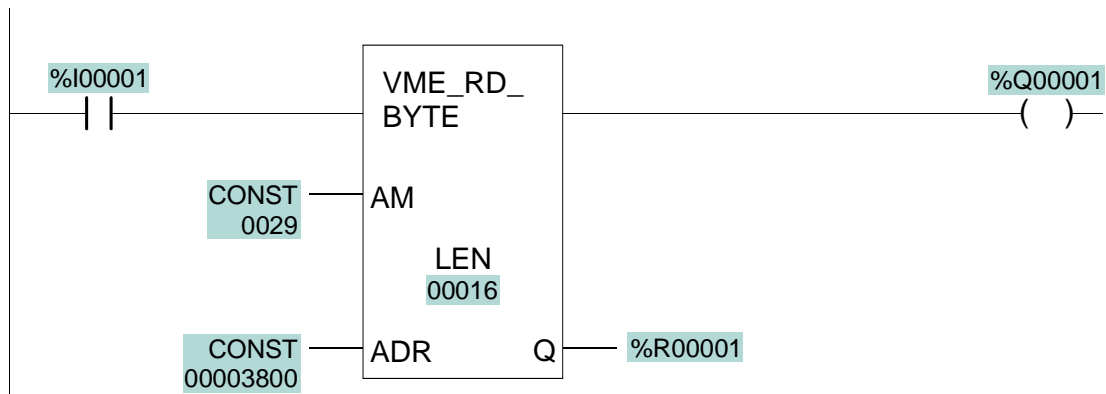


Figure 3.1 GE-Fanuc VME_RD_BYTE Function

NOTE

There are two VME READ functions, one for transferring bytes of data and one for transferring words. The VME_RD_WORD function will not work with the 7961. You must use the VME_RD_BYTE function.

Parts of the VME_RD_BYTE Function

Contact Input (%I00001)

Any type of contact can be used to enable the VME_RD function. In this example, the 7961 is read by the CPU whenever contact %I00001 is a logic “1” and the rung is scanned. You can omit the contact if you plan to read the 7961 every scan.

Coil Output (%Q00001)

The coil output becomes true when the VME_RD function completes successfully. Any type of coil can be used. In this example, coil %Q00001 becomes true when the transfer is complete.

You should use a coil output with the VME_RD function. This will allow you to test the coil at a later point in the scan to be sure that the transfer has completed successfully and the data is valid.

AM (Address Modifier) Code

All 7961’s are factory configured to respond to AM Code 29h. This corresponds to the Standard Short Non-Privileged VME access (16 bit address). The actual AM Code programmed into the VME_RD function depends on the rack that the module resides in. Table 3.1 on the following page lists the AM Codes for the different racks. Note that the module remains configured for the AM Code 29h. The GE Fanuc Expansion Module that controls the expansion rack converts the AM Code to 29h before it accesses the modules in its rack.

Parts of the VME_RD_BYTE Function (continued)

AM (Address Modifier) Code (continued)

Rack Number	VME_RD AM Code	7961 AM Code
0	29h	29h
1	1Eh	29h
2	1Dh	29h
3	1Ch	29h
4	1Bh	29h
5	1Ah	29h
6	19h	29h
7	18h	29h
AM Code 1Fh is reserved		

Table 3.1 Address Modifier (AM) Codes

Length Parameter

The Length parameter tells the CPU how many bytes to transfer from the module that the VME_RD targets. For the 7961, this parameter must always be set to sixteen.

Memory Address

This parameter is the starting memory address of the module. For the 7961 this parameter must be set to the address specified by the DIP switches on the back of the module. See *Memory Address Allocation*, starting on page 11 for information on setting the DIP Switches. Table 3.2 below lists the starting address of the 7961 if you use GE Fanuc's default memory locations for the slot. Refer to Table 2.1, *DIP Switch Settings* on page 12 for the possible starting addresses of the module if you use the User Defined memory addresses available in the rack.

Slot	Starting Address	Slot	Starting Address
PS	None	5	2800h
1	None	6	3000h
2	1000h	7	3800h
3	1800h	8	4000h
4	2000h	9	4800h
User Defined: See Table 2.1, page 12			

Table 3.2 VME_RD_BYTE Memory Address Allocations

Q: (Transfer Destination Address)

“Q” specifies the first location in the CPU user reference into which data read from the 7961 is to be stored. In this example, the 7961 data will be stored starting at the first Register Memory address. Note that eight Register Memory words, (1 through 8 in this example), will be used because the transfer is sixteen bytes long.

VME WRITE BYTE Function

The VME WRITE BYTE (VME_WRT_BYTE) function is used to write programming data from the 90-70 processor to the 7961. Figure 3.2 shows an example of the VME_WRT_BYTE function. The highlighted sections contain information that you must supply when entering the function.

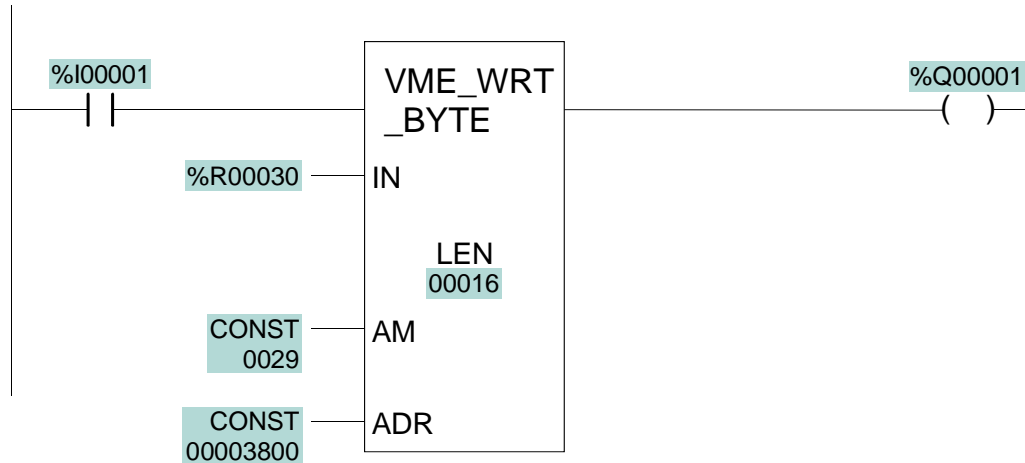


Figure 3.2 GE Fanuc's VME_WRT_BYTE Function

NOTE There are two VME WRITE functions, one for transferring bytes of data and one for transferring words. The VME_WRT_WORD function will not work with the 7961. You must use the VME_WRT_BYTE function.

NOTE You will use two VME_WRT_BYTE functions to write programming data to the 7961. The first writes fourteen bytes of *Parameter Data* and the second writes two bytes of *Command Bits*. The *Parameter Data* *must* be written to the 7961 first.

Parts of the VME_WRT_BYTE Function

Contact Input (%I00002)

Any type of contact can be used to enable the VME_WRT_BYTE function. In this example, the programming data is sent to the 7961 whenever contact %I0002 is a logic one while the rung is scanned.

Coil Output (%Q00002)

The coil output becomes true when the VME-WRT_BYTE completes successfully. Any type of coil can be used.

NOTE You should use a coil output with any VME_WRT function. This will allow you to test the coil at a later point in the scan to see if the function completed successfully.

Input Registers (%R00031)

The starting address of the registers that contain the data to be sent to the module. In the case of the 7961, this will be programming data to configure the module. If you are transferring a single word, a constant can be entered instead of a register address.

Parts of the VME_WRT_BYTE Function (continued)
AM (Address Modifier) Code

All 7961's are factory configured to respond to AM Code 29h. This corresponds to the Standard Short Non-Privileged VME access (16 bit address). The actual AM Code programmed into the VME_WRT function depends on the rack that the module resides in. Table 3.3 on the following page lists the AM Codes for the different racks. Note that the module remains configured for the AM Code 29h. The GE Fanuc Expansion Module that controls the expansion rack converts the AM Code to 29h before it accesses the modules in its rack.

Rack Number	VME_RD AM Code	7961 AM Code
0	29h	29h
1	1Eh	29h
2	1Dh	29h
3	1Ch	29h
4	1Bh	29h
5	1Ah	29h
6	19h	29h
7	18h	29h
AM Code 1Fh is reserved		

Table 3.3 Address Modifier (AM) Codes

Length Parameter

The Length parameter tells the CPU how many bytes to transfer to the module that is targeted by the VME_WRT. For the 7961, this parameter will either be fourteen or two, depending on the data that you are sending to the module.

Memory Address

The starting address for the programming data is 80h above the address that the 7961 is configured for. The two bytes of Command Bits start at this address. The fourteen bytes of Parameter Data starts at 82h above the configured address. Table below gives the starting addresses for the Parameter Data and Command Bits if you configure the module to use the default addresses assigned to the slot. If you use a 2K region of the User Defined Memory Addresses, refer to table 2.1 on page 12 for a listing of the available base addresses.

Slot	Parameter Data	Command Bits
2	1082h	1080h
3	1882h	1880h
4	2082h	2080h
5	2882h	2880h
6	3082h	3080h
7	3882h	3880h
8	4082h	4080h
9	4882h	4880h
User Defined	Base Address+82h	Base Address+80h

Table 3.4 VME_WRT_BYTE Memory Address Allocations

CHAPTER 4

DATA FORMAT AND PROGRAMMING

Programming Cycle

Programming changes are written to the 7961 with a *Programming Cycle*. All programmable parameters can be changed, and the Data Value preset, with one cycle. Programming Cycles are controlled with the *Transmit Bit* in the Command Bits of the VME_WRT data and the *Acknowledge Bit* in the VME_RD data.

Assuming that you have a VME_RD_BYTE that reads the module constantly, a Programming Cycle consists of four steps.

- 1) Write the new Parameter Data to the 7961 with a fourteen byte VME_WRT_BYTE function. This block of seven words contains the new parameter values only. It does not include the Command Bits.
- 2) Write the new Command Bits to the 7961 with a two byte VME_RD_BYTE function. This two word block contains the flags that tell the 7961 what Parameter Data it should act upon and sets the Transmit Bit.
- 3) When the VME_RD_BYTE data from the 7961 shows that the Acknowledge Bit is set, check for any errors and write 0000h to the 7961 Command Bits with a VME_WRT_BYTE. This resets the Transmit Bit.
- 4) The module will respond by resetting the Acknowledge Bit. The Programming Cycle is now complete.

The 7961 checks the parameter data for errors in the following order:

- 1) Clear nvRAM Error. This command is ignored if there is no error
- 2) Number of SSI Bits, Number of Data Bits and MSB Number
- 3) Scalar Multiplier and Scalar Divisor
- 4) Preset Value
- 5) Rate Update

The SSI Clock Frequency, Data Logic, Data Type and Count Direction parameters are bit values that cannot be checked for errors. All possible combinations for these bits are valid.

If the module encounters an invalid data value, it sets the appropriate error bit in word 1 of the VME_RD data and stops processing the Parameter Data. All of your data must be correct before the 7961 accepts any changes.

If you program the module and preset the Data Value with one Programming Cycle, all data must be correct before the 7961 will preset the position.

VME_WRT_BYTE Data Format

The Programming Data, written to the module with two VME_WRT_BYTE functions is eight words long and is used to program the 7961 and/or preset the Data Value. Its format is shown in figure 4.1. Word 1 of the Programming Data contains the Command Bits. Setting these bits tells the 7961 which data in the rest of the block to act upon. The remaining seven words contain the Parameter Data. These seven words, (fourteen bytes) must be written to the 7961 before the Command Bits. If the Command Bits are written at the same time as the Parameter Data, the 7961 may start acting on the Command Bits before the transfer of the Parameter data is complete.

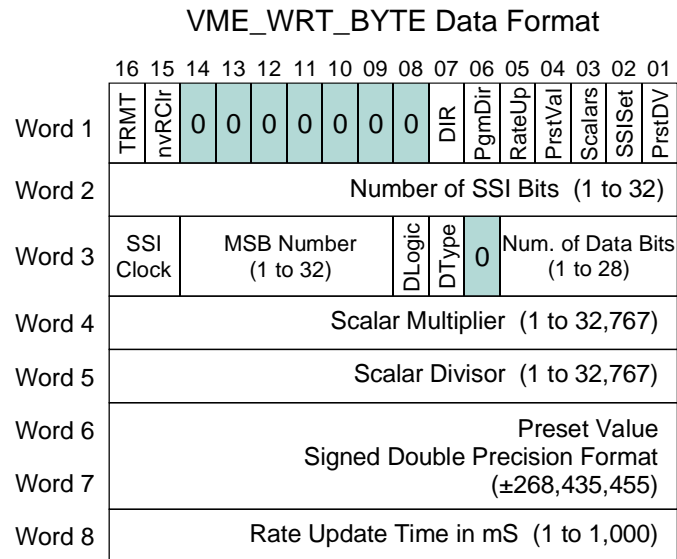


Figure 4.1 VME_WRT Data Format

Command Bits

- PrstDV: Preset Data Value: Bit 01.** Set this bit to preset the Data Value to the programmed Preset Value. The **PrstVal** bit (04), is used to change the Preset Value. Note that you can program the Preset Value and preset the Data Value to the new Preset Value with a single *Programming Cycle*.
- SSISet: Program SSI Setup Parameters: Bit 02.** Set this bit to program the Number of SSI bits parameter in word 2 and the SSI Clock Frequency, MSB Number, Number of Data Bits, Data Type, and Data Logic parameters in word 3. When you program these parameters, the two Scalars are reset to their default values of '1', and the Preset Value is reset to zero. When the **SSISet** bit is reset, the SSI Setup Parameters will not be programmed during the Programming Cycle.
- Scalars: Program Scalars: Bit 03.** Set this bit to program the Scalar Multiplier parameter in word 4 and the Scalar Divisor in word 5. Note that the Scalar Divisor must be greater than or equal to the Scalar Multiplier. When you program the Scalars, the Preset Value is reset to its default of zero. When this bit is reset, the two Scalars will not be programmed during the Programming Cycle.
- PrstVal: Program Preset Value: Bit 04.** Set this bit to program the Preset Value to the signed double precision value stored in words 5 and 6. The maximum/minimum value of the Preset Value is ±268,435,455. Note that programming the Preset Value has no effect on the Data Value. To preset the Data Value, you must set the **PrstDV** bit (bit 01) in word one during a Programming Cycle. If this bit is reset, the Preset Value will not be programmed during the Programming Cycle.

VME_WRT_BYTE Data Format (continued)

Command Bits (continued)

- RateUp: Program Rate Update Time: Bit 05.** Set this bit to program the Rate Update Time to the value in word 8. If this bit is reset, the Rate Update Time will not be programmed during the Programming Cycle.
- PgmDir: Program Count Direction: Bit 06.** Set this bit to program the Count Direction to the value specified by the **DIR** bit (07) in word 1. If this bit is reset, the Count Direction will not be programmed during the Programming Cycle.
- DIR: Count Direction Parameter: Bit 07.** When the **PgmDir** bit (06) is set and this bit reset, the Count Direction parameter will be set to its *Positive* value. When the **PgmDir** bit (06) is set and this bit set, the Count Direction parameter will be set to its *Negative* value. If this bit is set without setting the **PgmDir** bit, a command error is generated by the module
- nvRCI: Clear nvRAM Error: Bit 15.** Setting this bit will clear a nvRAM error during the Programming Cycle if one exists. Setting this bit if an error does not exist will do nothing.
- TRMT: Transmit Bit: Bit 16.** Setting this bit will start a Programming Cycle when the VME_WRT_BYTE sends the Command Bits to the module. All of the Parameter Data and Command Bits written to the module are ignored if this bit is reset.

Format Bits (Word 3)

- DType: Data Type Parameter: Bit 07.** When reset, the Data Type parameter is set to its *binary* value. When set, the Data Logic parameter is set to its *gray code* value. This bit is not acted upon if the **SSISet** bit (bit 02) in word 1 is not set.
- DLogic: Data Logic Parameter: Bit 08.** When reset, the Data Logic parameter is set to its *positive* value. When set, the Data Logic parameter is set to its *negative* value. This bit is not acted upon if the **SSISet** bit (bit 02) in word 1 is not set.
- SSI Clock: SSI Clock Frequency Parameter: Bits 15-16.** As figure 4.2 shows below, these two bit set the value of the SSI Clock Frequency parameter when the **SSISet** bit (bit 02) in word 1 is set.

Bit 15	Bit 14	SSI Clock Frequency
0	0	125 KHz
0	1	250 KHz
1	0	500 KHz
1	1	1 MHz

Figure 4.2 SSI Clock Frequency Table

VME_RD_BYTE Data Format

The VME_RD_BYTE data is eight words that give fault and programming error bits as well as the Data Value, Rate of Change, and raw SSI data to the processor. Figure 4.3 shows the format of the BTR data.

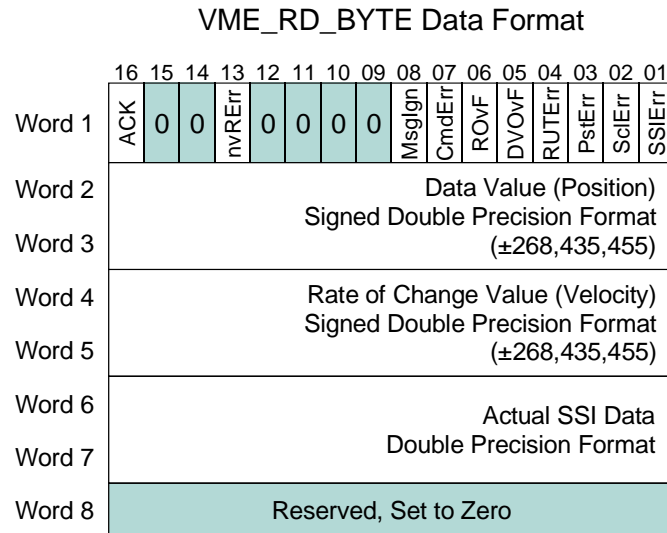


Figure 4.3 VME_RD Data Format

Word 1 Bits

SSIErr: Error in SSI Setup Parameters: Bit 01. This bit is set to signal one of the following conditions:

- 1) The **Number of SSI Bits** specified in word 2 of the VME_WRT data is not in the range of 1 to 32.
- 2) The **MSB Number** in word 3 of the VME_WRT data is zero, or greater than the **Number of SSI Bits** programmed in Word 2 of the VME_WRT data.
- 3) The **Number of Data Bits** specified in word 3 of the VME_WRT data is zero, greater than 28, or greater than the **Number of SSI Bits** programmed in Word 2 of the VME_WRT data.
- 4) The sum: (“**MSB Number**” + “**Number of Data Bits**”) exceeds the sum: (“**Number of SSI Bits**” + 1)

SciErr: Error in Scalar Parameters: Bit 02. This bit is set to signal one of the following conditions:

- 1) The **Scalar Multiplier** in word 4 of the VME_WRT data is not in the range of 1 to 32,767.
- 2) The **Scalar Divisor** in word 5 of the VME_WRT data is not in the range of 1 to 32,767.
- 3) The **Scalar Multiplier** is not less than or equal to the **Scalar Divisor**.

PstErr: Error with Preset Parameter: Bit 03. This bit is set if signed, double precision **Preset Value** (Words 6&7 in the VME_WRT data), is not in the range of ±268,435,455.

RUTErr: Error with Rate Update Time Parameter: Bit 04. This bit is set when the value of the **Rate Update Time** in word 8 of the VME_WRT data is not in the range of 1 to 1,000.

BTR Data Format (continued)

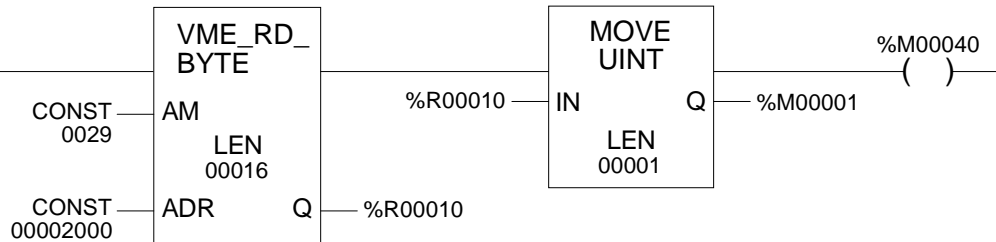
Word 0 Bits (continued)

- DVOvF: Data Value Overflow: Bit 05.** Set when the count in the Data Value is outside the bounds of $\pm 268,435,455$. When this bit is set, the reported Data Value is set to zero, but the Rate of Change data will continue to be correct.
- ROvF: Rate of Change Overflow: Bit 06.** Set when the Rate of Change value is outside the bounds of $\pm 268,435,455$ counts per second. When this occurs, the last valid Rate of Change value is sent to the processor.
- CmdErr: Command Error: Bit 07.** Set under the following conditions:
- 1) Any of the eight bits in the VME_WRT data that are defined as zero are set when the Transmit bit is set
 - 2) The Count Direction Parameter bit, (**DIR**: Word 1, bit 7), is set and the Program Count Direction bit (**PgmDir**: Word 1, bit 6), is not set when the Transmit bit is set.
- MsgIgn: Message Ignored: Bit 08.** If a programming error bit is set, the error must be cleared by reprogramming the incorrect parameter. This bit is set if you attempt to program a parameter with an incorrect value a second time.
- nvRErr: nvRAM Error: Bit 13.** This bit is set when one or more of the parameter values stored by the non-volatile RAM memory are corrupted. If this bit is set, start a Programming Cycle to the module with the **nvRClr** bit (word 1, bit 15) set. If the error remains when the Programming Cycle is complete, the nvRAM is damaged. If the error occurs every power-up but can be cleared, the battery in the nvRAM is dead. In either case, the module must be returned to AMCI for repairs. See the inside front cover for information on contacting AMCI.
- ACK: Acknowledge Bit: Bit 16.** Set by the 7961 to acknowledge programming data from the processor. Error bits in the VME_RD data are valid while this bit is set. The 7961 resets this bit after a VME_WRT_BYTE function resets the Transmit Bit.

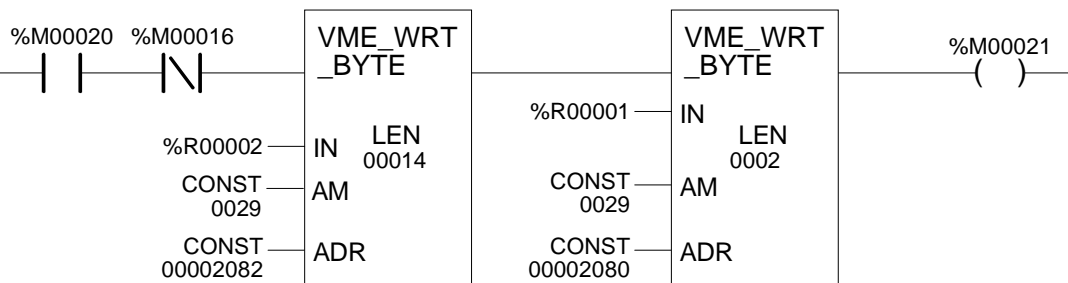
Sample Program

The ladder logic below shows one way of programming a 7961 module. It is certainly not the only way to program the module. The module is assumed to be located in slot 4 of rack 1 and uses the default memory addresses assigned to the slot.

Read data from the 7961. Data placed in system registers starting with %R00010. If it completes without error, copy the Status Bits to %M00001 through %M00016. This allows error detection with relay instructions. %M00016 = Acknowledge Bit. %M40 is reset if the transfer does not complete.



If the PLC has authorized a Program Cycle, (%M20 set), and the Acknowledge Bit (%M16) is reset, write the Parameter Data to the 7961. If the write completes, write the Command Bits to the 7961. If that write completes, set bit %M21 to signal that the writes completed successfully.



Once the Acknowledge Bit (%M16) is set, write 0000h to the 7961 as the Command Bits to reset the Transmit Bit. If the write completes, reset bit %M20 which is the bit that initiated the Programming Cycle. The Programming Cycle is complete. Do not attempt another Programming Cycle until the Acknowledge Bit (%M16) is reset.

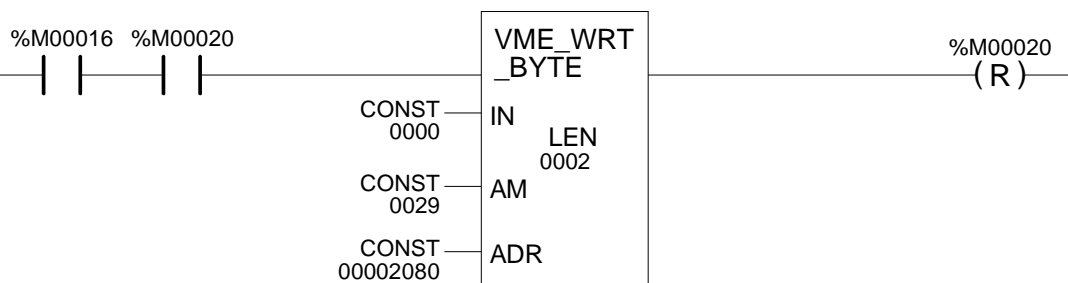


Figure 4.4 Sample Program



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