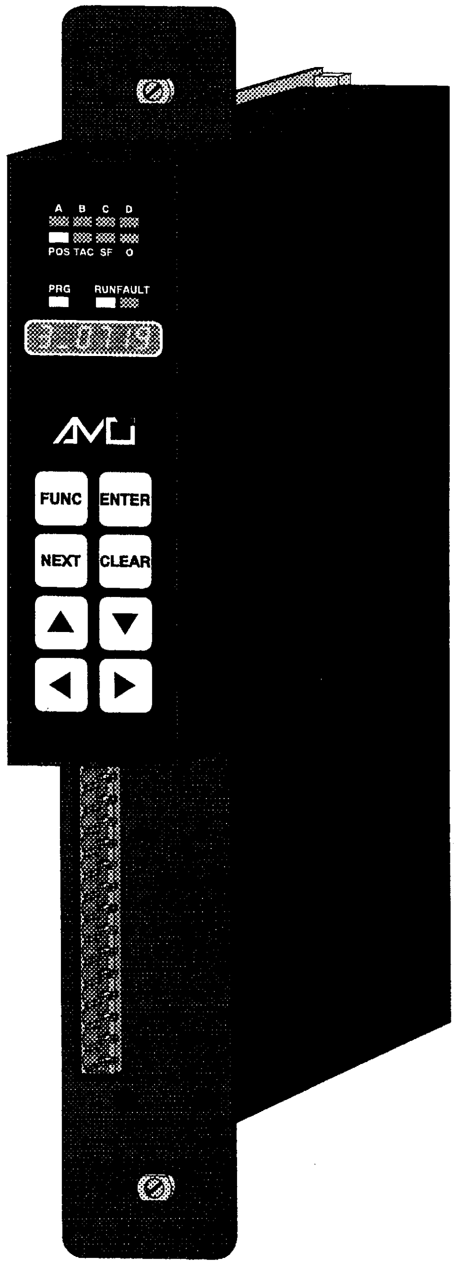
SERIES 1900

INTELLIGENT RESOLVER INTERFACE MODULE

USER'S MANUAL

Catalog Number 1900-794M



This manual is written to explain the operation of the following AMCI Modules for the GE-Fanuc Series 90™-70 systems:

1931	1932	1933	1934	1941	1942	1943	1944
1931-05	1932-05	1933-05	1934-05	1941-05	1942-05	1943-05	1944-05

ADVANCED MICRO CONTROLS INC.

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.

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

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

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Standard Warranty

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 (203) 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 (203) 583-7271.

Introduction

This manual explains the operation, installation, programming, and servicing the Series 1900 family of Resolver Interface Modules for the GE Fanuc Series 90™-70 programmable controller system. In general, there are two types of 1900 Modules. The standard modules are fully programmable from a front panel keypad and display and use an EEPROM IC to store programmed values in the absence of power. The 1900 Modules with a '-05' added to their part numbers are programmable from the front panel and the processor. They use Static RAM with an integral battery backup to store programmed values. Present EEPROM technology can store values for 25+ years but are limited to 10,000 writes to memory before damage may occur to the chip. Static RAM has an unlimited number of write cycles, but battery life is presently 10 years.

With the exception of backplane programmability and the technology used to store programmed values, these two types of modules are identical. Therefore, Chapters 1-5 apply to all modules except where noted. Chapters 6 and 7 cover programming the module from the backplane and apply only to '-05' modules.

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.

"Series 90" is a trademark of GE Fanuc Automation North America, Inc.

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, Plymouth Industrial Park, Terryville CT 06786, or fax us at (203) 584-1973.

Revision Record

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

This manual (1900-794M) supersedes manual 1900-493M. This revision adds backplane programming information for the modules with the '-05' option. It also eliminates information specific to 1900V Modules for standard VMEbus applications. This revision was first released 7/7/94.

Manual 1900-493M superseded manual 1900-C91M, the first revision. -493M revision incorporated new information for the users of the Series 1900V modules. The revision also improved the layout of the manual to make it easier to use. The revision was first released April 21, 1993.

Notes

General Information

About This Manual

Chapter 1: Introduction to the 1900 Resolver Interface Module

Chapter 2: 1900 Module Description

Chapter 3: Installation

Chapter 1: Introduction to the 1900 Resolver Interface Module

Chapter 2: 1900 Module Description

Chapter 3: Installation

Chapter 5: Series 1900 Data Transfer and Format

Chapter 6: Program Instructions and Error Codes

Chapter 7: Programming from the Processor

Prints

The 1900 Resolver Interface Modules

Today's manufacturing processes are becoming more and more complex. Achieving the goals of lower cost production, higher output, less wasted material, and fewer rejects is important if a company is to compete in today's global economy. To achieve these goals, programmable controller systems are being used in more and more applications because of the precise control and flexibility that such a system provides.

One device that can be use to accurately and dependably measure rotary position is the brushless resolver. With the introduction of the Series 1900 Modules for the GE Fanuc Series 90™-70 programmable controllers interfacing brushless resolvers to your system has been greatly simplified.

Built around a 16 bit microcontroller and a patented resolver to digital conversion technology, (US patent 4,989,001), the 1900 Modules are direct interfaces between brushless resolvers and your 90-70 programmable controller system. The many features of the 1900 Modules make them the most advanced products on the market today.

- Interfaces 1 to 4 brushless resolver based transducers to your programmable controller. Absolute single and multi-turn systems are available.
- Efficiently communicates absolute position and velocity data to the processor.
- Position resolution fully programmable to 8192 Counts per Turn. Velocity resolution is programmable to 1.0 or 0.1 RPM. Other features include programmable Position Offsets and Tachometer response times.
- Self-contained design eliminates the need for an external power supply.
- Extensive diagnostics continuously monitor the transducer and module for fault conditions.
- Sealed display and keyboard for setup programming or position and velocity data monitoring.

Series 1900 Family Members

1931	10 bit, one channel module	Maximum:	1024 total counts
1932	10 bit, two channel module	Maximum:	1024 total counts
1933	10 bit, three channel module	Maximum:	1024 total counts
1934	10 bit, four channel module	Maximum:	1024 total counts
1941	13 bit, one channel module	Maximum:	8192 total counts
1942	13 bit, two channel, module	Maximum:	8192 total counts
1943	13 bit, three channel module	Maximum:	8192 total counts
1944	13 bit, four channel module	Maximum:	8192 total counts
1961	18 bit, one channel module	Maximums:	100/180 turns
			1024 counts per turn
			184,320 total counts
1961-06	20 bit, one channel module	Maximums:	100/180 turns
			4096 counts per turn
			737,280 total counts
1962	18 bit, two channel module	Maximums:	Same as 1961

This manual deals with the programming and operation of the 1930 and 1940 modules. For instructions on the 1960 modules, refer to the Series 1960 User's Manual. If the 1930 or 1940 module has '-05' at the end of the model number (example: 1941-05) then the unit is programmable from the backplane as well as the front panel display and keypad.

Brushless Resolver Description

The brushless resolver is unsurpassed by and other type of rotary position transducer in its ability to withstand the harsh industrial environment. Originally developed for military applications, the resolver has benefited from more than 40 years of continuous use and development.

The resolver is essentially a variable rotary transformer, with one primary winding, the Reference Winding and two secondary windings, the SIN and COS Windings. (See Fig 1.1). The Reference Winding is located in the rotor of the resolver, the SIN and COS Windings in the stator. The SIN and COS Windings are mechanically displaced 90 degrees from each other.

In general, the Reference Winding is excited by an AC voltage called the Reference Voltage (V_R). (See Fig 1.2). In a brushless resolver, the Reference Voltage is supplied to the rotor by using a second rotary transformer on the input. The induced voltages in the SIN and COS Windings are equal to the value of the Reference Voltage multiplied by the SIN or COS of the angle of the input shaft from a fixed zero point.

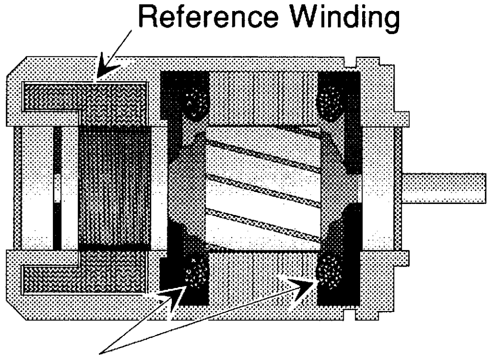


Fig 1.1 Resolver Cut away View

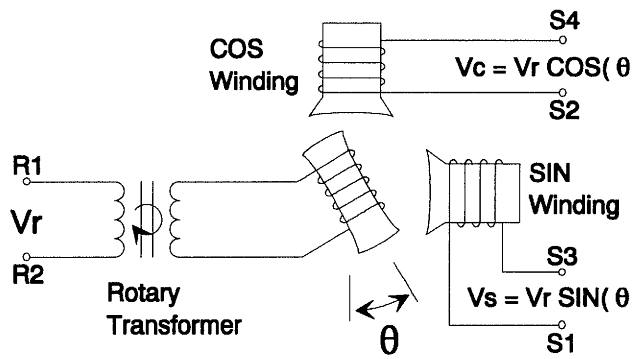


Fig 1.2 Resolver Schematic

The ratio of the SIN voltage to the COS voltage is equal to TAN θ, where θ is the angle of the input shaft from a fixed zero point. Thus, the resolver can provide a set of voltages whose ratio represents the absolute position of the input shaft. Because the ratio of the SIN and COS voltages is considered, any change in the resolvers' characteristics, such as those caused by aging or a change in temperature, are ignored.

Resolver Based Position Transducers

Mechanically connected to the shaft of the controlled machine, the transducer is subjected to severe environmental conditions such as continuous mechanical shock and vibration, extreme temperature and humidity variations, and exposure to contaminates such as oil mists, coolants, and solvents. AMCI manufactures three different types of rugged, brushless resolver transducers for use with the Series 1900 Family of Resolver Interface Modules to meet the challenges of this harsh environment. Every transducer manufactured by AMCI have the following features in common.

- Sealed Shaft Bearing.
- MIL Spec Connector for the transducer cable. Resolver wires are bonded to the connector to prevent them from breaking off due to any shock or vibration the transducer is subjected to.
- Entire transducer is sealed against liquid and airborne contaminants. (NEMA 13)
- Flexible Coupler between the transducer shaft and resolver on the HT-20 family protects the resolver from radial and axial shaft loading and high shaft acceleration that can occur when a motor is started.
- Simple six wire cabling per transducer to the modules' transducer input connector.

Compatible Position Transducers

The following resolver based transducers manufactured by AMCI can be used with any Series 1930 or 1940 module.

For Single Turn applications:

- HT-20 Heavy Duty Position Transducers. (Dwg. B1001)
- H25FE Size 25 Flange Mount Position Transducer. (Dwg. B1041)
- H25SE Size 25 Servo Mount Position Transducer, (Dwg. B1041)

For Multi-turn applications:

- HT-20-(x) Multi-turn Position Transducer. (Dwg. B1051)

Presently, the following turns ratios are available for the HT-20-(x):

2:1, 2.77:1, 3:1, 4:1, 4.8:1, 5:1, 6:1, 7:1, 8:1, 10:1, 12:1, 16:1, 20:1, 24:1, 36:1, 40:1, 50:1, 60:1, 64:1, 100:1, 150:1 and 250:1.

Other transducers with options such as different mounting patterns or connectors are also available from AMCI. If your application requires a special transducer, please contact AMCI at (203) 585-1254.

1900 Functions and Parameters

The 1900's perform two operations. These two operations are called Functions. These Functions are:

Position Function - Gives you information on the position of the transducers' shaft relative to a programmable zero point.

Tachometer Function - Gives you information on the angular velocity of the transducers' shaft in RPM.

> One or more inputs define each Function. One input is the AMCI resolver based transducer. The other inputs are programmable from the keyboard. These inputs are called Parameters.

Scale Factor - Sets the resolution to which the position of the transducers' shaft is determined.

Circular Offset - Changes the value of the Position Function without mechanically rotating the transducers shaft.

Linear Offset - Adds a fixed number to the value of the Position Function.

Tachometer Response - Sets the resolution and update time of the Tachometer Function.

Front Panel Description

The following is a description of the features found on the 1900 Modules. Separate sections of this chapter describe the parts in detail. Unless otherwise noted, all information presented in this chapter is applicable to all 1930 and 1940 Modules.

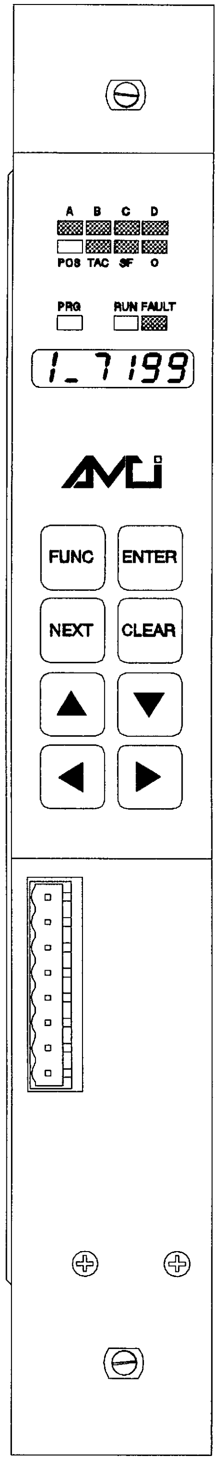


Fig 2.1 1900 Front Panel

Function Display - Used to show the Functions and Parameters of the 1900 Module. The eight LED indicators designate what is showing on the alpha-numeric display. When in Program Mode, a blinking digit on the display shows the position of the *Cursor*.

Status Indicators - Indicates the operating condition of the module.

- PRG - Yellow light is on when the module is in Program Mode.
- RUN - Green light is blinking when the module is operating.
- FAULT - Red light is on when there is a fault condition. The nature of the fault is shown on the alpha-numeric display.

Program Switch - Located on the top panel, hidden from view. Used to enable or disable Program Mode. When enabled, the module is programmable from the keyboard.

Keyboard - Used to examine or change the Functions and Parameters of the Module.

Transducer Input Connector - Connector for one to four AMCI brushless resolver based transducers.

Function and Parameter Displays

The following displays are available on the 1900 Modules. A brief description of each Function or Parameter is given to the right of the display. Unless noted, each of the displays is available on all 1930 and 1940 Modules. Please note that a shaded LED indicator is not lit on the display.

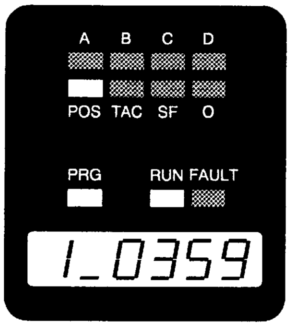


Fig 2.2 Position Display

Position Data Display - This display shows the current position of the transducer's shaft. Its value varies from (Linear Offset) to (Linear Offset + (Scale Factor - 1)) On multi-channel modules, the Position Data Display of the additional transducers is sequentially available by pressing the [NEXT] Key. The "1" on the display will be replaced by the number of the transducer being displayed. The Position data is available to the processor.

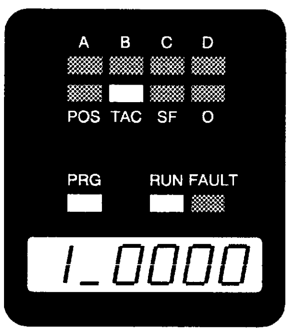


Fig 2.3 Tach Display

Tachometer Data Display - This display shows the speed of rotation of the transducer's shaft in RPM. The time between updates, which is the time it takes to determine a new speed and show it on the display, and the resolution of the Tachometer are programmable through the Tachometer Response Parameter. On multi-channel modules, the Tachometer Function of the additional transducers is sequentially available by pressing the [NEXT] Key. The Tachometer data is available to the processor.

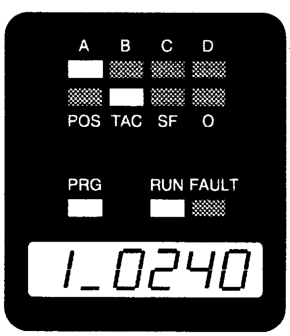


Fig 2.4 Tach Response

Tachometer Response Parameter - The tachometer response can be programmed to any one of four update periods, (time between tachometer updates), and one of two resolutions. This allows you to tailor the tachometers' response to the systems' needs. The four tachometer update periods are 32 mSecs, 60 mSecs, 120 mSecs, and 240 mSecs. The two resolutions, available with a 240 mSec update time only, are to 1 RPM or to 0.1 RPM. On multi-channel modules, the Tachometer Response Parameter of the additional transducers is sequentially available by pressing the [NEXT] Key.

The maximum speed that can be displayed by the module or sent to the processor depends on the chosen resolution and the update time. When the Tachometer Response is set to 240 mSecs, the maximum speed that can be displayed is 999.9 RPM if the resolution is 0.1 RPM or 1000 RPM if the resolution is set to 1.0 RPM. When the Tachometer Response is set to 120 mSecs or faster, the maximum speed that can be displayed is 2000 RPM. Exceeding these speeds will cause the module to display and send erroneous data to the processor.

Function and Parameter Displays (cont'd)

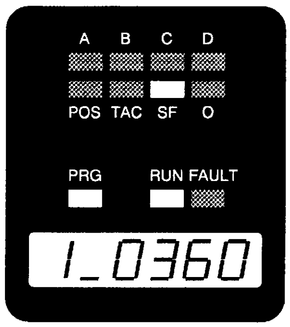


Fig 2.5 Scale Factor

Scale Factor Parameter - The Scale Factor parameter is used to set the resolution to which the module determines the position of the transducer's shaft. The Scale Factor can be programmed between 2 and 1024 for the 1930 modules and between 2 and 8192 for the 1940 modules. On multi-channel modules, the Scale Factor Parameter for the additional transducers is sequentially available by pressing the [NEXT] Key.

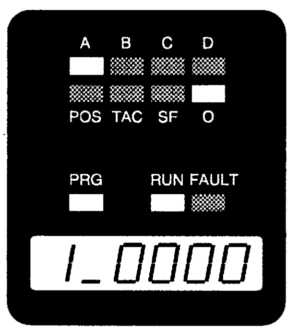


Fig 2.6 Circular Offset

Circular Offset Parameter - The Circular Offset parameter allows you to change the value of the Position Function without rotating the transducers' shaft. This offset is most commonly used to force the position to the correct count after the machine has been aligned. On multi-channel modules, the Circular Offset Parameter of the additional transducers is sequentially available by pressing the [NEXT] Key.

For example: One rotation of the transducer's shaft produces counts between 000 and 719. (The Scale Factor = 720) When the machine is aligned to mechanical zero the transducers position should equal 000. However, when the machine is aligned, the module reads a position of 695. An Offset must be programmed in to force the position to 000. The formula for determining the Offset is:

Scale Factor - Present Position + Present Offset + Desired Position = CIR. OFFSET

720 - 695 + 000 + 000 = 25

The maximum value of the Offset is: (Scale Factor - 1).
If the Calculated Offset is greater than the Scale Factor, the Actual Offset equals:
(Calculated Offset - Scale Factor).

When you enter a new value for the Scale Factor parameter, the Circular Offset is reset to zero.

Function and Parameter Displays (cont'd)

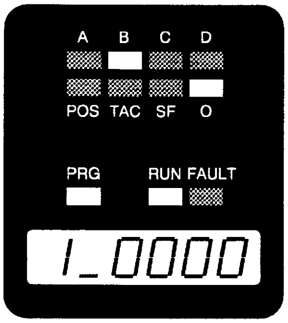


Fig 2.7 Linear Offset

Linear Offset Parameter - The Linear Offset Parameter is used to change the RANGE of values of the Position Function. This offset is most commonly used when the transducer is measuring linear distances such as with palletizing applications. On multi-channel modules, the Linear Offset Parameter of the additional transducers is sequentially available by pressing the [NEXT] Key.

For example: A 1941 is used to measure a total distance of 5.000 meters with a 1 millimeter resolution. This means that the total counts over your full travel is:

5.000 meters * 1000 mm / meter = 5000 Counts

And you program the Scale Factor to this value. The 5.000 meters that the transducer measures is in the range of 2.500 to 7.500 meters on the machine. You can use the Linear Offset to force the module to send its position data to the processor in the correct format instead of using the processor to add an offset to the position value from the module. The formula for the Linear Offset is as follows:

Minimum Desired Value	*	Resolution	=	LINEAR OFFSET
2.500 meters	*	1000 mm/meter	=	2500

The maximum position value that can be displayed is 9999. Therefore the maximum value of the Linear Offset is 9999 - (SF-1).

When you enter a new value for the Scale Factor, the Linear Offset is reset to 0000.

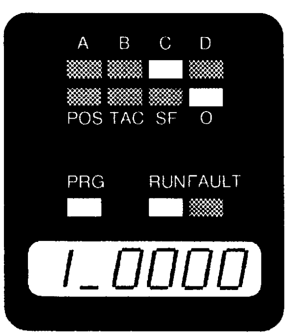


Fig 2.8 Preset Value

Preset Value Parameter - Available with '-05' Option, the Preset Value Parameter allows you to set the value of the position function without calculating the required offset. When in Program Mode and viewing the Position value, pressing the [CLEAR] Key will force the module to calculate and store the circular offset needed to bring the position value to the Preset Value. On multi-channel modules, the Preset Value Parameter of the additional transducers is sequentially available by pressing the [NEXT] Key.

Status Indicators

There are three single LED indicators below the alpha-numeric display that show the operating status of the module.

- PRG: This yellow light is on when the module is in Program Mode. While in Program Mode, all of the parameters can be inspected and altered from the keyboard.
- RUN: A blinking green light indicates that the module is powered and operational.
- FAULT: This red light is on when the module recognizes a fault condition. The type of fault is shown on the alpha-numeric display. The 1900 Modules recognize two types of faults.

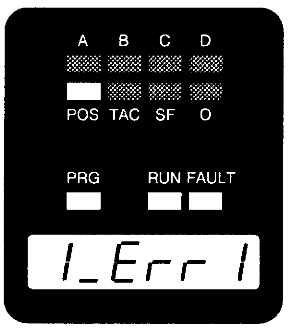


Fig 2.9 Transducer Fault

Error Class 1: Transducer Fault - This message is shown only when the module is displaying the Position or Tachometer Functions. The Parameters will be displayed normally. If the message is blinking, press the [CLEAR] key to clear the fault and display the Position or Tachometer data. There are four major causes of this fault:

- Broken Transducer Cable.
- Non-compatible Transducer.
- Improper wiring of the Transducer Cable.
- Faulty Transducer.

If you are using a multi-channel module, the transducer fault may not be on the channel that is being shown on the modules' display. In this case, the fault light will be on but the module will be displaying Position and Tachometer information. Use the [NEXT] Key to cycle through the modules' channels until the fault is found.

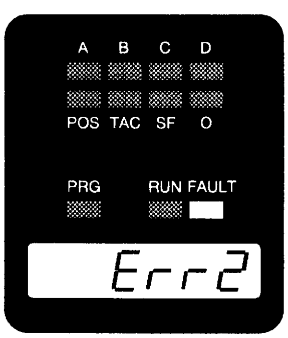


Fig 2.10 E^2PROM Fault

Error Class 2: E^2PROM or nvRAM Fault - This message is displayed at all times. The module recognizes that the program data (Scale Factor, Offsets, etc.) is incorrect. This error can be cleared by pressing the [CLEAR] Key. If the " Err 2" message remains after pressing the [CLEAR] Key, the E^2PROM or non-volatile RAM memory is damaged and the module must be returned for repairs. If you are using a nvRAM and the " Err 2" message appears on every power up, the RAM is working but the battery is discharged. See inside front cover *Returns Policy:* for additional information.

Program Switch

The Program Switch is used to enable or disable programming of the 1900 Module. The module is programmable (Program Mode, PRG light ON) when the switch is pushed towards the front of the module. When in Program Mode, all parameters can be modified. The module is not programmable (Display Mode, PRG light OFF) when the switch is pushed towards the back of the module. When in Display Mode, all parameter values can be examined but cannot be modified.

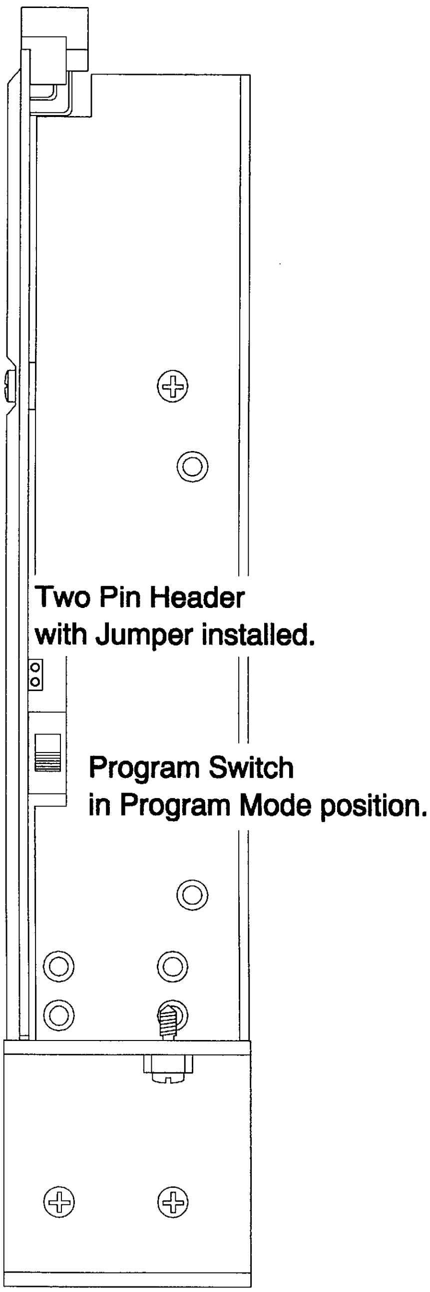


Fig 2.11 Program Switch

⚠WARNING Remove system power before removing or installing a module in the I/O Rack. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personnel.

The Program Switch can be disabled by removing the jumper on the two pin header next to the switch. Removing this jumper locks the 1900 in Display Mode. It is usually good practice to remove this jumper once the system is operational. This will prevent someone from accidentally changing the 1900's parameters while the system is running. The only times that changes to the modules programming should be allowed are during set-up or trouble shooting procedures.

Keyboard Description

The following table describes what the keys do when you are in Display Mode, (PRG light OFF) or Program Mode (PRG light ON). When in Program Mode, a parameter that you show on the display can be changed if one of the digits on the display is blinking. The blinking digit shows the position of the Cursor.

Key	*Display Mode*	*Program Mode*
FUNC	Use this key to select the function or parameter you wish to show on the display.	Same as Display Mode.
ENTER	Not used in Display Mode.	If a parameter is shown with the Cursor, pressing this key will store the displayed value in E^{2}PROM or nvRAM Memory.
CLEAR	Use this key to recover from fault conditions. The exact nature of the fault is shown on the display. See *Status Indicators* Pg. 2-5.	Same as Display Mode. If the Position Function is on the display, press this key to use the AUTO PRESET feature
NEXT	Used to switch between the transducer inputs on a multi-channel module.	Same as Display Mode.
▲ ▼	Not used is Display Mode.	If the Cursor is shown, use these keys to increment [▲] or decrement [▼] the number under the cursor.
◀ ▶	These Keys can be used to select the Function or Parameter that you wish to show on the display.	If the Cursor is shown, these keys shift the Cursor to the left [◀] or the right [▶] by one digit.

Fig 2.12 Keyboard Description

Transducer Input Connector

The Transducer Input Connector on the 1931, 32, 41, and 42 modules has eight contacts while the Transducer Input Connector on the 1933, 34, 43, 44 modules has fourteen contacts. The following table lists the AMCI and Phoenix Contact part numbers on the mating connectors:

	1/2 Channel Modules	3/4 Channel Modules
AMCI Part #	MS-8	MS-14
Phoenix Part #	MSTB1.5/8-ST-5.08	MSTB1.5/14-ST-5.08

Fig 2.13 Transducer Input Connector Part Numbers

The pin-out of the cables are given in Chapter 3, **Installation**.

Fuse Replacement

If the Power Fuse fails, it can be easily replaced. The factory installed fuse is a 3.5 Amp Fast Blow, Littelfuse Part Number 22503.5. Fuse kits are available from AMCI. The AMCI Part number is SKF-1. Each fuse kit contains five fuses.

CAUTION To insure continued and adequate protection, any replacement fuse must have a rating of 3.5 Amp Fast Blow. Using a higher ampere rating or slow blow fuses may not protect the module from damage if the fault conditions are again applied to the module.

WARNING Remove system power before removing or installing a module in the I/O Rack. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personal.

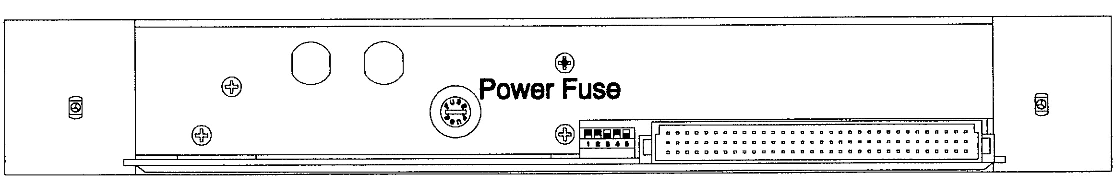


Fig 2.14 Power Fuse

Series 1900 Specifications

Module Interface

Bus slave module. Compatible with GE Fanuc's Industrialized VMEbus (VME-I).

Position Transducer

AMCI Brushless Resolver

Transducer Input

Transformer Isolated

Compatible Transducers

1930/40: HT-20(/S), H25F/SE, HT-20-(X)
1960: HTT-20-100/180/1000/1800

Maximum Position Resolution

1930: Programmable to 1 part in 1024
1940: Programmable to 1 part in 8192
1960: Programmable to 1 part in 1024 per turn

New Position Throughput Time

400 µSec: 1931, 32, 41, 42, 61
800 µSec: 1933, 34, 43, 44, 62

Programmable Parameters

Scale Factor	
Number of Turns	(1961/2 only)
Decimal Point Position	(1961/2 only)
Circular Offset	
Linear Offset	
Preset Value	
Tachometer response time	(1930/40 only)
Tachometer resolution	(1930/40 only)

Number of Turns

1930/40: 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 16, 20, 24, 36, 40, 50, 60, 64, 100, 150, 250.

1960: 100 Turn Transducer:
1, 2, 4, 5, 10, 20, 25, 50, 100 turns.
180 Turn Transducer:
1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 30, 36, 45, 60, 90, 180 turns.

Programmable Tach Response Time

32, 60, 120, or 240 mSec:	(1930/40)
Set to 32 mSec:	(1960)

Tachometer Resolution

1 RPM at 32, 60, 120 mSec response times.
Programmable to 1.0 RPM or 0.1 RPM at 240 mSec response time.

Tachometer Range

0 to 2000 RPM at 32, 60, or 120 mSec response times
0 to 1000 RPM or 0.0 to 999.9 RPM at 240 mSec response time

Position Offset

Circular Offset programmable from 0 the Full Scale Count
Linear Offset programmable from 0 to:
(9999 - Full Scale Count) 1930/40
(999999 - Full Scale Count) 1960

Data Available to Processor

Transducers' Shaft Position, Shaft Velocity, and Fault Diagnostics data

Program Input

Modules' self-contained keyboard and display

Program Storage

E^2PROM or nvRAM (-05 option) Memory

DC Supply Current from Backplane

+5 Vdc @ 1.05 A max. (1934/44/62 Modules)

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% (w/o condensation)
Storage Temperature:	-40 to 85° C

NOTES

Power Requirements

Each 1900 Module draws its power from the backplane's +5 Vdc Supply. The maximum current draw is 1.050 Amps (5.25W). Add this to the power requirements of all other cards in the rack to avoid exceeding backplane or power supply capacity.

AM Code Configuration

The Address Modifer (AM) Code is part of the VMEbus specification. The AM Code allows two modules to occupy the same address space if they respond to different AM Codes. Every 1900 Module is factory configured to respond to the address modifier (AM) code of 29H, which is the default used by GE-Fanuc Series 90™-70 systems. For standard GE-Fanuc installations, you need only set the slot number (address range) with DIP Switches located next to the backplane connector.

If you are using a Series 1900 Module in a non-standard GEF system, you can configure the module to respond to different AM Codes. Please contact Technical Support at (203) 583-7271 for instructions on modifying the AM code.

Memory Address Allocation

You must assign the memory addresses that the module responds to with the DIP Switch located on the back of the module as shown in figure 3.1. GE Fanuc assigns default memory locations for each slot in an I/O rack. In most applications, the 1900 Module should be configured to use the memory locations assigned to the slot that it resides in. GE Fanuc systems also set aside a User Defined Memory Area, addresses 5000h to FFFFh, in each rack. This memory area can be used be a 1900 Module if another module in the rack requires the memory normally assigned to the module.

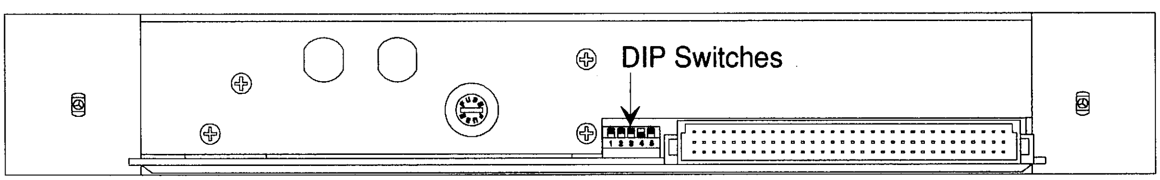


Fig 3.1 DIP Switch Location

DIP Switches 1 through 5 correspond to address lines A15 through A11 on the backplane. The starting memory location, in Binary, of the 1900 Module is:

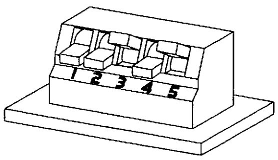
XXXX X000 0000 0000b, where: XXXX X are the values specified by the DIP Switches.

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.

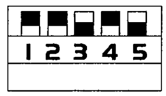
The table on the following page lists the memory locations that a 1900 Module can be configured for with the default AM Code configuration. Also listed are the GE Fanuc Slot Numbers and the required DIP Switch settings.

Memory Address Allocation (cont'd)

A closed DIP Switch, (lever towards the PC Board), sets the Address bit to a "0". An open Dip Switch, (lever towards the metal case), sets the Address bit to a "1".



=



=

Default Addressing Slot 5
2800h - 2FFFh

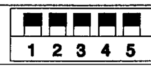
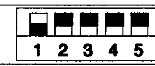
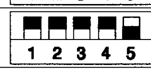
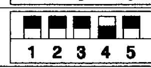
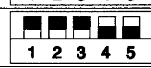
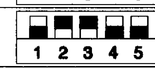
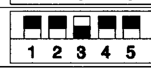
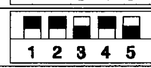
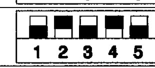
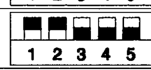
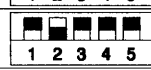
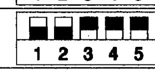
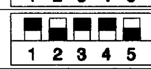
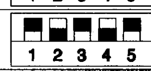
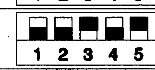
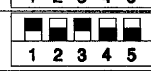
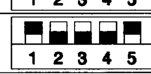
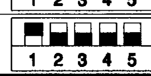
Memory Locations	GE Slot #	DIP Switch	Memory Locations	GE Slot #	DIP Switch
0000h - 07FFh	None		8000h - 87FFh	User Def.	
0800h - 0FFFh	None		8800h - 8FFFh	User Def.	
1000h - 17FFh	2		9000h - 97FFh	Used Def.	
1800h - 1FFFh	3		9800h - 9FFFh	User Def.	
2000h - 27FFh	4		A000h - A7FFh	User Def.	
2800h - 2FFFh	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.	

Fig 3.2 DIP Switch Settings

Installing the Module

⚠WARNING Remove system power before removing or installing a module in the rack. Failure to observe this warning can result in damage to the module's circuitry and/or undesired operation with possible injury to personal.

After selecting the proper AM Code and memory addresses, the module is ready to be inserted into the rack. Insert the P.C. Board into the card guides and gently seat the connector into the backplane. Seating the connector does not require a great amount of force. Applying to much pressure on a mis-aligned connector may damage the module or backplane.

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

CAUTION The two mounting screws that secure the module to the rack are also the grounding points for the 1900. These two screws MUST be tightly screwed into the rack for proper operation.

Transducer Mounting

All AMCI resolver based transducers are designed to operate in the industrial environment and therefore require little attention. However, there are some general guidelines that should be observed to ensure long life.

– Limit transducer shaft loading to the following maximums:

Shaft Diameter	Radial Loads	Axial Loads
5/8"	100 lbs. (445 N)	50 lbs. (222.5 N)
3/8"	30 lbs. (133 N)	15 lbs. (66.5 N)

Fig 3.3 Recommended Shaft Loading Maximums

– Minimize shaft misalignment when direct coupling shafts. Even small misalignments produce large loading effects on front bearings. It is recommended that you use a flexible coupler whenever possible.

The figures on the next two pages are dimensional drawings of the HT-20, HT-20/S, HT-20-(x), H25SE and H25FE transducers. Engineering Prints of these transducers are at the back of the manual. The print numbers are:

– **B1001 Rev A**: HT-20 Outline Drawing
– **B1041 Rev C**: H25SE/FE Outline Drawings
– **B1115 Rev B**: HT-20/S Outline Drawing
– **B1051 Rev A**: HT-20-(x) Outline Drawing

Transducer Mounting (cont'd)

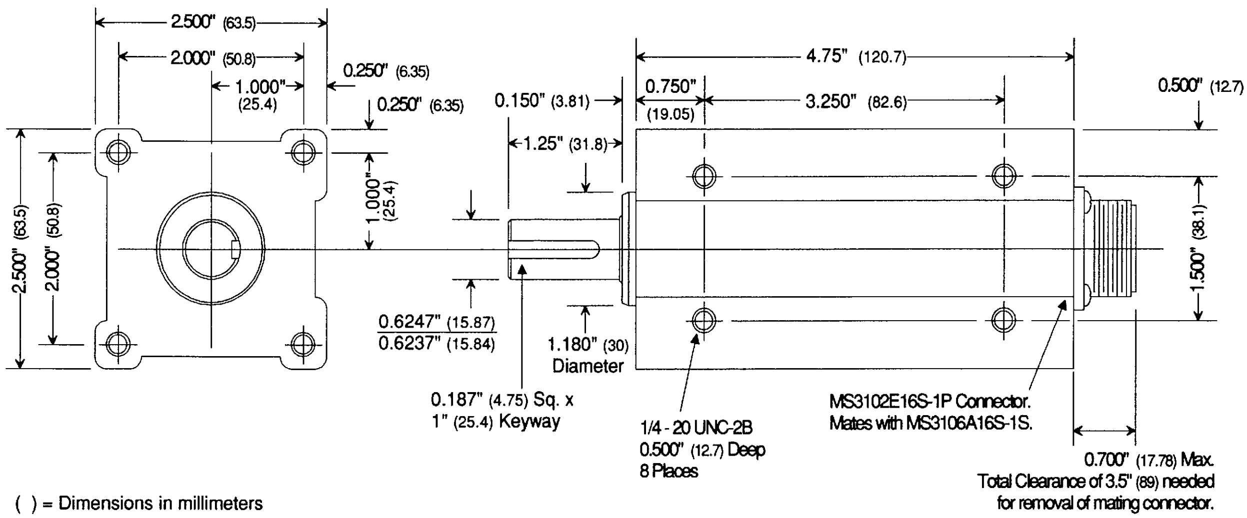


Fig 3.4 HT-20 Outline Drawing

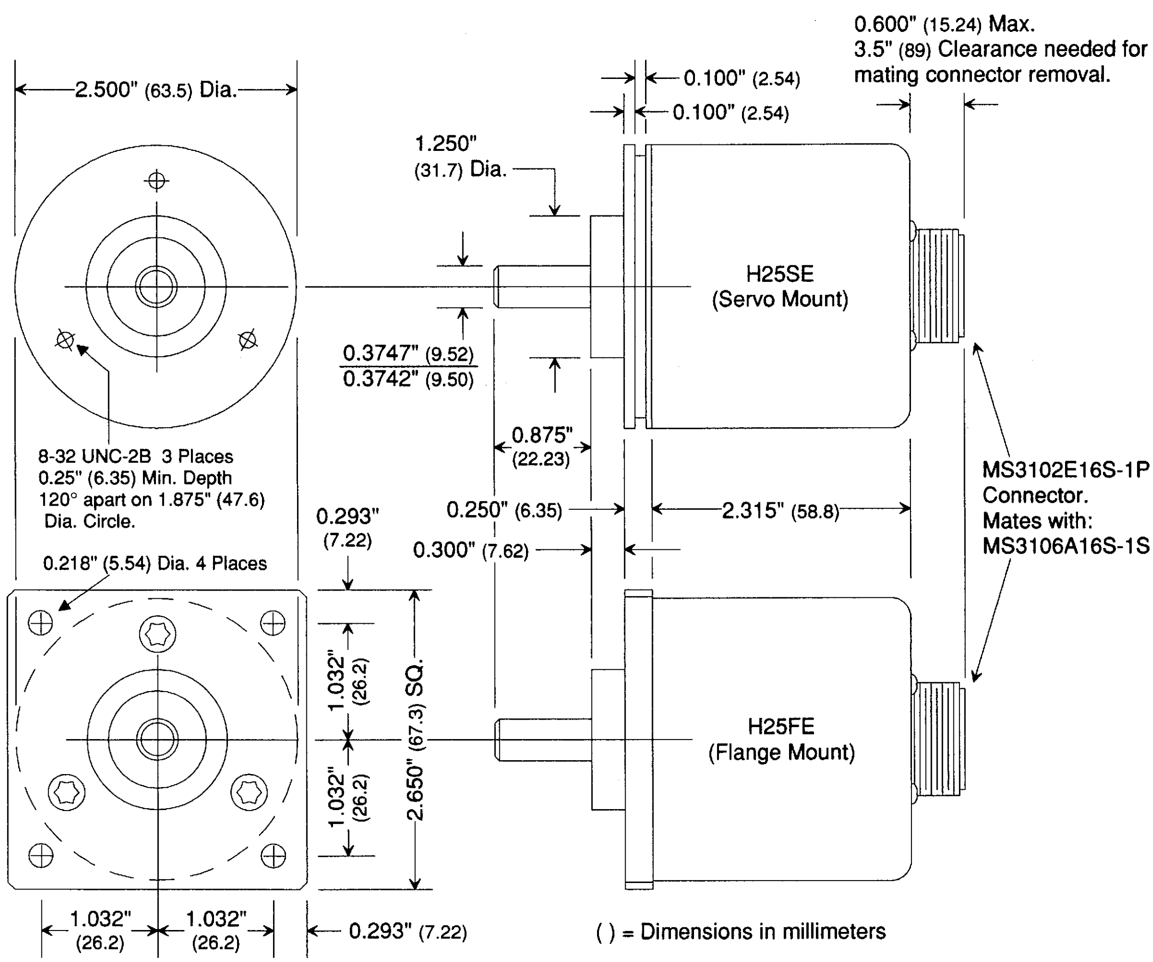
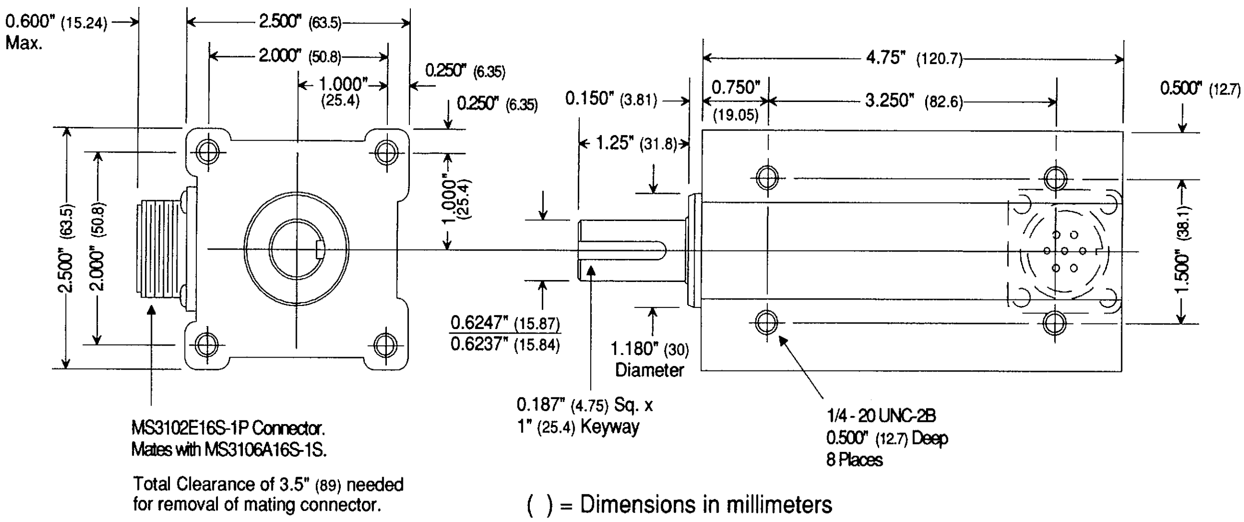


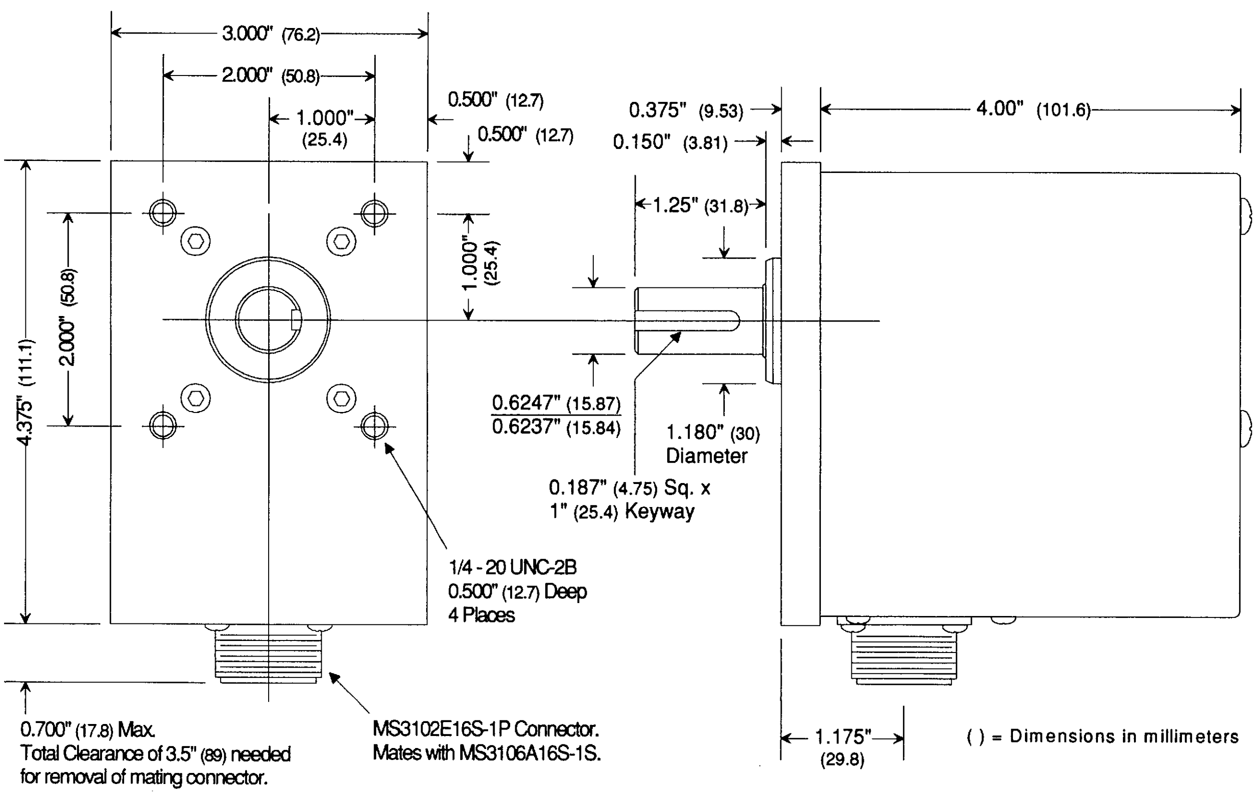
Fig 3.5 H25SE/FE Outline Drawing

Transducer Mounting (cont'd)



( ) = Dimensions in millimeters

Fig 3.6 HT-20/S Outline Drawing



( ) = Dimensions in millimeters

Fig 3.7 HT-20-(x) Outline Drawing

Transducer Cable Installation

Use the table below to determine the correct cable and connectors for your application. Cables that have been assembled and tested are available from AMCI under the given part numbers. If you plan to make your own cables, the required cable and connectors can be ordered from AMCI.

Module	AMCI Cable #	Belden # -100ft	Belden # 100ft+	Module Conn.	Transducer Conn.
1931/41	C1T - (x)	9873	9730	MS-8	MS-16 (1)
1932/42	C2T - (x)	9873	9730	MS-8	MS-16 (2)
1933/43	C3T - (x)	9873	9730	MS-14	MS-16 (3)
1934/44	C4T - (x)	9873	9730	MS-14	MS-16 (4)

Fig 3.8 Transducer Cable Part Numbers

The figures on the following two pages are the wiring diagrams of the transducer cables. Engineering prints of these cables are also given at the back of the manual. The print numbers are:

- **B1110 Rev E**: C1T-(x) Cable Drawing
- **B1046 Rev C**: C2T-(x) Cable Drawing
- **B1113 Rev B**: C3T-(x) Cable Drawing
- **B1052 Rev C**: C4T-(x) Cable Drawing

CAUTION — Cable shields must be grounded at the 1900 Module ONLY! The shields must not be connected to the transducer and must be isolated from the raceway that the cable is installed in. This practice will eliminate ground loops that may induce EMI noise into the cable or damage the 1900 module.

CAUTION — Pin 1 of the Transducer Input Connector is located towards the top of the module, NOT the bottom as these drawings may imply. Reversing the wires on the Module Connector will not harm the module or the transducer, but the transducer will not operate.

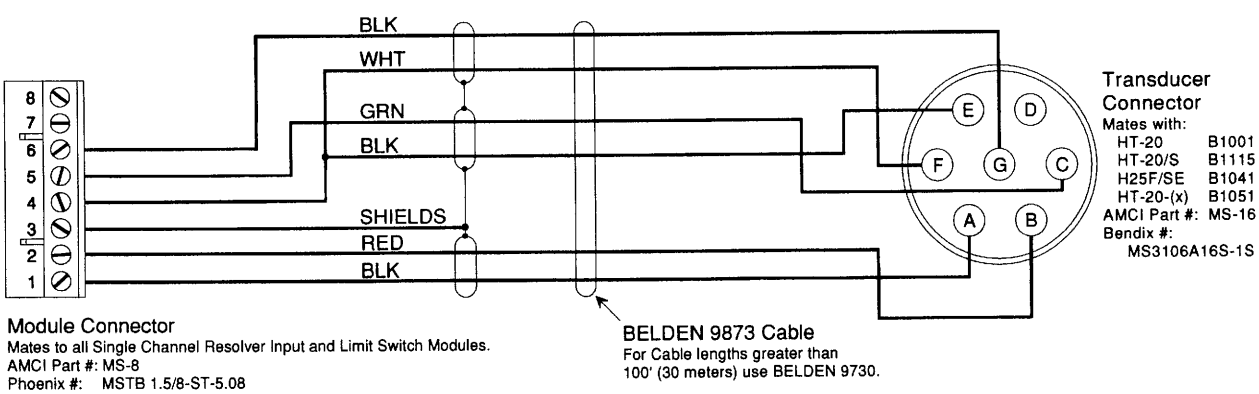


Fig 3.9 C1T-(x) Wiring Diagram

Transducer Cable Installation (cont'd)

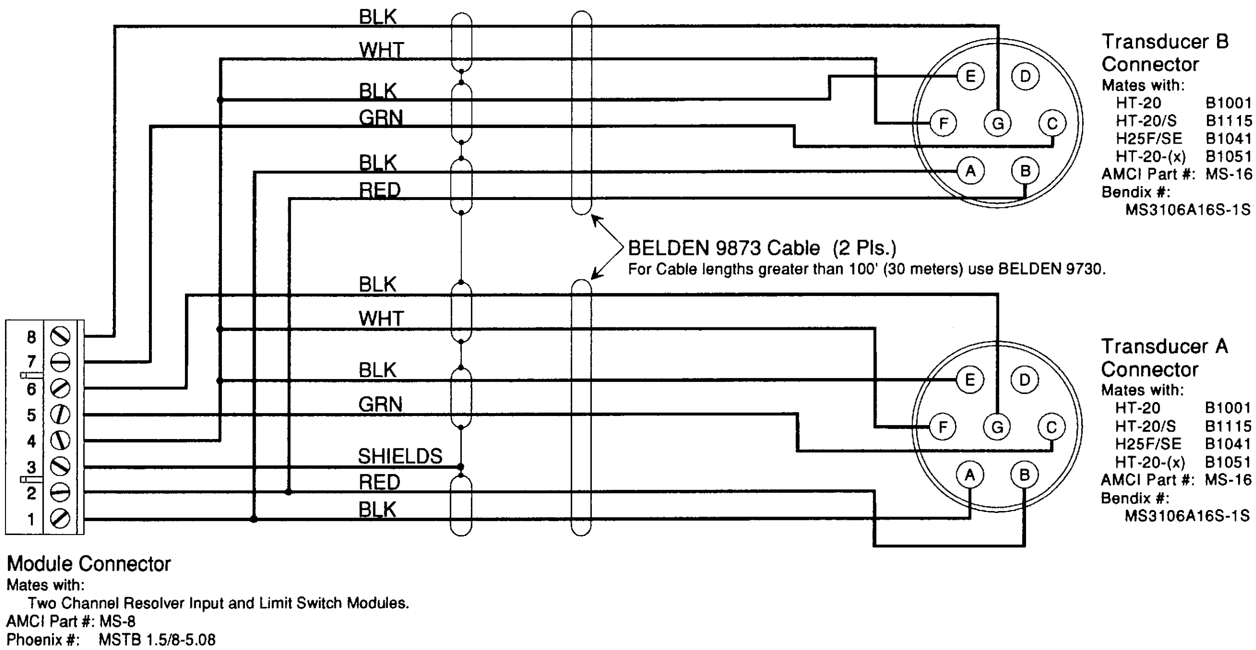


Fig 3.10 C2T-(x) Wiring Diagram

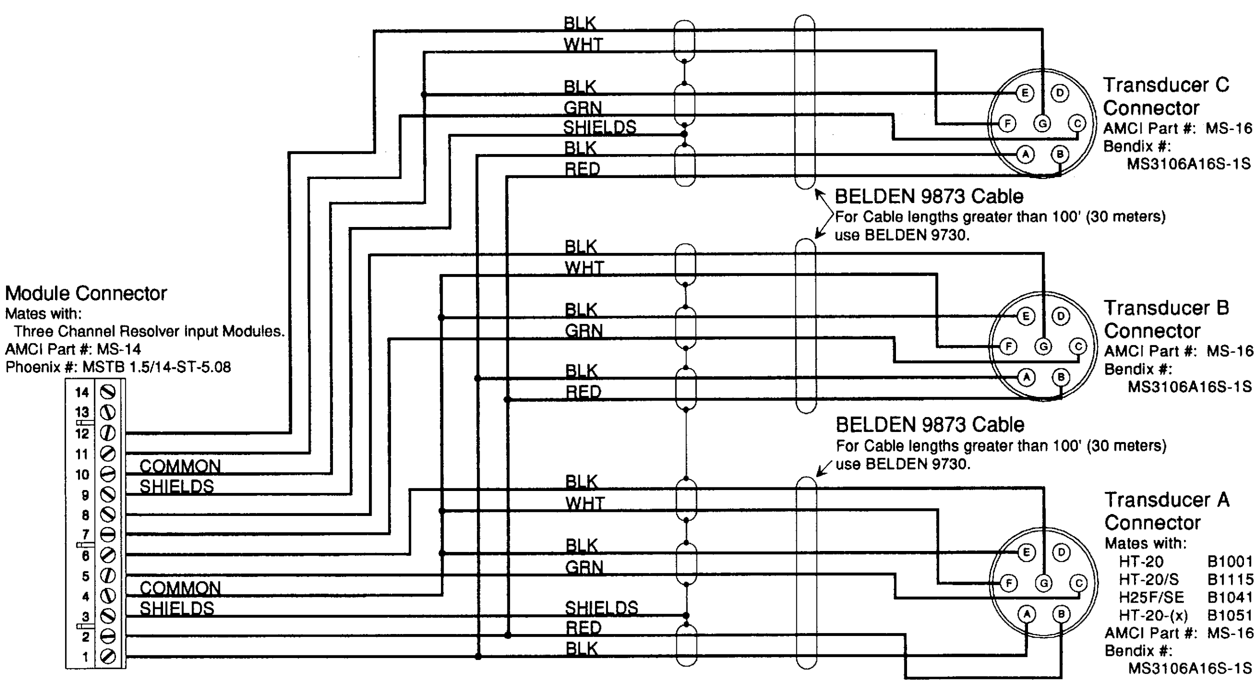


Fig 3.11 C3T-(x) Wiring Diagram

Transducer Cable Installation (cont'd)

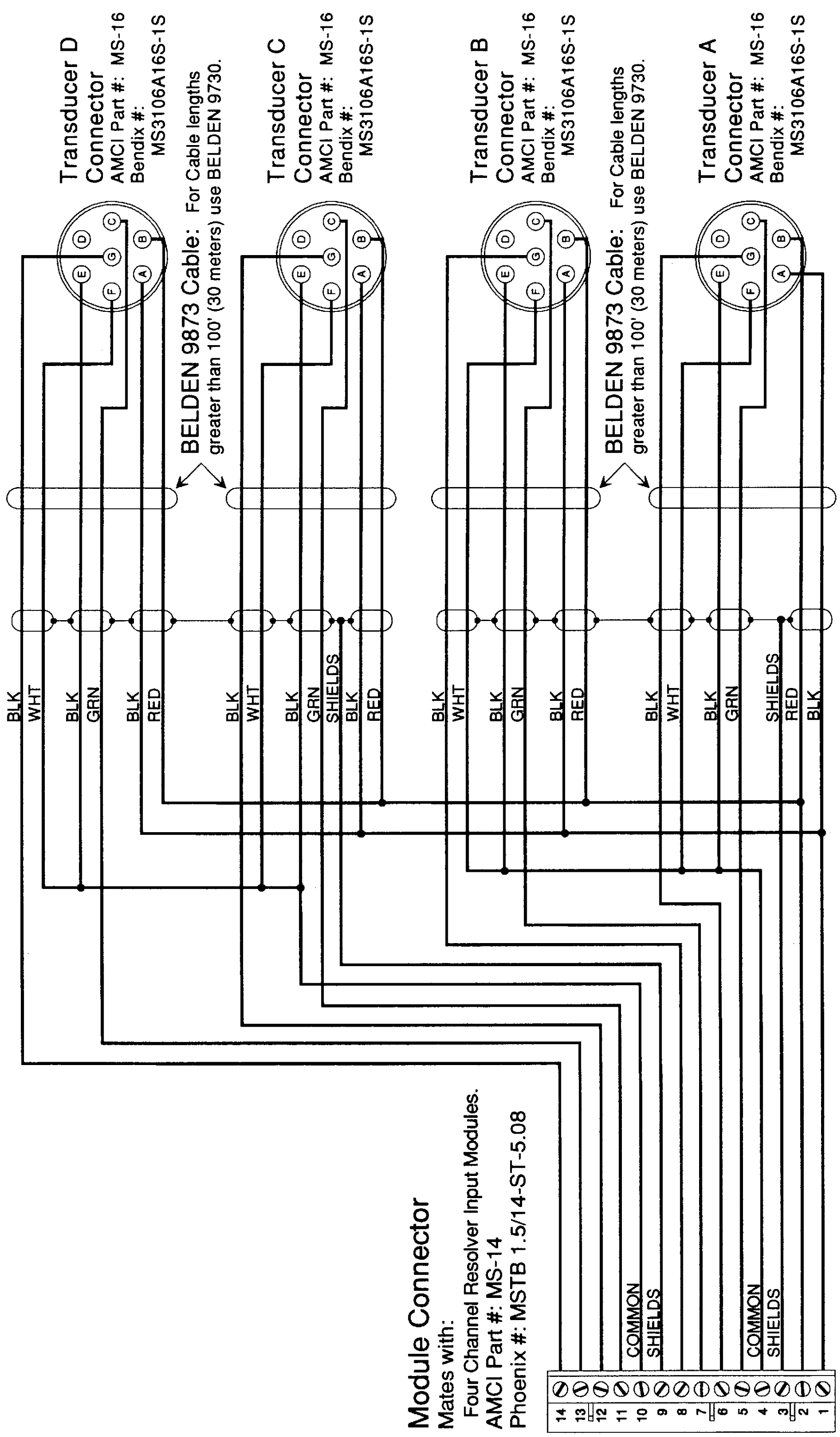


Fig 3.12 C4T-(x) Wiring Diagram

This chapter offers examples on how to program the 1900 Modules. Unless noted, all programming examples are applicable to all 1900 Modules.

Before any of the 1900's parameters can be programmed, the module must be in Program Mode. (Program Switch set ON. See *Program Switch* Pg. 2-6 for more information.) When the module is in this mode, the yellow PRG light on the front panel is lit.

Conventions

The following conventions are used when describing the keystrokes needed to program the different parameters.

[KEY]: Used to show the key pressed on the module. The key's name will be inside the brackets.

If an asterisk appears before a key, (Example: *[FUNCTION]), the key must be pressed until the display matches what is shown in the instructions.

If a "X" and a number follow a key, (Example: [▲]X3), the key must be pressed the shown number of times. (In this example, the [▲] key would be pressed 3 times.)

IND. LEDS: Indicator LEDs that indicate the function or parameter being displayed or programmed.

"Display": Information shown on the 6 digit display. The blinking cursor is shown by a double underline.

The following keystroke examples use the least number of keystrokes. However, any series of keystrokes is valid as long as the data is correct before the [ENTER] key is pressed.

Tachometer Response

You want the tachometer to update every 32 mSec. The tachometer response is presently at its default value of 240 mSec with a 1 RPM resolution.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	TAC + A	"1 _ 0240"	Present Value.
[▲]	TAC + A	"1 _ 240.0"	240 mSec, 0.1 RPM Resolution.
[▲]	TAC + A	"1 _ 0032"	Desired value of 32 mSec.
[ENTER]	TAC + A	"1 _ 0032"	Value stored in E^2PROM. Blinking Cursor removed.

Scale Factor

Your setup requires a Scale Factor of 720 for the second transducer on a 1933. Presently, the default Scale Factor of 360 is programmed in.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	SF	"1 _ xxxx"	Transducer 1 Scale Factor.
[NEXT]	SF	"2 _ 0360"	Transducer 2 Scale Factor.
[►], [▲]X4, [►], [▼]X4	SF	"2 _ 0720"	Desired value of 720 Counts per Turn.
[ENTER]	SF	"2 _ 0720"	Value stored in E^2PROM. Blinking Cursor removed.

Circular Offset

You want to program a Circular Offset of 25 counts. The default value of 0000 is presently in memory.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	OF + A	"1 _ 0000"	Present Offset.
[►]X2, [▲]X2, [►], [▼]X5	OF + A	"1 _ 0025"	Desired Circular Offset of 25 Counts.
[ENTER]	OF + A	"1 _ 0025"	Value stored in E^2PROM. Blinking Cursor removed.

Linear Offset

You want a Linear Offset of 2500 on the third transducer of a 1944.. The default value of 0000 is presently in memory.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION], [NEXT]X2	OF + B	"3 _ 0000"	Transducer 3 Linear Offset.
[▲]X2, [►], [▲]X5, [ENTER]	OF + B	"3 _ 2500"	Value stored in E^2PROM. Blinking Cursor removed.

Preset Value: (Available with '-05' option only)

When your machine is at its home position, the position data should be 180. Instead of calculating the required circular offset you set the Preset value and use the Auto Preset feature.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	O + C	"1 _ 0000"	Default Preset Value.
[►], [▲], [►], [▼]X2, [ENTER]	O + C	"1 _ 0180"	Value stored in E^2PROM. Blinking cursor removed.

Auto Preset Feature

You can zero the position data from the keypad by pressing the [CLEAR] Key while displaying the transducer position. The module calculates the proper circular offset for you. If you have a '-05' option, the position value will change to the programmed preset value.

PRESS	IND. LEDS	DISPLAY	COMMENTS
*[FUNCTION]	POS	"1 _ xxxx"	xxxx = Present Position.
[CLEAR]	POS	"1 _ 0000"	Position reset to zero.
*[FUNCTION]	O + A	"1 _ yyyy"	yyyy = Calculated Offset

Notes

VME READ BYTE Function

The VME READ BYTE (VME_RD_BYTE) Function is used to read Position, Tachometer and Fault diagnostic data from the module to the GE Fanuc CPU. Figure 5.1 shows a VME_RD_BYTE Function for a single channel module in a ladder logic rung. The highlighted sections contain information that you must supply when the Function is entered.

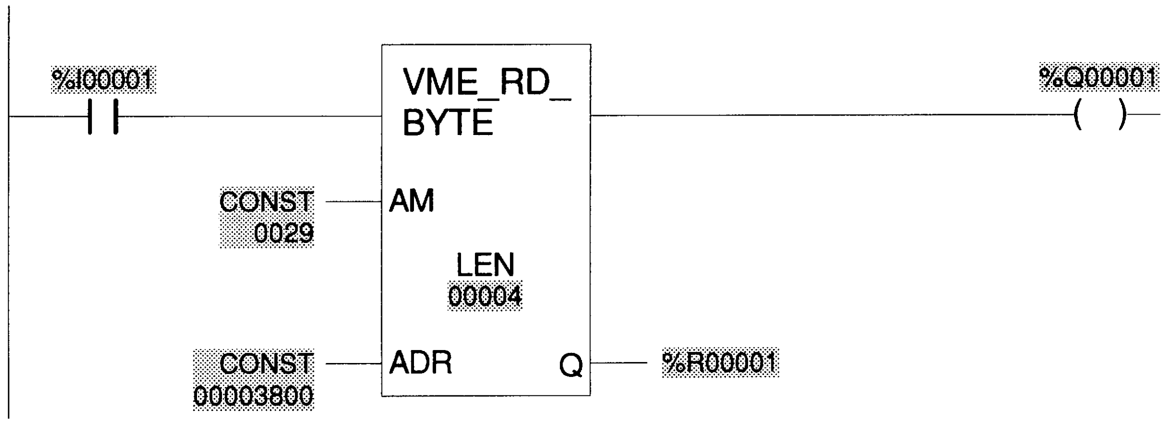


Fig 5.1 GE Fanucs' VME_READ_BYTE Function

> **NOTE:** There are two VME READ Functions, one for transferring bytes of data, the other for transferring words. The VME_RD_WORD Function will not work with the Series 1900 Modules. The VME_RD_BYTE Function must be used.

Parts of the VME_RD_BYTE Function

Contact Input (%I00001)

Any type of contact can be used to enable the VME READ Function. In this example, the 1900 Module will be read by the CPU when contact %I00001 is a logic "1". If you want the 1900 Module to be read by the CPU on every scan, the contact can be omitted.

Coil Output (%Q00001)

The coil output will become true when the VME READ Function successfully completes. Any type of coil can be used. In this example, coil %Q00001 will become true when the Function successfully completes.

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

Parts of the VME_RD_BYTE Function (cont'd)

AM (Address Modifier) Code

All 1900 Modules are factory configured to respond to the AM Code of 29H. This corresponds to the Standard Short Non-Privileged VME access (16 bit address). The actual AM Code programmed into the VME READ Function depends on the rack that the module resides in. Figure 5.2 lists the AM Codes for the different racks. Note that the AM Code that the module is configured for remains 29H. The GE Fanuc Expansion Module that controls the expansion rack uses the programmed AM Code to determine when it's rack is being accessed and converts the AM Code to 29H before it accesses the modules in it's rack.

Rack	Programmed AM Code	Board Configured 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		

Fig 5.2 Address Modifier (AM) Codes

LENgth Parameter

The Length Parameter tells the CPU the number of Bytes to transfer from the Series 1900 Module. Figure 5.3 lists the number of bytes that must be transferred from each 1900 Module.

Module Type	# of Bytes	Module Type	# of Bytes
1931/41	4	1931/41-05	6
1932/42	8	1932/42-05	10
1933/43	12	1933/43-05	14
1934/44	16	1934/44-05	18

Fig 5.3 Length Parameter Values

⚠WARNING All 1900 Modules use a device called a Dual Port RAM as it's interface to the backplane. This device has two banks of RAM. When the module is writing the new Position and Tach values to one bank, the GE Fanuc CPU has access to the other bank so that it can read the latest, complete information. Once the GE Fanuc CPU has accessed a bank, the 1900 Module will not switch the banks until CPU has read the LAST Byte of information in the bank. CONSEQUENTLY, If the Length Parameter is set to a value less than the ones listed above, the GE Fanuc CPU will NEVER have access to the new Position and Tach Information from the 1900 Module. **You Must Read All Information From The Series 1900 Modules, Even If You Will Only Use Some Of The Available Information In Your Program.**

Parts of the VME_RD_BYTE Function (cont'd)

Memory Address

This parameter must be set to the Memory address set by the bank of 5 DIP Switches located on the back of the Module. (See Memory Address Allocation: Pgs 3-1 and 3-2.) You have two choices when allocating memory addresses to a Series 1900 Module. You can choose the default memory addresses used by the GE Fanuc Modules or you can choose a 2K section of the User Defined memory addresses. Figure 5.4 lists the address allocations used by the GE Fanuc Modules and the User Defined Area.

Slot	Address Range	Slot	Address Range
PS	None	5	2800h - 2FFFh
1	None	6	3000h - 37FFh
2	1000h - 17FFh	7	3800h - 3FFFh
3	1800h - 1FFFh	8	4000h - 47FFh
4	2000h - 27FFh	9	4800h - 4FFFh
User Defined 5000h - FFFFh			

Fig 5.4 Address Allocations

Q: (Transfer Destination Address)

Q specifies the first location in the CPU user reference into which the data read from the Series 1900 module is to be stored. In the example on page 5-1 the information from the 1900 Module will be stored starting at the first Register Memory Address. Note that only 2 Register Memory Words will be used because the Transfer Length is 4 Bytes. (2 Bytes = 1 Word.)

Data Byte Significance

As noted in Chapter 5 of the GE Fanuc's GFK-0448A, "User's Guide To Integration of 3rd Party VME Modules" GE Fanuc uses the Intel Convention for storing word data in bytes. In this convention, the least significant byte of data is stored at the even byte location in memory. The VME Standard, and therefore most VME modules including the Series 1900V Modules, use the Motorola Convention of storing the least significant byte of data at the odd byte locations in memory. Because of this difference, you must perform byte, and sometimes word, swapping before the data from a standard VME Module can be used. THIS DOES NOT HOLD TRUE FOR THE SERIES 1900 MODULES. HOWEVER, it does hold true if you use a Series 1900V Module in a GE Fanuc system.

Because the Series 1900 Modules use the VMEbus D8(EO) data transfer method, the GE Fanuc CPU will automatically place the bytes of data in their proper location in the memory registers. **BYTE SWAPPING IS NOT NECESSARY WHEN USING A SERIES 1900 MODULE.**

Series 1900 Data Format

This data format information applies to Series 1900 Modules without the '-05' option. For information on the data format from modules with the '-05' option, refer *to Series 1900-05 Data Format* starting on page 5-5.

When a VME READ BYTE Function accesses a Series 1900 Module, the Module transmits four bytes to the CPU for each of its channels. The first two bytes contain the Position value, the second two contain the Tachometer value. The order and format of the words is shown below.

NOTE:

- 1931/41 transmit words 1-2 only
- 1932/42 transmit words 1-4 only
- 1933/43 transmit words 1-6 only
- 1943/44 transmit words 1-8
- **BYTE SWAPPING IS NOT NECESSARY WHEN USING A SERIES 1900 MODULE**

	ODD BYTE			EVEN BYTE
Word 1	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 1
Word 2	E*			14 bit Tachometer Data TRANSDUCER 1
Word 3	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 2
Word 4	E*			14 bit Tachometer Data TRANSDUCER 2
Word 5	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 3
Word 6	E*			14 bit Tachometer Data TRANSDUCER 3
Word 7	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 4
Word 8	E*			14 bit Tachometer Data TRANSDUCER 4

Fig 5.5 Series 1900 Data Format

NOTES:

E* - When there is a fault condition, the hexadecimal number 8000, (1000 0000 0000 0000 BIN), is sent to the CPU in place of the Position and Tachometer values. Fault conditions reported in this way are transducer and E^2PROM Errors. This is the only time bit 16 is set by the 1900 Module so the bit can be used for efficient error detection. When there is a transducer fault, only the words of the affected transducer are changed. In the case of an E^2PROM error, all transmitted words are changed. For more information on fault conditions, refer to Status Indicators, Pg. 2-5.

Because both the Position and Tachometer values are less than 16 bits in length, both have preceding zeros to complete the 16 bit words.

14 bit Tachometer data occurs when the Tachometer Response parameter is set to 240 mSec with 0.1 RPM resolution. The maximum data value with this response is 9999. (999.9 RPM)

Series 1900-05 Data Format

> This data format information applies to Series 1900 Modules with the '-05' option. For information on the data format from modules without the '-05' option, refer to *Series 1900 Data Format* on page 5-4.

When a VME READ BYTE Function accesses a Series 1900-05 Module, the Module transmits two bytes of status information and four additional bytes for each of its channels. The first two of these additional bytes contain the Position value, the second two contain the Tachometer value. The order and format of the words is shown below.

NOTE:

- 1931/41 transmit words 1-3 only
- 1932/42 transmit words 1-5 only
- 1933/43 transmit words 1-7 only
- 1943/44 transmit words 1-9

	ODD BYTE			EVEN BYTE
Word 1	STATUS WORD			
Word 2	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 1
Word 3	E*	0		14 bit Tachometer Data TRANSDUCER 1
Word 4	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 2
Word 5	E*	0		14 bit Tachometer Data TRANSDUCER 2
Word 6	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 3
Word 7	E*	0		14 bit Tachometer Data TRANSDUCER 3
Word 8	E*	0	0	13 or 10 Bit Position Data TRANSDUCER 4
Word 9	E*	0		14 bit Tachometer Data TRANSDUCER 4

Fig 5.6 Series 1900-05 Data Format

Notes:

E* - When there is a fault condition, the hexadecimal number 8000, (1000 0000 0000 0000 BIN), is sent to the CPU in place of the Position and Tachometer values. Fault conditions reported in this way are transducer and E^2PROM Errors. This is the only time bit 16 of a position or tachometer word is set by the 1900-05 Module so the bit can be used for efficient error detection. When there is a transducer fault, only the words of the affected transducer are changed. In the case of a nvRAM error, all transmitted words are changed. For more information on fault conditions, refer to Status Indicators, Pg. 2-5.

Because both the Position and Tachometer values are less than 16 bits in length, both have preceding zeros to complete the 16 bit words.

14 bit Tachometer data occurs when the Tachometer Response parameter is set to 240 mSec with 0.1 RPM resolution. The maximum data value with this response is 9999. (999.9 RPM)

Series 1900-05 Data Format (cont'd)

Status Word

Bit Number	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Status Word	ACK	RS*	CM*	NR*	T4*	T3*	T2*	T1*	Programming Error Code							

Fig 5.7 Status Word Format

ACK - Acknowledge Bit. The 1900-05 module sets this bit in response to Programming Instructions from the processor. The remainder of this byte contains status and hardware error information. A byte value of 80h or C0h means that the Program Instructions were accepted without error. See Chapter 7: **Programming From the Processor** for a full description.

RS* - Read Status Mode Bit. Read Status Mode allows you to read back the programmed values of the modules' parameters instead of Position and Tachometer data. A full description of this mode is found in Chapter 6: **Program Instructions and Error Code.** This bit equals '0' when reading Position and Tachometer values and it equals '1' when in Read Status Mode.

CM* - Command Error Bit. Set when there is an error in the Program Instructions sent to the module.

NR* - nvRAM Error Bit. Set when there is a problem with the non-volatile RAM. If the error can be cleared but occurs with every power up, the battery in the nvRAM is discharged. If the error cannot be cleared, the RAM is damaged.

T4 - T1 - Transducer Fault Bits. The appropriate bit is set when there is a transducer fault on a channel.

The Programming Error Code byte of the Status Word details the nature of the programming error reported by the CM* Bit. When the Program Instructions complete sucessfully, this byte equals zero. Refer to Programming Error Codes, starting on pg. 6-7 for more information.

Programming Structure

You can use your ladder logic to program the 1900-05 Module. This is done by transferring Program Instructions from the PLC to the module with the VME_WRT_BYTE Function. Each Program Instruction is made up of one or more 16 bit words.

The first word of every Program Instruction is the **Command Word**. The Command Word tells the module what action to take. This may be changing the value of the Scale Factor, preseting the position value or disabling the modules' Program Switch. The additional words of a Program Instruction are the **Data Words**. They contain the new values of the parameters: i.e. the new Scale Factor. The number of Program Instructions that can be sent to the Module at one time is limited to 64 Words in one program scan. For a complete description of programming the module from the processor, refer to Chp 7: "*Programming from the Processor*".

Figure 6.1 shows the conceptual format of a group of Program Instructions.

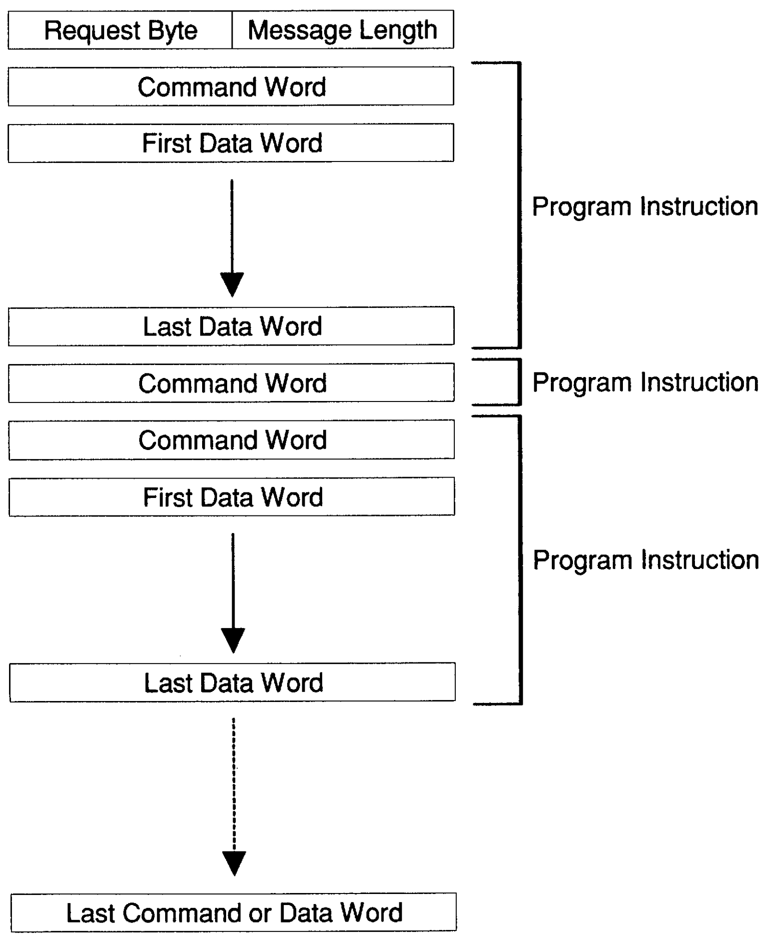


Fig 6.1 1900-05 Program Instruction Format

The word that contains the Request and Message Length Bytes is used to control the data transfer to the 1900-05. When bit 8 of the Request Byte is set, the 1900-05 uses the number of words specified by the Message Length byte as Program Instructions. Note that the Message Length does not include the Request Byte/Message Length word. This programming format is fully explained in Chapter 7: "*Programming from the Processor*".

Program Instructions

Program Instructions can be broken down into three categories: Module Instructions, Transducer Instructions, and Read Status Instructions.

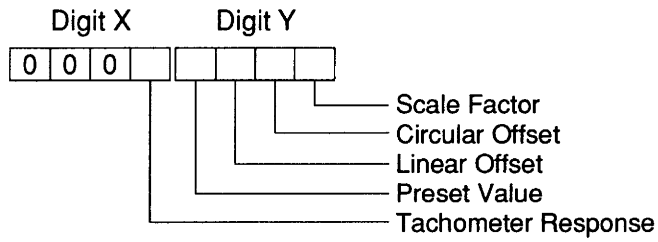
- **Module Instructions:** Instructions that affect the operation of the Module. These Instructions are: Disable Keyboard Programming, Enable Keyboard Programming, Clear Errors, Enter Read Status Mode and Exit Read Status Mode.
- **Transducer Instructions:** Instructions that affect the Transducer Parameters. These Instructions are: Store Parameters: Transducer 1, Store Parameters: Transducer 2, Store Parameters: Transducer 3 and Store Parameters: Transducer 4.
- **Read Status Instructions:** Instructions that force the 1900-05 to transmit present Parameter values instead of Position and Tachometer information.

Module Instructions

COMMAND	COMMAND WORD	COMMENTS
Disable Keyboard Programming	8100h	Use this instruction to prevent programming the 2900 from the keyboard. See *Program Switch*, Pg. 2-7 for more information.
Enable Keyboard Programming	8200h	Use this instruction to counteract a previous Disable Keyboard Programming Instruction. See *Program Switch*, Pg. 2-7 for more information.
Clear Errors	8400h	Use this instruction to clear errors generated because of improper Program Instruction syntax or transducer fault messages. See *Programming Error Codes*, Pg. 6-8 and *Status Indicators*, Pg. 2-6 for more information.
Enter Read Status Mode	8E00h	Enter this mode to read the values of the programmable parameters. Use this mode when debugging your system or to verify that program changes have not been made from the keypad. When in this mode, the 15th bit of the Status Word equals '1'.
Exit Read Status Mode	8F00h	Use this instruction to counteract a previous Enter Read Status Mode Instruction. When this command is issued, the module will transmit transducer position and tachometer data to the CPU.

Fig 6.2 Module Instructions Table

Transducer Instructions

COMMAND	COMMAND WORD	COMMENTS
Store Parameters Transducer 1	88XYh	(X = {0,1}, Y = {1...F}). Use this instruction to program the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response Parameters of Transducer 1.  Bit Set to "1" = Store New Parameter. Bit Set to "0" = Leave Parameter as is. EXAMPLE: 8801h = Store new Scale Factor. The new parameter values are stored as Data Words immediately after the Command Word. New values are stored in BCD format. The order is: Scale Factor (Changing resets all offsets and the Preset Value to 0) Circular Offset Linear Offset Preset Value Tach Response The module checks the validity of each new Parameter Value. Valid ranges are: Scale Factor: 2 to 1024 (193X-05), 2 to 8192 (194X-05) Circular Offset: 0 to (Scale Factor -1) Linear Offset: 0 to (10,000 - (Scale Factor)) Preset Value: 0 to (Scale Factor - 1) Tach Response: 0 to 4 0 = 32 mSec Response 1 = 60 mSec Response 2 = 120 mSec Response 3 = 240 mSec Response / 1.0 RPM Resolution 4 = 240 mSec Response / 0.1 RPM Resolution **NOTE:** Changing the Preset Value does not preset the Position value. Use the Preset Transducer (n) Instruction to actually preset the Position value. **EXAMPLE:** Set Circular Offset to 90 Tach Response to 120 mSec Command Word: 8812h Data Words: 0090h Position Offset 0002h Tach Response

(Continued on following page)

Transducer Instructions (cont'd)

COMMAND	COMMAND WORD	COMMENTS
Store Parameters Transducer 2	98XYh	(X = {0,1}, Y = {0...F}). Not available with the 1931/41-05 Modules, use this instruction to program the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response of Transducer 2. The format of the instruction is identical to the Store Parameters Transducer 1 Instruction.
Store Parameters Transducer 3	A8XYh	(X = {0,1}, Y = {0...F}). Not available with the 1931/41-05 or 1932/42-05 Modules, use this instruction to program the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response of Transducer 3. The format of the instruction is identical to the Store Parameters Transducer 1 Instruction.
Store Parameters Transducer 4	B8XYh	(X = {0,1}, Y = {0...F}). Available only with the 1934/44-05 Modules, use this instruction to program the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response of Transducer 4. The format of the instruction is identical to the Store Parameters Transducer 1 Instruction.
Preset Transducer 1	8500h	Use this command to set the Position Function of Transducer 1 to the Preset Value.
Preset Transducer 2	9500h	Use this command to set the Position Function of Transducer 2 to the Preset Value.
Preset Transducer 3	A500h	Use this command to set the Position Function of Transducer 3 to the Preset Value.
Preset Transducer 4	B500h	Use this command to set the Position Function of Transducer 4 to the Preset Value.

Fig 6.3 Transducer Instructions Table

Read Status Instructions

In order to read the programmed values of the modules' parameters, you must include the Enter Read Status Mode Instruction in the block of programming instructions transmitted to the module. Once this Instruction is accepted, use one of the four instructions given below to tell the module which parameters to transmit. These instructions are valid only after the Enter Read Status Mode instruction is accepted and **MUST** be the last instruction in a group written down to the module with a single VME_WRT_BYTE Function. The format if the data transmitted back to the module while in Read Status Mode is given in the following section: *Read Status Data Format.*

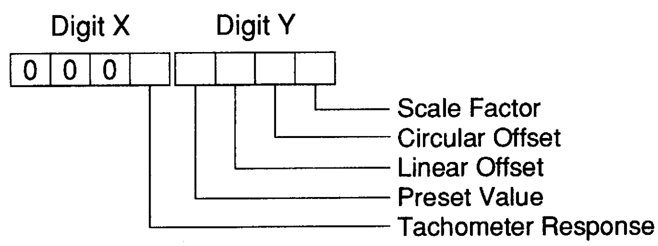
COMMAND	COMMAND WORD	COMMENTS
Read Parameters Transducer 1	86XYh	(X = {0,1}, Y = {1...F}). Use this instruction to read the present values of the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response Parameters of Transducer 1.  Bit Set to "1" = Read Parameter Value. Bit Set to "0" = Don't Read Parameter Value. EXAMPLE: 8601h = Read Scale Factor Value.
Read Parameters Transducer 2	96XYh	(X = {0,1}, Y = {0...F}). Not available with the 1931/41-05 Modules, use this instruction to read the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response values of Transducer 2. The format of the instruction is identical to the Read Parameters Transducer 1 Instruction.
Read Parameters Transducer 3	A6XYh	(X = {0,1}, Y = {0...F}). Not available with the 1931/41-05 or 1932/42-05 Modules, use this instruction to read the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response values of Transducer 3. The format of the instruction is identical to the Read Parameters Transducer 1 Instruction.
Read Parameters Transducer 4	B6XYh	(X = {0,1}, Y = {0...F}). Available only with the 1934/44-05 Modules, use this instruction to read the Scale Factor, Circular Offset, Linear Offset, Preset Value and Tach Response values of Transducer 4. The format of the instruction is identical to the Read Parameters Transducer 1 Instruction.

Fig 6.4 Read Status Instructions Table

Read Status Data Format

The format of the data sent to the CPU when in Read Status Mode is given below.

	ODD BYTE	EVEN BYTE
Word 1	STATUS WORD	
Word 2	Echo of Last Read Parameters Command	
Word 3	First Requested Parameter Value	
Word 4	Second Requested Parameter Value	
Word 5	Third Requested Parameter Value	
Word 6	Fourth Requested Parameter Value	
Word 7	Fifth Requested Parameter Value	
Word 8	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Word 9	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0

Fig 6.5 Read Status Data Format

Notes:

1) A Read Parameters Transducer (n) Instruction must be the last instruction transmitted to the 1900-05 module with a single VME_WRT_BYTE instruction. If any instruction follows this command a programming error will result. Because of this, Read Status Mode cannot be entered and exited with a single instruction.

2) Only Read Status Transducer (n) Instructions are echoed back to the CPU. All other instructions can still be executed.

3) All parameters are echoed back in BCD format.

4) A 1931/41-05 transmits only words 1 - 3. Therefore only one parameter value can be transmitted to the CPU at one time. Likewise, a 1932/42 can transmit only three parameters at a time. The remaining modules, 1933/43/34/44-05 can transmit all five parameters with one instruction. Requesting more parameter than can be transmitted results in an error.

5) When in Read Status Mode, bit 15 of the Status Word is set to '1'. This distinguishes Position/Tach data from Parameter Values.

6) If you are in Read Status Mode and change the value of a parameter that is being transmitted to the CPU, you must issue another Read Parameters Transducer (n) Instruction before the new parameter value is sent to the CPU.

Status Word

The format of the Status Word remains the same when transmitting Position and Tachometer information or Parameter values. The odd byte transmits hardware fault and module status bits while the even byte transmits software error codes. Software errors occur when there is an error with the data, or the format of, the Program Instructions sent to the module. The format of the Status Word is given on the following page.

Read Status Data Format (cont'd)

Status Word (cont'd)

Bit Number	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Status Word	ACK	RS*	CM*	NR*	T4*	T3*	T2*	T1*	Programming Error Code							

Fig 6.6 Status Word Format

ACK - Acknowledge Bit. The 1900-05 module sets this bit in response to Programming Instructions from the processor. The remainder of this byte contains status and hardware error information. A byte value of 80h or C0h means that the Program Instructions were accepted without error. See Chapter 6: **Program Instructions and Error Codes** for a full description.

RS* - Read Status Mode Bit. Read Status Mode allows you to read back the programmed values of the modules' parameters instead of Position and Tachometer data. A full description of this mode is found in Chapter 6: **Program Instructions and Error Codes.** This bit equals 0 when reading Position and Tachometer values and it equals 1 when in Read Status Mode.

CM* - Command Error Bit. Set when there is an error in the Program Instructions sent to the module.

NR* - nvRAM Error Bit. Set when there is a problem with the non-volatile RAM. If the error can be cleared but occurs with every power up, the battery in the nvRAM is discharged. If the error cannot be cleared, the RAM is damaged.

T4 - T1 - Transducer Fault Bits. The appropriate bit is set when there is a transducer fault on a channel.

Programming Error Codes

If one of your Program Instructions contain an error, or the 1900-05 Module is experiencing a hardware fault, the Module will not accept any Program Instructions until the error is cleared. Hardware errors are reported to the processor with the Hardware Error Bits listed above and in the Position and Tachometer Data Words. (See *Data Format* Pg. 5-5). Errors in Program Instructions are reported to the processor by setting the Command Error Bit (Bit 14) of the Status Word. The actual error is defined by the value of the Programming Error Code byte of the Status Word.

When an error occurs in the Program Instructions, the module stops accepting Program Instructions until the Clear Error Command is transmitted. For example, your VME_WRT_BYTE Instructions transmits five Program Instructions, the third of which sets the Scale Factor to an invalid number. The 1900 will accept the first two instructions normally but when it recognizes an invalid Scale Factor, the module will send an error code to the CPU and will not process the fourth or fifth Program Instructions.

A table on the following page lists the Programming Error Codes transmitted in the even byte of the Status Word.

Programming Error Codes (cont'd)

PROGRAMMING ERROR NAME	ERROR CODE	COMMENTS
Invalid Command	21_{bcd}	Occurs when a Command Word is incorrect. This error is usually generated when a Data Word is interpreted as a Command Word. For example, a Store Parameters Transducer (n) Instruction specifies three new parameter values and four are included in the instruction. The fourth Data Word would be interpreted as a Command Word.
Invalid Message Length	22_{bcd}	This error occurs when the final instruction in the VME_WRT_BYTE function does not contain enough Data Words to complete the instruction. Another cause is having another instruction after *any* Read Parameters Transducer (n) Instruction.
Message Ignored	24_{bcd}	You attempted to write Program Instructions to the 1900-05 while its reporting a Programming Error.
Invalid Transducer Number	25_{bcd}	You attempted to write parameters to a transducer channel that does not exist on the module. Example: Writing the Scale Factor for Transducer 4 on a 1942-05.
Invalid Mode	26_{bcd}	Occurs when you send a Read Parameters Transducer (n) Instruction and the 1900-05 is not in Read Status Mode.
Invalid Parameter Number	27_{bcd}	Occurs when a Read Parameters Transducer (n) Instruction requests more parameter values than then the module can transmit at one time. See *Read Status Data Format:,* Note 4, Pg. 6-6 for more information.
Invalid Scale Factor	41_{bcd}	New Scale Factor value is out of range.
Invalid Circular Offset	42_{bcd}	New Circular Offset value is out of range.
Invalid Linear Offset	43_{bcd}	New Linear Offset value is out of range.
Invalid Preset Value	44_{bcd}	New Preset Value is out of range.
Invalid Tachometer Response	45_{bcd}	New Tachometer Response value is out of range.

Fig 6.7 Programming Error Codes Table

VME WRITE BYTE Function

The VME WRITE BYTE (VME_WRT_BYTE) Function is used to write Program Instructions to a Series 1900-05 Module from the GE Fanuc CPU. Figure 7.1 shows a VME_WRT_BYTE Function in a ladder logic rung. The highlighted sections contain information that you must supply when the Function is entered.

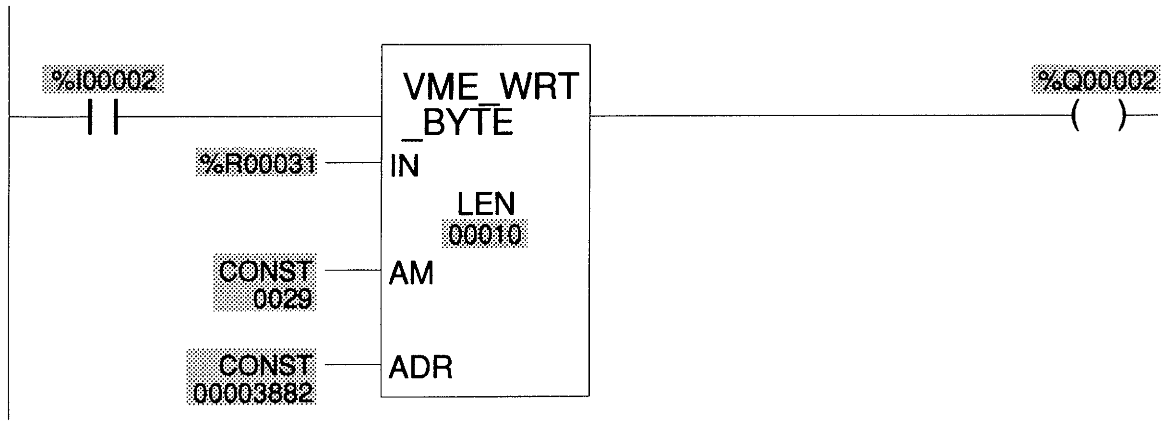


Fig 7.1 GE Fanucs' VME_WRITE_BYTE Function

> **NOTE:** There are two VME WRITE Functions, one for transferring bytes of data, the other for transferring words. The VME_WRT_WORD Function will not work with the Series 1900-05 Modules. The VME_WRT_BYTE Function must be used.

> **NOTE:** Two VME_WRT_BYTE Functions are required to program the 1900-05 from the processor. The first transfers all of the Program Instructions, the second transfers the Request Byte / Message Length Word. If the Request Byte / Message Length Word is transmitted with the Program Instructions, an error may result.

Parts of the VME_RD_BYTE Function

Contact Input (%I00002)

Any type of contact can be used to enable the VME WRITE BYTE Function. In this example, the Program Instructions will be sent 1900-05 Module by the CPU when contact %I00002 is a logic "1".

Coil Output (%Q00002)

The coil output will become true when the VME WRITE BYTE Function successfully completes. Any type of coil can be used. In this example, coil %Q00002 will become true when the Function successfully completes.

You should use a coil output with the VME WRITE BYTE Function. This will allow you to test the coil at a later point in the scan to be sure that the Function has completed successfully.

Parts of the VME_WRT_BYTE Function (cont'd)

INput Registers (%R00031)

The starting address of the registers that contain the Program Instructions or Request Byte / Message Length Word to be sent to the 1900-05. When transferring a single word, a constant can be entered instead of a register address.

AM (Address Modifier) Code

All 1900-05 Modules are factory configured to respond to the AM Code of 29h. This corresponds to the Standard Short Non-Privileged VME access (16 bit address). The actual AM Code programmed into the VME WRITE BYTE Function depends on the rack that the module resides in. Figure 7.2 lists the AM Codes for the different racks. Note that the AM Code that the module is configured for remains 29h. The GE Fanuc Expansion Module that controls the expansion rack uses the programmed AM Code to determine when it's rack is being accessed and converts the AM Code to 29H before it accesses the modules in it's rack.

Rack	Programmed AM Code	Board Configured 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		

Fig 7.2 Address Modifier (AM) Codes

LENgth Parameter

The Length Parameter tells the CPU the number of Bytes to transfer to the 1900-05 Module. It equals (2 * Number of Words). Maximum value is 126.

Parts of the VME_WRT_BYTE Function (cont'd)

Memory Address

This parameter must be set to the Memory Address that the 1900-05 is configured for: + 82h when transferring Program Instructions or + 80h when transferring the Request Byte / Message length Word. (See Memory Address Allocation: Pgs 3-1 and 3-2.) You have two choices when allocating memory addresses to a Series 1900-05 Module. You can choose the default memory addresses used by the GE Fanuc Modules or you can choose a 2K section of the User Defined memory addresses. Figure 7.3 lists the starting address for Program Instructions and Request Byte / Message Length Word based on slot locations and the User Defined Area.

Slot	Program Instruction Address	Request / Length Address
PS	None	None
1	None	None
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 Def.	5082h - F882h	5080h - F880h

Fig 7.3 Address Allocations

Transferring Program Instructions

The transfer of Program Instructions to a 1900-05 requires a short addition to your ladder logic program. Two bits, the Request Bit and the Acknowledge Bit, control the transfer. (See Fig 7.4.) To initiate the transfer, your ladder logic must transfer the Program Instructions and the Request Byte / Message Length Word to the 1900-05 with the Request bit set to "1". The Request bit is the 8th bit of the Request Byte. The Message Length is the number of words used to transfer the Program Instructions. **NOTE: THIS REQUIRES TWO VME_WRT_BYTE INSTRUCTIONS, ONE TO TRANSMIT THE PROGRAM INSTRUCTIONS, ONE TO TRANSMIT THE REQUEST BYTE /MESSAGE LENGTH WORD.**

When the 1900-05 finishes decoding the Program Instructions, it will, if necessary, write an Error Code in the Programming Error Code Byte and set the Acknowledge Bit to '1'. Your ladder logic must test the value of the Acknowledge Bit to determine when the 1900-05 is done with the Program Instructions. Error Codes from the module are not valid until the Acknowledge Bit is set.

Once your ladder logic senses that the Acknowledge Bit is set, the program must write the word "0000h" to the 1900-05. (This word resets the Request Bit and tells the 1900-05 that the message length is zero for this transfer.) The module will respond by resetting the Acknowledge Bit. The transfer is now complete and another transfer can begin.

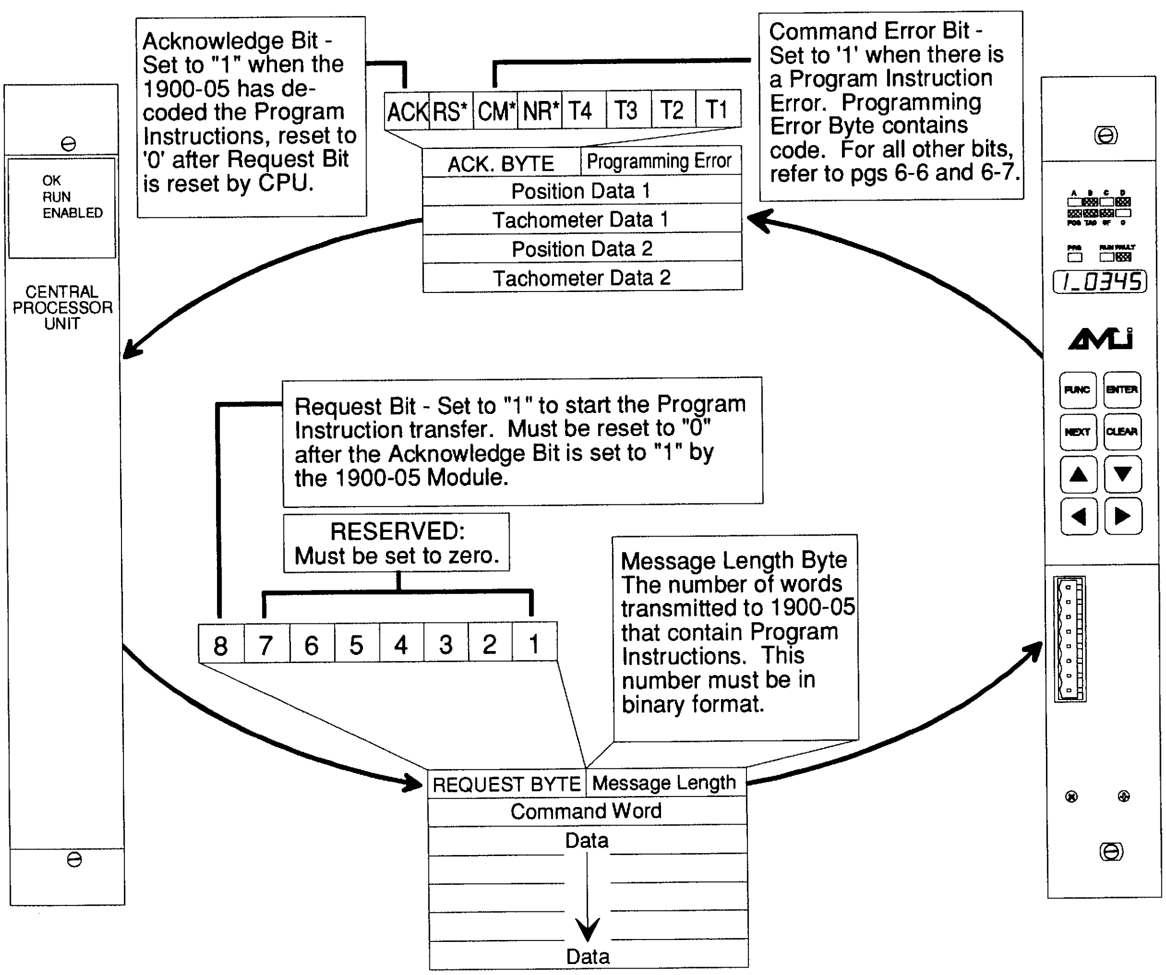


Fig 7.4 Transfer Control Bits

Sample Programming Sequence

The following flowchart suggests one method of reading and writing data to a 1900 Module. It assumes that the ladder logic instructions are stored in their own Program Block. Ladder logic that implements this flowchart is given in the next section.

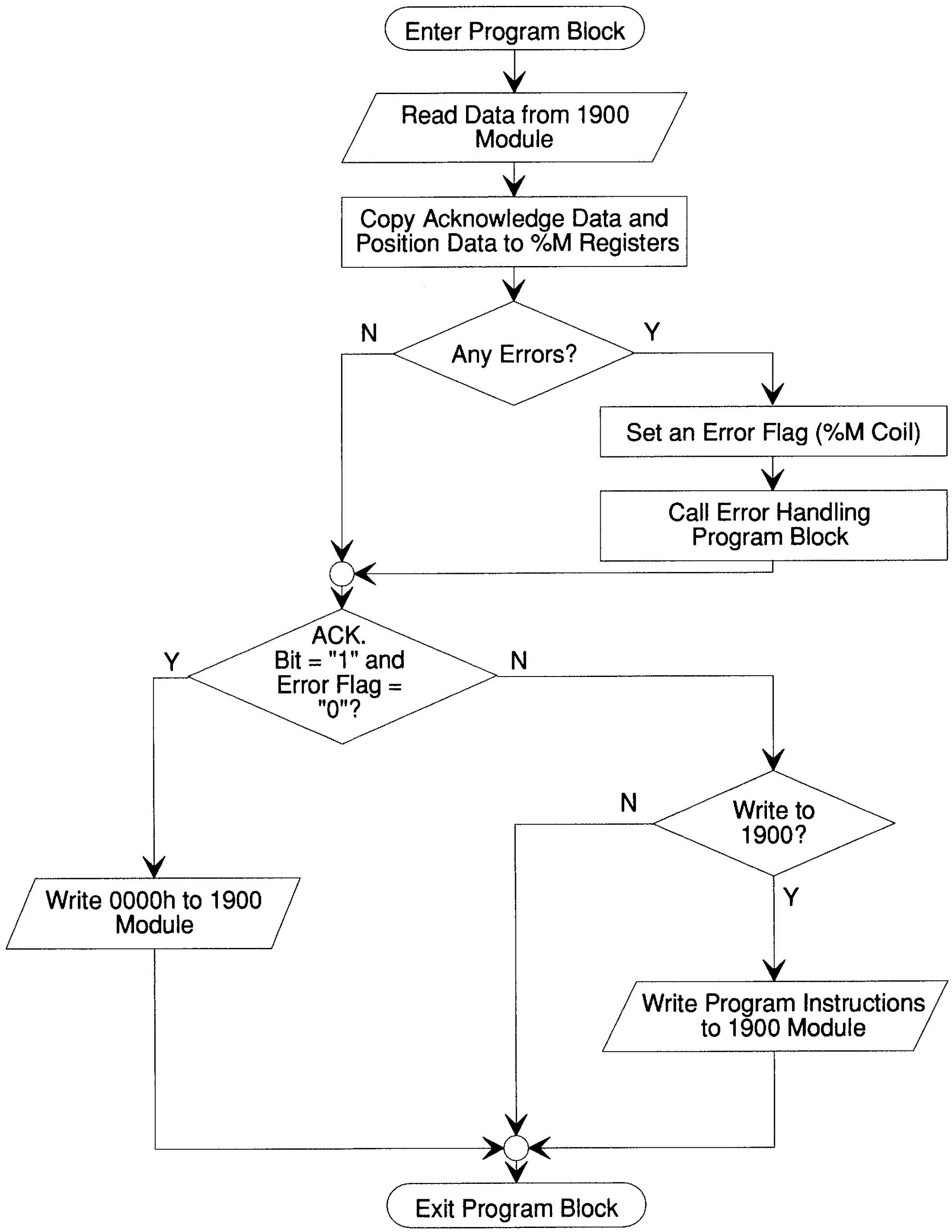
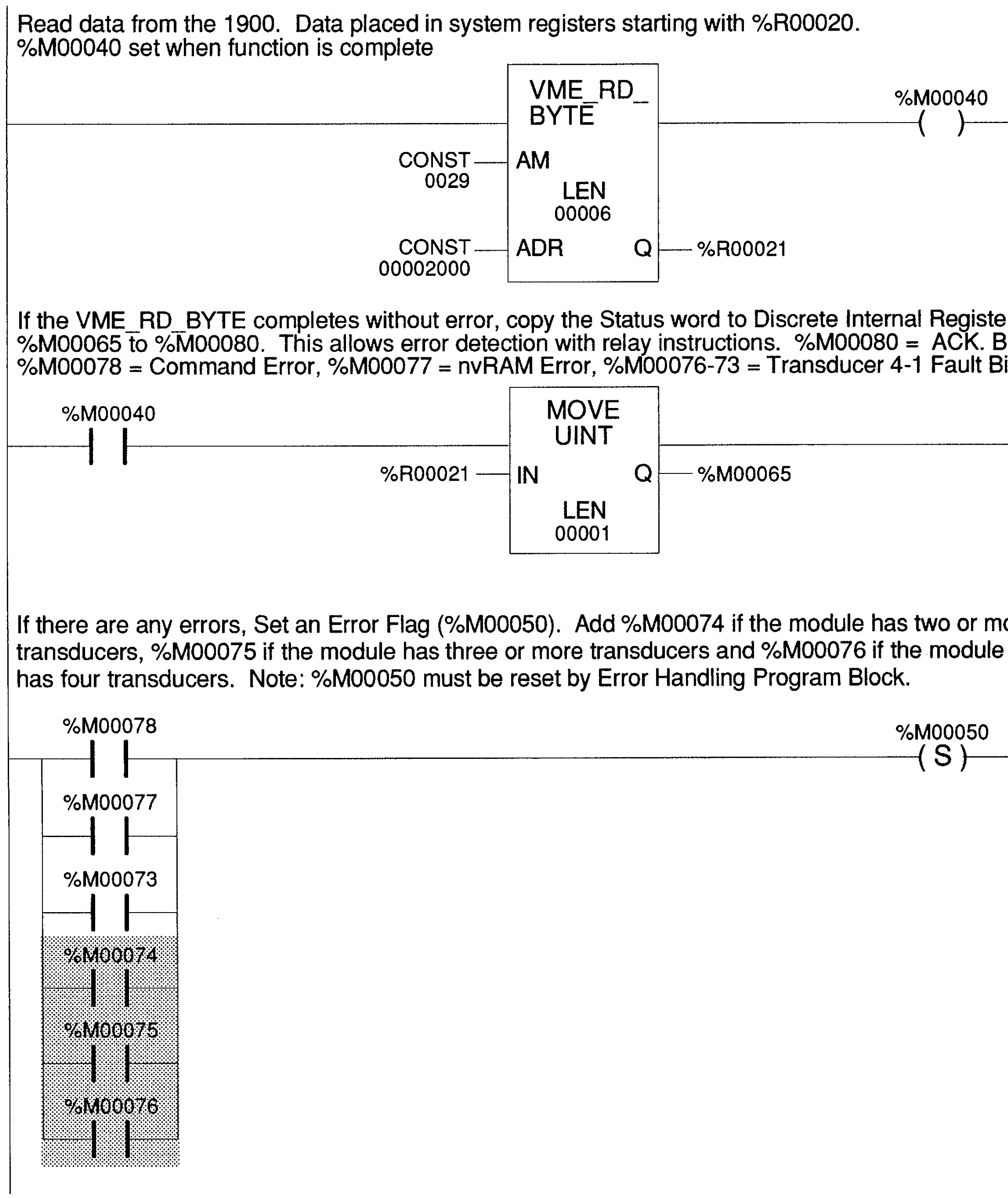


Fig 7.5 Program Flowchart

Sample Ladder Logic Program

The following ladder logic implements the flowchart on the previous page. Written for use with a 1941-05 Module, the program highlights the contacts that should be added before using the program with a multi-channel module. The 1941-05 is assumed to be located in slot 4 of rack 1.

The Error Handling Program Block, (PBK2) is not defined in this sample. Error handling varies from application to application and cannot be specifically defined in this manual. However, this sample assumes that the Error Handling Program Block will provide all necessary code, including resetting the Acknowledge bit before trying to clear the error.



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Sample Ladder Logic Program (cont'd)

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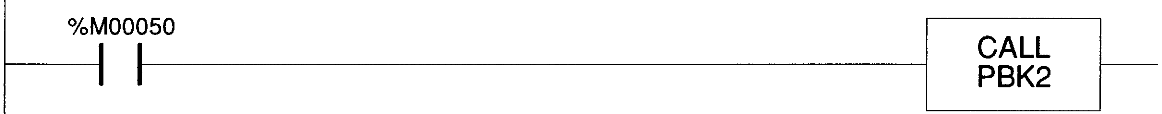
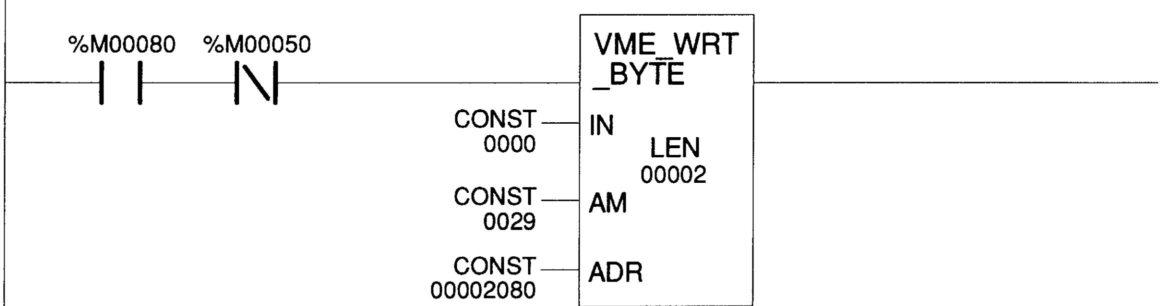
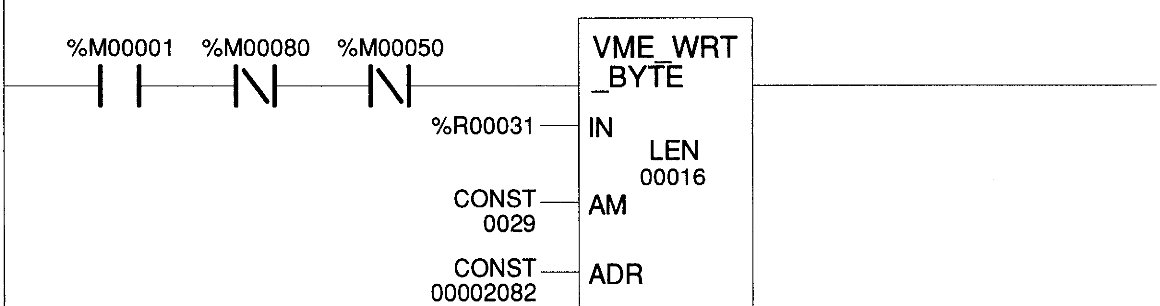
Branch to the Error Handling Program Block if any error exists.



If the Acknowledge Bit is set and the Error Handling Program Block has not been called, write 0000h to the 1900 to reset the ACK. Bit. (Program assumes Error Handling Block will perform this action in its routine.) Because you are writing the Request Byte / Message Length Word, the address is 80h above the read address.



If the main program has authorized a write to the 1900, write the Program Instructions as long as the acknowledge bit is reset and the Error Handling Program Block has not been called. Because you are writing Program Instructions to the 1900, the starting address is 82h above the read address.



If the main program has authorized a write to the 1900, write the Request Byte/ Message Length as long as the acknowledge bit is reset and the Error Handling Program Block has not been called. Because you are writing the Request Byte / Message Length word to the 1900, the starting address is 80h above the read address. Reset the Authorization bit after the write is done.

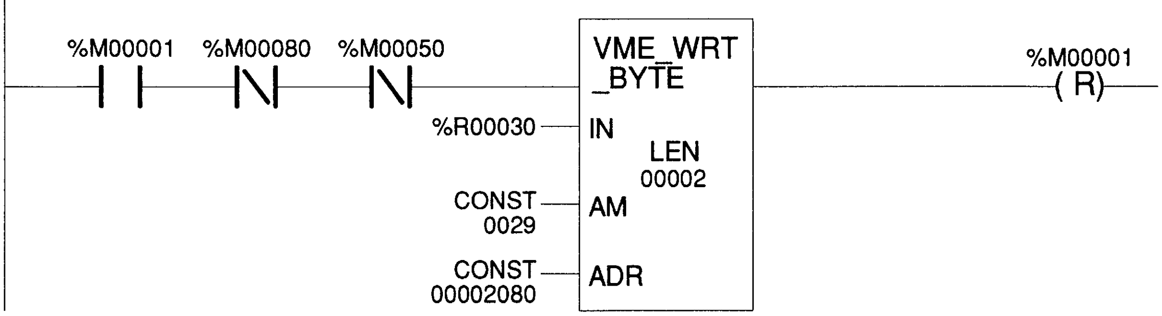


Fig 7.6 Sample Ladder Logic Program Block

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