User Manual

Series 1700
Intelligent Resolver Interface Modules

AMCI

Allen-Bradley
1771 I/O
Module

ROCKWELL AUTOMATION
ENCOMPASS™
AMERICAS PARTNER

1731 1741
1732 1742
1733 1743
1734 1744

Manual: 940-57011

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

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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.

Introduction

This manual explains the operation, installation, programming, and servicing of eight Series 1700 Intelligent Resolver Interface Modules for the Allen-Bradley 1771 I/O programmable controller systems. These modules are the 1731, 1732, 1733, 1734, 1741, 1742, 1743, and 1744. The other four module in this series, the 1761, 1762, 1761-21, and 1763, are covered by the following three manuals.

- *Series 1760 Intelligent Resolver Interface Module User Manual*
- *1761-21 Intelligent Resolver Interface Module User Manual*
- *1763 Intelligent Resolver Interface Module User Manual*

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.

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, 940-57011, supersedes 940-57010. It adds the outline drawings and specifications of the H25-FL and H25-SL transducers and updates all other transducer and cabling prints. This electronic manual corresponds to the printed version of the manual 940-07011 and software version 8, checksum 1339 which is used on revision H+ of the main PC board. This software revision incorporates several features into the standard products that were only available as specialty options before. These new features are described in chapter 1: *Series 1700 Introduction*. The hardware revision is a change over from through-hole to surface mount components. Minor design enhancements were also included.

Past Revisions

940-57010: Original release of the manual. It was released in two parts, 57010A.pdf and 57010B.pdf.

Notes

This chapter serves as an introduction to the Series 1700 modules. It highlights the Series 1700 family members, potential applications, compatible transducers, and all of the modules' features, including those added since the last revision.

Overview

The Series 1700 modules are Allen Bradley 1771 I/O compliant cards that convert resolver signals to digital position and tachometer data that can be reported over the backplane using either block or single transfers. The 1700 modules eliminate the separate resolver decoder box, PLC input card, and associated wiring needed to bring the digital data into a PLC.

Figure 1.1 1700 Module & HT-20

Like an absolute optical encoder, a resolver is a sensor that converts an angle into electrical signals. However, this is where the similarities end. The resolver is an analog device that does not contain sensitive components such as optics and electronics that may be damaged by severe environmental conditions. Also, the position resolution of a resolver is limited only by the electronics that decode its signals. When attached to a 1700 module, the resolver gives an absolute position value with up to thirteen bit position resolution over a six conductor cable.

A 1700 module application generally falls into one of two categories.

- Rotary Application - The resolver position directly correlates to an angular position on the machine. One example is monitoring a press ram. As the press cycles through one turn, the resolver position is used to monitor and control such functions as material feed and part blow-off.
- Linear Application - The resolver position correlates to a physical length. These applications can be either single turn or multi-turn. An example of a single turn application is a packaging machine where the resolver completes one turn for each product. Here the resolver position is used to control when glue is applied or when the package is cut to length. An example of a multi-turn application is monitoring the position of a load on either a track or ball screw. In this type of application, linear position is translated to rotary position through either a wheel or gearing. The transducer completes several rotations in order to travel the complete distance.

  AMCI also has a line of cable reel transducers for use in linear applications. A cable reel transducer has a stranded stainless steel cable wrapped around a spring loaded drum. As the cable is pulled out of the transducer, the drum rotates, which in turn rotates the internal resolver. The cable is retracted by the force of the drums' spring. Distances of up to forty-five feet can be measured with these transducers.

Physically, the Series 1700 modules are two slot cards that have one, two, three, or four resolver inputs, called resolver, or transducer, channels. Their integral keyboard and display allow you to setup the module and monitor position and tachometer data.

Overview (continued)

All of the modules have programmable *Transducer Setup Parameters* that allow you to scale and adjust the position and tachometer data. Additional *Module Setup Parameters* define the type of transducer attached to the module, the digital format of the position and tachometer data, and how the module communicates this data to the processor. The module can be configured to use either block or single transfers.

When configured to use block transfers, you can further configure the module to accept programming instructions and commands over the backplane. With backplane programming enabled, you can read back parameter values instead of position and tachometer data by entering *Read Status Mode*.

Series 1700 Family Members

The twelve modules in the 1700 series are shown in the table below. The shaded out models are multi-turn modules not covered in this manual. Refer to *About this Manual*, pg. I *Introduction,* for more information on the manuals for these modules.

Model	Transducer Inputs	Resolution
1731	1	10 bit (1,024 counts)
1732	2	10 bit (1,024 counts)
1733	3	10 bit (1,024 counts)
1734	4	10 bit (1,024 counts)
1741	1	13 bit (8,192 counts)
1742	2	13 bit (8,192 counts)
1743	3	13 bit (8,192 counts)
1744	4	13 bit (8,192 counts)
1761	1	12 bit (4,096) per turn, 180 turns max. (737,280 counts max.)
1761-21	1	12 bit (4,096) per turn, 180 turns max. (737,280 counts max.) Reset input. Programmable to fractional number of turns.
1762	2	12 bit (4,096) per turn, 180 turns max. (737,280 counts max.)
1763	1	10 bit (1,024) per turn, 10,000 turns max. (10,000,000 counts max.)

Table 1.1 Series 1700 Family Members

The 1730 and 1740 modules covered by this manual are primarily intended for single turn applications. They can be used in multi-turn applications by placing a gear ratio between the output shaft of the machine and the transducer. AMCI has a line of transducers with an internal (x):1 ratio for use in these applications. However, you must remember that the maximum number of counts remains fixed at either 1,024 or 8,192 counts. If you need higher resolution, you must use a 1760 module. These modules provide up to 4,096 counts *per turn* over a maximum of 180 turns. (737,280 counts max.)

See pg. 1-4, *AMCI Compatible Transducers,* for more information on the single and multi-turn transducers available from AMCI for use with the 1730 and 1740 modules.

Brushless Resolver Description

The brushless resolver is unsurpassed by any other type of rotary position transducer in its ability to withstand the harsh industrial environment. An analog sensor that is absolute over a single turn, the resolver was originally developed for military applications and has benefited from more than 50 years of continuous use and development.

The resolver is essentially a rotary transformer with one important distinction. The energy coupled through a rotary transformer is not affected by shaft position whereas the magnitude of energy coupled through a resolver varies sinusoidally as the shaft rotates. A resolver has one primary winding, the Reference Winding, and two secondary windings, the SIN and COS Windings. (See figure 1.2, Resolver Cut away View). 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 a brushless resolver, energy is supplied from the Reference Winding to the rotor by a rotary transformer. This eliminates brushes and slip rings in the resolver and the reliability problems associated with them.

In general, the Reference Winding is excited by an AC voltage called the Reference Voltage (V_R). (See figure 1.3, Resolver Schematic). 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. Thus, the resolver provides two voltages whose ratio represents the absolute position of the input shaft. (SIN θ / COS θ = TAN θ, where θ = shaft angle.) Because the ratio of the SIN and COS voltages is considered, any changes in the resolvers' characteristics, such as those caused by aging or a change in temperature, are ignored.

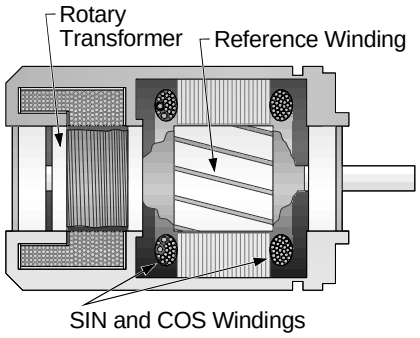


Figure 1.2 Resolver Cut away View

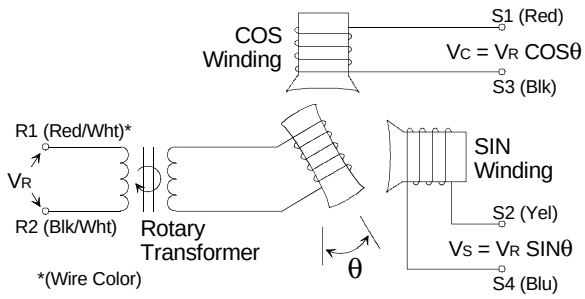


Figure 1.3 Resolver Schematic

AMCI Compatible Transducers

Table 1.2 lists the AMCI transducers compatible with the 1700 modules.

Model	Shaft	Mount	Turns	Comments
R11X-J10/7	0.120”	Servo	1	NEMA 1, size 11 resolver
R11X-J12/7	0.188”	Servo	1	NEMA 1, size 11 resolver
HT-6	0.188”	Front/Side	1	NEMA 13 R11X-J12/7 transducer
HT-20	0.625"	Front/Side	1	NEMA 13 heavy duty transducer
HT-20S	0.625"	Front/Side	1	HT-20 w/ side mounted connector.
HT-20C	0.625"	Front/Side	1	NEMA 4X, stainless steel HT-20, w/ Viton® shaft seal, conduit connector.
HT-20K	0.625"	Front/Side	1	NEMA 4X, stainless steel HT-20, w/ Viton shaft seal.
HT-20L	0.625"	Front/Side	1	NEMA 4X, stainless steel HT-20, w/ Nitrile shaft seal.
H25-FE	0.375”	Flange	1	NEMA 4, size 25, end connector
H25-FS	0.375”	Flange	1	NEMA 4, size 25, side connector
H25-FL	0.375”	Flange	1	NEMA 4, size 25, integral 15 foot (3 meter) cable
H25-SE	0.375”	Servo	1	NEMA 4, size 25, end connector
H25-SS	0.375”	Servo	1	NEMA 4, size 25, side connector
H25-SL	0.375”	Servo	1	NEMA 4, size 25, integral 15 foot (3 meter) cable
HT-400, HT-400A, HT-400B	0.625"	Front/Side	1	NEMA 4, HT-20 Bolt-in replacement for Autotech RL100 transducers. Conduit, Autotech connector, or AMCI connector styles available.
HT-20-(X)	0.625"	Front	(X)†	HT-20 w/ internal (X):1 gear ratio
HTT-20-1	0.625"	Front	1	Redundant single turn resolvers‡
HTT-400-1	0.625"	Front	1	Redundant single turn resolvers‡, Bolt-in replacement for Autotech RL220 transducers.
HTCR-9n-1	0.047" Cable	Foot	12"	Cable Reel Transducer, 12" span, 0.003" max. resolution, 45 ft stranded stainless cable standard.
HTCR-9n-6	0.047" Cable	Foot	76"	Cable Reel Transducer, 76" span, 0.010" max. resolution, 45 ft stranded stainless cable standard.
HTCR-9n-20	0.047" Cable	Foot	254"	Cable Reel Transducer, 254" span, 0.032" max. resolution, 45 ft stranded stainless cable standard.

† Available gear ratios are: 2:1, 2.5:1, 2.77:1, 3:1, 4:1, 4.8:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 12:1, 13:1, 15:1, 16:1, 20:1, 24:1, 36:1, 40:1, 50:1, 60:1, 64:1, 100:1, 105:1, 150:1,180:1, 250:1 and 256:1

‡ This package contains two resolvers geared 1:1 with the input shaft. Most commonly used in systems that mandate redundant sensors, AMCI can install two different size 11 resolvers in the package per customer requirements. Contact AMCI for more information.

Table 1.2 Compatible AMCI Transducers

Other Compatible Transducers

In addition to AMCI transducers, the 1700 modules directly support Autotech transducers. The Autotech models supported are:

- All SAC-RL100 Transducers. (Size 40, NEMA 13)
- All E6R and E7R-RL101 Transducers. (Size 25, NEMA 13)
- SAC-RL101-010 Transducer. (Size 11, NEMA 1)

If your project is a new installation, or you can budget the cost of replacing the transducer, we *strongly* suggest using AMCI transducers. AMCI is the only company in the marketplace that designs and manufactures the resolvers used in its products. Our transducers and modules are designed to work together, and when specified and installed properly will work for years to come.

If your project involves converting system originally designed for Autotech products you can most likely use AMCI transducers without re-designing transducer mounting brackets. Table 1.3 lists Autotech transducer part numbers and the AMCI bolt-in replacements. Note that the resolvers used in AMCI transducers are for AMCI products and all connectors are AMCI standard connectors, unless otherwise stated.

Autotech Transducer	AMCI Transducer	Comments
SAC-RL101-010	R11X-J10/7	Mechanically identical except that wires come out the back instead of the side.
E6R-RL101-000EF E7R-RL101-000EF	H25-FE	Bolt-in replacement. Shorter body length.
E6R-RL101-000ES E7R-RL101-000ES	H25-SE	Bolt-in replacement when servo mounting. Different bolt pattern on front, shorter body.
E6R-RL101-000SF E7R-RL101-000SF	H25-FS	Bolt-in replacement. Shorter body length, side connector in different location.
E6R-RL101-000SS E7R-RL101-000SS	H25-SS	Bolt-in replacement when servo mounting. Different bolt pattern on front, shorter body length, side connector in different location.
SAC-RL100-010	HT-400-1	Direct replacement.
SAC-RL100-M11	HT-400A-1 HT-400B-1	Direct replacement, Autotech connector. Direct replacement, AMCI connector.
SAC-RL220-G010C	HTT-400-1	Direct replacement.
SAC-RL220-G010M	HTT-400A-1 HTT-400B-1	Direct replacement, Autotech connector. Direct replacement, AMCI connector.

Table 1.3 Autotech / AMCI Transducer Cross-reference

If you decide to use your Autotech transducers, you must change the *Resolver Type* parameter from the keyboard or processor. The module then sets the reference voltage to Autotech levels. If you set the Resolver Type to *Autotech* and you are using a multi-channel module, then all of the transducers must be Autotech's. If you wish to bring both types of transducers into a single module, you must set the Resolver Type parameter to *AMCI* and use an AMCI RM-3 Reference Module to connect the Autotech transducers. For more information on using AMCI and Autotech transducer, refer to chapter 3, pg. 3-13, *Using AMCI and Autotech Transducers Together.*

The remainder of this chapter introduces the many programmable features of the 1700 modules. It also introduces backplane programming concepts that allows you to control the module from the processor instead of using the modules keyboard and display.

Programmable Parameters

A 1700 module is configured by setting its programmable parameters. Parameters are broken into two groups.

- Transducer Setup Parameters - Six parameters that affect the position and tachometer data of each transducer. Multi-channel modules repeat these parameters for each transducer. For example, if you have a four channel module, you will have four Scale Factor parameters, one for each transducer. These parameters are programmable from the keyboard or the processor.
- Module Setup Parameters - Five parameters that sets module communication with the processor and the type of resolvers attached to the card. There is only one of each of these parameters. They are not repeated for each transducer of multi-channel modules. They are programmable only from the keyboard.

Programmable parameters are stored in the modules nonvolatile memory. Therefore, you do not have to configure the module after every power up. Prior to hardware revision H of the module, the nonvolatile memory was EEPROM. This technology has the advantage of retaining programmed values for over 100 years. Its disadvantage is its limited number of write cycles, approximately ten thousand, before the memory will begin to fail.

With revision H, the nonvolatile memory has been changed to battery backed, non-volatile, static RAM (nvRAM). The battery in nvRAM is rated for ten years but the nvRAM has an unlimited number of write cycles. The nvRAM has the additional advantage of significantly decreasing the time needed to store new parameter values.

-05 option

Prior to hardware revision H, customers could order modules with nvRAM instead of EEPROM by adding “-05” to the end of the part number. This practice has been eliminated because nvRAM is now standard on the modules. If your module is a replacement for an older “-05” module, it will work correctly.

Transducer Setup Parameters

Tachometer Response

This parameter sets the time between tachometer updates and the tachometers resolution. Update times are 32, 60, 120, or 240 mSec. The two resolutions, available only with the 240 mSec update time, are 1.0 or 0.1 RPM.

- The tachometer response default value is 240 mSec with 1.0 RPM resolution.

Update time affects the maximum speed that the module can report without error. If the speeds listed in the table below are exceeded, the module will display erroneous data as well as send it to the processor.

Update Time	Resolution	Max. Speed
32 mSec	1.0 RPM	5000 RPM
60 mSec	1.0 RPM	5000 RPM
120 mSec	1.0 RPM	5000 RPM
240 mSec	1.0 RPM	5000 RPM
240 mSec	0.1 RPM	999.9 RPM

Table 1.4 Maximum Tachometer Values

Scale Factor

The Scale Factor sets the number of counts per turn of the resolver.

- The Scale Factor default value is 360. This gives 1 degree resolution.
- 1730 modules can program the Scale Factor to any value between 2 and 1024.
- 1740 modules can program the Scale Factor to any value between 2 and 8192.

Count Direction

This new parameter sets the direction of transducer shaft rotation to increase the position count. *If the transducer cable is wired as specified in this manual* and the count direction is set to *positive*, the position count will increase with clockwise rotation (looking at the shaft). If the count direction is set to *negative*, the position count to increase with counter-clockwise rotation.

- The Count Direction default value is *positive*.

NOTE It is also possible to reverse the count direction by reversing two wires in the transducer cable. If you are installing this module either as a replacement for an older module or on a machine that is a copy installation of a previous system, you will probably not need to set this parameter. Once the machine is setup, you can easily change this parameter if the position is increasing in the wrong direction.

Transducer Setup Parameters (continued)

Circular Offset

The Circular Offset lets you change the position count without rotating the transducer shaft. This offset is most commonly used to force the position to the correct count after the machine has been mechanically aligned.

- The Circular Offset default value is zero.
- The Circular Offset can be programmed from zero to (Scale Factor -1).
- Programming the Scale Factor resets the Circular Offset to zero.

NOTE The Preset Value parameter is directly related to the Circular Offset. Presetting the position count to the Preset Value is accomplished by recalculating the Circular Offset. For more information on the Preset Value parameter, see its section below.

Linear Offset

The Linear Offset changes the *range* of position counts by adding a fixed number to it. The Linear Offsets use is best illustrated with an example.

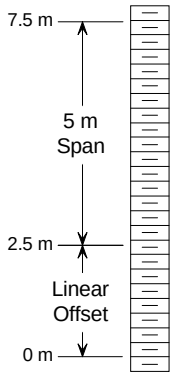


Figure 1.4
Linear Offset
Example

A 1741 is used to measure a 5.000 meter span with one millimeter resolution. Therefore, the total number of counts over the full travel is:

5.000 meters * 1000 mm/meter = 5000 counts.

The Scale Factor parameter is then set 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 the position data to the processor in the correct format instead of using the processor to add an offset once the position value is in the data table. The formula for the Linear Offset is:

Minimum Desired Value	*	Resolution	=	Linear Offset
2.500 meters	*	1000 mm/meter	=	2500 counts

- The Linear Offset default value is zero.
- The Linear Offset can be programmed from zero to (9,999 - (Scale Factor -1)).
- Programming the Scale Factor resets the Linear Offset to zero.

Preset Value

The Preset Value parameter allows you to set the value of position count without calculating the required offset. Programming the Preset Value does not change the position data, it only sets the value that the position will change to when a *Preset Command* is initiated. The position can be preset from the keyboard or with a backplane command.

- The Preset Value defaults to zero.
- The Preset Value can be programmed from zero to (Scale Factor - 1).
- Programming the Scale Factor resets the Preset Value to zero.
- If the Linear Offset value is not equal to zero, the new position value will be (Linear Offset + Preset Value) after it is preset.

Module Setup Parameters

Data Format

This parameter allows you to choose the format of the position and tachometer data reported over the backplane. The choices are *Binary* or *BCD*. It is included for PLC-2 users that require BCD data for PLC-2 math instructions. All other applications should chose *Binary* data format.

- The Data Format parameter default value is *Binary*.
- The Data Format parameter can only be changed from the keyboard.

NOTE

1) AMCI uses the most significant bit of the position and tachometer data words as error bits. Therefore, the maximum position value that can be transmitted in BCD is 7,999. If the sum: (Linear Offset + Scale Factor) is greater than 8,000, the module will lock the Data Format parameter to its *Binary* value. You will not be able to change the Data Format parameter until you decrease the value of either the Linear Offset or Scale Factor.
2) The 1731 and 1741 transfer their data using either block or single transfers. If you select single transfers, the Data Format parameter is locked to *Binary*.

Transfer Type

If you have a 1731 or 1741 module, this parameter allows you to define how the module will communicate over the backplane. You select either *block* or *single transfer*. All multi-channel modules have this parameter locked to the *block transfer* value.

- The Transfer Type default value is *block transfer*.
- The Transfer Type can only be changed from the keyboard.

NOTE

1) If you configure the module for *single transfers*, you will not be able to program the Transducer Setup Parameters from the backplane.
2) If you configure the module for *single transfers*, the Data Format parameter will be locked to its *Binary* value
3) After changing this parameter, you must cycle power to the module to reinitialize the A-B backplane interface chip.

PLC Program

The PLC Program parameter tells the module to accept or ignore programming instructions from the backplane. This parameter is only available if you have selected *block transfers* with the Transfer Type parameter. If you selected *single transfers*, the Single Transfer Length parameter is shown instead.

- The PLC Program default value, *read only*, prevents the module from accepting programming instructions. In order to enable backplane programming, you must set the parameter to *program enabled.*
- The PLC Program parameter is only programmable from the keyboard.

NOTE

1) When backplane programmable, the module requires an additional word in its block transfer read file. Because of this, you may have to modify your existing data file sizes as well as your ladder logic if upgrading your system.
2) After changing this parameter, you must cycle power to the module to re-initialize the A-B backplane interface chip.

Module Setup Parameters (continued)

Single Transfer Length

The Single Transfer Length parameter is a new parameter used to specify either a 16 or 32 bit transfer. This parameter is only available if you have selected *single transfers* with the Transfer Type parameter. If you selected *block transfers*, the PLC Program parameter is shown instead.

- The Single Transfer Length default is 16 bit. This allows the transfer of position data only. Setting the parameter to 32 bit allows the transfer of both the position and tachometer data.
- The Single Transfer Length parameter is only programmable from the keyboard.

NOTE

1) If the Single Transfer Length parameter is set to 16 bit, the chassis can be configured for 2-slot, 1-slot, or ½-slot addressing. If the parameter is set to 32 bit, you must use 1-slot or ½-slot addressing.
2) After changing this parameter, you must cycle power to the module to re-initialize the A-B backplane interface chip.

-08 option

Prior to hardware revision H, customers could order modules with 32 bit single transfer by adding "-08" to the end of the part number. This practice has been eliminated because 32 bit single transfer is now standard on the modules. If your module is a replacement for an older "-08" module, it will work correctly if the Transfer Type parameter is set to *single* and the Single Transfer Length parameter is set to *32 bit*.

Resolver Type

The Resolver Type parameter is a new parameter that makes most Autotech transducers compatible with the Series 1700 modules.

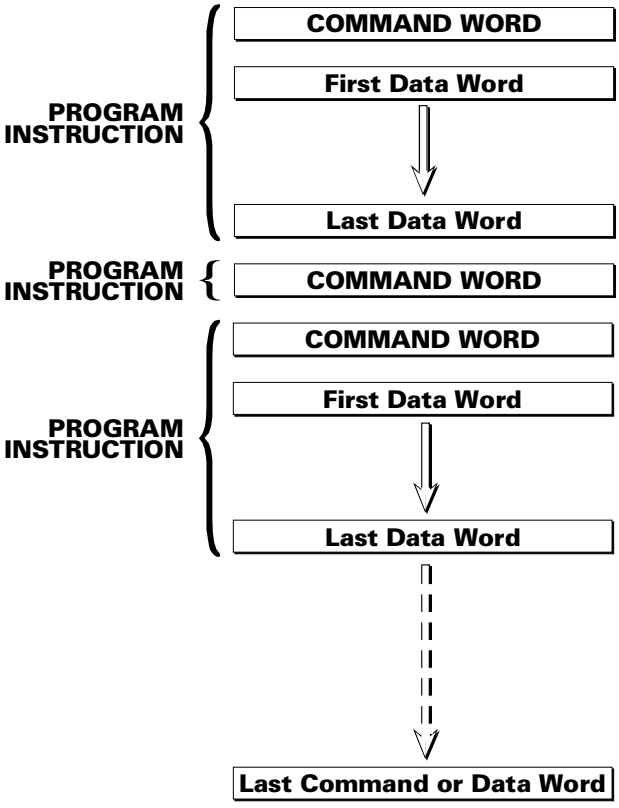
- The Resolver Type default value is AMCI, *resolver 1*. If you are using Autotech transducers, set this parameter to *resolver 2*.
- The Resolver Type parameter is only programmable from the keyboard.

NOTE

If you plan to use both AMCI and Autotech resolvers with a single module you must set the Resolver Type to AMCI, *resolver 1*. You will need an RM-3 Reference Module to interface the Autotech transducers with the card. See Chapter 3, pg. 3-13, *Using AMCI and Autotech Transducers Together* for more information on using an RM-3.

Backplane Programming

When a Series 1700 module is configured to use block transfers, you have the option of programming the module using data sent to it by block transfer writes. (See *Transfer Type Parameter* and *PLC Program Parameter* sections, pgs. 1-8, 1-9.) The programming format is a series of *Program Instructions* as shown below. Block transfers can transmit a maximum of sixty-four words. However, this does not limit how many parameters you can program at one time.



- Each program instruction is made up of a *Command Word* and zero or more *Data Words.*
- All transducer setup parameters can be programmed from the backplane. Module setup parameters cannot be programmed from the backplane.
- There are nine additional program instructions called *Auxiliary Commands*. These commands do not have data associated with them and allow you to preset the position, enable or disable programming from the keyboard, clear programming errors and transducer faults, and enter or exit *Read Status Mode*. Four additional commands are enabled when the module is in read status mode. Use these commands to tell the module which parameter values to transmit to the PLC instead of position and tachometer data.

Figure 1.5 1700 Programming Structure

Auxiliary Commands

Auxiliary Commands affect the operation of the module and do not have data associated with them. There are nine commands.

- Clear Errors - This command clears any programming error messages and any transducer faults.
- Preset Transducer (1-4) - These four commands set the position count of transducer (1-4) equal to the programmed preset value.
- Disable Keyboard - Disables all programming from the keyboard. Parameter values can be monitored but they cannot be changed.
- Enable Keyboard - This command counteracts a previous Disable Keyboard command. The status of the keyboard disable is retained when power is removed. The only way to enable the keyboard after a Disable Keyboard command has been accepted is with this command.

Auxiliary Commands (continued)

- Enter Read Status Mode - This command puts the module in read status mode. While in this mode, the module will transmit parameter values instead of position and tachometer data. Four additional commands are enabled while in this mode that allow you to specify which parameter values are to be read back.
- Exit Read Status Mode - This command places the module back into its normal mode of operation. Position and tachometer data will be transmitted after this command is accepted.

Read Status Mode

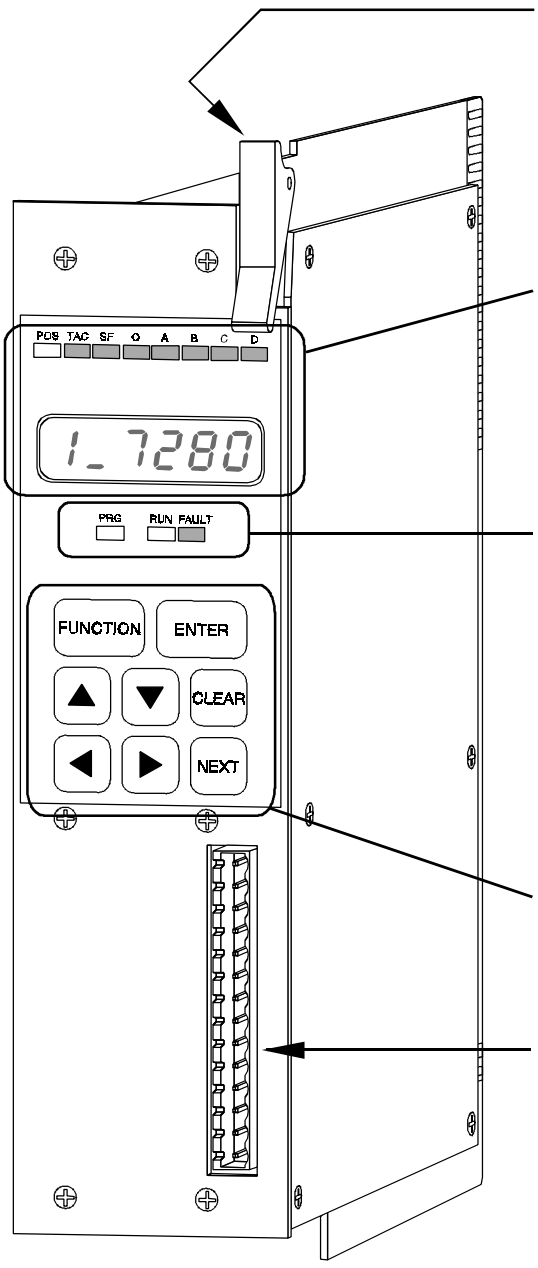
This special mode of operation allows you to read back the transducer setup parameter values. Position and tachometer data is not transmitted while in this mode.

Because the block transfer read length from a 1700 module is fixed, it is not to read back all of the parameter values with a single block transfer. For this reason, four additional commands are enabled while in this mode. These commands allow you to specify which parameters are to be read back. Once specified, the parameter values will be transmitted with every block transfer read until new parameters are specified or you exit read status mode.

For more information on read status mode, refer to Chapter 6, *Backplane Programming.*

This chapter describes the physical layout of a Series 1700 module as well as keyboard programming.

Front Panel Description



Program Switch - (On other side of PC Board, hidden from view.) Used to enable programming the module from the keyboard. A two pin header next to the switch can be removed to disable Program Mode. The switch can also be disabled from the processor.

Function Display - Used to display position data and parameter values. The eight LED indicators designate what is showing on the display. When programming a parameter, a blinking digit in the display shows the position of the *Cursor*.

Status Indicators - Indicates the operating status 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 module fault. The type of fault is shown on the display.

Keyboard - Used to examine position and tachometer data as well as examine or change the programming of the module.

Transducer Input Connector - Connector for one to four transducers. A fourteen pin connector is shown. The 1731, 1732, 1741, and 1742 modules have an eight pin connector.

Figure 2.1 Series 1700 Front Panel

Program Mode vs. Display Mode

The front panel has two operating modes.

- Program Mode – (Yellow PRG light on) The parameters can be modified from the keyboard. The position can be preset by pressing the [**CLEAR**] key while displaying the position value.
- Display Mode – (Yellow PRG light off) The parameters can be inspected, but not modified. You cannot preset the position from the keyboard.

Program Mode and Display Mode refer to the modules' front panel only. Once enabled by setting the *Transfer Type* and *PLC Program* parameters appropriately, you can always program the module from the backplane.

The module can be locked into Display Mode in one of two ways. The first is by removing a jumper on the module. The second is writing the *Disable Keyboard* auxiliary command from the processor. It is usually good practice to lock the module in display mode once the system is operational. This will prevent someone from accidentally changing the parameters while the system is running. The only times that changes to the programming should be allowed are during set-up or trouble shooting procedures.

Program Switch

The Program Switch is used to quickly enable or disable program mode as long as the 1700 module has not been locked in display mode from the processor. The module is in program mode when the switch is pushed towards the back of the module. The module is in display mode when the switch is pushed towards the front of the module. The yellow PRG light is on when the module is in program mode.

The Program Switch can be disabled by removing the jumper on the two pin header next to the switch. Removing this jumper locks the 1700 in display mode. You can also lock the module in display mode with the *Disable Keyboard* auxiliary command. See chapter 1, pg. 1-10, *Auxiliary Commands* for more information on enabling or disabling the keyboard from the processor.

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

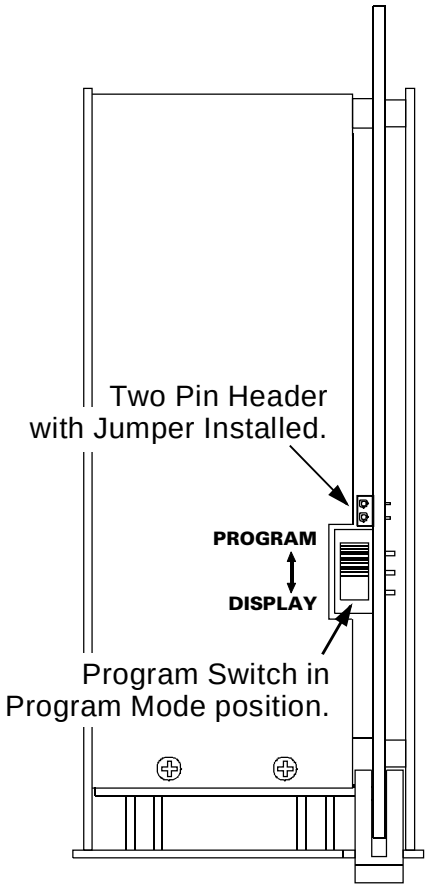


Figure 2.2 Program Switch

Using the Function Display and Keyboard

You can examine position and tachometer values as well as inspect or program all of the programmable parameters using the display and keyboard. The [**FUNCTION**] key, along with the [►] and [◄] keys, are used to cycle between the displays. Figure 2.3 shows the display order.

Navigating in Display Mode

When compared to program mode, display mode is easier to navigate. If you are unfamiliar with the module, learn how to navigate between displays while in display mode. Navigating in program mode will then be easier to learn.

The [**FUNCTION**] and [►] keys cycle you through the displays in one direction (Down in the figure). The [◄] cycles you through the displays in the opposite direction. Note that the display order is circular. Pressing the [**FUNCTION**] key while displaying the resolver type parameter will return you to the position display. Pressing the [◄] key will then return you the resolver type parameter.

You will see either the PLC Program or the Single Transfer Length display. The value of the Transfer Type parameter dictates which display is shown.

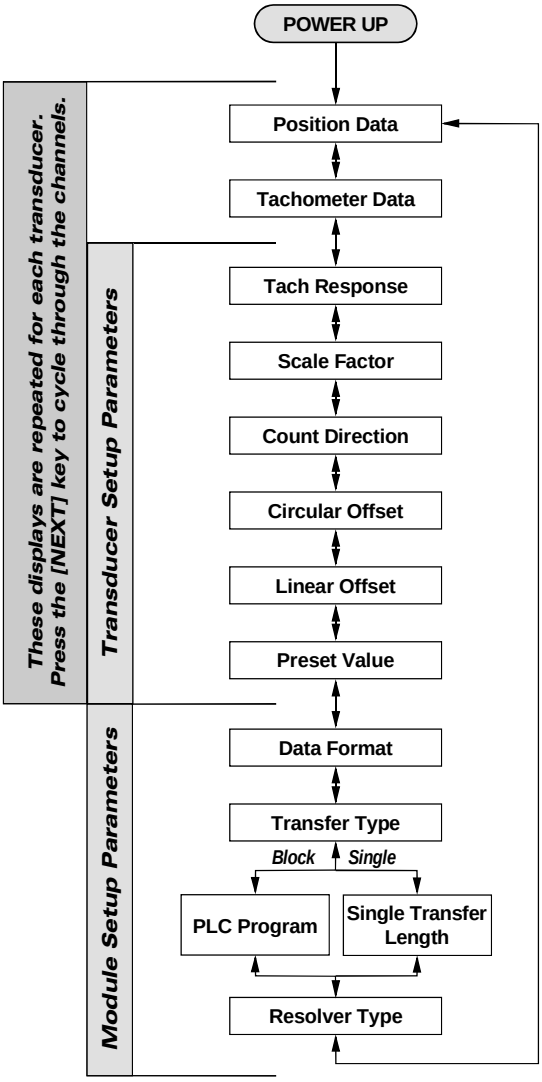


Figure 2.3 Module Display Order

Navigating in Program Mode

The [**FUNCTION**] key is still used to cycle through the displays.

When you switch to a parameter display, the first digit of the value will be blinking. This shows the position of the *Cursor*. Use the [►] and [◄] keys to move the cursor and the [▲] and [▼] keys to change the value of the digit under the cursor. To quickly set most parameters to zero, press the [**CLEAR**] key. Once the parameter value is correct, press the [**ENTER**] key to accept it. The cursor is removed from the display if the new value is valid.

The module will only accept valid values for the parameters. If the module does not accept a value, it will return the display to the last valid number and move the cursor to the first digit. The valid range for many parameters is based on the values of other parameters. If the module does not accept a new value, check the other parameter settings.

Pressing the [**FUNCTION**] key at any time will remove the cursor and the module will display the last valid setting for the parameter. You can then use [**FUNCTION**], [►], or [◄] keys to move to the next or previous display.

Using the Function Display and Keyboard (continued)

Switching Between Channels

Pressing the [**NEXT**] key will cycle through the transducer channels when displaying the position value, tachometer value, or transducer setup parameters. You will remain in the same display, only switching channels. For example, if you have a 1744 and are displaying the Scale Factor parameter, pressing the [**NEXT**] key four times will cycle you through the four Scale Factor values.

The first digit of these displays usually tells you which channel is being displayed. The one exception is the Count Direction display. This display shows "**dir**" followed by the channel number.

Indicator LED Patterns

The eight LEDs above the seven segment displays are the indicator LEDs. Figure 2.4 is a list of the displays and their indicator LED patterns. Note that some of the parameters have the same indicator pattern. In these cases, the actual displays are different enough to distinguish between the parameters.

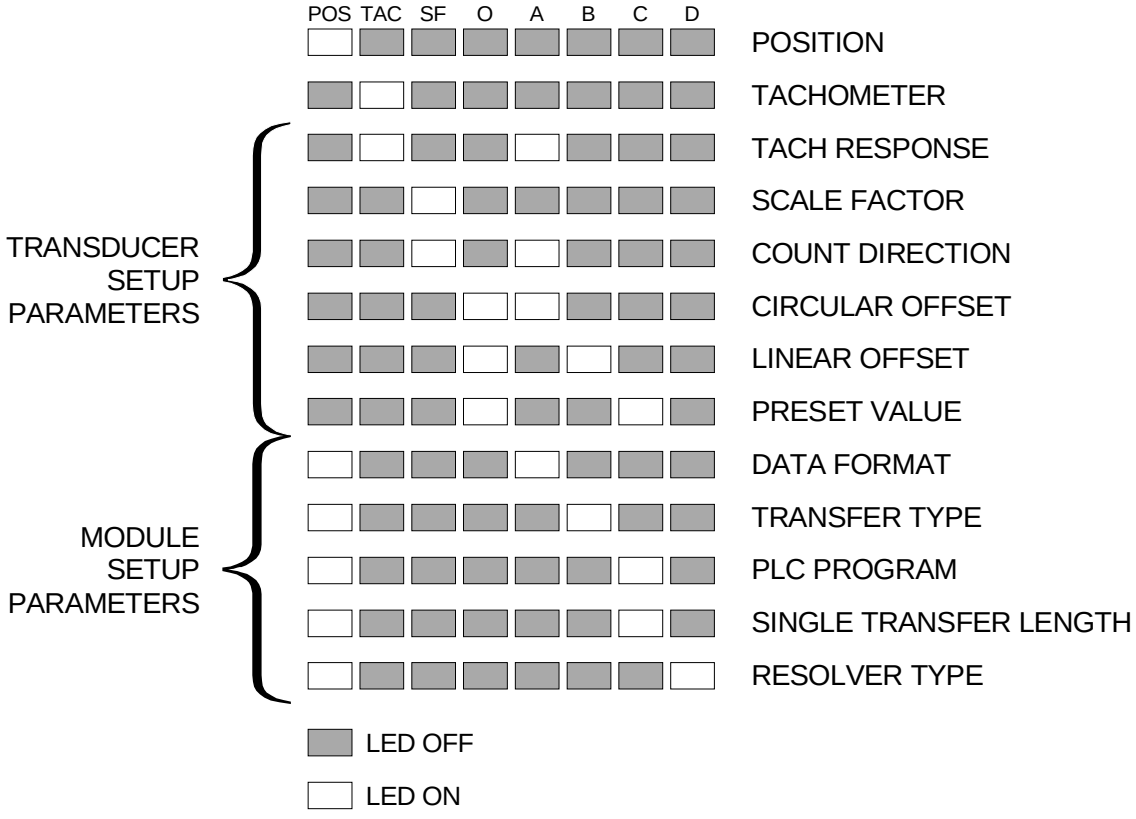


Figure 2.4 Indicator LED Patterns

Position Display

As shown in figure 2.5a, the position display shows the current position when a transducer is properly attached to the channel. The first digit is the transducer channel. If you have a multi-channel module, press the [**NEXT**] key to cycle through the additional position displays.

If there is a transducer fault on the input channel, the position display will change to the one shown in figure 2.5b. The red FAULT LED is lit when there is a transducer fault. If this LED is on while the position is displayed, the fault is on one of the other channels. Use the [**NEXT**] key to switch to the faulted channel. The fault can be cleared by pressing the [**CLEAR**] key if the 'Err1' message is blinking.

Refer to the *Error Messages* section on page 2-9 for more information on the causes of a transducer fault.

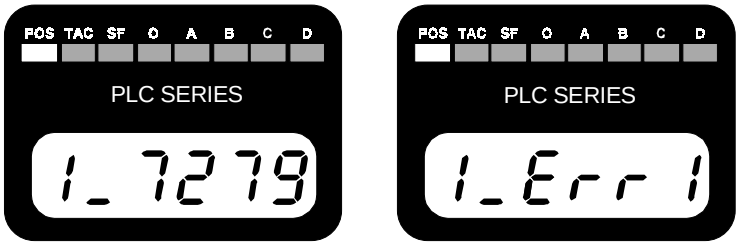


Fig A
CURRENT POSITION

Fig B
TRANSDUCER FAULT
(ERROR 1)
CHANNEL 1

Figure 2.5 Position and Transducer Fault Displays

Tachometer Display

Figure 2.6 Tachometer Display

The tachometer display shows the current speed of the transducer in revolutions per minute with either 1.0 or 0.1 RPM resolution.

If there is a transducer fault, the display will show the '**Err1**' message instead of the current speed. (See Position Display above.) The red FAULT LED is lit when there is a transducer fault. If this LED is on while the tachometer is displayed, the fault is on one of the other channels. Use the [**NEXT**] key to switch to the faulted channel. The fault can be cleared by pressing the [**CLEAR**] key if the 'Err1' message is blinking.

Transducer Setup Parameters

The following are the front panel displays of the transducer setup parameters along with default values, range of values, and any special programming instructions. The first digit of these displays usually tells you which channel is being displayed. The one exception is the count direction display. This display shows "**dir**" followed by the channel number. If you have a multi-channel module, use the [**NEXT**] key to switch between channels.

The page number given in the heading is the page in chapter one that more fully describes the function of the parameter.

Tachometer Response Pg. 1-6

Figure 2.7 Tach Response

Default: 240 mSec update, 1.0 RPM resolution

Range: 32 mSec update, 1.0 RPM resolution
60 mSec update, 1.0 RPM resolution
120 mSec update, 1.0 RPM resolution
240 mSec update, 1.0 RPM resolution
240 mSec update, 0.1 RPM resolution

Special: The [▲] and [▼] keys change the entire value, not one digit. The [◄] and [►] keys have no effect. The display shows '0240' for 1 RPM resolution, '240.0' for 0.1 RPM resolution.

Scale Factor Pg. 1-6

Figure 2.8 Scale Factor

Default: 360 Counts (1° resolution)

Range: 2 to 1024 counts inclusive (1731, 1732, 1733, 1734)
2 to 8192 counts inclusive (1741, 1742, 1743, 1744)

NOTE Programming this parameter will reset the Circular Offset, Linear Offset, and Preset Value parameters to their default settings of zero.

Count Direction Pg. 1-6

Figure 2.9 Count Direction

Default: Positive. (Clockwise increasing counts)

Range: Positive (Clockwise increasing)
Negative (Counter-clockwise increasing)

Special: The [▲] and [▼] keys change the entire value, not one digit. The [◄] and [►] keys have no effect. The transducer channel number is the fourth digit, after '**dir**'.

Transducer Setup Parameters (continued)

Circular Offset Pg. 1-7

Figure 2.10 Circular Offset

Default: 0

Range: 0 to (Scale Factor - 1)

NOTE Programming the Scale Factor parameter resets the Circular Offset to zero.

Linear Offset Pg. 1-7

Figure 2.11 Linear Offset

Default: 0

Range: 0 to (9,999 - (Scale Factor - 1))

NOTE Programming the Scale Factor parameter resets the Linear Offset to zero.

Preset Value Pg. 1-7

Figure 2.12 Preset Value

Default: 0

Range: 0 to (Scale Factor -1)

NOTE Programming the Scale Factor parameter resets the Preset Value to zero.
If the Linear Offset is not equal to zero, the new position value will be (Linear Offset + Preset Value).

Module Setup Parameters

The following are the front panel displays of the module setup parameters along with default values, range of values, and any special programming instructions. The page number given in the heading is the page in chapter one that more fully describes the function of the parameter.

For all of these displays, the [▲] and [▼] keys change the entire value, not one digit. The [◄] and [►] keys have no effect.

Data Format Pg. 1-8

Figure 2.13 Data Format

Default: Binary data format

Range: Binary
BCD

Module Setup Parameters (continued)

Transfer Type Pg. 1-8

Figure 2.14 Transfer Type

Default: Block transfer

Range: Block
Single

PLC Program Pg. 1-8

Figure 2.15 PLC Program

Default: Read Only

Range: Read Only
Program Enabled

NOTE This parameter is only shown when the Transfer Type parameter is set to *block transfer*. If Transfer Type is set to *single transfer*, the Single Transfer Length display is shown.

Single Transfer Length Pg. 1-9

Figure 2.16 Single Transfer Length

Default: 16 bit

Range: 16 bit
32 bit

NOTE This parameter is only shown when the Transfer Type parameter is set to *single transfer*. If Transfer Type is set to *block transfer*, the PLC Program display is shown.

Resolver Type Pg. 1-9

Figure 2.17 Resolver Type

Default: 1: AMCI resolvers

Range: 1: AMCI resolvers
2: Autotech Resolvers

Error Messages

There are three types of faults that a 1700 module will recognize.

- Transducer Fault (Error 1) – A problem exists on a transducer channel.
- nvRAM Fault (Error 2) – A problem exists with the non-volatile RAM or parameter values are not stored correctly.
- Reference Voltage Fault – The reference voltage constants could not be automatically restored while clearing a nvRAM error.

In all cases, the red FAULT LED will be on and the module will display an error message as shown below. These errors are also reported over the backplane. *See Chapter 7 Data Format,* for information on how errors are reported over the backplane.

Transducer Fault (Error 1)

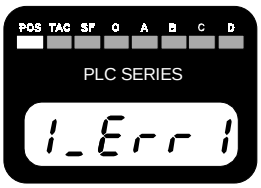


Figure 2.18
Transducer Fault

This message is only shown when the module is displaying position or tachometer data. The parameters are displayed normally. If the FAULT LED is on while the position is displayed, the fault is on one of the other channels. Use the [**NEXT**] key to switch to the faulted channel. The fault can be cleared by pressing the [**CLEAR**] key if the 'Err1' message is blinking. There are six major causes of a transducer fault.

- Broken or intermittent transducer cable
- Non-compatible transducer
- Improper wiring of the transducer cable
- Improper installation of the transducer cable
- Faulty transducer
- Faulty module

nvRAM Fault (Error 2)

All of the parameters are stored in a non-volatile static RAM memory when power is removed from the module. The nvRAM has an integral lithium battery that will maintain the parameter values in the absence of power for approximately ten years from the date of manufacture.

It is remotely possible that the values can become corrupted through electrical noise or an inopportune power outage. If this occurs, the module display will change to figure 2.19.

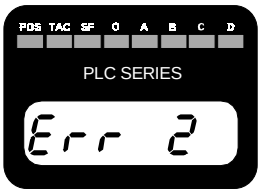


Figure 2.19 nvRAM Error

This message is displayed at all times. This error can be cleared by pressing the [**CLEAR**] key. If the message remains after pressing the [**CLEAR**] key, the nvRAM is damaged. If the message appears on every power up but can be cleared, the battery is discharged. In either case, the module must be returned to AMCI for repairs. See the inside front cover, *Returns Policy*, for additional information.

A 1700 module stores constants in the nvRAM that allow it to adjust the reference voltage for either AMCI or Autotech transducers. If these constants are corrupted, the module will recalculate them as long a working transducer is attached. While calculating the constants, the display will show "rEF_nn" where nn = 00 to 99. Once recalculated, the display will change to the position display. If these constants cannot be calculated, the display changes to the reference voltage fault display.

Error Messages (continued)

Reference Voltage Fault

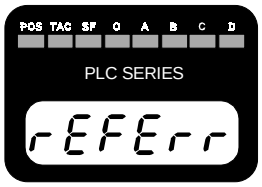


Figure 2.20
Reference Voltage
Fault

A 1700 module stores adjustment constants in the nvRAM memory that allow it to set the reference voltage for either AMCI or Autotech transducers. Usually, these constants can be restored automatically when a nvRAM fault is cleared. If the restoration fails, the module displays this "reference error" message. Make sure a working transducer is properly attached to the module and press the [**CLEAR**] key. The module will then recalculate the constants. If the message remains after pressing the [**CLEAR**] key, contact AMCI. See the inside front cover, *24 Hour Technical Support Number,* for more information on contacting AMCI.

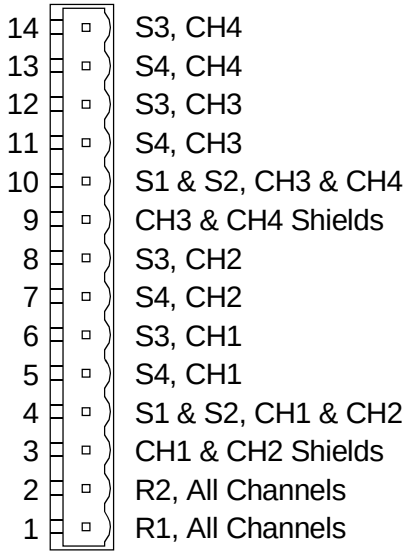
Transducer Input Connector

The transducer input connector of a 1731, 1732, 1741, or 1742 module has eight contacts while the connector of a 1733, 1734, 1743, or 1744 module has fourteen contacts. The following table lists the AMCI and Phoenix Contact part numbers on the mating connectors.

	8 Pin Connector	14 Pin Connector
AMCI Part #	MS-8	MS-14
Phoenix Part #	MSTB2.5/8-ST-5.08 1757077	MSTB2.5/14-ST-5.08 1757132

Table 2.1 Transducer Input Connector

Figure 2.21 shows the pinout to industry standard resolver wire designations. Cabling information for AMCI and Autotech transducers is given in chapter 3, starting on page 3-8, *Transducer Cable Installation.*



- CH – Channel Number
- R1/R2 – Reference Winding
- S1/S3 – COS Winding
- S2/S4 – SIN Winding

Figure 2.21 Transducer Input Connector

This chapter describes how to install the Series 1700 module into the I/O chassis. It also give information on installing AMCI transducers. This includes information on transducer mounting, shaft loading, and cable installation. Information on interfacing Autotech transducers is also included.

Power Requirements

The 1700 modules draw power from the I/O chassis +5Vdc supply. The maximum current draw is dependent on the number of transducer channels and is given in the table below. Add this to the power requirements of all other modules in the chassis when sizing the chassis power supply.

Model Number	1731/1741	1732/1742	1733/1743	1734/1744
Maximum Current Draw	675 mA	700 mA	725 mA	750 mA

Table 3.1 Backplane Current Draw

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 personal.

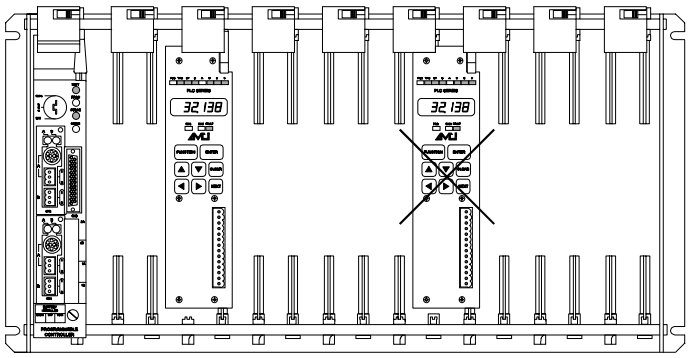


Fig 3.1 Module Installation

Install the module in a single slot pair within the chassis. A slot pair is two adjacent backplane slots, the left of which is even numbered. Most A-B chassis have the slots numbered on the backplane silkscreen. Figure 3.1 shows two modules. The module on the left is installed correctly in a single slot pair while the module on the right is incorrectly installed in two slot pairs.

All addressing and programming examples in this manual assume that the module is installed in a single slot pair.

Keying Bands

Plastic keying bands can be inserted into the top backplane connector to prevent the insertion of other modules. Insert the bands between the following pins:

- Pins 28 and 30
- Pins 32 and 34.

Transducer Specifications

Specification	All HT and HTT's	All H25's	HT-6
Shaft Diameter	0.625"	0.375"	0.188"
Radial Shaft Loading	400 lbs. Max.	40 lbs. Max.	8 lbs. Max.
Axial Shaft Loading	200 lbs. Max.	20 lbs. Max.	4 lbs. Max.
Starting Torque	8 oz.in. @ 25°C	1.5 oz.in. @ 25° C	0.5 oz.in. @ 25°C
Moment of Inertia	20 oz-in-sec²	4 oz-in-sec^2	2.1 x 10^{-4} oz-in-sec²
Weight	4 lbs.	1 lb.	0.7 lb.
Enclosure	NEMA 13 or 4X	NEMA 4	NEMA 13
Environmental (All Transducers)			
Operating Temp -20 to 125°C	Shock 50G's for 11 mSec	Vibration 5 to 2000 Hz @ 20 G's	

Table 3.2 Transducer Specifications

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:

	Radial Load	Axial Load
All 0.625" Shafts	100 lbs. (445 N)	50 lbs. (222 N)
All 0.375" Shafts	30 lbs. (133 N)	15 lbs. (66.7 N)
All Other Shafts	4 lbs. (17.8 N)	2 lbs. (8.9 N)

Table 3.3 Transducer Bearing Loads

- 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.

Transducer Outline Drawings

The appropriate outline drawing is included with the transducer when shipped. Outline drawings for select transducers are also available on the following pages of this manual. If you are using one of the transducers printed here and need a dimensional drawing, check our web site or contact us and we will fax you the spec sheet.

Transducer Outline Drawings (continued)

HT-20: Anodized Aluminum Body, 1070 Steel Shaft, NEMA 13

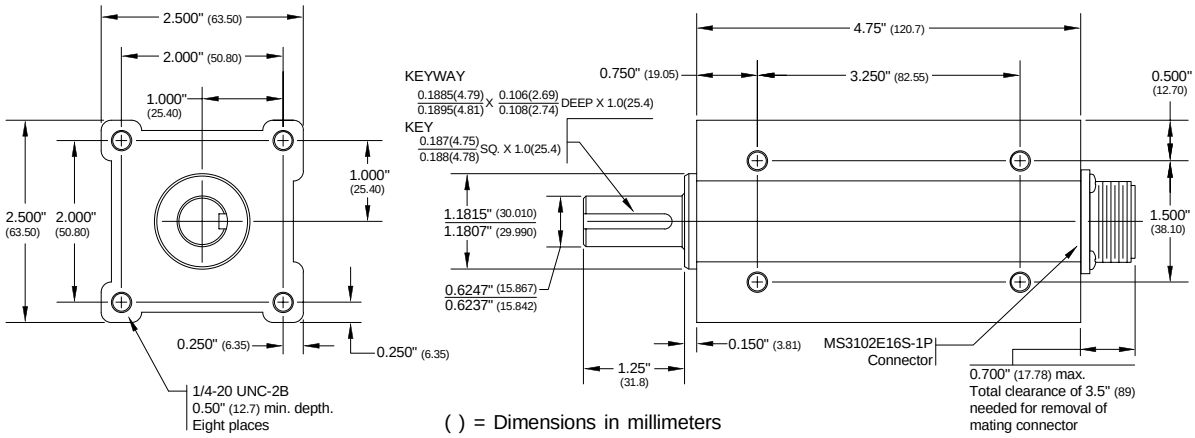


Figure 3.2 HT-20 Outline Drawing

HT-20S: Anodized Aluminum Body, 1070 Steel Shaft, NEMA 13

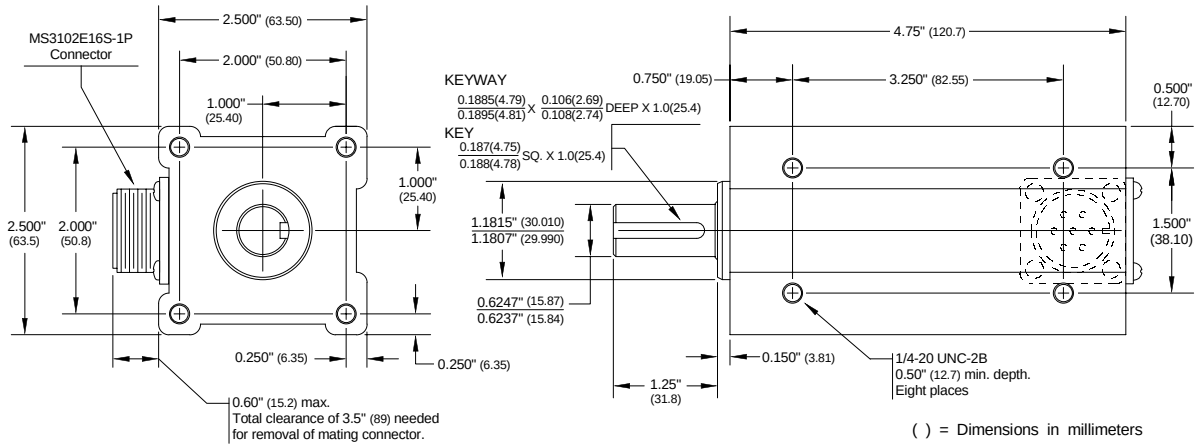


Figure 3.3 HT-20S Outline Drawing

HT-20K/L: Hard Coat Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4X

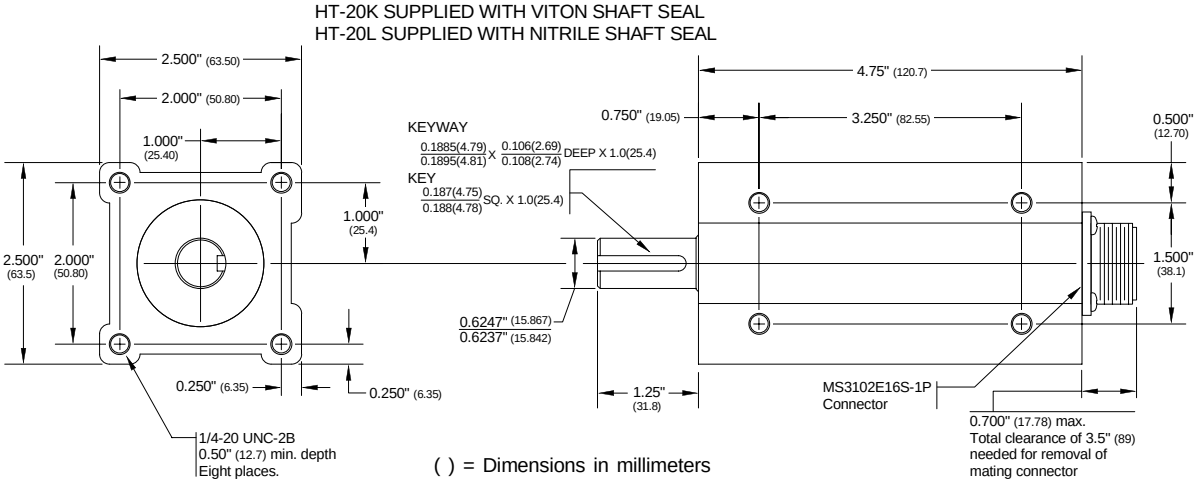


Figure 3.4 HT-20K/L Outline Drawing

Transducer Outline Drawings (continued)

H25FE: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

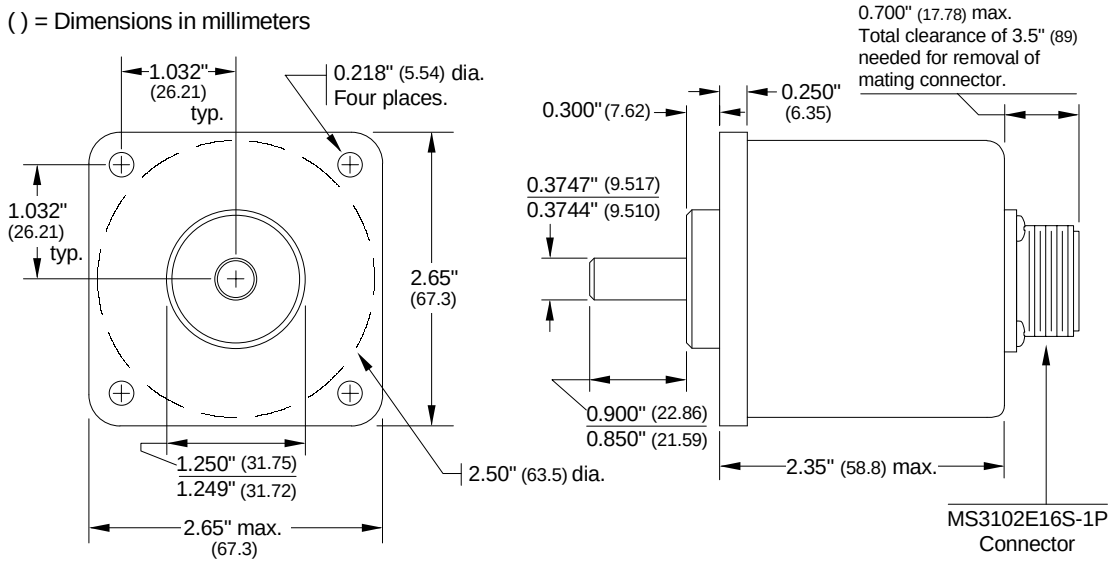


Figure 3.5 H25FE Outline Drawing

H25SE: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

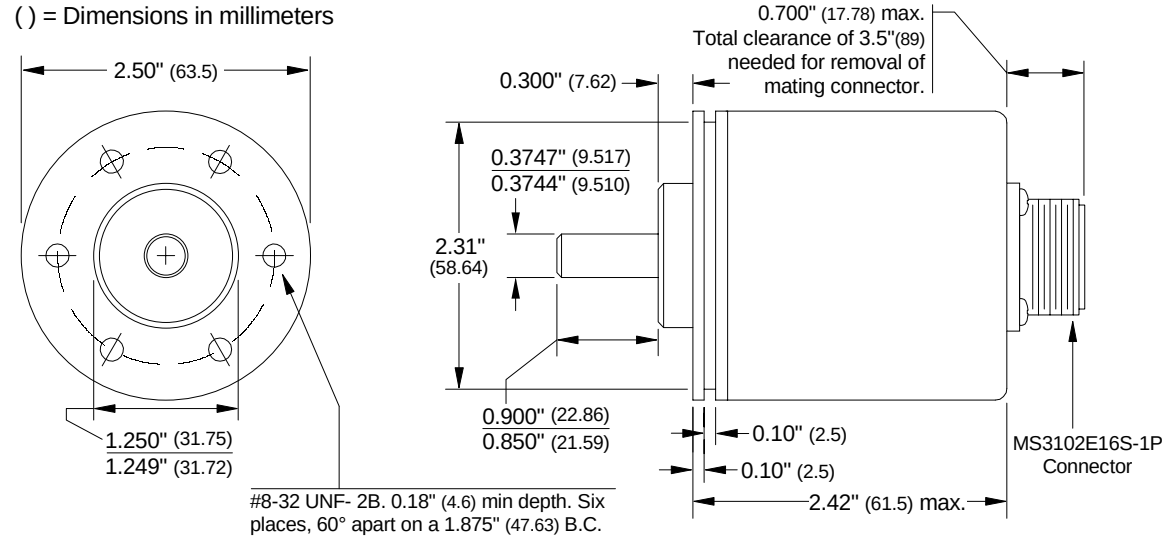


Figure 3.6 H25SE Outline Drawing

Transducer Outline Drawings (continued)

H25FS: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

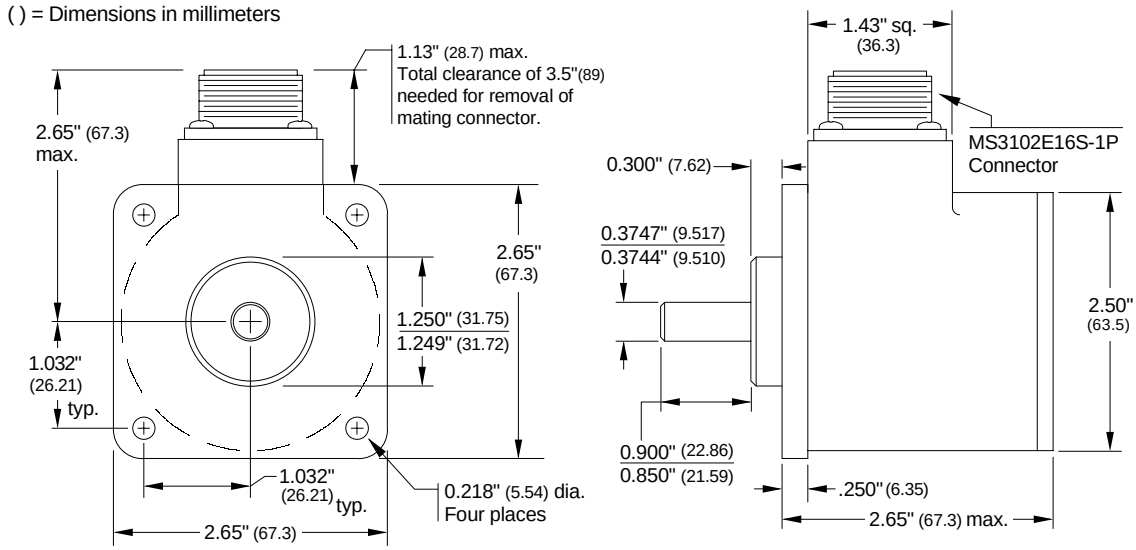


Figure 3.7 H25FS Outline Drawing

H25SS: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

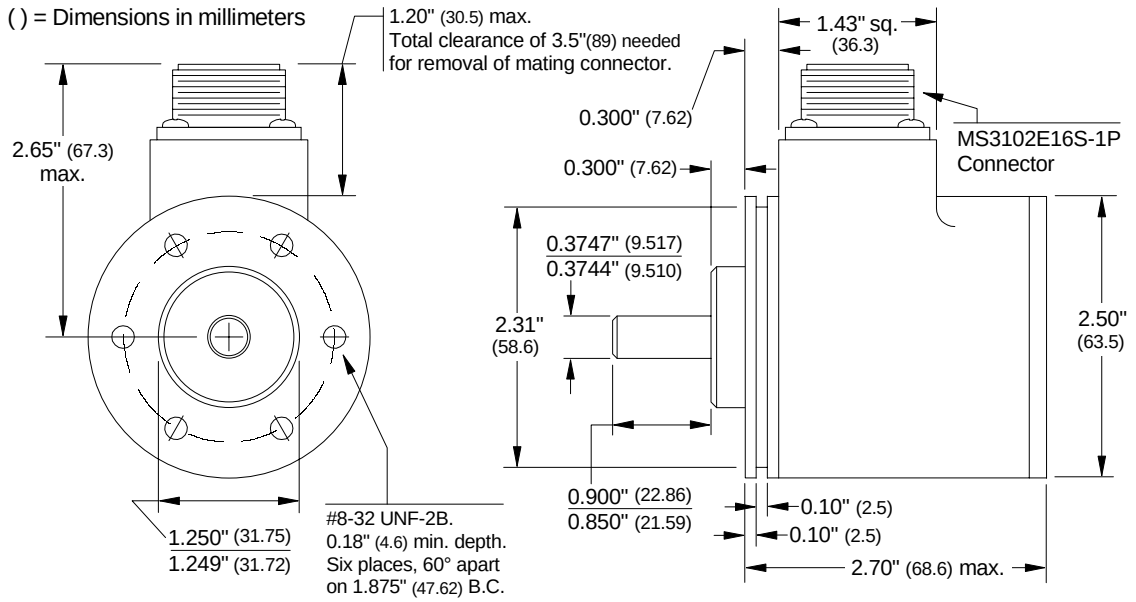


Figure 3.8 H25SS Outline Drawing

Transducer Outline Drawings (continued)

H25FL: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

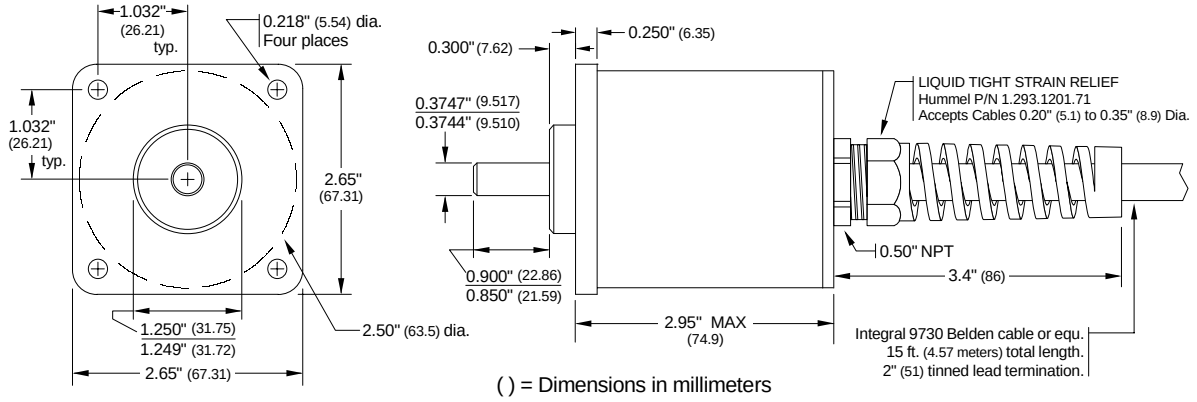


Figure 3.9 H25FL Outline Drawing

H25SL: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 4

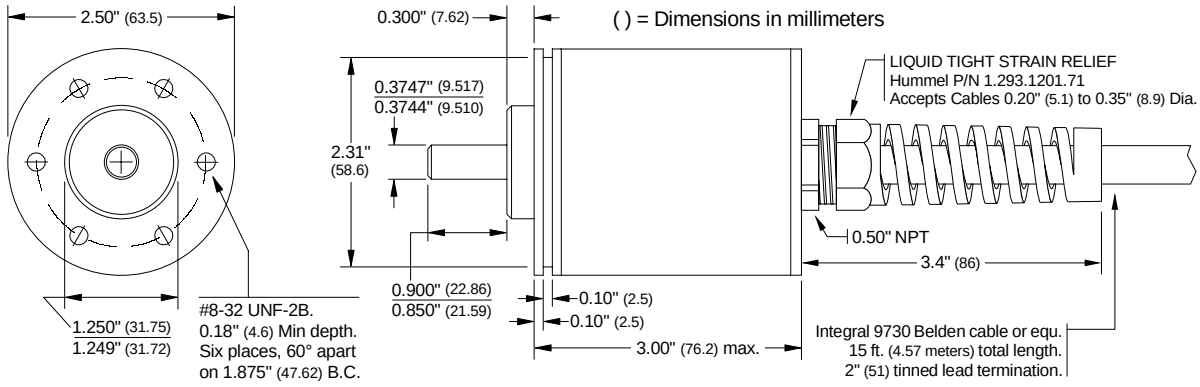


Figure 3.10 H25SL Outline Drawing

HT-6: Anodized Aluminum Body, 303 Stainless Steel Shaft, NEMA 13

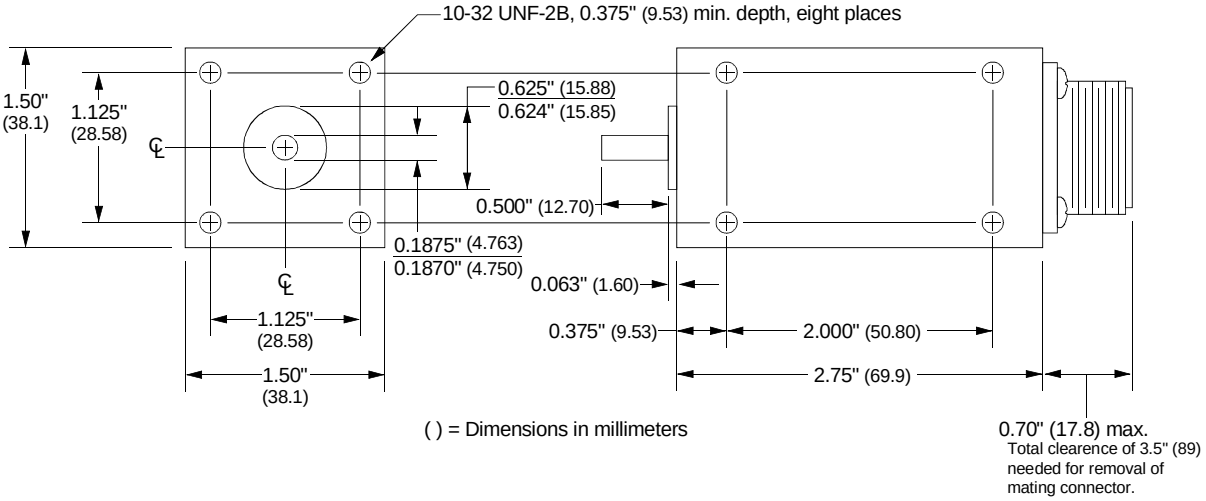


Figure 3.11 HT-6 Outline Drawing

Transducer Outline Drawings (continued)

HT-400: Anodized Aluminum Body, 1070 Carbon Steel Shaft, NEMA 4

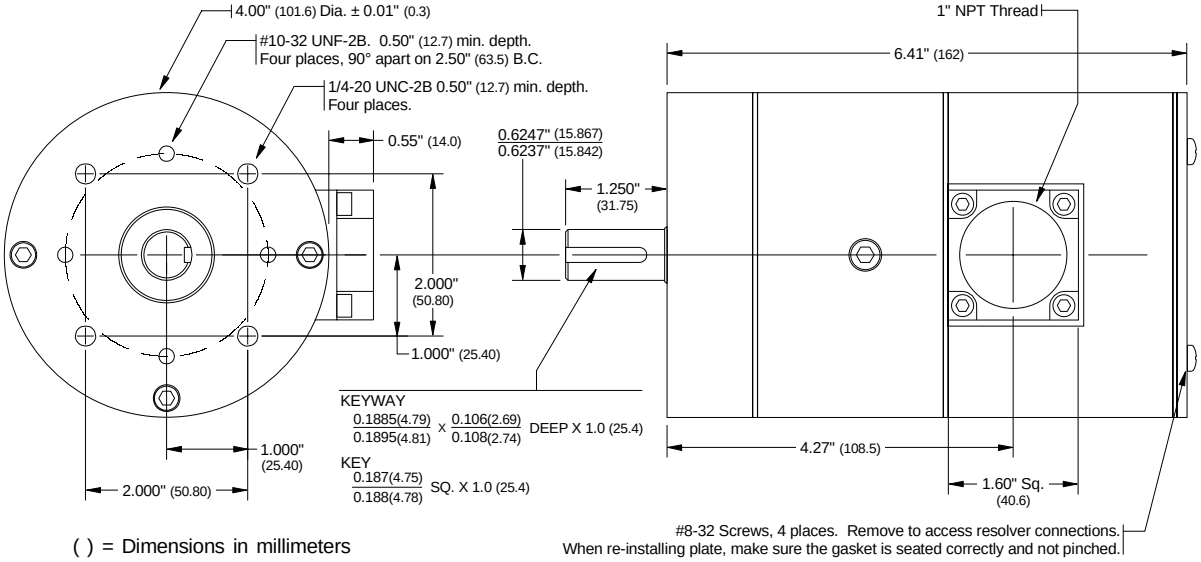


Figure 3.12 HT-400 Outline Drawing

HT-20-(x): Anodized and Painted Aluminum Body, 1070 Carbon Steel Shaft, NEMA 4
(x) = Number of shaft turns needed to complete one rotation of the internal resolver.

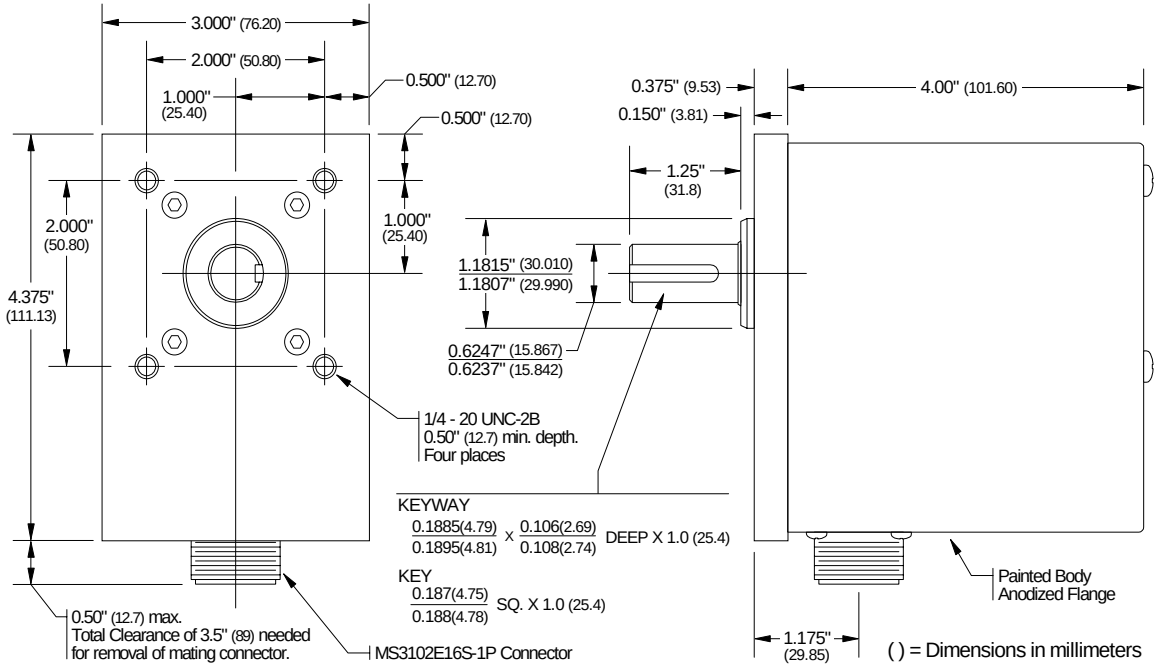


Figure 3.13 HT-20-(x) and HTT-20-1 Outline Drawing

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 are making your own cables, cable and connectors can be ordered from AMCI.

		Belden Cable #			
Module	**AMCI Part #**	**-100ft**	**100ft+**	**Module Conn.**	**Transducer Conn.**
1731/41	C1T - (x)	9873	9730	MS-8	MS-16 (1)
1732/42	C2T - (x)	9873	9730	MS-8	MS-16 (2)
1733/43	C3T - (x)	9873	9730	MS-14	MS-16 (3)
1734/44	C4T - (x)	9873	9730	MS-14	MS-16 (4)

Table 3.4 Transducer Cable Numbers

NOTE

1) Resolvers are low voltage, low power devices. If you are using A-B guidelines for cabling installation, treat the transducer cable as a Category 2 cable. It 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. Refer to the *Allen Bradley Programmable Controller Grounding and Wiring Guidelines* manual, Publication number 1770-4.1 for more information.

2) The shields of the transducer cable must be grounded at the 1700 module *only!* When installing the cable, treat the shield as a 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.

GC-1 Grounding Clamp

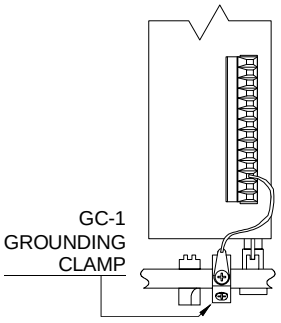


Figure 3.14
GC-1 Clamp

The shield of the transducer cable must be attached to the chassis with a Grounding Clamp (AMCI part number GC-1). This guarantees a low impedance path to ground for any EMI radiation that may be induced into the cable. The drain wire from the Grounding Clamp must be connected to pin 3 of the MS-8 or MS-14 Transducer Input Connector. Pin 9 of the MS-14 connector is internally connected to pin 3 and does not need an additional wire. The grounding clamp package includes installation instructions.

Transducer Cable Wiring Diagrams

C1T-(x) Wiring Diagram: For 1731 & 1741, (x) = length in feet

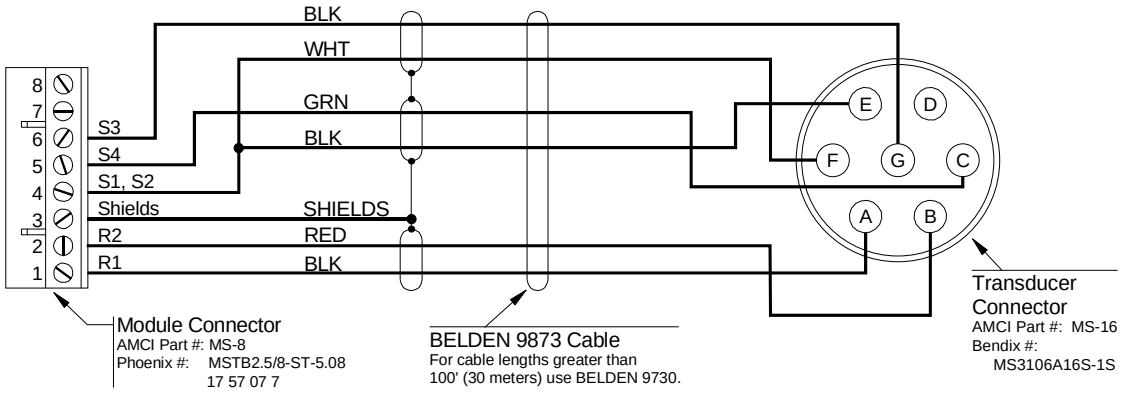


Figure 3.15 C1T-(x) Wiring Diagram

C2T-(x) Wiring Diagram: For 1732 & 1742, (x) = length in feet

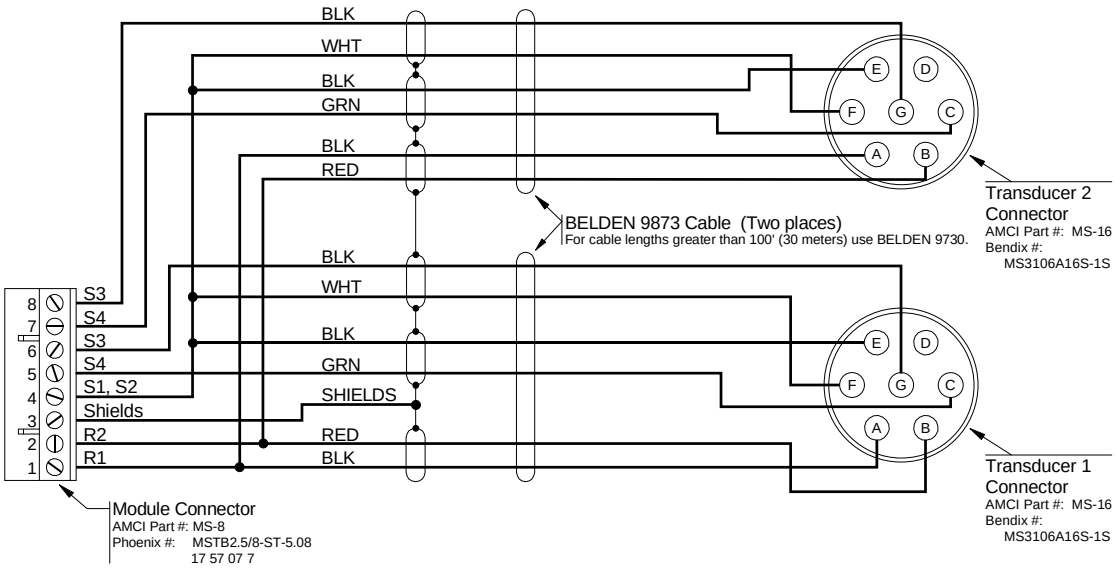


Figure 3.16 C2T-(x) Wiring Diagram

Transducer Cable Wiring Diagrams (continued)

C3T-(x) wiring Diagram: For 1733 & 1743, (x) = length in feet

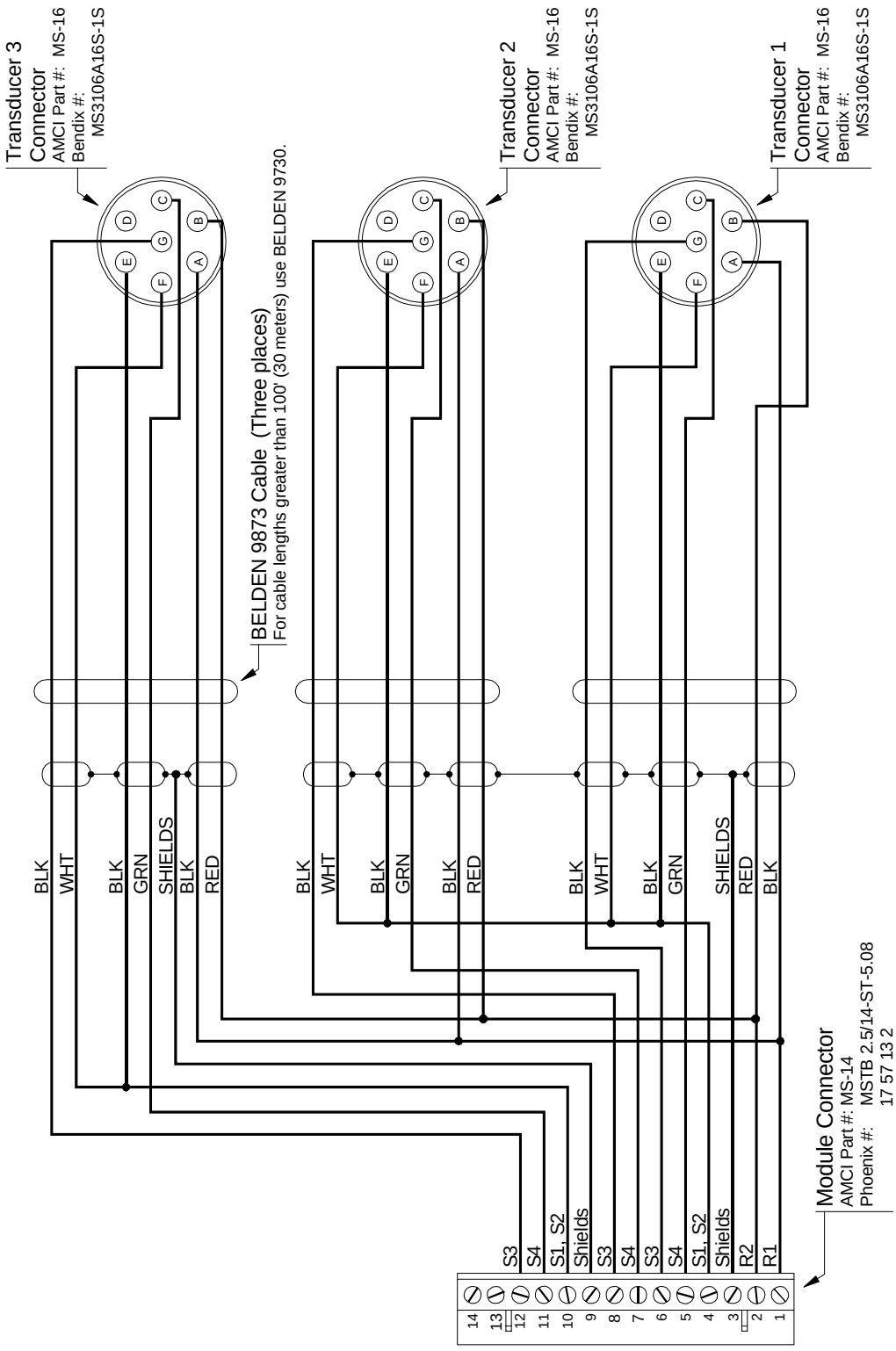


Figure 3.17 C3T-(x) Wiring Diagram

Transducer Cable Wiring Diagrams (continued)

C4T-(x) Wiring Diagram: For 1734 & 1744, (x) = length in feet

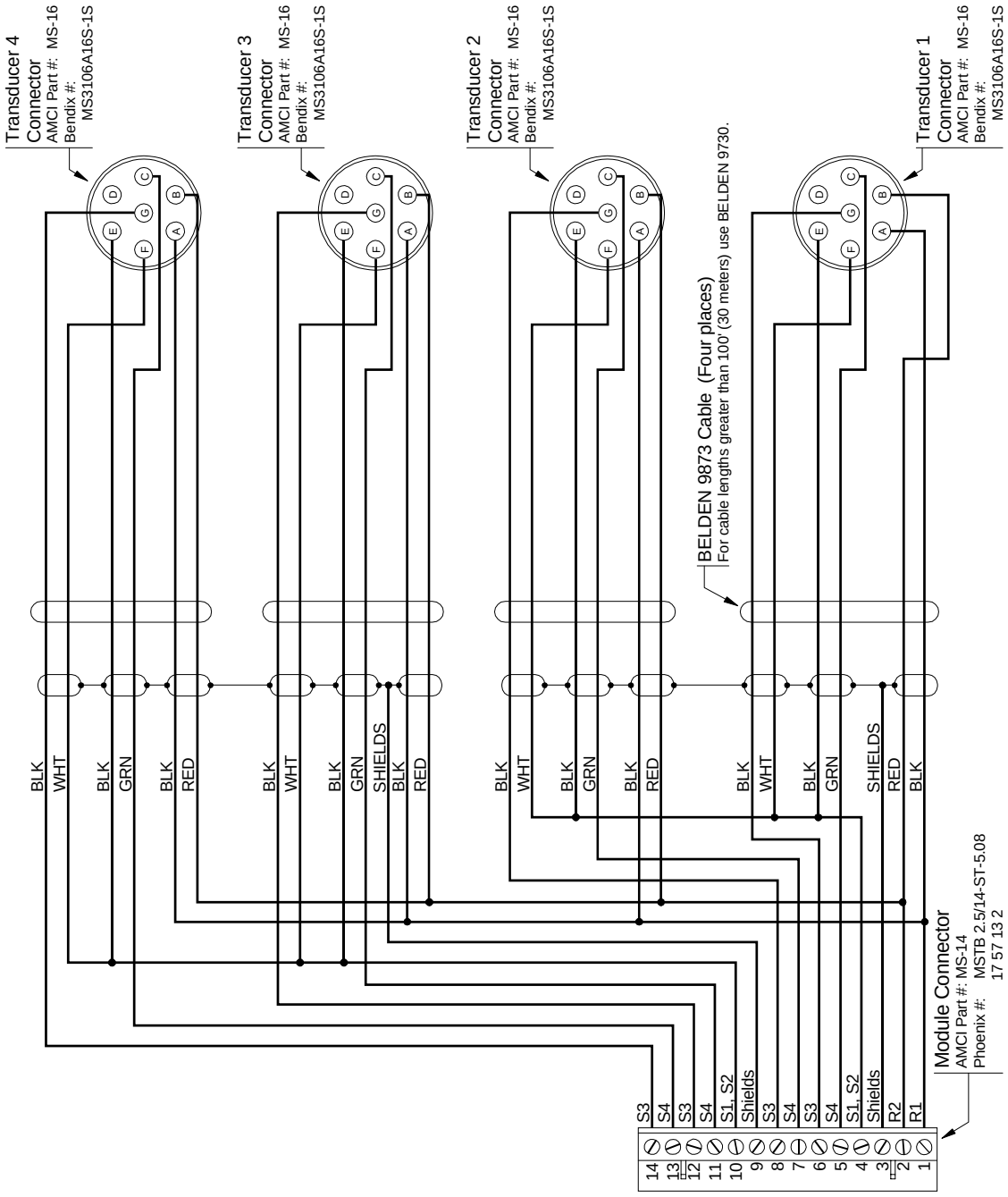


Figure 3.18 C4T-(x) Wiring Diagram

IMT Transducer Interface Module

The IMT is an interface module that simplifies field wiring to a 1733, 1734, 1743 or 1744. This module has terminal blocks that connect four C1T transducer cables to a single eight foot cable. This cable connects the IMT to the module. Figure 3.19 is an outline drawing of the IMT and cable. The C1T cable wiring diagram is figure 3.15, on page 3-9.

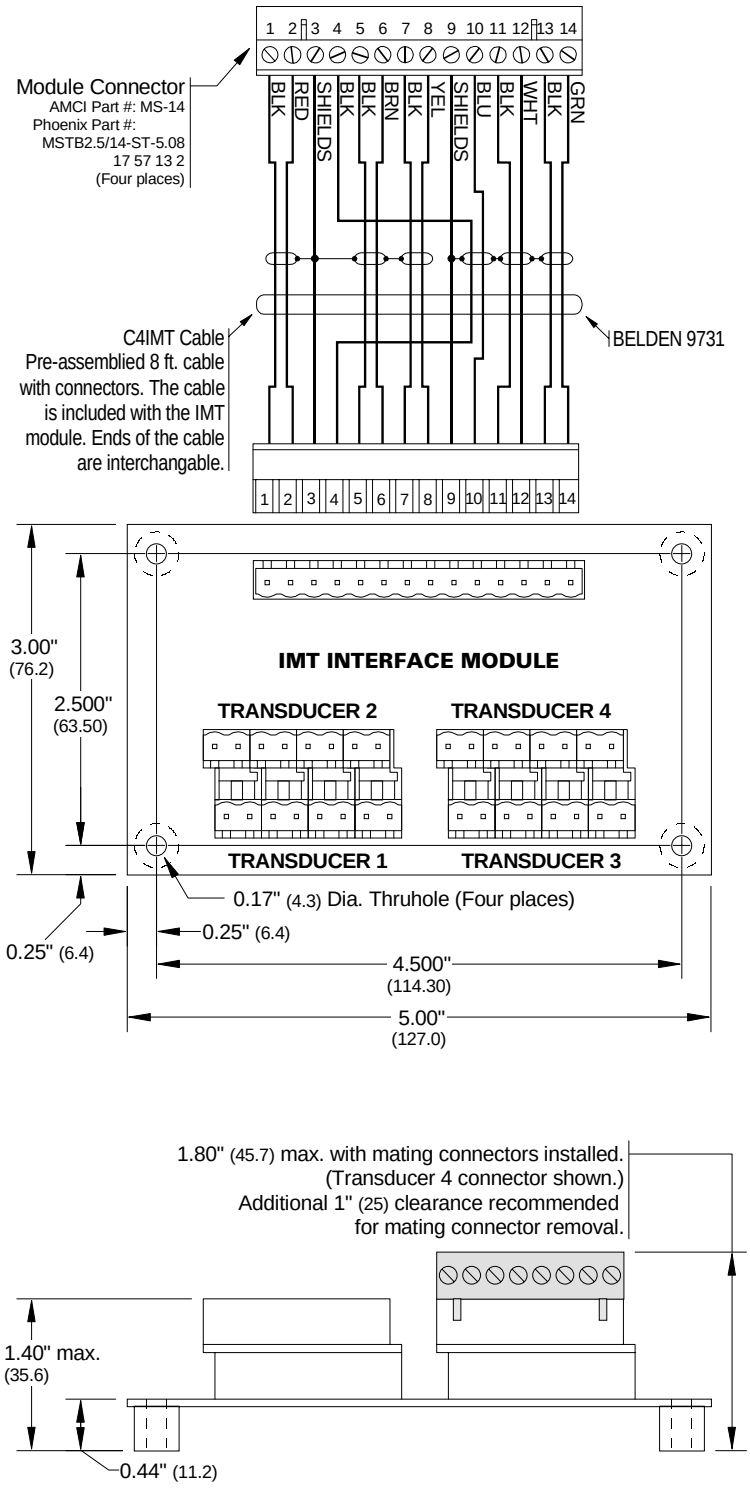


Figure 3.19 IMT Outline Drawing

Autotech Transducer Installation

Transducer Mounting

Series 1700 modules support Autotech SAC-RL100, E6R and E7R-RL101, and SAC-RL101-010 transducers. Refer to Autotech Controls literature for dimensional drawings and mounting recommendations.

Even though Autotech transducers are usable, we strongly recommend using AMCI transducers whenever possible. Refer to the Autotech/AMCI cross reference table on page 1-5 for information on our recommended replacements for Autotech transducers.

Transducer Wiring

Table 3.5 is a wiring table for all supported Autotech transducers. The table cross references AMCI wire color, resolver designations, and Autotech connector pin-out.

AMCI Wire Color	Resolver Designations	SAC-RL101-010 Wire Color	SAC-RL100-010 Terminals	SAC-RL100-Gxxx Terminals	Autotech MS Conn.
BLK/RED[1]	R1	RED/WHT[2]	R1(RL)	1	F
RED	R2	YEL/WHT[2]	R2(RH)	2	E
WHT	S1	RED	S1	3	D
BLK/WHT[1]	S3	BLK	S3	4	C
BLK/GRN[1]	S2	YEL	S2	5	B
GRN	S4	BLU	S4	6	A

1: Denotes black wire of black and colored wire pair.
2: Denotes colored wire with white stripe.

Table 3.5 Autotech Transducer Wiring

CAUTION

Do not, *under any circumstances*, connect the shields of the transducer cable to the earth ground connection of the transducer. This connection may form a ground loop that could damage the 1700 module or PLC. The earth ground connection on the MS style connectors is pin G. The earth ground connection on the screw terminal transducers is a green screw.

Using AMCI and Autotech Transducers Together

If you are connecting AMCI and Autotech transducers to the same 1700 module, you must set the resolver type parameter to AMCI (resolver 1) and use a RM-3 reference module to adjust the reference to the Autotech resolvers. The figure below shows an outline drawing and connection diagram for a RM-3. The RM-3 should be mounted as close to the 1700's transducer input connector as possible.

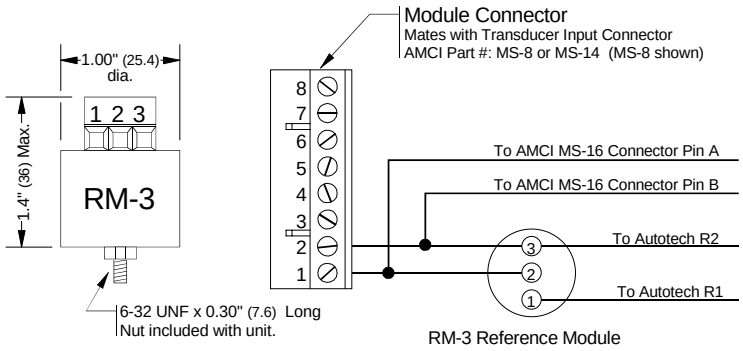


Figure 3.20 RM-3 Outline Drawing and Wiring Diagram

Notes

This chapter explains how to address a 1700 module in a PLC-5 programmable controller system. If you are using a PLC-2 or PLC-3 system, contact AMCI if you need assistance.

When you configure your programmable controller system, a unique address is assigned to each slot of each chassis in the system. The *I/O Rack Number* and *I/O Group Number* make up each address. A block transfer address is further specified with a *Module Slot Number*.

Note that an I/O Chassis is not the same as an I/O Rack. An I/O Chassis is the physical enclosure for the processor and I/O modules. An I/O Rack Number is part of a modules' address in the system. Each I/O Chassis can have ¼ to 4 I/O Racks associated with it.

Definition of Terms

Block Transfer

The transfer of a block of data over the backplane in one scan. A Block Transfer Read transmits data from an I/O module to the processor. A Block Transfer Write transmits data from the processor to an I/O module. Up to sixty-four words can be transmitted per block transfer.

Single Transfer

The transfer of a single unit (8, 16, or 32 bits) of data over the backplane. The transfer occurs between I/O modules and the processors' Input or Output Image Tables. A 1731 or 1741 can be configured to transmit 16 or 32 bits of data with single transfers. Single transfers occur automatically every I/O scan and can occur during a program scan with the use of Immediate Input and Immediate Output Instructions.

I/O Rack

The number of I/O Racks, not the number of chassis, define the programmable controller system. In PLC-5 systems the first I/O Rack is assigned the number 0. Each I/O Rack is further divided into 8 I/O Groups.

When specifying a block transfer or single transfer address, all I/O Rack and Group numbers are expressed in octal. (i.e. 00, 01, 02, ... 06, 07, 10, 11, ...)

I/O Group

An I/O Group consists of 16 input and 16 output bits. Eight I/O Groups, numbered 0 through 7, make up a single I/O Rack.

Slot Pair

Backplane slots of an I/O Chassis are numbered consecutively from zero starting at the leftmost *I/O slot*. The processor slot is not numbered. A slot pair is two adjacent backplane slots, the left of which is even numbered. Most A-B chassis have the slot numbers printed on the backplane.

The module must be installed in a single slot pair to operate properly. See chapter 3, page 3-1, *Installing the Module*. The figures in this chapter show the module in a single slot pair.

Definition of Terms (cont'd)

2-Slot Addressing

Two slot addressing assigns one I/O group to each slot pair in the chassis. Block transfers use the I/O group for control bits. You cannot use 32 bit single transfers if the chassis is configured with 2-slot addressing.

CAUTION The A-B backplane interface IC was designed primarily as a block transfer controller. Because of this, 16 bit single transfers with 2-slot addressing may not work with some processors. It is the users responsibility to test 16 bit single transfers in the system to determine if transfer operates correctly.

1-Slot Addressing

With 1-slot addressing, one I/O group (16 I/O bits) is assigned to each slot in the chassis. Therefore, a 1700 module has two I/O groups in its slot pair, one in each slot. Block transfers use the odd numbered I/O group for control bits. When using 16 bit transfers, the position value is in the odd numbered I/O group. When using 32 bit single transfers, the position data is at the even I/O group, the tachometer value at the odd I/O group.

CAUTION The A-B backplane interface IC was designed primarily as a block transfer controller. Because of this, 32 bit single transfers with 1-slot addressing may not work with some processors. It is the users responsibility to test 32 bit single transfers in the system to determine if transfer operates correctly.

½-Slot Addressing

With ½-slot addressing, two I/O groups (32 I/O bits) are assigned to each slot in the chassis. Therefore the 1700 has four I/O groups in its slot pair, two in each slot. The 1700 module does not use the first or second I/O groups. Block transfers use the third I/O group for control bits. When using 16 or 32 bit single transfers, the third I/O group contains the position value. When using 32 bit single transfers, the tachometer value is in the fourth I/O group.

Addressing the 1700 as a Block Transfer Module

When configured as a block transfer module, the processor reads data from the 1700 with block transfer read (BTR) instructions. If enabled with the PLC Program parameter, the processor can program setup parameters and issue auxiliary commands with block transfer write (BTW) instructions.

The block transfer address is made up of four digits. They are the I/O Rack Number (two digits), the I/O Group Number (one digit), and the Module Slot Number (one digit).

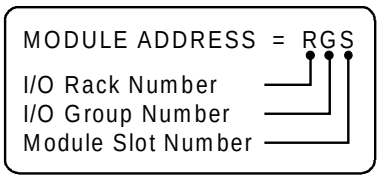


Figure 4.1 BT Module Address

Addressing Shortcuts

- Always base the address on the slot the PC Board plugs into.
- 2-slot address: Slot number always equals one.
- 1-slot address: Group number always odd, slot number always equals zero.
- ½-slot address: Group number always even, slot number always equals zero.

Addressing the 1700 as a Single Transfer Module

Once a 1731 or 1741 is configured correctly, the processor reads position and tachometer data with single transfers. To use this data, you must know the memory locations in the input image table associated with the module.

- **PLC-5 Input Table:** The characters "I:" followed by a three digit number. The first two digits are the I/O rack number, followed by the I/O group number.

Addressing Shortcuts

- 2-slot address: 16 bit transfers only. Position data at I/O Group address. Because of A-B backplane interface IC is designed primarily for block transfer use, 2-slot single transfers will not work in all systems. Check for proper function before using this mode.
- 1-slot address: 16 bit transfer: Position data at odd numbered I/O Group.
  32 bit transfer: Position data at even numbered I/O Group.
  Tachometer data at odd numbered I/O Group.
  Because of A-B backplane interface IC is designed primarily for block transfer use, 32 bit transfers with 1-slot addressing will not work in all systems. Check for proper function before using this mode.
- ½-slot address: Always base address on the slot the PC Board plugs into.
  16 bit transfer: Position data at even numbered I/O Group.
  32 bit transfer: Position data at even numbered I/O Group.
  Tachometer data at odd numbered I/O Group.

Addressing Examples

The following are examples of module addressing for 2-slot, 1-slot and ½-slot configurations. The PLC-5 addresses for block and single transfers are also shown.

In the following figures, the module is placed in a single slot pair. See chapter 3, pg. 3-1, *Installing the Module* for more information.

2-Slot Addressing

Rack Number: 00
I/O Group Numbers: 4
Module Slot Number: 1

BT Address: 0041
Single Position Addr: I:004

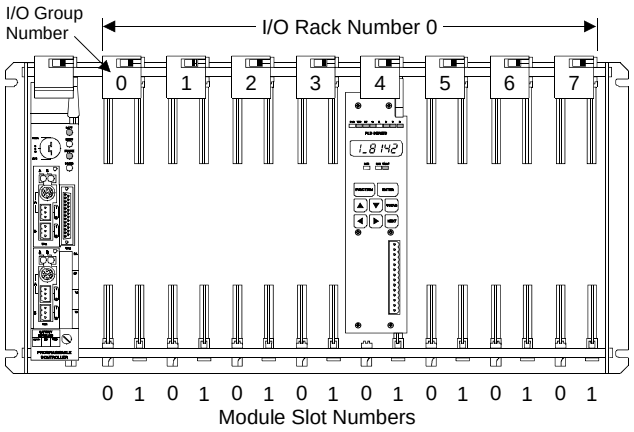


Figure 4.2 2-Slot Address Example

Addressing Examples (cont'd)

1-Slot Addressing

Rack Number: 01
I/O Group Numbers: 0,1
Module Slot Number: 0

BT Address: 0110
16 bit single Position Addr: I:011
32 bit single Position Addr: I:010
32 bit single Tach Addr: I:011

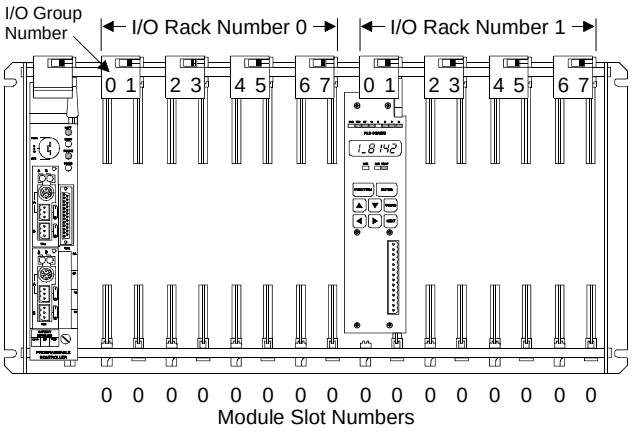


Figure 4.3 1-Slot Address Example

1/2-Slot Addressing

Rack Number: 02
I/O Group Numbers: 2,3
Module Slot Number: 0

BT Address: 0220
Single Position Addr: I:022
Single Tach Addr: I:023

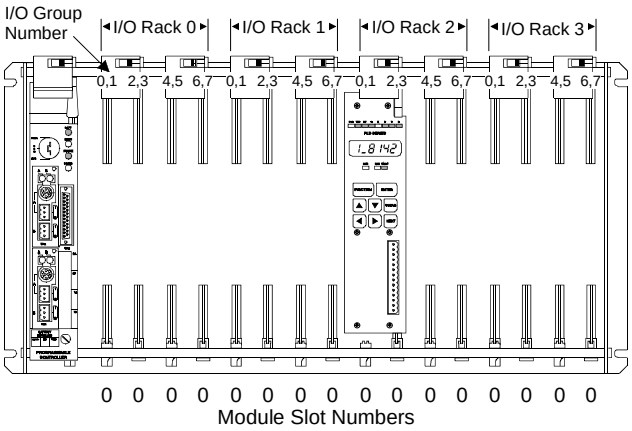


Figure 4.4 ½-Slot Address Example

Restrictions and Warnings

- The 1700 module must be installed in a single slot pair in order to operate properly. See chapter 3, pg. 3-1, *Installing the Module.*
- The A-B backplane interface IC was designed primarily as a block transfer controller. Because of this, 16 bit single transfers with 2-slot addressing and 32 bit single transfers with 1-slot addressing may not work with some processors. It is the users responsibility to test 16 bit and 32 bit single transfers in the system to determine if transfer operates correctly.
- When using a 1700 module in a Remote I/O chassis, the I/O Adapter must be a 1771 - ASB, Series B, Firmware Rev. F, or later. Using a Remote I/O Adapter that has an earlier Series or Firmware Revision may not work properly with a 1700 module.
- If you change the Transfer Type or PLC Program parameters, you must cycle power to the module to re-initialize the A-B backplane interface IC.
- If your system presently uses a 1731 or 1741 as a block transfer module and you are converting the module to single transfer, remember to remove all block transfer instructions that access the module. Block transfers use the I/O group bits for block transfer control. Therefore, block transfers can corrupt single transfer data.

Overview

All PLC-5 processors have Block Transfer Instructions in their instruction sets. There are five parts to PLC-5 BT Instructions. They are:

- **Module Address –** The I/O rack, I/O group, and module slot numbers where the module is located.
- **Control Block** – The starting address of the five word block in memory that controls the Block Transfer.
- **Data File** – The starting address of the file that stores the data written to or read from the module.
- **File Length** – The number of words needed to store the data written to or read from the module.
- **Continuous Parameter** – Determines how often the block transfer is carried out.

Module Address

The Module address is the I/O rack, I/O group, and module slot numbers where the module is located in the system. These three numbers are entered separately in the block transfer instruction.

Control Block

The Control Block is a block of five words that control the actual transfer of data. The address entered into the BT instruction is the first address of the block. The control block must have an integer or BT data type and can be its own file or part of a larger file.

> Each BT Instruction requires it own control block, even if multiple instructions access the same module.

Data File

The Data File is the block of words that stores information read from or written to the 1700 module. The Data Address is the address of the first word used in the file. The data file must have an integer or binary data type. It can be a separate file or part of a larger file.

File Length

Block Transfer Reads

The File Length is the number of words in your data file. When programming a BTR instruction, you can set the Block Length to 00. This will reserve 64 words in the PLC-5 memory, but the module will only transmit the number of words necessary. The number of words transmitted depends on the type of module and the value of the PLC Program parameter. When programmable from the backplane, the modules transmit one additional word. Table 5.1 lists the number of transferred based on module numbers and PLC Program value.

PLC Program	1731 / 1741	1732 / 1742	1733 / 1743	1734 / 1744
Read Only	2 words	4 words	6 words	8 words
Program Enabled	3 words	5 words	7 words	9 words

Table 5.1 1700 Block Transfer Read Lengths

File Length (continued)

Block Transfer Writes

When programming a BTW instruction, you must specify the exact number of words that contain your programming instructions. You cannot use a file length of zero with a BTW instruction unless you are actually transmitting sixty-four words. If you do so, the module will issue an error message to the processor.

Continuous Parameter

The Continuous parameter controls how often the block transfer instruction is executed. When the continuous parameter is set to "NO", the block transfer is executed only on a false to true transition on the rung. This means that a non-continuous block transfer can occur at most every other scan. When the continuous parameter is set to "YES", the block transfer will occur when the BT instruction is first scanned and then every scan thereafter until an error in communication occurs.

Block Transfer Writes to a 1700 module *must* have the Continuous Parameter set to "NO". Continuously writing Program Instructions to the module may interfere with normal operation. **Block Transfer Reads** to a 1700 module can have their Continuous Parameter set to "YES".

Enable (EN), Error (ER), and Done (DN) Bits

Used to signal the start and finish of a block transfer, the processor sets the EN bit to start the transfer and after successfully completing the transfer the module sets the DN bit. If an error occurs in the transfer, the module will set the ER bit instead of the DN bit.

The EN, ER, and DN bits are located in the first word of the Control File. The EN Bit is bit 15, the ER Bit is bit 12 and the DN Bit is bit 13.

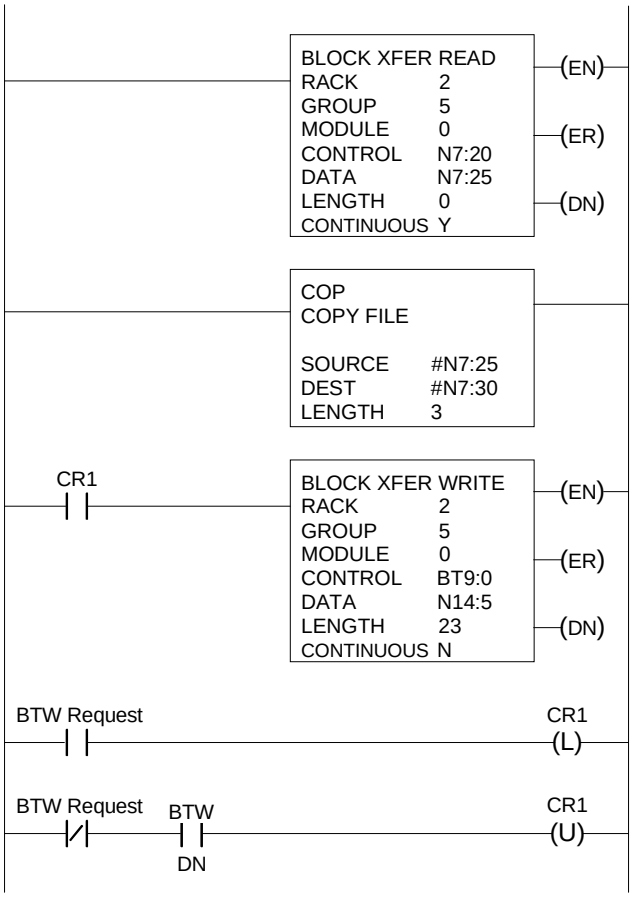
The following warning is taken verbatim from Allen-Bradley's PLC-5 Family Programmable Controllers Processor Manual, Publication 1785-6.8.2 - November, 1987 and refers to the control bits of the BT instruction. These bits include the Enable, Error, and Done bits.

"**IMPORTANT:** The processor executes block-transfer instructions asynchronous to the program scan. The status of these bits could change at any point in the program scan. When you test these bits (especially the done bit), test them only once every ladder program scan. If necessary, set temporary storage bits for the purpose of enabling subsequent rungs from them.

Also, your ladder program should condition the use of block transfer data on the examination of the block-transfer error bit. An error may occur when the processor is switched from run mode, or when processor communications are interrupted."

Programming Example

The following example assumes 1-Slot addressing with a 1741 module in I/O Rack 2, I/O Groups 4 & 5 of the system.



Rung 1: BTR Instruction to the AMCI module. An Integer file controls the transfer. Data transferred every scan with continuous transfer enabled.

Rung 2: Copy File Instruction buffers the data from the module. This insures that the program will use the same data throughout each scan.

Rung 3: The BT write is enabled whenever CR1 is latched on. A BT file controls the transfer. Note that the continuous parameter is set to NO.

Rung 4: CR1 is latched on when a BTW request is made.

Rung 5: CR1 is unlatched when the BTW request is removed and the BTW Done bit is set.

Figure 5.1 PLC-5 Programming Example

PLC-5 Restrictions and Warnings

- It is important to have the 1700 module installed in a single slot pair. See chapter 3, pg. 3-1, *Installing the Module*.
- When using the 1700 module in a remote chassis, the Remote I/O Adapter must be a 1771 - ASB, Series B, Firmware Rev. F, or later. Using a Remote I/O Adapter that has an earlier Series or Firmware Revision may not work properly with a 1700 module.
- When the processor enables a block transfer, it puts all of the needed information into a queue. A queue is a data structure where the first piece of information put into the queue is the first piece of information taken out. Once the information is queued, a separate part of the processor performs the block transfer while the rest of the processor continues with the program scan. Each I/O rack in the system has it's own queue. Each queue can hold 17 BT requests. When the block transfer has its Continuous bit set to 1, Continuous Parameter is “YES”, the Block Transfer is placed permanently in the queue.

  Each queue has a “Queue Full” bit in word 7 of the processor's status file. Bit 8 is for Rack 0, Bit 9 is for Rack 1, and so on up to bit 15 for Rack 7. The appropriate bit is set when a queue is full of BT Requests. Once set, your ladder logic program must clear these bits. We recommend that your program monitor these bits and take appropriate action if these bits are set.

  If you have more than 17 block transfers associated with one rack and you set all of their continuous parameters to YES, only the first 17 block transfers scanned will be performed. All other transfers cannot be put into the queue and will never be performed.

This chapter contains all of the information needed to learn how to use block transfer writes to program a 1700 module from the backplane. This information includes data on programming structure, programming instructions, and error codes. Information on the format of the data sent to the processor while it is in Read Status Mode is also included.

You must set the transfer type parameter to *block transfers* and the PLC program parameter to *program enabled* before backplane programming is enabled. See chapter 1, pgs. 1-8,9 as well as chapter 2, pgs. 2-7,8 for information on these parameters.

Programming Structure

You program a 1700 module by sending it a series of *Program Instructions* with a block transfer write. Each program instruction is made up of a *Command Word* and zero or more *Data Words*. Block transfers can transmit a maximum of sixty-four words at one time. However, this does not limit how many parameters you can program at one time. As you will see, you can program all of the parameters of a four channel module with only twenty-four words.

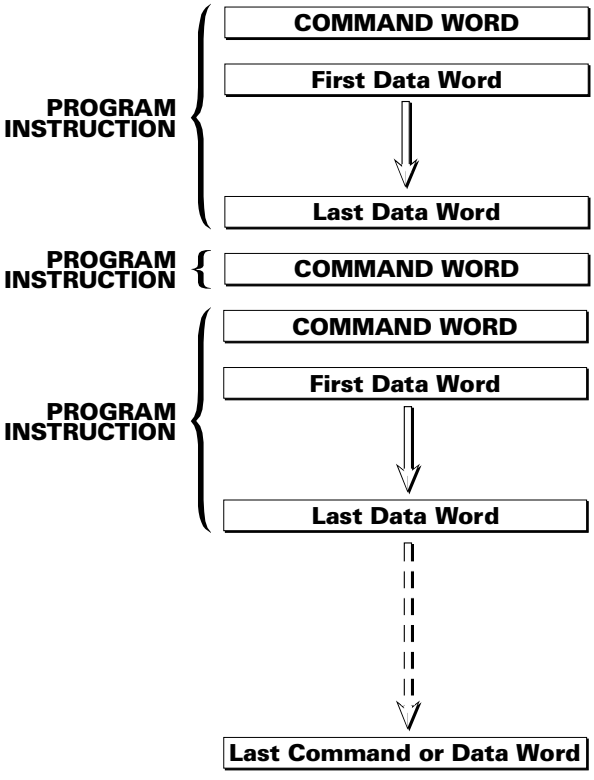


Figure 6.1 1700 Programming Structure

- All transducer setup parameters can be programmed from the backplane.
- Module setup parameters cannot be programmed from the backplane. You should program these from the keyboard before you program the transducer setup parameters from the backplane.
- There are nine additional program instructions called *Auxiliary Commands*. These commands do not have data associated with them and allow you to preset the position, enable or disable programming from the keyboard, clear programming errors and transducer faults, and enter or exit *Read Status Mode*.
- Four additional commands are enabled when the module is in read status mode. Use these commands to tell the module which parameter values to transmit to the PLC instead of position and tachometer data.

A 1700 module decodes instructions one at a time. If the module encounters an error with an instruction it will stop processing the instructions and issue an error. An instruction must be completely correct before the module accepts it. Therefore, if you write an instruction to change three parameter values and the second value is incorrect, none of the parameters will be changed. If you write multiple instructions to the module with one block transfer write and one of the instructions is incorrect, that instruction, and all that follow it, will be ignored.

Program Instructions

Program Instructions are broken down into three categories

- Auxiliary Commands – Nine instructions that affect the operation of the module and do not have data words associated with them. These instructions are:

  Disable Keyboard Programming
  Enable Keyboard Programming
  Clear Errors
  Preset Transducer 1-4 (Four separate instructions)
  Enter Read Status Mode
  Exit Read Status Mode

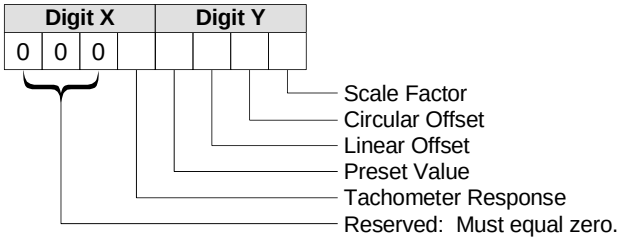
- Transducer Setup Instructions – Four instructions that program the transducer setup parameters, one for each channel. If you attempt to program parameters for a channel that does not exist on your module, it will respond with a programming error code.
- Read Status Instructions – Four instructions that are enabled while in read status mode. These four instructions specify which transducer setup parameter values should be transmitted to the processor in place of position and tachometer data.

Auxiliary Commands

Command	Command Word	Comments
Disable Keyboard	8100h	Disables all programming from the keyboard. Parameter values can be inspected but they cannot be changed.
Enable Keyboard	8200h	This command counteracts a previous Disable Keyboard command. The status of the keyboard programming disable is retained when power is removed. The only way to enable keyboard programming after a Disable Keyboard command is with this instruction.
Clear Errors	8400h	This command clears all programming errors and transducer faults.
Preset Transducer 1	8500h	Use this command to set the position data of transducer 1 to its programmed preset value. Use the Transducer 1 Setup instruction to change the value of the preset parameter.
Preset Transducer 2	9500h	Use this command to set the position data of transducer 2 to its programmed preset value. Use the Transducer 2 Setup instruction to change the value of the preset parameter.
Preset Transducer 3	A500h	Use this command to set the position data of transducer 3 to its programmed preset value. Use the Transducer 3 Setup instruction to change the value of the preset parameter.
Preset Transducer 4	B500h	Use this command to set the position data of transducer 4 to its programmed preset value. Use the Transducer 4 Setup instruction to change the value of the preset parameter.
Enter Read Status Mode	8E00h	Enter this mode to read back the value of the transducer setup parameters in place of position and tachometer data.
Exit Read Status Mode	8F00h	When you exit read status mode, the module transmits position and tachometer data instead of transducer setup parameter values.

Table 6.1 Auxiliary Commands

Transducer Setup Instructions

<table>
<tr><th>Command</th><th>Command Word</th><th>Comments</th></tr>
<tr><td>Transducer 1 Setup</td><td>88XYh</td><td>(X = {0,1}, Y = {1...F}). Use this instruction to program the transducer setup parameters of transducer 1.
 

Bit set to "1" = Store new parameter value.
Bit reset to "0" = Leave parameter value as is.</td></tr>
<tr><td></td><td></td><td>EXAMPLE: 8801h = Store new Scale Factor.</td></tr>
<tr><td></td><td></td><td>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 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 (173X), 2 to 8192 (174X)
Circular Offset: 0 to (Scale Factor -1)
Linear Offset: 0 to (9,999 - (Scale Factor - 1))
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 data. Use the Preset Transducer 1 auxiliary command to actually preset the position.</td></tr>
<tr><td></td><td></td><td>PROGRAMMING EXAMPLE
Set the circular offset to 90, and the tach response to 120 mSec.
Command Word: 8812h
Data Words: 0090h Position Offset
0002h Tach Response</td></tr>
</table>

Table 6.2 Transducer Setup Instructions (continued next page)

Transducer Setup Instructions (continued)

Command	Command Word	Comments
Transducer 2 Setup	98XYh	(X = {0,1}, Y= {1…F}). Use this instruction to program the transducer setup parameters of transducer 2. The format of the instruction is identical to the Transducer 1 Setup instruction.
Transducer 3 Setup	A8XYh	(X = {0,1}, Y= {1…F}). Use this instruction to program the transducer setup parameters of transducer 3. The format of the instruction is identical to the Transducer 1 Setup instruction.
Transducer 2 Setup	B8XYh	(X = {0,1}, Y= {1…F}). Use this instruction to program the transducer setup parameters of transducer 4. The format of the instruction is identical to the Transducer 1 Setup instruction.

Table 6.2 Transducer Setup Instructions

Read Status Instructions

Before reading transducer setup parameter values you must transmit the *Enter Read Status Mode* instruction to the 1700. Once this command is accepted, use one of the four instructions below to tell the 1700 which parameters to transmit. These instructions are valid only after the Enter Read Status Mode instruction is accepted. A read status instruction *must* be the last instruction in the group written down to the module or error will result. The format of the data transmitted back to the module while in Read Status Mode is given in the following section.

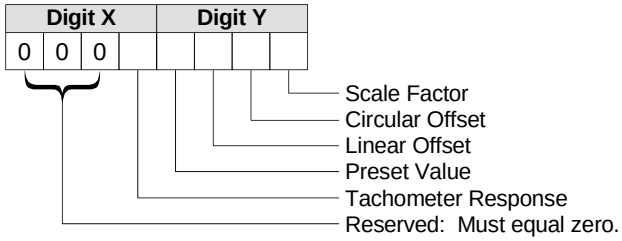
Command	Command Word	Comments
Read Transducer 1 Setup	86XYh	(X = {0,1}, Y = {1...F}). Use this instruction to read the values of the transducer setup parameters of transducer 1.  Bit set to "1" = Read parameter value. Bit reset to "0" = Don't read parameter value.
		EXAMPLE: 8602h = Read circular offset value.
Read Transducer 2 Setup	96XYh	(X = {0,1}, Y= {1…F}). Use this instruction to read the values of the transducer setup parameters of transducer 2. The format of the instruction is identical to the Transducer 1 Setup Instruction.
Read Transducer 3 Setup	A6XYh	(X = {0,1}, Y= {1…F}). Use this instruction to read the values of the transducer setup parameters of transducer 3. The format of the instruction is identical to the Transducer 1 Setup Instruction.
Read Transducer 4 Setup	B6XYh	(X = {0,1}, Y= {1…F}). Use this instruction to read the values of the transducer setup parameters of transducer 4. The format of the instruction is identical to the Transducer 1 Setup Instruction.

Table 6.3 Read Status Instructions

Read Status Data Format

The four figures below show the format of read status data. Because a 1700's block transfer read length is fixed, the format of the data is based on the module you are using. A 1731 or 1741 can transmit only one parameter value at a time. A 1732 or 1742 can transmit up to three parameters while the remaining modules can transmit a maximum of five parameters at a time.

	1731 / 1741
Word 1	Echo of last Read Status Instruction
Word 2	Requested parameter value
Word 3	Status Word

	1732 / 1742
Word 1	Echo of last Read Status Instruction
Word 2	First requested parameter value
Word 3	Second requested parameter value
Word 4	Third requested parameter value
Word 5	Status Word

	1733 / 1743
Word 1	Echo of last Read Status Instruction
Word 2	First requested parameter value
Word 3	Second requested parameter value
Word 4	Third requested parameter value
Word 5	Fourth requested parameter value
Word 6	Fifth requested parameter value
Word 7	Status Word

	1734 / 1744
Word 1	Echo of last Read Status Instruction
Word 2	First requested parameter value
Word 3	Second requested parameter value
Word 4	Third requested parameter value
Word 5	Fourth requested parameter value
Word 6	Fifth requested parameter value
Word 7	Not Used, Set equal to 0000h
Word 8	Not Used, Set equal to 0000h
Word 9	Status Word

Figure 6.2 Read Status Data Format

- All 1700 module set bit 7 of the status word while in read status mode. The module resets this bit when transmitting position and tachometer data. Use this bit to determine the mode of operation.
- If you enter read status mode and do not request any parameters, the module sends 000h in the echo and parameter value words.
- When using a 1731, 1741, 1732, or 1742, you can request more parameter values than the module can transmit back. If you do this, the module will respond with an error code in the status word.
- The first word of read status data is an echo of the last read status instruction accepted by the module. See table 6.3 on the following page for the format of the read status instructions.
- Parameters are read from the module by channel. For example, you cannot read the scale factor of channels one and two at the same time.
- The precedence order of the parameter values is:
  Scale Factor
  Circular Offset
  Linear Offset
  Preset Value
  Tachometer Response
- Parameter values are transmitted in BCD format. The tachometer response value uses the same format it is programmed with. Its range is zero to four.
- You can still program the module while it is in read status mode. However, you must issue a read status instruction to read the new value once a parameter is changed.

Status Word

The status word is broken down into two bytes. The low byte, bits 0 – 7, is used to report hardware faults. The format of this byte is shown in figure 6.3. The high byte, bits 8 –15, is used to report programming errors. Table 6.4 lists the error codes and a brief description of the their causes.

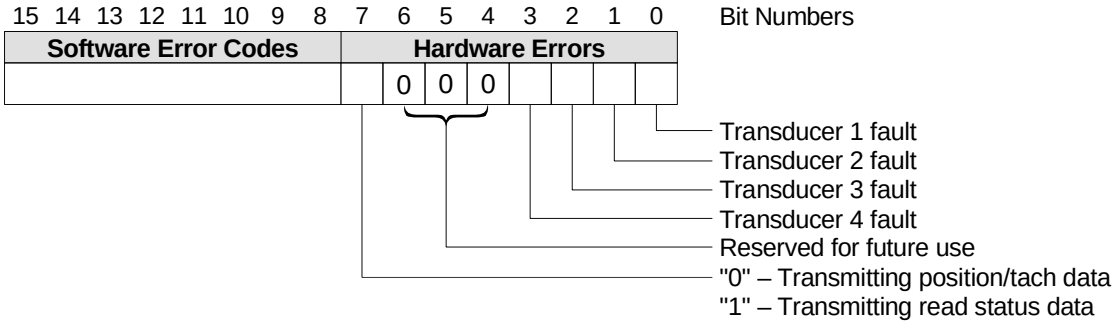


Figure 6.3 Hardware Error Bits

Program Error	Error Byte	Comments
Invalid Command	21h	The Command Word of an instruction is incorrect. Usually occurs when a data word is interpreted as a command word. For example, a Transducer 1 Setup instruction specifies three new parameters and four are included. The fourth instruction will be interpreted as a command word.
Invalid Message Length	22h	1) The final instruction of the block transfer write file does not contain enough data words to complete the instruction. Check the *length* parameter of the block transfer write. 2) An instruction follows any Read Status instruction.
Message Ignored	24h	You attempted to write a program instruction to the module while it was reporting a programming error.
Invalid Transducer Number	25h	You attempted to write parameter values for a transducer channel that does not exist on your module. Example: Writing to transducer 4 on a 1732.
Invalid Mode	26h	Occurs when you send a Read Status instruction to the module that is not in read status mode.
Invalid Parameter Number	27h	Occurs if the Read Status instruction sent to the module requests more parameters than the block transfer read file can transmit. Example: Requesting two parameter values from a 1731.
Invalid SF	41h	A programmed scale factor is out of range.
Invalid CO	42h	A programmed circular offset is out of range.
Invalid LO	43h	A programmed linear offset is out of range.
Invalid PV	44h	A programmed preset value is out of range.
Invalid TR	45h	A programmed tachometer response value is out of range.

Table 6.4 Programming Error Codes

This chapter outlines the format of the position and tachometer data sent from a 1700 module with either block or single transfers.

Block Transfer Data Format

When a block transfer read instruction accesses a 1700 module, the module transmits two 16 bit words for each transducer channel. If the 1700 module is programmable from the back-plane, (the PLC Program parameter is set to its *program enabled* value), one additional word, the Status Word, is also transmitted. The format of the data is shown in the figure below.

	1731 / 1741	
Word 1	E*	Transducer 1 Position Value
Word 2	E*	Transducer 1 Tachometer Value
Word 3		Status Word

	1732 / 1742	
Word 1	E*	Transducer 1 Position Value
Word 2	E*	Transducer 2 Position Value
Word 3	E*	Transducer 1 Tachometer Value
Word 4	E*	Transducer 2 Tachometer Value
Word 5		Status Word

	1733 / 1743	
Word 1	E*	Transducer 1 Position Value
Word 2	E*	Transducer 2 Position Value
Word 3	E*	Transducer 3 Position Value
Word 4	E*	Transducer 1 Tachometer Value
Word 5	E*	Transducer 2 Tachometer Value
Word 6	E*	Transducer 3 Tachometer Value
Word 7		Status Word

	1734 / 1744	
Word 1	E*	Transducer 1 Position Value
Word 2	E*	Transducer 2 Position Value
Word 3	E*	Transducer 3 Position Value
Word 4	E*	Transducer 4 Position Value
Word 5	E*	Transducer 1 Tachometer Value
Word 6	E*	Transducer 2 Tachometer Value
Word 7	E*	Transducer 3 Tachometer Value
Word 8	E*	Transducer 4 Tachometer Value
Word 9		Status Word

Figure 7.1 BTR Data Format

E* Error bit. When there is a transducer or nvRAM fault, the module transmits 8000h (1000 0000 0000 0000b) in place of position and tachometer data. This is the only time the most significant bit of a position data word is set. If the error is a transducer fault, only the words of the faulted channel are changed. If the error is a nvRAM fault, all of the data words are changed.

- 1731, 1732, 1733, and 1734 modules transmit position and tachometer data in binary or BCD format. The Data Format parameter sets the format of this data. See chapter 1, pg. 1-8, *Data Format Parameter* for more information on this parameter.
- The Status word is only transmitted when the PLC Program parameter is set to its *program enabled* value. See chapter 1, pg. 1-9, *PLC Program Parameter* for more information on this parameter.

Block Transfer Data Format (continued)

Status Word

The status word is transmitted when the 1700 is configured to be programmable from the backplane. It is broken into two bytes. The low byte, bits 0 – 7, is used to report hardware faults. The format of this byte is shown in figure 7.2. The high byte, bits 8 –15, is used to report programming errors. Table 7.1 lists the error codes and a brief description of the their causes.

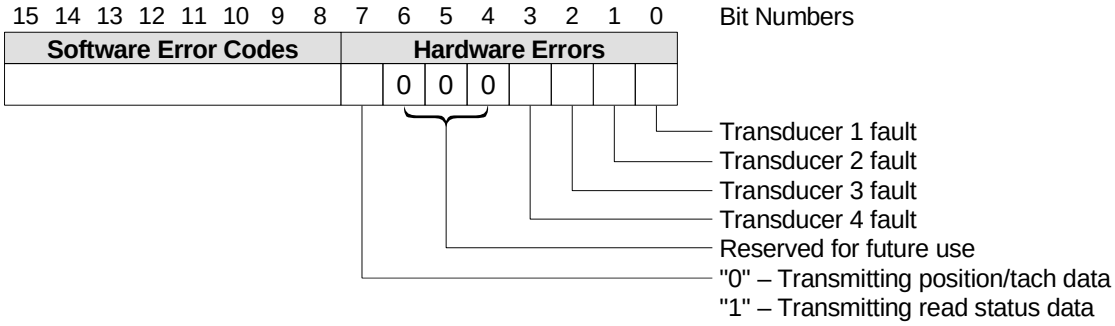


Figure 7.2 Hardware Error Bits

Program Error	Error Byte	Comments
Invalid Command	21h	The Command Word of an instruction is incorrect. Usually occurs when a data word is interpreted as a command word. For example, a Transducer 1 Setup instruction specifies three new parameters and four are included. The fourth instruction will be interpreted as a command word.
Invalid Message Length	22h	1) The final instruction of the block transfer write file does not contain enough data words to complete the instruction. Check the *length* parameter of the block transfer write. 2) An instruction follows any Read Status instruction.
Message Ignored	24h	You attempted to write a program instruction to the module while it was reporting a programming error.
Invalid Transducer Number	25h	You attempted to write parameter values for a transducer channel that does not exist on your module. Example: Writing to transducer 4 on a 1732.
Invalid Mode	26h	Occurs when you send a Read Status instruction to the module that is not in read status mode.
Invalid Parameter Number	27h	Occurs if the Read Status instruction sent to the module requests more parameters than the block transfer read file can transmit. Example: Requesting two parameter values from a 1731.
Invalid SF	41h	A programmed scale factor is out of range.
Invalid CO	42h	A programmed circular offset is out of range.
Invalid LO	43h	A programmed linear offset is out of range.
Invalid PV	44h	A programmed preset value is out of range.
Invalid TR	45h	A programmed tachometer response value is out of range.

Table 7.1 Programming Error Codes

Single Transfer Data Format

A 1731 or 1741 module can be configured to transmit its position and tachometer information with single transfers by setting its Transfer Type parameter to *single transfer* and its Single Transfer Length parameter to either *16* or *32 bits.*

When configured for 16 bit transfers, only the position data is available. When configured for 32 bit transfers, both the position and tachometer data is available. The data is always transmitted in binary format.

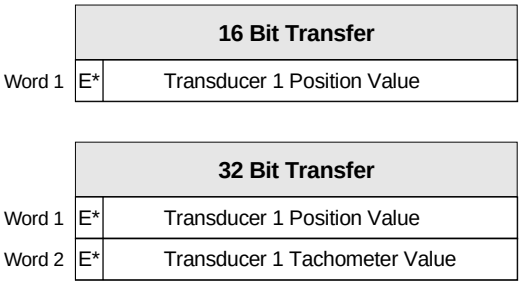


Figure 7.3 Single Transfer Data Format

E* Error bit. When there is a transducer or nvRAM fault, the module transmits 8000h (1000 0000 0000 0000b) in place of position and tachometer data. This is the only time the most significant bit of a position data word is set. If the error is a transducer fault, only the words of the faulted channel are changed. If the error is a nvRAM fault, all of the data words are changed.

Notes

The following ladder logic program is an example of how block transfer instructions can be used to read and program a 1700 module using block transfers.

The program shows how to read and buffer data from a 1700 module, and how a single block transfer write instruction can be used to send various program instructions to the module. Data table values that are referenced to in the program are also included in this chapter.

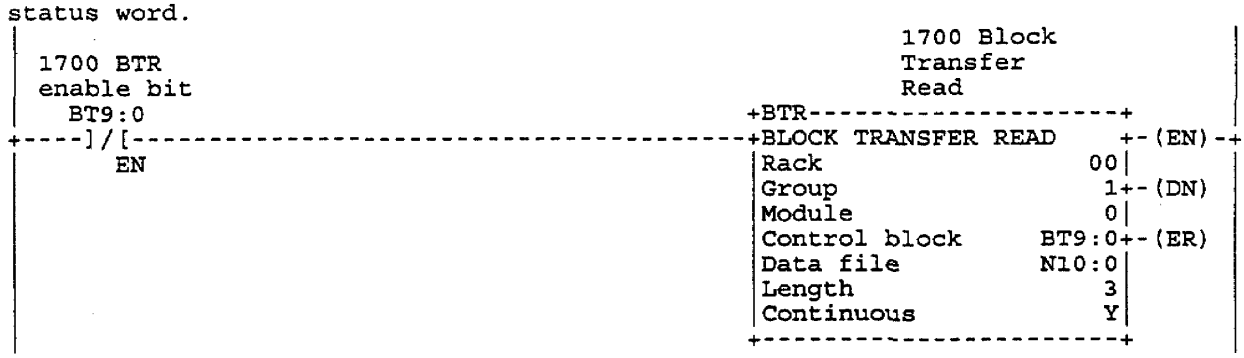
The example assumes a 1731 or 1741 module that is setup to use block transfers and accept programming instructions from the backplane. If you are using a different module, you must adjust the length of the block transfer read instruction appropriately.

```
+-----------------------------------------------------+
|              Rockwell Software Company              |
|                  6200 Series Software               |
|          PLC-5 Programming Terminal Software        |
|                       Release 5.21                  |
|                  Program Listing Report             |
|                                                     |
|            AMCI 1700 Module Example Program         |
|             Tue Feb 25, 1997 - 10:38:33 am          |
|                                                     |
|     File: C:\IPDS\ARCH\PLC5\1700EXAM                |
|                                                     |
|                                                     |
|   REPORT OPTIONS                                    |
|     Page Width:                                80   |
|     Page Length:                               66   |
|     Graphics Capabilities:                     NO   |
|     Right Power Rail:                         YES   |
|     Address Display:                       SYMBOL   |
|     Address Comments:                         YES   |
|     Rung Comments:                            YES   |
|     Output Cross Reference:                    NO   |
|     Ladder Cross Reference:                  NONE   |
|     Starting Rung:                            2:0   |
|     Ending Rung:                        999:32767   |
|     Formatting Commands:                   ACTIVE   |
+-----------------------------------------------------+
```

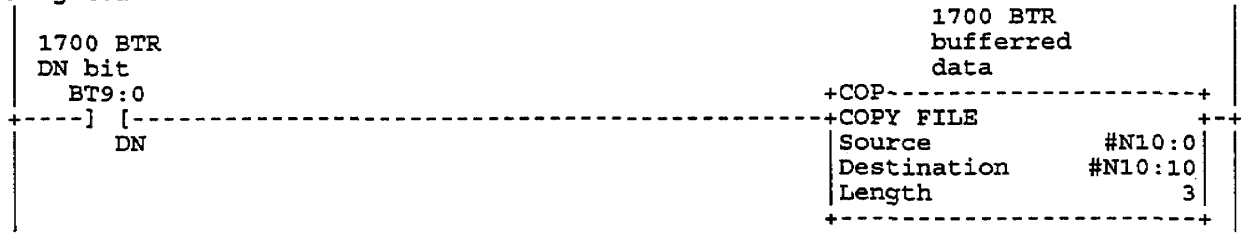
```
AMCI 1700 Module Example Program                    Tue Feb 25, 1997   Page 1
Program Listing Report          PLC-5/11    File 1700EXAM            Rung 2:0
```

Rung 2:0

This sample program reads data from and writes data to a 1700 module. This module is located in slot 1 of a PLC-5 rack set for 1 slot addressing. This program was written to communicate with a single channel module, a 1731 or 1741, that is programmable from the backplane. (PLC program parameter set to "Program Enabled") If a multi-channel module is used, the length parameter of the BTR and COP instructions must be changed, as well as the address of the status word.



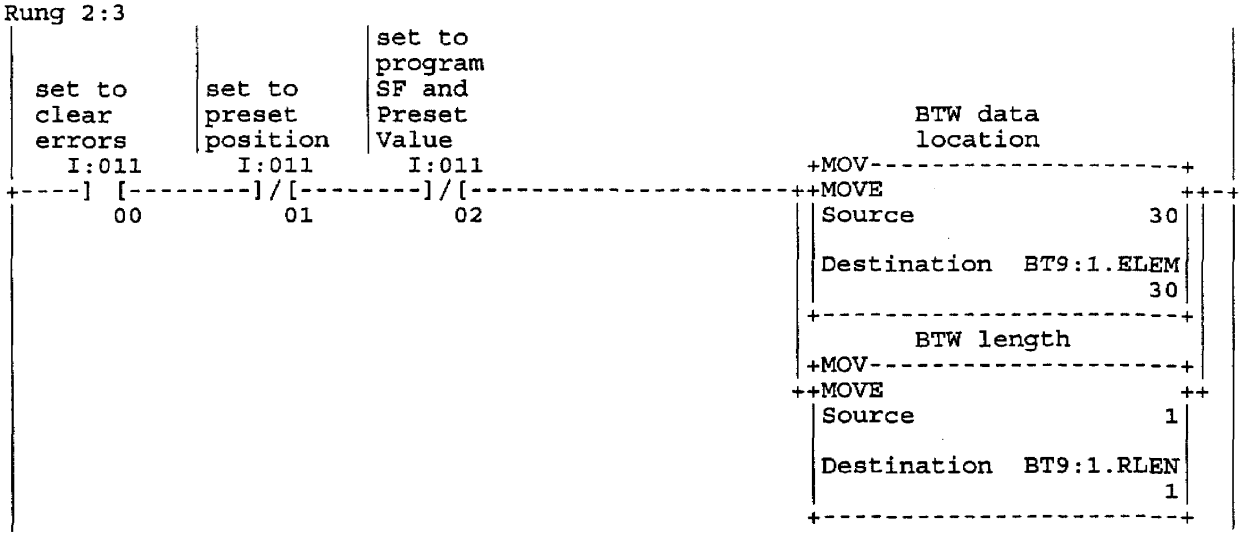
Rung 2:1



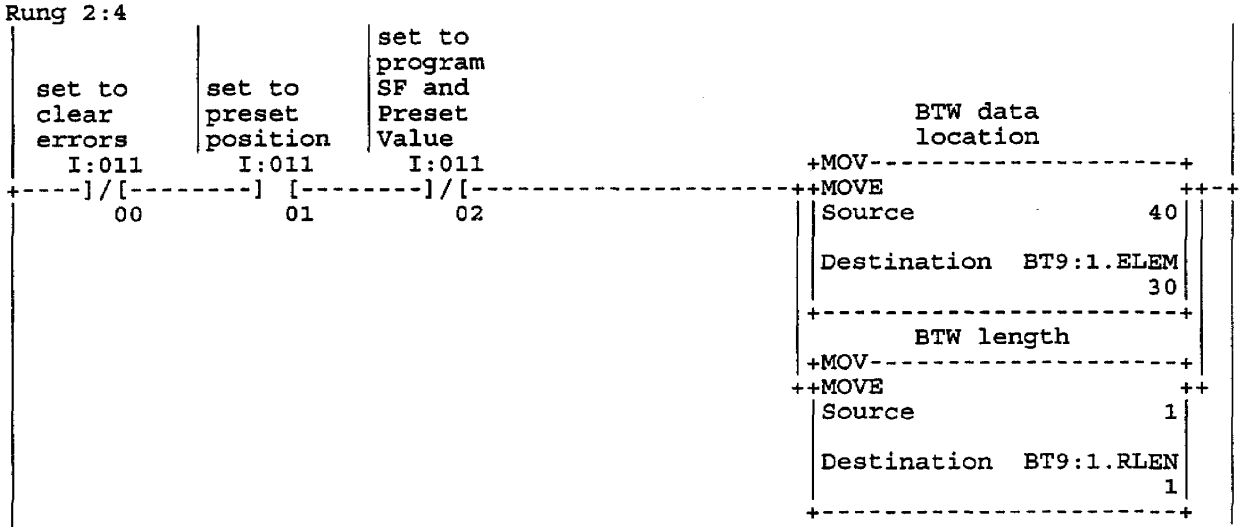
Rung 2:2

AMCI 1700 Module Example Program — Tue Feb 25, 1997 — Page 2
Program Listing Report — PLC-5/11 — File 1700EXAM — Rung 2:3

Rung 2:3

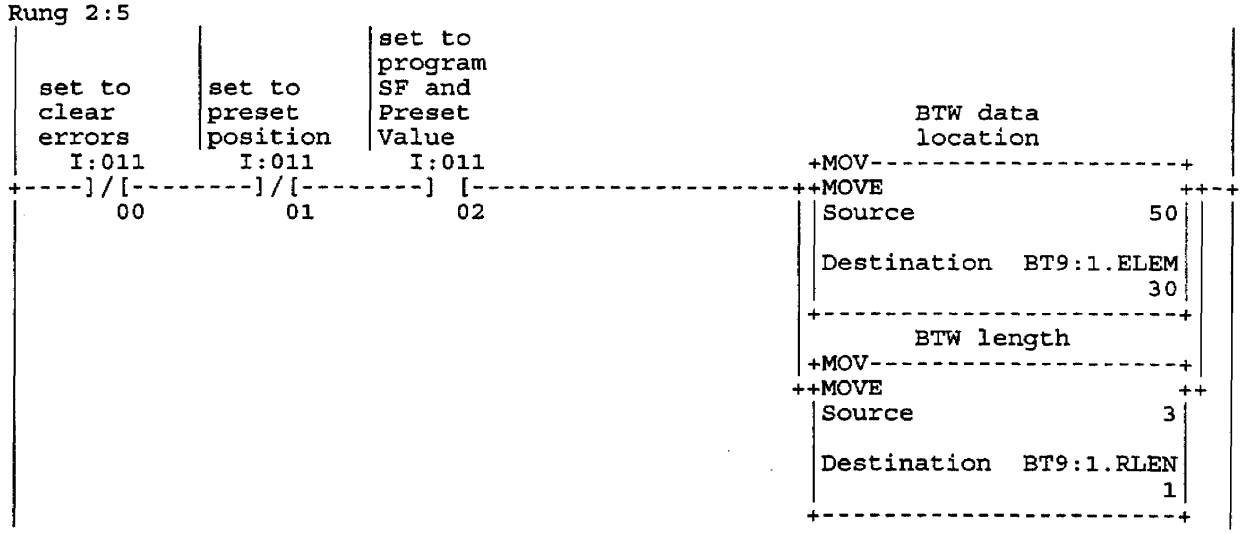


Rung 2:4

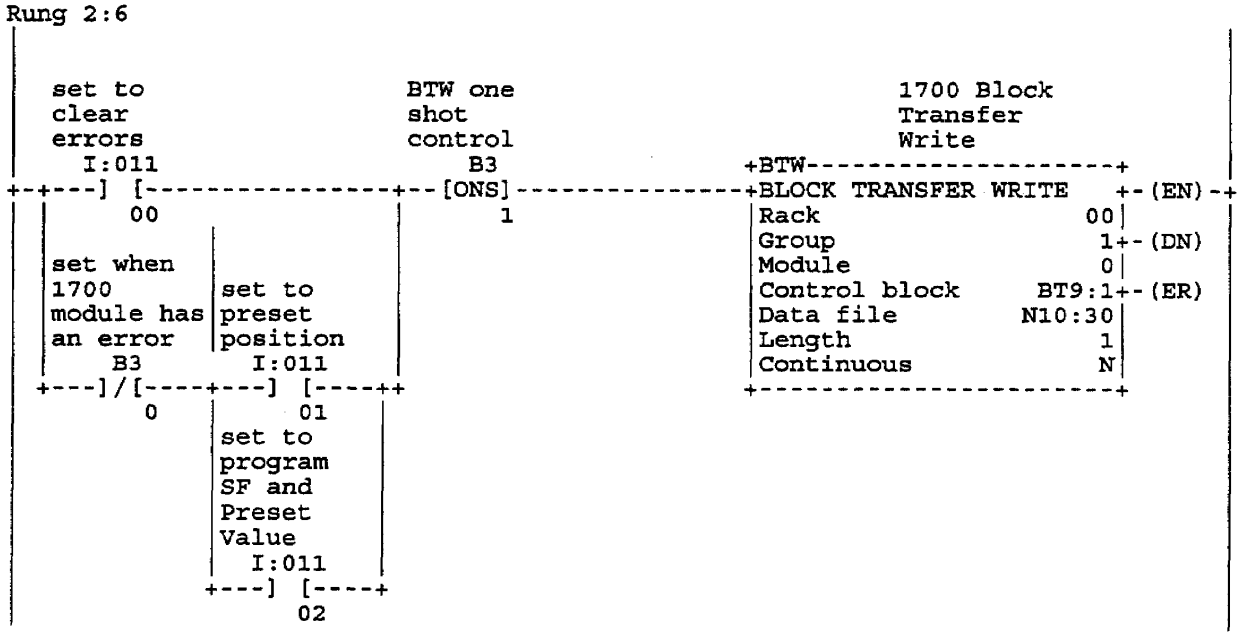


```
AMCI 1700 Module Example Program                    Tue Feb 25, 1997   Page 3
Program Listing Report          PLC-5/11    File 1700EXAM            Rung 2:5
```

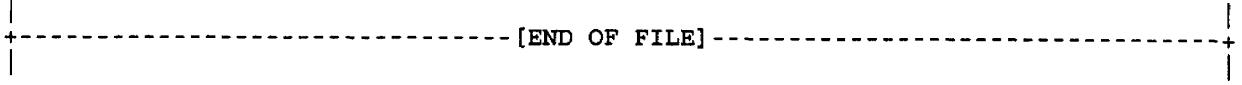
Rung 2:5



Rung 2:6



Rung 2:7



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+-------------------------------------------------------+
|              Rockwell Software Company                |
|                  6200 Series Software                 |
|           PLC-5 Programming Terminal Software         |
|                       Release 5.21                    |
|                    Data Table Report                  |
|                                                       |
|             AMCI 1700 Module Example Program          |
|              Tue Feb 25, 1997 - 10:38:34 am           |
|                                                       |
|       File: C:\IPDS\ARCH\PLC5\1700EXAM                |
|                                                       |
|                                                       |
|     REPORT OPTIONS                                    |
|       Page Width:                              80     |
|       Page Length:                             66     |
|       Graphics Capabilities:                   NO     |
|       Starting File:                           10     |
|       Ending File:                             10     |
+-------------------------------------------------------+
```

AMCI 1700 Module Example Program Tue Feb 25, 1997 Page 1
Data Table Report PLC-5/11 File 1700EXAM Data Table File N10:0

Address	0	1	2	3	4	5	6	7	8	9
N10:0	0	0	0	0	0	0	0	0	0	0
N10:10	0	0	0	0	0	0	0	0	0	0
N10:20	0	0	0	0	0	0	0	0	0	0
N10:30	-31744	0	0	0	0	0	0	0	0	0
N10:40	-31488	0	0	0	0	0	0	0	0	0
N10:50	-30711	864	291	0	0	0	0	0	0	0

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