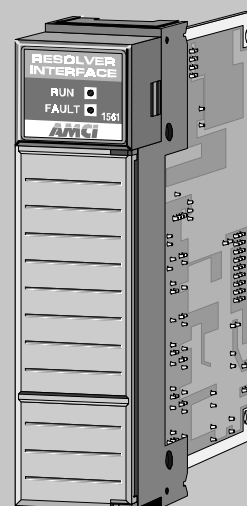


1561 Multi-Turn Resolver Interface Modules

User Manual



Allen-Bradley SLC 500 I/O Modules

GENERAL INFORMATION

Important User Information

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

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



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



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

No patent liability is assumed by AMCI, with respect to use of information, circuits, equipment, or software described in this manual.

The information contained within this manual is subject to change without notice.

Standard Warranty

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

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

Returns Policy

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

24 Hour Technical Support Number

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

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NOTES

ABOUT THIS MANUAL

It is strongly recommended that you read the following manual. It was first written for the release of hardware series E, firmware version 6, which introduced many new features into the 1561 module. Backwards compatible “out-of-the-box” with older versions of this module, the new features are easily enabled over the backplane. If there are any unanswered questions after reading this manual, call the factory. An applications engineer will be available to assist you.

SPECIFICATIONS

Module Location

Any SLC 500 I/O slot, including the processor slot of an extended rack. Occupies one slot.

Position Transducer

Default of AMCI multi-turn brushless resolver transducer

Can be programmed to use Autotech RL210 128 turn transducers.

Transducer Input Isolation

1500 Vac through isolation transformers

Data Available to Processor

Transducer Position, Velocity and Fault
Diagnostic data

Programmable Parameters

Transducer Type
Number of Turns
Full Scale Count
Preset Value
Count Direction
Transducer Fault Latch

Program Storage

EEPROM Memory
Minimum 100,000 write cycles

Position Update Time

400 microseconds

Position Resolution

AMCI 100, 180 turn Transducers:

Programmable to 4,096 counts per turn

AMCI 1,000, 1,800 turn Transducers

Programmable to 409.6 counts per turn

Autotech Transducers:

Programmable to 1,024 counts per turn

Tachometer Resolution and Range

1 RPM over 0 to 3,750 RPM range. Updated every 32 milliseconds

DC Supply Voltage from Backplane

0.090A max. @ 5Vdc nominal

0.055A max. @ 24Vdc nominal

0.160A max. @ 24Vdc under short circuit conditions

Environmental Conditions

Operating Temperature: 0 to 60° C

Relative Humidity: 5 to 95%
(w/o condensation)

Storage Temperature: -40 to 85°

Module ID Code

3514

Reserves 8 Input and 8 Output Registers

Number of registers scanned can be set using SPIOGA Configuration.

Registers Used

4 Input, 7 Output

CHAPTER 1

INTRODUCTION

Overview

The Series 1561 module is an Allen-Bradley SLC 500 I/O compliant card that converts resolver signals from an absolute, dual resolver, multi-turn transducer to digital position and tachometer data that is reported over the backplane. Status information is also reported. The 1561 eliminates the separate resolver decoder box, PLC input card, and associated wiring needed to bring resolver data into a SLC.

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 1561 module, the resolver gives an absolute position value with up to twenty bits of position resolution over one hundred eighty turns using a twelve conductor cable. An absolute optical encoder would require a cable with at least twenty-two wires to accomplish the same resolution.

A 1561 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 rotary table by attaching a multi-turn transducer to the drive motor and using it to monitor and control such functions as motor braking to stop the table at its stations.
- **Linear Application** - The resolver position correlates to a physical length. One example is monitoring the position of a load on either a track or ball screw such as a press shut height monitor. 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 entire distance.

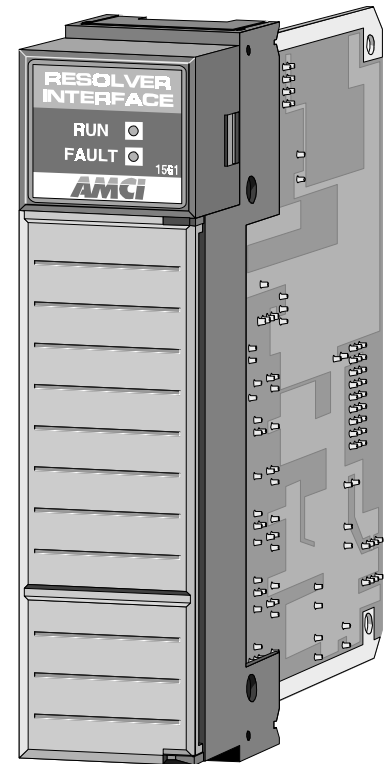


Figure 1.1 1561 Module

New Features

The hardware series E, firmware revision 6 release of the 1561 modules adds several new features to the product. These features are:

- **Preset Value:** Allows you to preset the position value to any count within its range. Previous versions of the module only allowed you to reset the position to zero.
- **Count Direction:** Allows you to set the direction of rotation that produces increasing counts. With previous versions of the module, you had to change the transducer cable wiring to reverse count direction.
- **Transducer Fault Latch:** Allows you to decide if a transducer fault should clear itself when possible, or latch the fault and stay in the fault condition until it is cleared from the backplane. Previous versions of the modules always self-cleared the fault.
- **Autotech RL210 Compatibility:** You can program the Transducer Type parameter to a value of 128. When you do this, the module automatically adjusts the reference voltage to the transducer to make the module directly compatible with the Autotech RL210 128 turn transducers.



Backwards Compatibility

With these new features, you may have some concerns if you are using a new 1561 module to replace an older one, or building a new machine based on a design that used an older module. Rest assured that AMCI took backward compatibility issues into account when designing this upgrade.

Modules built on series E, firmware 6 and later, are backwards compatible with older modules “out-of-the-box”. When shipped from the factory, all of the parameters are set to their default values, which makes the newer 1561’s behave exactly as the older ones. All backplane programming of the new features use bits and words that were previously reserved. If you followed AMCI’s suggestion and made all of these reserved bits zero in your old ladder logic and data, your program will work without error. The only reason to change your program and data is to program the new features.

“-19 option”

An option was available on certain older 1561 modules that made them compatible with transducers from Autotech Controls. This option was denoted by adding “-19” to the end of the part number. With the release of series E, version 6, all 1561 modules can be programmed to directly support AMCI or Autotech transducers. Consequently, the “-19” option is being phased out. If you are replacing a module with a “-19” option, you can now order a standard product and have the same functionality.

Model	Transducer Inputs	Comments
1531	1	
1532	2	
1541	1	
1542	2	
1541-12	1	
1541-03	1	
1561	1	

AMCI Compatible Transducers

Table 1.2 lists the AMCI transducers compatible with the 1561 module.

Model	Shaft	Mount	Turns	Comments
HTT-20-100	0.625"	Front	100	NEMA 4 heavy duty transducer
HTT-20-180	0.625"	Front	180	NEMA 4 heavy duty transducer
HTT-20-1000	0.625"	Front	1,000	HTT-20-100 w/ additional 10:1 gearing on input shaft.
HTT-20-1800	0.625"	Front	1,800	HTT-20-180 w/ additional 10:1 gearing on input shaft.
HTT425-Ann-100†	0.250"	Motor	100	A-B Series 1326 motor mount transducer. "nn" in part number defines connector style.
HTT425-Mnn-100†	10 mm	Motor	100	Universal motor mount w/ required adapter plate. "nn" in part number defines connector style.
HTT425-Fnn-100†	0.625"	Front	100	NEMA 4X, HTT-20-100 w/ Viton shaft seal. "nn" in part number defines connector style.
HTT425-Tnn-100†	0.625"	Foot	100	NEMA 4X, HTT-20-100 w/ Viton shaft seal. "nn" in part number defines connector style.
HTT-400-180	0.625"	Front	180	NEMA 4, HTT-20-180. Bolt-in replacement for Autotech RL210 transducers.

† A 1,000 turn version is also available.

Table 1.2 Compatible AMCI Transducers

Each transducer contains two resolvers. The first resolver, called the fine resolver, is attached directly to the input shaft with a flexible coupler. The second resolver, called the course resolver, is geared to the fine. This gear ratio, either 99:100 or 179:180 determines the total number of turns the transducer can encode.

At the mechanical zero of the transducer, the electrical zeros of the two resolvers are aligned. See Figure 1.2A. After one complete rotation, the zero of the course resolver lags behind the zero of the fine by one tooth, either 1/100 or 1/180 of a turn. After two rotations the lag is 2/100 or 2/180. See Figures 1.2B and 1.2C. After 100 or 180 turns, the electrical zeros of the resolvers are realigned and the multi-turn cycle begins again.

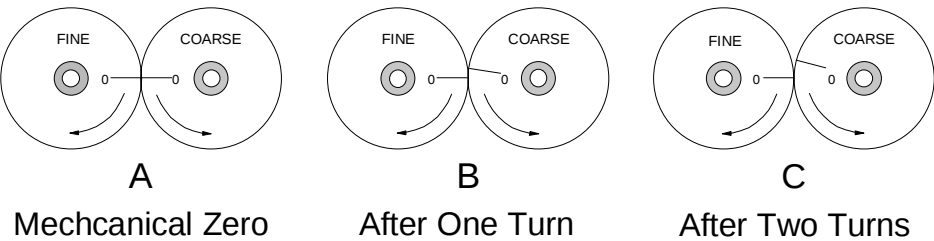


Figure 1.2 Resolver Alignment in Multi-turn Transducers

The fine resolver yields the absolute position within the turn directly. Using a proprietary algorithm, the module determines the number of turns completed by the difference in positions of the two resolvers. The absolute multi-turn position is then calculated as ((number of turns completed * counts per turn) + fine resolver position).

The 1,000 and 1,800 turn transducers have a 10:1 gear ratio between the input shaft and the resolvers. Therefore they can encode ten times the number of turns but at a tenth of the resolution.

Other Compatible Transducers

In addition to AMCI transducers, the 1561 now directly support Autotech multi-turn transducers. The Autotech models supported are:

- All SAC-RL210-G128 Transducers. (Size 40, NEMA 13)

Autotech also manufactures a SAC-RL210-G64 transducer which is not supported by AMCI.

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.

You select between AMCI and Autotech transducers over the backplane from the processor. The module then sets the reference voltage according to your selection. When using Autotech transducers, only 10 bit resolution, (1,024 counts per turn), is supported. If you require a higher resolution in an Autotech style package, AMCI offers the HTT-400-180, which is a direct bolt-in replacement for the Autotech RL210. AMCI strongly suggests using the HTT-400-180 transducer instead of the Autotech RL210 in all new installations.



Due to differences in construction, AMCI does not support installations that use transducer cables supplied by Autotech Controls. When using Autotech transducers, you *must* use Belden 9731 cable. See [Transducer Cable Installation](#) on page 13 and [Autotech Transducer Wiring](#) on page 16 for information on wiring Autotech transducers.

The remainder of this chapter introduces the programmable parameters of the module. It also introduces backplane programming concepts that you will use to configure the module.

Programmable Parameters

You configure your 1561 module by setting the values of its programmable parameters. These parameters are stored in the modules nonvolatile memory. Therefore, you do not have to configure the module after every power up. The nonvolatile memory is an EEPROM that is rated for approximately 100,000 write cycles.

Transducer Type

This parameter specifies the type of transducer attached to the input channel. The module needs this information in order to combine the positions of the two resolver inside the transducer into one multi-turn position.

- The default value is 100. This value is for all AMCI 100 turn transducers
- The Transducer Type can be programmed to 100, 180, 1,000, 1,800, and 128
- Set the Transducer Type to 128 to support Autotech 128 turn RL210 transducers. The 1561 will automatically set the transducer's reference voltage to the proper value.
- The Transducer Type, Number of Turns, and Full Scale Count parameters are programmed as a group. All three values must be correct before any of them are accepted.
- Programming the Transducer Type resets the Preset Value parameter to its default value of zero.

Programmable Parameters (continued)

Number of Turns

The maximum number of turns a transducer can encode is fixed by the gearing inside of it. However, the 1561 have the ability to divide this maximum number of turns into smaller multi-turn cycles. The module does this without loss of absolute position within the smaller cycle. An example of this feature is shown in figure 1.3. It shows how the 180 turn mechanical cycle of an HTT-20-180 can be broken down into three electronic cycles of sixty turns each. The 180 turn cycle could also be broken down into sixty cycles of three turns each.

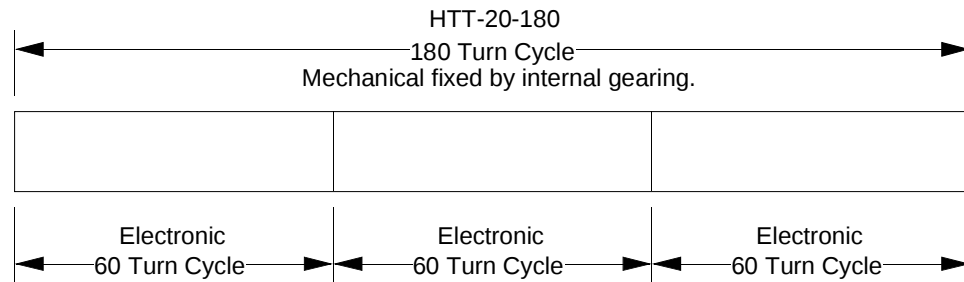


Figure 1.3 Programmable Number of Turns Example

The range of values for the Number of Turns parameter is dependent on the value of the **Transducer Type** parameter.

- **When Transducer Type = 100:** Number of Turns is programmable to 1, 2, 4, 5, 10, 20, 25, 50, or 100.
- **When Transducer Type = 180:** Number of Turns is programmable to 1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 30, 36, 45, 60, 90, or 180.
- **When Transducer Type = 1,000:** Number of Turns is programmable to 10, 20, 40, 50, 100, 200, 250, 500, or 1,000.
- **When Transducer Type = 1,800:** Number of Turns is programmable to 10, 20, 30, 40, 50, 60, 90, 100, 120, 150, 180, 200, 300, 360, 450, 600, 900, or 1,800.
- **When Transducer Type = 128:** Number of Turns is programmable to 1, 2, 4, 8, 16, 32, 64, or 128.
- The Transducer Type, Number of Turns, and Full Scale Count parameters are programmed as a group. All three values must be correct before any of them are accepted.
- Programming the Number of Turns resets the Preset Value parameter to its default value of zero.

Full Scale Count

The Full Scale Count parameter specifies the number of counts over the programmed number of turns. The range of values for the Full Scale Count parameter is dependent on the values of the **Transducer Type** and **Number of Turns** parameters.

For AMCI Transducers

- Default value is (Number of Turns * 4,096) if Transducer Type equals 100 or 180
- Default value is (Number of Turns * 409.6) if Transducer Type equals 1,000 or 1,800
- Range is 2 to (Default Value)

For Autotech Transducers (Transducer Type equals 128)

- Default value is (Number of Turns parameter) * 1,024
- Range is 2 to (Default Value)
- The Transducer Type, Number of Turns, and Full Scale Count parameters are programmed as a group. All three values must be correct before any of them are accepted.
- Programming the Full Scale Count resets the Preset Value parameter to its default value of zero.

Programmable Parameters (continued)

Count Direction

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

- The default Count Direction Value is *positive*.

NOTE

It is also possible to reverse the count direction by reversing four wires in the transducer cable. If you are installing this module 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 Fault Latch

Normally, a transducer fault is cleared by the module as soon as a working transducer is properly attached. If you have a situation where electrical noise or an intermittent wiring problem is causing spurious transducer faults, you may never detect them because the module can detect and clear transducer faults much faster than the processor scans the module. If you suspect that these transient faults can or are occurring, you must enable the Transducer Fault Latch to reliably capture them. With the latch enabled, the module will report a transducer fault until the processor issues a *Clear Errors* command.

- The default Transducer Fault Latch value is *disabled*.

Preset Value

The Preset Value parameter allows you to set the value of the position data to any count within its range. Programming the Preset Value does not change the position data, it only sets the value that the position will change to when an *Apply Preset Command* is initiated.

- The default Preset Value is zero.
- The Preset Value range is: 0 to (Full Scale Count -1).
- Programming the Transducer Type, Number of Turns, or Full Scale Count, resets the Preset Value to zero and resets any offset introduced by an *Apply Preset* command.

Backplane Programming

A 1561 module is programmed by writing data to it through the output image table. Changes to the bits that program the modules parameters are not acted upon until you initiate a Programming Cycle in your ladder logic.

Programming Cycle

A Programming cycle consists of six steps and is controlled by the Transmit Bit in the output image table and the Acknowledge Bit in the input image table.

- 1) Write the new programming data into the output image table with the Transmit Bit reset. This step insures that the correct data is in the output image table before the Programming Cycle begins.
- 2) Set the Transmit bit. A Programming Cycle is initiated when this bit makes a 0→1 transition.
- 3) Once the 1561 is done with the programming data, it will set any necessary error bits and the Acknowledge Bit in the input image table.
- 4) Once you see that the Acknowledge Bit is set, check for any errors. The error bits are only valid when the Acknowledge Bit is set.
- 5) Respond to any errors and reset the Transmit Bit.
- 6) The module responds by resetting the Acknowledge Bit. The Programming Cycle is complete.

CHAPTER 2

INSTALLATION

Power Requirements

The 1561 draws its power from the I/O rack's 5Vdc and 24Vdc supplies. The maximum current draw on the 5Vdc supply is 95 mA, (0.475 W). Under normal conditions, the maximum current draw on the 24Vdc supply is 55 mA, (1.32 W). When the Reference Voltage is shorted to ground, the maximum current draw on the 24Vdc supply changes to 160mA, (3.84W) while the power draw on the 5Vdc supply remains the same. Add these power requirements to the requirements of all the other modules in the rack when sizing the power supply.

Installing the Module



WARNING

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

You can install the 1561 module in any free slot, including the processor slot of an expanded local rack, as long as the power requirements are met.

- 1) Align the module's circuit board with the top and bottom card guides in the rack.
- 2) Gently slide the module into the rack until the top and bottom latches secure the module in place.

To remove the module, depress the top and bottom latches and slide the module out of the rack.

Module ID Code

All 1561 modules covered by this manual have an ID Code of 3514. This reserves 8 Input and 8 Output words for the module.



NOTE

When configuring the slot, you can enter the 'SPIOGA Configuration' menu and reduce the number of input and output words scanned by the processor. This will significantly decrease the access time for the module. Set the number of input words to 4 and the number of output words to 7.

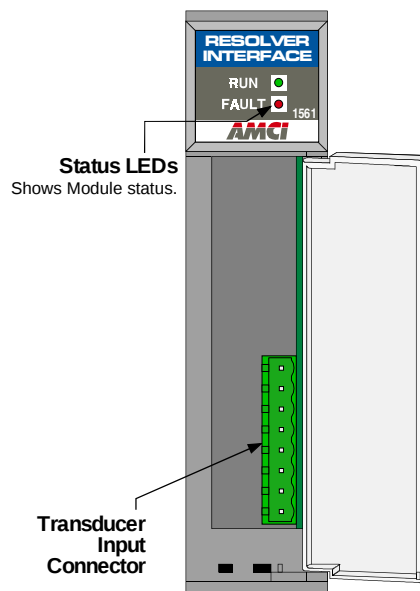


Figure 2.1 1561 Front Panel

Status LED's

As shown in figure 2.1, the front panel has two *Status LED's*, **RUN** and **FAULT**. Once power is applied, these two LED's indicate the operating status of the module. Table 2.1 shows the patterns that may appear on the LED's and their meaning.

RUN LED	FAULT LED	COMMENT
OFF	ON	MODULE FAULT The parameters stored in the EEPROM are corrupt. The fault is cleared by setting the Clear Module Fault bit in the output image table and initiating a Programming Cycle as described in Chapter 3. If the error clears, the parameters are set to their default values. If the error still exists, the module must be returned for repair.
ON	ON	NON-CLEARABLE TRANSDUCER FAULT This LED pattern indicates that there is a transducer fault that the module cannot clear. There are six major causes of this fault. ➤ Broken transducer cable ➤ Non-compatible transducer ➤ Improper wiring of the transducer cable ➤ Improper transducer cable installation ➤ Faulty transducer ➤ Faulty module
ON	FLASHING	CLEARABLE TRANSDUCER FAULT Only appearing when the Transducer Fault Latch is enabled, this LED pattern indicates that there is a latched transducer fault that can be cleared with a Clear Errors command from the backplane. When the Transducer Fault Latch is disabled, which it is by default, the transducer fault clears itself and this display will not occur. A transducer fault of this type is most often caused by a burst of electrical noise, an intermittent connection, or a mis-wired transducer cable.
ON	OFF	MODULE OK The module and transducer are operating properly without faults.

Table 2.1 Status LED's

Transducer Input Connector

The Transducer Input Connector has eight contacts. The mating connector is not supplied with the module. It comes as part of an AMCI pre-assembled transducer cable or it can be ordered as a separate item. The AMCI part number for the mating connector is MS-8. It is a Phoenix Contact connector, part number MSTB2.5/8-ST-5.08, order number 17 57 07 7.

Figure 2.2 shows the connector pin out to industry standard wire designations.

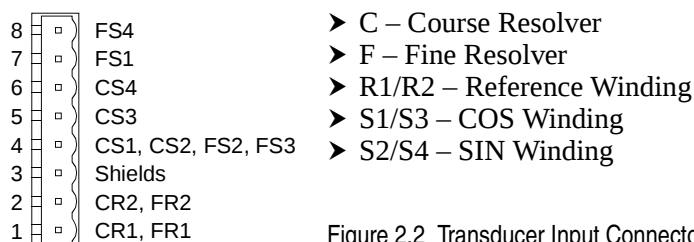


Figure 2.2 Transducer Input Connector

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.

Module	AMCI Part #	Belden Cable	Module Conn.	Transducer Conn.
1561	CTT - (x)	9731	MS-8	MS-20 (1)

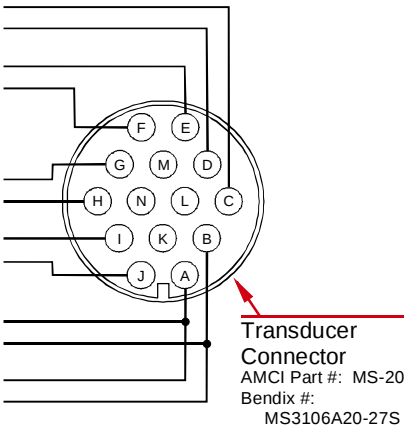
Table 2.2 Transducer Cable Numbers

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 *Automation Wiring and Grounding Guidelines*, Publication number 1770-4.1 for more information.
- 2) The shields of the transducer cable must be grounded at the 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. These precautions will minimize the possibility of ground loops that could damage the module or SLC.

Transducer Cable Wiring Diagram

CTT-(x) Wiring Diagram (1561)



Transducer Specifications

HTT-20, HTT-400, HTT425-F, & HTT425-T Transducers	HTT425 Motor Mount Transducers
Shaft Diameter 0.625"	Shaft Diameter0.250" or 10mm
Shaft Loading Radial: 400 lbs. max. Axial: 200 lbs. max.	Shaft LoadingRadial: 40 lbs. max. Axial: 20 lbs. max.
Starting Torque 8 oz.in. @ 25° C	Starting Torque1.5 oz.in. @ 25° C
Moment of Inertia 6.25×10^{-4} oz-in-sec ²	Moment of Inertia 1.25×10^{-4} oz-in-sec ²
Enclosure HTT-20, 400: NEMA 4 HTT425: NEMA 4X	EnclosureNEMA 4 When properly installed
Environmental (All Transducers)	

Trans**Trans**

using the standard HTT-20-(x) transducer and need the outline drawing, check our website first. If you cannot find it there, contact AMCI and we will fax you the appropriate information.

Transducer Outline Drawings (continued)

HTT-20-(x) Outline Drawing

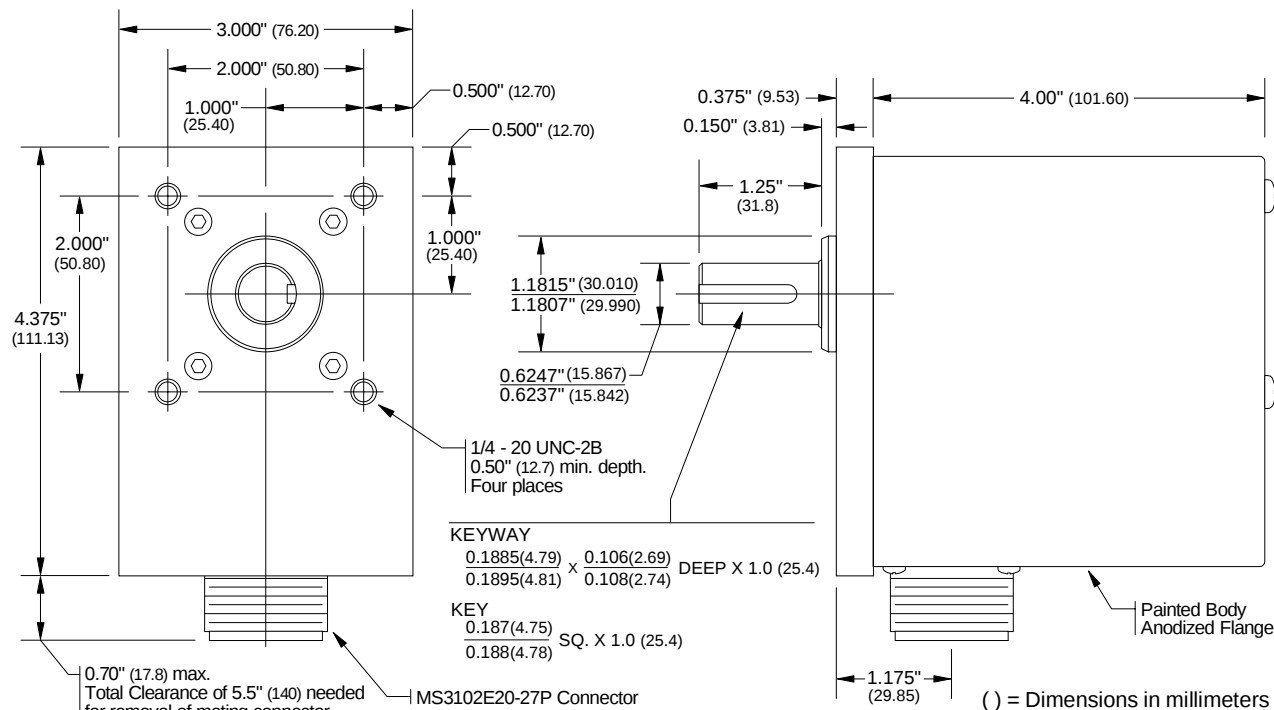


Figure 2.4 HTT-20-(x) Outline Drawing

Transducer Connector Pinout

All of the AMCI transducers that are compatible with the 1561 module have the same connector. Figure 2.5 is the connector pinout to the industry standard wire designations. Note that the HTT-400-180 has screw terminals and a conduit connection. It has resolver designations printed next to its connection terminals.

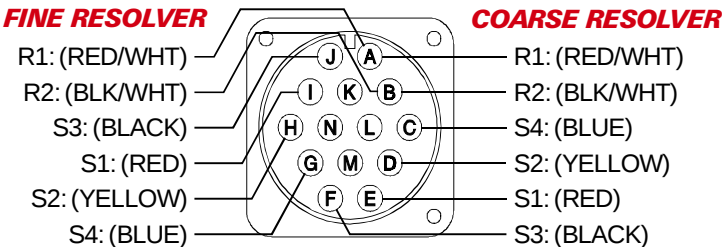


Figure 2.5 Transducer Connector Pinout

Autotech Transducer Installation

Supported Transducers

The 1561 module directly supports Autotech SAC-RL210-G128 transducers. The Autotech SAC-RL210-G64 transducers are not supported by AMCI. Refer to Autotech literature for dimensional drawings and mounting recommendations. When using Autotech transducers, only 10 bit resolution, (1,024 counts per turn) is supported. If you need higher resolution in an Autotech package, AMCI offers the HTT-400-180 which is a direct bolt-in replacement for the Autotech RL210. AMCI strongly suggests using the HTT-400-180 transducer instead of the Autotech RL210 in all new installations.

Autotech Transducer Installation (continued)**Autotech Transducer Wiring**

Table 2.5 is a wiring table for all supported Autotech transducers. The table cross references resolver designations, AMCI wire color, Autotech terminal and connector pin outs, and Transducer Input Connector pin out.

NOTE

- 1) Autotech CBL-10T22 cable is not supported. Belden 9731 or exact equivalent must be used.
- 2) Cable drawings for connecting Autotech transducers are available. If you want a cable drawing instead of using the table, contact AMCI. A drawing will be faxed to you upon request.

Resolver Designation ¹	9731 Wire Color	SAC-RL210 Terminals	SAC-RL210 MS Connector	1561 Connector
R1	RED	1	A	1
R2	BLK/RED ²	2	B	2
R1	BRN	1	A	1
R2	BLK/BRN ²	2	B	2
CS1	WHT	3	C	6
CS3	BLK/WHT ²	5	E	4
CS2	BLK/GRN ²	4	D	5
CS4	GRN	6	F	4
FS1	YEL	7	H	4
FS3	BLK/YEL ²	9	L	8
FS2	BLK/BLU ²	8	K	4
FS4	BLU	10	M	7

1: F = Fine Resolver C = Coarse Resolver

2: Denotes black wire of black and colored wire pair.

Table 2.5 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 could form a ground loop that may damage the 1561 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 the green screw.

CHAPTER 3

BACKPLANE PROGRAMMING

A 1561 module communicates with the SLC processor through the input and output image tables. The input image table is used to transmit Status, Position, and Tachometer data to the processor. The output image table is used to setup the 1561 as well as preset the position value and clear latched transducer faults. This chapter details the data format of the input and output image tables and how to program the 1561.

Data Addressing

Data address are defined in the following manner.

I:X.n Input Image Table

O:X.n Output Image Table

Where 'X' is the slot number of the 1561 and 'n' is the word number in the data block. When referring to a specific bit in a word, the characters "/bb" will be appended to the file address where 'bb' is the bit address.

Programming Cycle

Programming changes are written to the module with a *Programming Cycle*. All programmable parameters can be changed, and the Position value preset, with a single Programming Cycle. Programming Cycles are controlled with the *Transmit Bit* and *Acknowledge Bit*.

- 1) Write the new programming data into the output image table with the Transmit Bit reset. This step insures that the correct data is in the output image table before the Programming Cycle begins.
- 2) Set the Transmit bit. A Programming Cycle is initiated when this bit makes a 0→1 transition.
- 3) Once the 1561 is done with the programming data, it will set any necessary error bits and the Acknowledge Bit in the input image table.
- 4) Check for errors once the Acknowledge bit makes a 0→1 transition. The error bits are only valid while the Acknowledge Bit is set.
- 5) Respond to any errors and reset the Transmit Bit.
- 6) The module responds by resetting the Acknowledge Bit. The Programming Cycle is complete.

If the module encounters an error, it will set the appropriate error bit in Input Word 0 and stop processing the data. All of your data must be correct before the 1561 accepts any changes.

CAUTION

The EEPROM used to store parameter values, and the internal offset that is calculated every time you preset the position, is guaranteed for approximately 100,000 write cycles before writing to it will cause it to fail. Therefore, continuously presetting the position or writing new parameters should be avoided. If your application requires you to continuously preset the position, consider calculating the required position offset in your ladder logic program.

Guidelines for Programming an Older Module

If your module has a serial number below 59,730, then the new features that were incorporated into the module with the release of hardware rev. E are not available on your module. You can use the programming instructions in this chapter as long as you adhere to the following guidelines.

- 1) Programming bits in the output image table associated with the new features must remain reset during a Programming Cycle. If any of these bits are set, the module responds by setting the Message Ignored bit and does not process the programming data.
- 2) The maximum Full Scale Count value is $(1,024 * \text{Number of Turns})$ in all cases.
- 3) The bit in the output image table that are used to preset the position (I:X.0/00) can still be used. However the position can only be reset to zero because the older modules do not support the Preset Value parameter.

Multi-Word Format

The Full Scale Count and Preset Value parameters exceed 32,767. Therefore these two parameters require two words to hold their data. The lower three digits of the value, (ones, tens, and hundreds), are stored in the second word. The “thousands” digits are stored in the first word. For example, a Preset Value of 123,456 would be stored as 123 in the first word and 456 in the second word.

The position data can also exceed 32,767. It is transmitted to the processor using the same two word format as the Full Scale Count and Preset Value parameters.

Output Image Table

Figure 3.1 shows the format of the output image table data that is used to program the 1561. Word 0 contains programming bits as well as the Transmit Bit. The other data words contain the actual data being sent to the module.

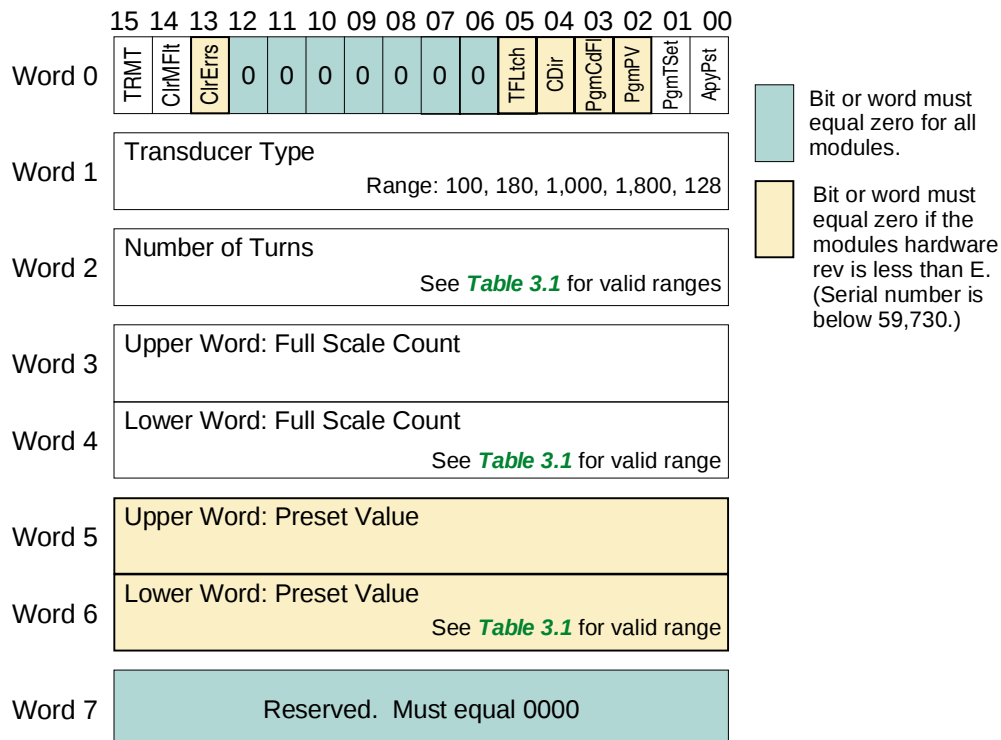


Figure 3.1 Output Image Table Data Format

Apply Preset Bit: O:X.0/00

ApyPst: Apply Preset, O:X.0/00. Set this bit to preset the Position data to the programmed Preset Value. When this bit is reset, the Position value is left unchanged. Applying the Preset Value is the last action taken by the module during a Programming Cycle, so you can program a new Preset Value and then apply it in one programming cycle.

CAUTION

Every time you apply a Preset Value, the module calculates the position offset needed to bring the position to the Preset Value and stores this offset in EEPROM memory. The EEPROM on the 1561 modules is guaranteed for 100,000 writes before writing to it will cause it to fail. Therefore, continuously presetting the position should be avoided. If your application requires you to continuously apply the Preset Value, consider calculating and applying the required position offset in your ladder logic program.

Output Image Table (continued)

Programming Bits O:X.0/01 to O:X.0/05

Programming Bits O:X.0/01 and O:X.0/02 control when the programming data in output words O:X.1 through O:X.6 is acted upon. If a bit is reset when a Programming Cycle is initiated, the data values in the corresponding words are ignored. Likewise, the PgmCdFl bit (O:X.0/03) controls when the state of the Count Direction bit, (CDir, O:X.0/04) and the Transducer Fault Latch bit, (TFLtch, O:X.0/05) is used to program the Tachometer Response.

PgmTSet: Program Transducer Setup, O:X.0/01. Set this bit to program the Transducer Type, Number of Turns, and Full Scale Count parameters in words one through four. These three parameters are programmed as a group and cannot be programmed separately. All values are in binary, and the Full Scale Count parameter uses the **Multi-Word Format** as described on page 18.

PgmPV: Program Preset Value, O:X.0/02. *This parameter is only available on 1561's with serial numbers above 59,730. (Firmware rev E+, Software rev 6+.) This bit must remain reset when programming a module with a serial number below 59,730.* Set this bit to program the Preset Value parameter to the value stored in words 5 and 6. The Preset Value uses the **Multi-Word Format** as described on page 18. Note that programming the Preset Value does not change the position count. To change the position to your Preset Value, set the Apply Preset Value bit (O:X.0/00) before initiating a Programming Cycle.

PgmCdFl: Program Count Direction and Transducer Fault Latch, O:X.0/03. *This parameter is only available on 1561's with serial numbers above 59,730. (Firmware rev E+, Software rev 6+.) This bit must remain reset when programming a module with a serial number below 59,730.* Set this bit to program the Count Direction parameter to the value specified by the CDir bit (O:X.0/04) and the Transducer Fault Latch parameter to the value specified by the TFLtch bit (O:X.0/05). When this bit is reset, the two parameters are not programmed and the CDir and TFLtch bits must be reset.

CDir: Count Direction, O:X.0/04. *This parameter is only available on 1561's with serial numbers above 59,730. (Firmware rev E+, Software rev 6+.) This bit must remain reset when programming a module with a serial number below 59,730.* This bit is only acted upon when the PgmCdFl bit (O:X.0/03) is set. If the PgmCdFl bit is reset, this bit must also be reset. When the PgmCdFl bit (O:X.0/03) is set and this bit is reset, the Count Direction parameter will be set to its *positive* value. When the PgmCdFl bit (O:X.0/03) is set and this bit is set, the Count Direction parameter will be set to its *negative* value.

TFLtch: Transducer Fault Latch, O:X.0/05. *This parameter is only available on 1561's with serial numbers above 59,730. (Firmware rev E+, Software rev 6+.) This bit must remain reset when programming a module with a serial number below 59,730.* This bit is only acted upon when the PgmCdFl bit (O:X.0/03) is set. If the PgmCdFl bit is reset, this bit must also be reset. When the PgmCdFl bit (O:X.0/03) is set and this bit is reset, the Transducer Fault Latch will be *disabled*. When the PgmCdFl bit (O:X.0/03) is set and this bit is set, the transducer Fault Latch will be *enabled*.

Command Bits: O:X.0/13 and O:X.0/14

ClrErrs: Clear Errors, O:X.0/13. Set this bit to clear programming errors and latched transducer faults. If a transducer fault still exists after a Programming Cycle that had this bit set, the transducer fault is non-clearable and user intervention is required to fix the fault.

ClrMFlt: Clear Module Fault, O:X.0/14. Set this bit to clear a module fault. If the module fault still exists after a Programming Cycle that had this bit set, contact AMCI for assistance. See the **Inside Front Cover** for information on contacting AMCI. If the fault does clear, the module reset all parameters back to their factory defaults. Setting this bit has no affect if a module fault does not exist.

Output Image Table (continued)**Transmit Bit: O:X.0/15**

TRMT: Transmit Bit, O:X.0/15. A 0→1 transition on this bit initiates a Programming Cycle. The values of the other bits and words in the output image table are ignored until this bit transitions. Also, the other bits and words must have correct values in them before this bit transitions or the module will respond with a programming error.

Ranges and Factory Default Values

Parameter	Range	Factory Default
Transducer Type	100, 180, 1,000, 1,800, or 128 Turn Transducer	100 Turn
Number of Turns	100 Turn: 1, 2, 4, 5, 10, 20, 25, 50 or 100 180 Turn: 1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 30, 36, 45, 60, 90 or 180 1,000 Turn:(Any 100 turn value) * 10 1,800 Turn:(Any 180 turn value) * 10 128 Turn: 1, 2, 4, 8, 16, 32, 64, 128	100
Full Scale Count	2 to (# of Turns * 4,096) if AMCI 100 or 180 Turn 2 to (# of Turns * 409.6) if AMCI 1000 or 1800 Turn 2 to (# of Turns * 1,024) if Autotech 128 turn transducer	102,400
Preset Value	0 to (Full Scale Count - 1)	0
Count Direction	Positive (CW increasing), Negative (CCW increasing).	Positive
Transducer Fault Latch	Disabled, Enabled	Disabled

Table 3.1 Transducer Setup Parameter Values

Input Image Table

Figure 3.2 shows the format of the input image table data that is sent from the 1561 to the processor. Word 0 contains Status and Error bits as well as the Acknowledge Bit. The other three data words contain Position and Tachometer data.

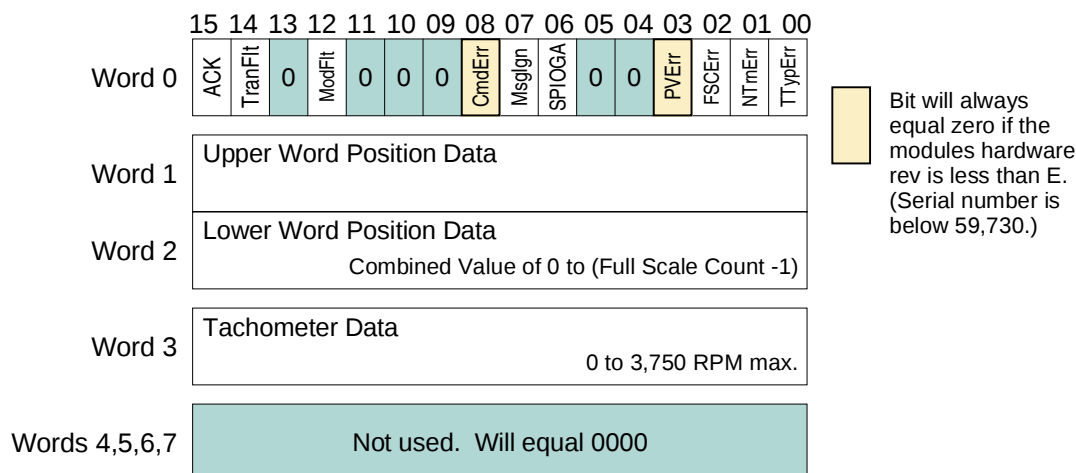


Figure 3.2 Input Image Table Data Format

Position and Tachometer Data

Both the position and tachometer values are transmitted in binary. The position data is transmitted in the **Multi-Word Format** described on page 18.

Input Image Table (continued)

Programming Error Bits: I:X.0/00 to I:X.0/08

- TTypErr:** Transducer Type Error, I:X.0/00. Set when you attempt to program the Transducer Type parameter to any value other than 100, 180, 1,000, 1,800, or 128.
- NTrnErr:** Number of Turns Error, I:X.0/01. Set when you attempt to program the Number of Turns parameter to a value outside of its range. See table 3.1, *Transducer Setup Parameter Values*, on page 20 for a list of this parameter's range of values. If the programmed value seems to be correct, you may have programmed the Transducer Type parameter incorrectly. For example, "90" is valid for the Number of Turns parameter when using a 180 turn transducer. If you incorrectly program the Transducer Type parameter to 100 instead of 180, the module will report an error with the Number of Turns parameter even though the problem is with the Transducer Type parameter.
- FSCErr:** Full Scale Count Error, I:X.0/02. Set when you attempt to program the Full Scale Count parameter to a value outside of its range. See table 3.1, *Transducer Setup Parameter Values*, on page 20 for a list of this parameter's range of values. If the programmed value seems to be correct, you may have programmed the Number of Turns parameter incorrectly. Another source of error is not converting the value into its multi-word format correctly. See *Multi-Word Format* on page 18 for a description of the format.
- PVErr:** Preset Value Error, I:X.0/03. Set when you attempt to program the Preset Value parameter to a value outside of its range of 0 to (Full Scale Count -1). If the programmed value seems to be correct, you may have programmed the Full Scale Count parameter incorrectly. Another source of error is not converting the value into its multi-word format correctly. See *Multi-Word Format* on page 18 for a description of the format.
- SPIOGA:** SPIOGA Error, I:X.0/06. Set when there is a communications error between the processor and the modules' SPIOGA backplane interface IC.
- Msglgn:** Message Ignored, I:X.0/07. Set under the following conditions:
- 1) Your ladder logic attempts to program the module while an EEPROM error exists.
 - 2) No Command bits are set when a Programming Cycle was initiated. Command bits are in output word zero. (O:X.0/00-05)
 - 3) If one of the Programming Error bits in input word zero is set, (I:X.0/00-03), the error must be cleared by re-programming the incorrect parameter or using the Clear Errors bit (O:X.0/13). This bit is set if you attempt to program a different parameter before correcting the error on the first.
- CmdErr:** Command Error, I:X.0/08. Set under the following conditions:
- 1) One or more of the reserved bits in output word zero, O:X.0/06-12, are set when a Programming Cycle is initiated.
 - 2) The Count Direction bit, (O:X.0/04) or the Transducer Fault Latch bit (O:X.0/05) is set and the Program Count Direction and Transducer Fault Latch bit (O:X.0/03) is reset when a Programming Cycle is initiated.

Status Bits: I:X.0/12 and I:X.0/14

- ModFlt:** Module Fault, I:X.0/12. Set when there is an EEPROM memory error or other hardware fault. If this bit is set, initiate a Programming Cycle with the Clear Module Fault bit, (O:X.0/14) set. If the error does not clear, contact AMCI for assistance. If it does clear, all parameters will be reset to their default values.
- TranFlt:** Transducer Fault, I:X.0/14. Set when there is a non-clearable transducer fault on channel 1 or when a transient fault has occurred and the Transducer Fault Latch is enabled.

Acknowledge Bit: I:X.0/15

- ACK:** Acknowledge Bit, I:X.0/15. Set by the module to acknowledge programming data from the processor. Programming Error Bits in input word zero, (I:X.0/00-03), are valid only while this bit is set. Status Bits, (I:X.0/12,14), are always valid. The module resets the Acknowledge Bit after the processor resets the Transmit Bit.

Programming Example**Data Table Values**

Sample data table values are given in figure 3.3. All values are shown using the decimal radix.

Offset	0	1	2	3	4	5	6	7	8	9
N7:0	0	0	0	0	0	0	0	0	0	0
N7:10	8239	180	90	368	640	123	456	0	0	0
N7:20	0	0	0	0	0	0	0	0	0	0

Figure 3.3 Sample Program Data Values

N7:10 is the Command Word. The value of 8,239 (202Fh) issues the Clear Errors command and programs all of the modules parameters.

N7:11-16 contain the new parameter values that are shown in table 3.2.

Parameter	Location	Value
Count Direction	N7:10/04	Positive
Transducer Fault Latch	N7:10/05	Enabled
Transducer Type	N7:11	180 turn
Number of Turns	N7:12	90
Full Scale Count	N7:13-14	368,640
Preset Value	N7:15-16	123,456

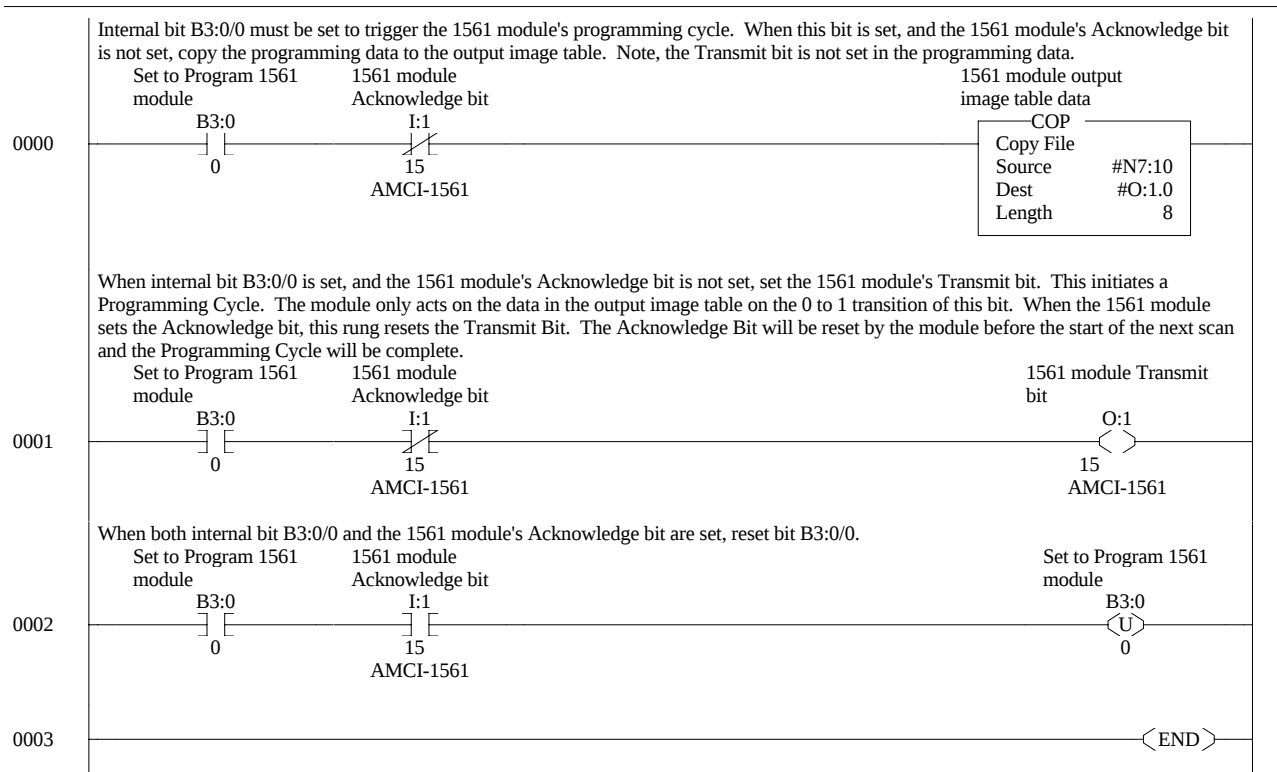
Table 3.2 Sample Program Parameter Values

Programming Example (continued)

Ladder Logic

1561_EXAMPLE.RSS

LAD 2 - --- Total Rungs in File = 4





LEADERS IN ADVANCED CONTROL PRODUCTS