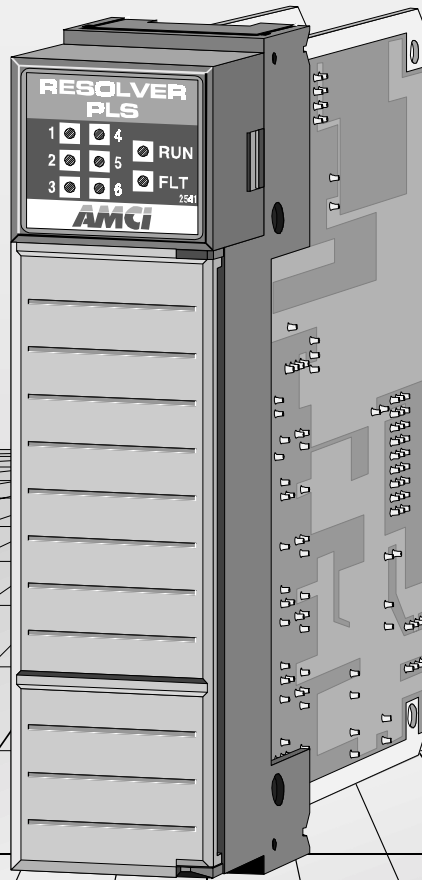


User Manual

2541 High Speed Programmable Limit Switch Module



AMCI
Allen-Bradley
SLC 500 I/O
Module

GENERAL INFORMATION

Important User Information

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

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.

UNDER NO CIRCUMSTANCES WILL ADVANCED MICRO CONTROLS, INC. BE RESPONSIBLE OR LIABLE FOR ANY DAMAGES OR LOSSES, INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM THE USE OF ANY INFORMATION CONTAINED WITHIN THIS MANUAL, OR THE USE OF ANY PRODUCTS OR SERVICES REFERENCED HEREIN.

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 and serial numbers 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 leave a detailed message and the telephone number that you can be reached at. The system will page one of two engineers on call. Please have your product model number and a description of the problem ready before you call.

ABOUT THIS MANUAL

Introduction

This manual explains the operation, installation, and programming of the 2541 High Speed Programmable Limit Switch for Allen-Bradley SLC 500™ systems. 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.

AMCI is a registered trademark of Advanced Micro Controls Inc.

The AMCI is a trademark of Advanced Micro Controls Inc.

SLC and SLC 500 are trademarks of Allen-Bradley Company.

This product incorporates technology which is licensed by Allen-Bradley Company, Inc. Allen-Bradley has not technically approved, nor does it support this product. All warranty and support for this product and its application is provided solely by Advanced Micro Controls Inc.

Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual and the information it contains are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, 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, 940-05071, supersedes 940-05070. The changes reflect the change to the limit switch output connector from an eight pin green connector to a nine pin black connector. This hardware change was made to distinguish the LS output connector from the transducer input connector. The revision was first released April 14, 1999.

Past Revisions

940-05070: Initial Release, 3/31/1999

ABOUT THIS MANUAL

Notes

2541 INTRODUCTION

Overview

Until the introduction of AMCI's PLS modules, interfacing a high speed programmable limit switch to a SLC 500 programmable controller was a difficult task. Additional I/O wiring, separate panel mounting, and perhaps even a custom serial protocol were needed to interface the PLS and SLC together. A 2541 Resolver PLS module eliminates all of these difficulties. The 2541 plugs into the SLC 500 I/O rack and is under the complete control of processor. All programming is accomplished over the backplane using the I/O data tables and two M files.

The many features of the 2541 makes it the most advanced PLS module on the market today.

- ▶ Uses a brushless resolver based transducer for position feedback.
- ▶ Programmable position resolution from 2 to 4,096 counts per turn.
- ▶ Programmable position offset.
- ▶ Position preset function
- ▶ Tachometer Scalars allow you to scale the tachometer value to any meaningful unit of measure, not just RPM.
- ▶ Six limit switch outputs:
 - ▲ 100 μ S update time.
 - ▲ 100mA @ 28Vdc rated drivers.
 - ▲ Eight on/off setpoint pairs per output.
 - ▲ Separate on/off automatic advances for speed compensation.
 - ▲ Can be programmed as position, timed, or pulsed limit switches
- ▶ A limit increment/decrement function that allows you to 'tweak' limit switch settings on the fly.
- ▶ Four 30Vdc inputs that allow you to disable the first four outputs based on external conditions.
- ▶ Two programmable motion detectors that allow you to independently disable any of the outputs based on machine speed.
- ▶ Programmable on/off force bits that allow you to set an output to a given state regardless of programming and conditions.
- ▶ Extensive fault detection routines continuously monitor the integrity of the module, transducer, and transducer cabling.

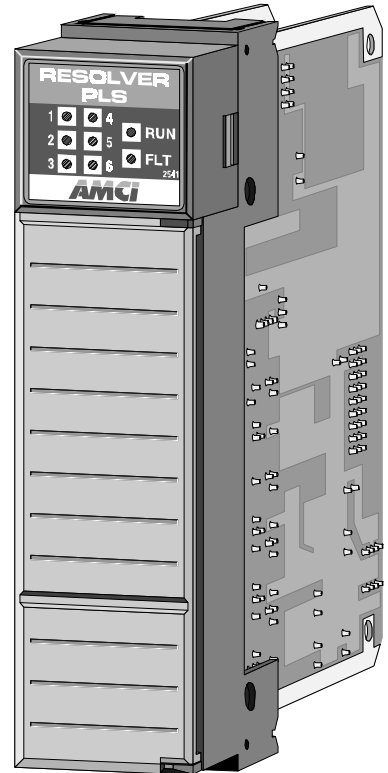


Figure 1.1 2541 Module

Overview (continued)

The 2541 is programmed for the backplane using a combination of I/O data words and two M files. You can easily read back any data sent to the module. Also, all of the data generated by the module is reported to the processor. This includes the Position, position offset, and tachometer values as well as the status of the limit switches, the inputs, and the motion detectors. Therefore you can report this data to an operator using a remote display, generate other limit switches in ladder logic, or use this data in any other way appropriate to your machine.

NOTE 

With the use of M files, the SLC processor in the system must be a 5/02 or above. Fixed SLC systems and 5/01 processors cannot be used. The use of M files also restricts the 2541 to local or local extended racks. The 2541 cannot be used in a remote rack.

Programmable Parameters

You configure the 2541 by setting its *Programmable Parameters*. The programmable parameters are broken down in the following three groups:

- ▶ **Module Setup Parameters** – Parameters that setup the tachometer, motion detectors, and active state of the inputs. The output on/off force values are also included in these parameters.
- ▶ **Transducer Setup Parameters** – Parameters that affect the position data.
- ▶ **Limit Switch Parameters** – Parameters that program the type of limit switch and any ANDing with the motion detectors as well as setpoint and on/off advances.



Module Setup Parameters

Tachometer Response

A bit value that sets how often the 2541 updates the tachometer data to the processor. With a default of 504 mS, the two choices are 504 mS and 120 mS. Internally, the tachometer updates every 24 mSec. This update time is used when calculating the limit switch on/off advance values.

Tachometer Scalars

The 2541 allows you to scale the tachometer value reported to the processor. Therefore you can have the module report a tachometer value scaled to boxes per minute, inches per minute, or any other meaningful value instead of revolutions per minute. The tachometer is scaled with three values, *Tach Multiplier*, *Tach Divisor*, and *Tach Decimal Point*. The tachometer reports the rounded off integer value of the equation:

►
$$\left(\frac{\text{Speed}[\text{RPM}] * \text{Tach Multiplier}}{\text{Tach Divisor}} \right) / \text{Tach Decimal Point}$$

The Tach Multiplier can be any integer between 0 and 1,100. The Tach Divisor can be any integer between 1 and 63. The Tach Decimal Point can be 1, 10, 100, or 1000. As an example, assume a speed of 100 RPM, a multiplier of 2, a divisor of 3. The table below shows the different tachometer values based on the Tach Decimal Point value.

	DECIMAL POINT VALUE			
	1	10	100	1000
Calculated Tach	66.67	6.67	0.67	0.067
Reported Tach	67	7	1	0

Table 1.1 Effect of Tachometer Scalars

When programming the Tach Decimal Point, you will enter a value of 0, 1, 2, or 3 into your programming data. This corresponds to a Tach Decimal Point value of 1, 10, 100, or 1,000.

Input Active State

These four bit values program the active state of the four inputs on the front of the module. When an Active State bit is set to its default value of zero, the corresponding input works like a normally closed relay. The input must have current flowing through it to be deactivated. When an Active State bits is set to one, the corresponding input works like a normally open contact. The input must have current flowing through it to be active.

- If you are not using the inputs, leave the Input Active State bits in their default reset state. The outputs will then fire without anything attached to the inputs.

Input Forces

You can force any of the four inputs on or off by setting the appropriate bit in the output image table. A Force OFF bit take precedence over the corresponding Force ON bit.

Module Setup Parameters (continued)

Output Forces

You can force any output on or off by setting the appropriate bit in the output image table. A Force OFF bit take precedence over the corresponding Force ON bit.

- ▶ If your application does not require six limit switch outputs, you can use any uncommitted limit switch output as a standard DC output by referencing the Force ON bit.

Motion Detector ON/OFF setpoints

The 2541 has two motion detectors, *MD1* and *MD2*, that function as speed based limit switches. You program a low speed setpoint and a high speed setpoint for each motion detector. If the low speed setpoint is less than the high speed setpoint then the output will be on when the velocity is between the two setpoints and off at all other speeds. If the low speed setpoint is greater than the high speed setpoint then the output will be off when the velocity is between the two setpoints and on at all other speeds. You can logically AND any limit switch output with either motion detector. This disables the limit switch unless the machine is running within the programmed range. The motion detector setpoints are always programmed in RPM, regardless of the values of the Tachometer Scalars. The motion detector setpoints have a range of zero to 32,767 RPM.

NOTE 

The state of the motion detectors is updated when the tachometer value is calculated. Therefore, the motion detectors update every 102 or 504 mS, based on the value of the Tachometer Response parameter. If you are using the motion detectors to disable limit switch outputs on a machine that accelerates quickly, you may have to change the Tachometer Response parameter from its default of 502 mS to 120 mS. This insures that the limit switches will be enabled as quickly as possible once the machine is at operating speed.



Transducer Setup Parameters

Count Direction

A bit value that sets the direction the transducer shaft must rotate to increase the position value. It defaults to *clockwise* and can be set to *clockwise* or *counter-clockwise*. Note that it is also possible to reverse the count direction by switching one of the pairs in the transducer cable.

Scale Factor

Sets the position resolution of the 2541 module. It defaults to 4,096 counts per turn and is programmable to any value between 2 and 4,096.

PresetValue

The value that the position data will be set to when you preset it from the backplane. With a default of zero, it is programmable to any value between 2 and (Scale Factor - 1). See *Position Offset* below for more information on how the Preset Value works.

Position Offset

This number is added to the absolute resolver position to calculate the position value of the 2541. With a default of zero, it is programmable to any value between 2 and (Scale Factor - 1). The Position Offset give you the ability to set the Position value to any value without rotating the transducer shaft.

NOTE

- 1) Presetting the position forces the module to recalculate the Machine Offset.
- 2) The 2541 does not store the Position Offset in non-volatile memory but the value is placed in its M0 file and available to the processor as a data word. In order to keep the position value absolute, you must store the Position Offset in an integer file and write it down to the 2541 every time you configure the module. If you do not do this, you will have to reset the machines position every time you cycle power.



Limit Switch Parameters

Limit Switch Type Parameter

Programs the type of limit switch the output channel will be. The three choices are *Normal*, *Timed*, and *Pulse*. Normal outputs turn on and off based on position. Timed outputs function like a timing relay, turning on at a programmed position and remaining on for a programmed length of time. Pulse outputs generate a pulse train between two position values.

Motion ANDing Parameter

You can disable the a limit switch output by ANDing it with one of the two motion detectors. This prevents the output from firing until the machine is running within the range set by the motion detector. This parameter specifies which motion detector is ANDed with the limit switch output. You can also choose not to AND the output with either motion detector.

Limit Switch ON / OFF Setpoints

Limit switch setpoints are pairs of position values that set where the outputs turn on and off. Setpoints can be programmed to any value between zero and (Scale Factor - 1).

Normal Limit Switch – Eight pairs of ON / OFF setpoints that give you the ability to turn the output on and off eight times per turn. If the ON setpoint is less than the OFF setpoint, the output is on when the position value is between the two limits and off when outside the limits. If the ON setpoint is greater than the OFF setpoint, the output is off when the position value is between the two limits and on when outside the limits.

Pulse Limit Switch – One ON / OFF setpoint pair that sets the leading edge of the first pulse in the train and the trailing edge of the last pulse in the train. Two additional parameters set the total number of pulses in the train and the number of counts that each pulse is on.

Timed Limit Switch – One ON / OFF setpoint pair that sets the ON position and off position of the limit. A third parameter sets the amount of time the output is on. Usually, the output will turn on at the ON setpoint and remain on for the specified length of time. However, if the OFF setpoint is reached before the output times out, then the output will turn off. The maximum length of time an output can be on is 9.999 seconds.

Limit Switch ON / OFF Advances

Two parameters that allow the limit switch channel to compensate for fixed delays in the system by turning on or off before or after the actual programmed setpoint. The maximum compensation is ± 99.9 mSec. Setting the Advance to a positive value will force the output to turn on at an earlier position. Setting the Advance to a negative value will force the output to turn on at a later position.

INSTALLATION

This chapter describes how to install a Series 8500 system. It covers module, transducer, and relay board installation and the cabling needed to connect the components together.

System Requirements

Processor Requirements

A 2541 uses a M0 and M1 files to communicate with the processor. Therefore the processor used in your system must be a 5/02 or greater. Fixed SLC and 5/01 processors cannot be used with the 2541 module.

Rack Requirements

A 2541 must be installed in a local or expanded local rack. Note that the 2541 cannot be installed the processor slot of the expanded local rack. The module cannot be installed in a remote rack because of the use of the M files.

Power Requirements

A 2541 module draws its power from the I/O rack +5Vdc and +24Vdc supplies. The maximum current draw from the +5Vdc supply is 0.195 amps, (0.98 W). The maximum current draw from the +24Vdc supply under normal operating conditions is 0.035 mA, (0.84 W). If the reference voltage generated by the module is shorted, the current draw from the +24Vdc supply rises to 0.15A, (3.6W) 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.

2541 Connectors

Figure 4.1 shows the placement of the I/O and Transducer Input Connectors on the 2541.



The mates of the Transducer Input and LS Output Connectors can be plugged into the wrong connector. Crossing these connections can damage the module if DC power for the limit switches is instead applied to the Transducer Input Connector. Check all wiring before applying power to the 2541.

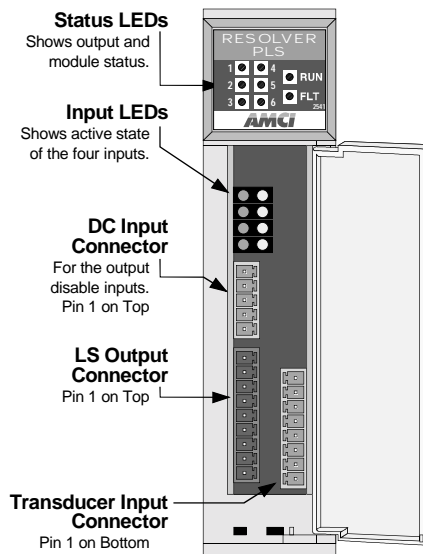


Figure 4.1 2541 Connectors

Installing the Module



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 personal.

- 1) Align the modules' right 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 2541s have an ID Code of 9935. This reserves 8 Input and 8 Output words for the module. When configuring the slot you must also enter the 'SPIO CONFIG' menu and specify a M0 File size of 120 words and a M1 File size of 650 words. If you do not configure the M files correctly you will get an error message when you switch the processor to Run Mode. The error message is "M1/M0 File Configuration Error, slot X" where "X" is the slot the 8500 plugs into. If you are using AI software, you must use version 8.15+ to program the M file lengths correctly.

Status LED's

The front display has a total of eight LED's. The six that are numbered are status LED's for the six outputs. When external power is supplied, these LED's will light when the corresponding output is on. The other two, labeled 'RUN' and 'FLT' indicate the operating status of the module.

RUN	FLT	COMMENT
OFF	ON	MODULE FAULT The module failed its power-up diagnostics. Cycle power to the module. If the error still exists, the module must be returned to AMCI for repair.
ON	ON	NON CLEARABLE TRANSDUCER FAULT There is a transducer fault that the module cannot clear. There are six major causes of this fault. <ul style="list-style-type: none"> ➤ Broken or intermittent transducer cable ➤ Non-compatible transducer ➤ Improper wiring of the transducer cable ➤ Improper installation of the transducer cable ➤ Faulty transducer ➤ Faulty module
ON	FLASHING	CLEARABLE TRANSDUCER FAULT There is a transducer fault that can be cleared with a <i>Clear Errors</i> command from the backplane. 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 is operating without any faults. The transducer is operating properly.

Table 2.1 Status LED's



Transducer Input Connector

The Transducer Input Connector has eight contacts. The mating connector for the 2541 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. See *figure 2.3, C1TP-(x) Wiring Diagram* below for the mating connector part numbers.

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

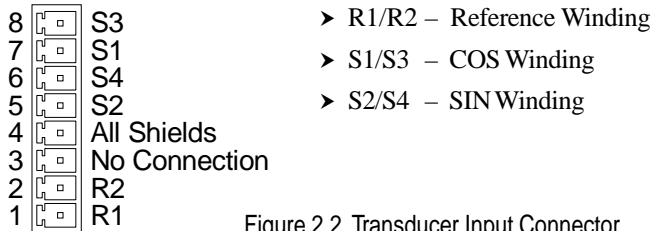


Figure 2.2 Transducer Input Connector

Transducer Cable Installation

Pre-assembled and tested cables are available from AMCI under the part number *C1TP-(x)*, where (x) is the length in feet. Figure 2.3 is a wiring diagram of the *C1TP-(x)* cable.

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.
- 2) The shields of the transducer cable must be grounded at the 2541 module *only!* When installing the cable, treat the shield as a signal 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 SLC.

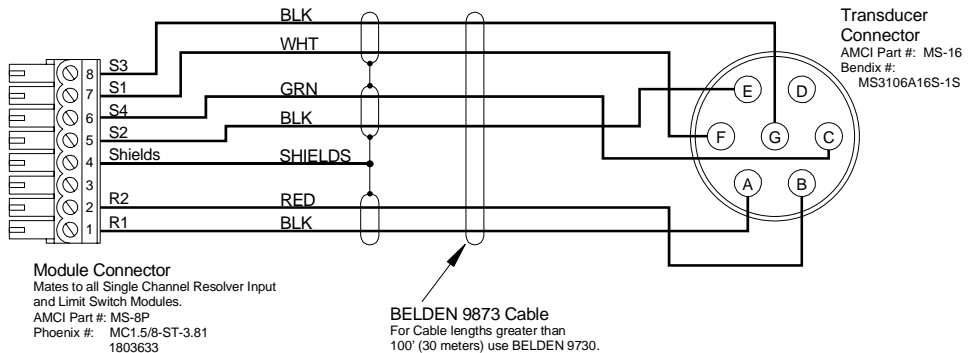


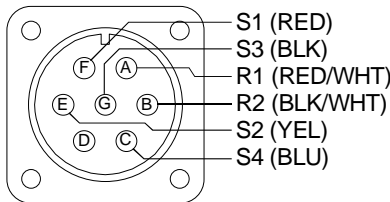
Figure 2.3 C1TP-(x) Wiring Diagram

Transducer Specifications

The following table contains mechanical and environmental specifications for all of the AMCI rotary position transducers that are compatible with the 2541.

Specification	All HT-20 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-sec [†]	4 oz-in-sec ²	2.1 x 10 ⁻⁴ oz-in-sec [†]
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 2.2 Transducer Specifications



S1 (RED) All of the AMCI transducers that are compatible with the
 S3 (BLK) 2541 have the same connector. The connector pin out to
 R1 (RED/WHT) industry standard wire designations is given in figure 2.4.
 R2 (BLK/WHT)
 S2 (YEL)
 S4 (BLU)

Figure 2.4 Transducer Connector Pin Out

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 HT-20 Transducers	100 lbs. (445 N)	50 lbs. (222 N)
All H25 Transducers	30 lbs. (133 N)	15 lbs. (66.7 N)
All Other Transducers	4 lbs. (17.8 N)	2 lbs. (8.9 N)

Table 2.3 Transducer Bearing Loads

Transducer Mounting (continued)

- ▶ Minimize shaft misalignment when direct coupling shafts. Even small misalignments produce large loading effects on front bearings. It is recommended that you use a flexible coupler whenever possible.
- ▶ The transducer housing must be connected to Earth Ground. This is usually accomplished through its mounting. If not properly grounded through its mounting, run a heavy gauge wire from the transducer housing to an Earth Ground point as close as possible to the transducer.

Transducer Outline Drawings

AMCI offers a broad line of resolver based transducers for use with the 2541 module. Outline drawings of selected transducer are included here in the manual. Listed below are the transducer outline drawings that are not included. Contact AMCI if you need one of these outline drawings. They will be faxed to you upon request.

- ▶ R11X-J10/7 NEMA 1 Size 11 Resolver, 0.120" Shaft
- ▶ R11X-J12/7 NEMA 1 Size 11 Resolver, 0.188" Shaft
- ▶ HT-6 NEMA 13 R11X-J12/7 Resolver
- ▶ HT-20C NEMA 4X Stainless Steel Transducer
- ▶ H25FL & H25SL NEMA 4 Size 25 Transducers, Integral Cable

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

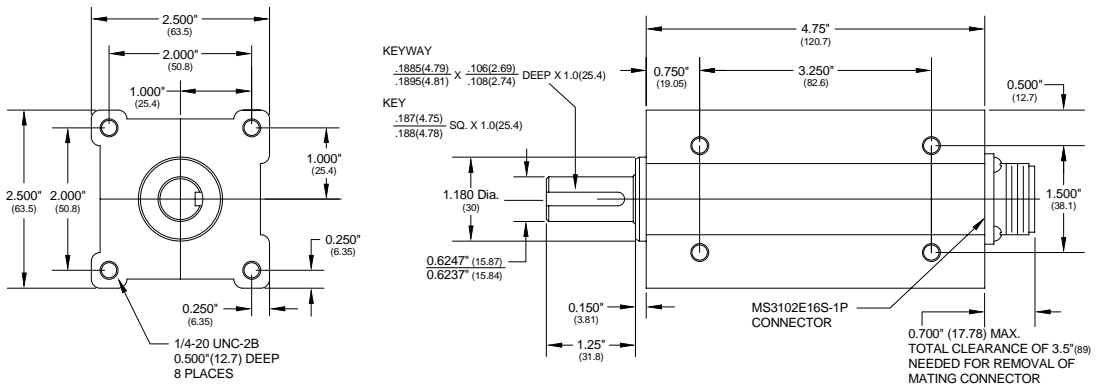


Figure 2.5 HT-20 Outline Drawing



AMCI Transducer Outline Drawings (continued)

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

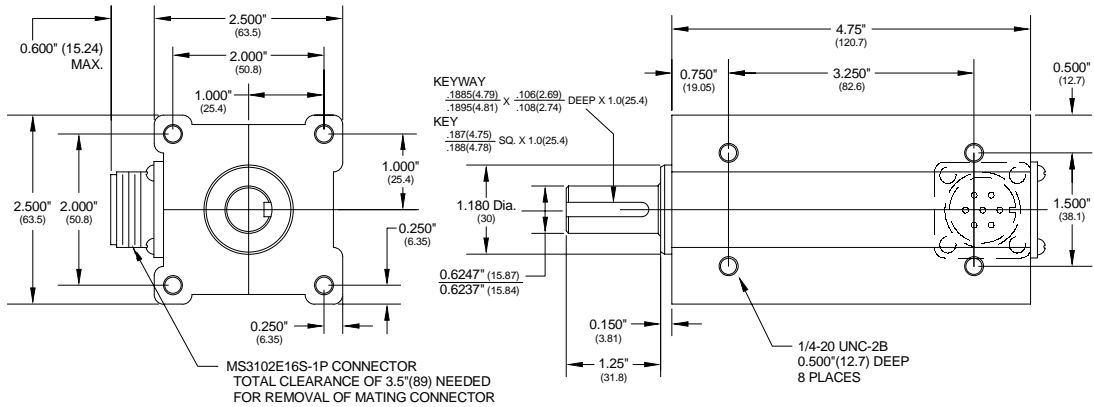


Figure 2.6 HT-20S Outline Drawing

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

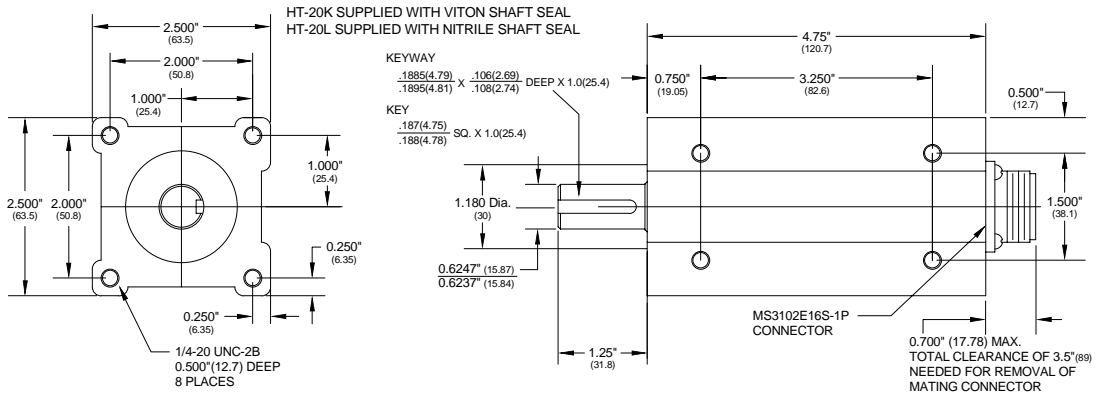


Figure 2.7 HT-20K Outline Drawing

Transducer Outline Drawings (continued)

H25SE & H25FE: Anodized Aluminum Body, 1070 Steel Shaft, NEMA 4

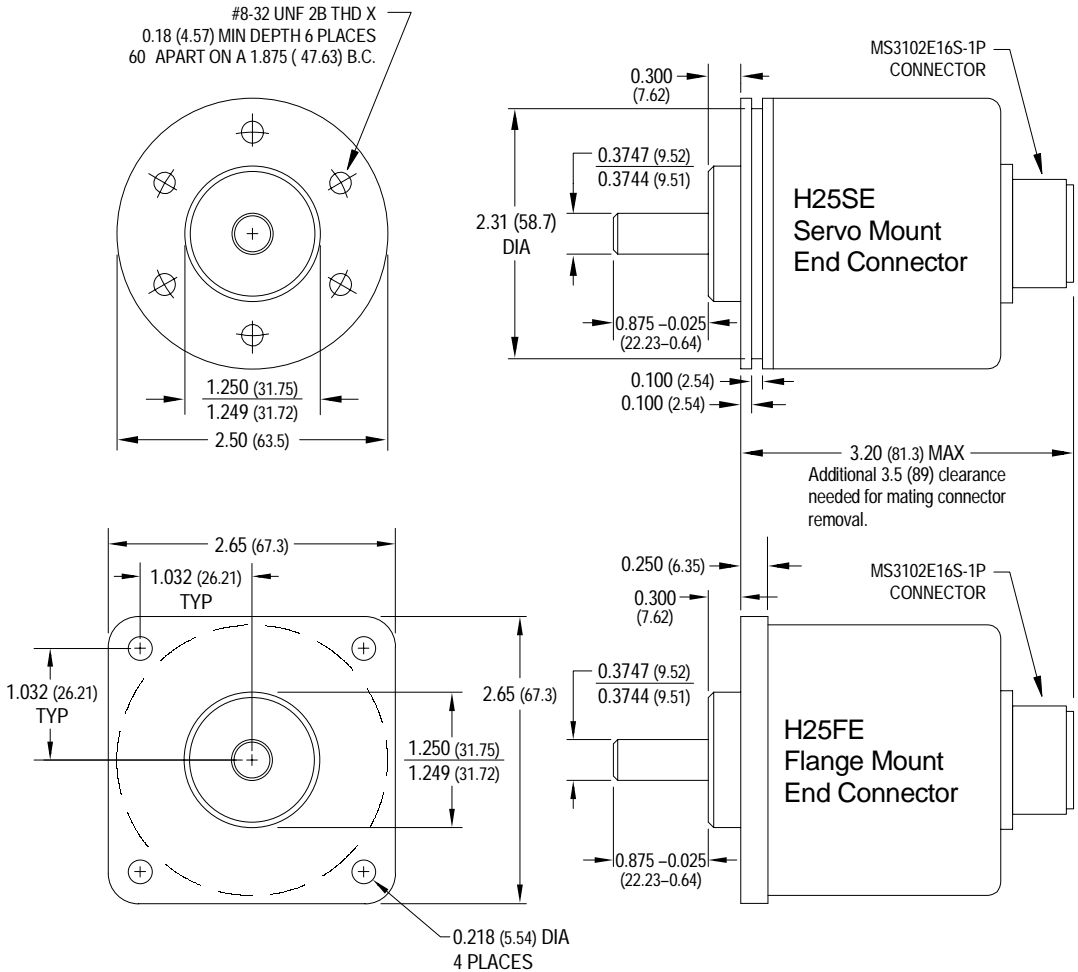


Figure 2.8 H25FE and H25SE Outline Drawing



Transducer Outline Drawings (continued)

H25SS & H25FS: Anodized Aluminum Body, 1070 Steel Shaft, NEMA 4

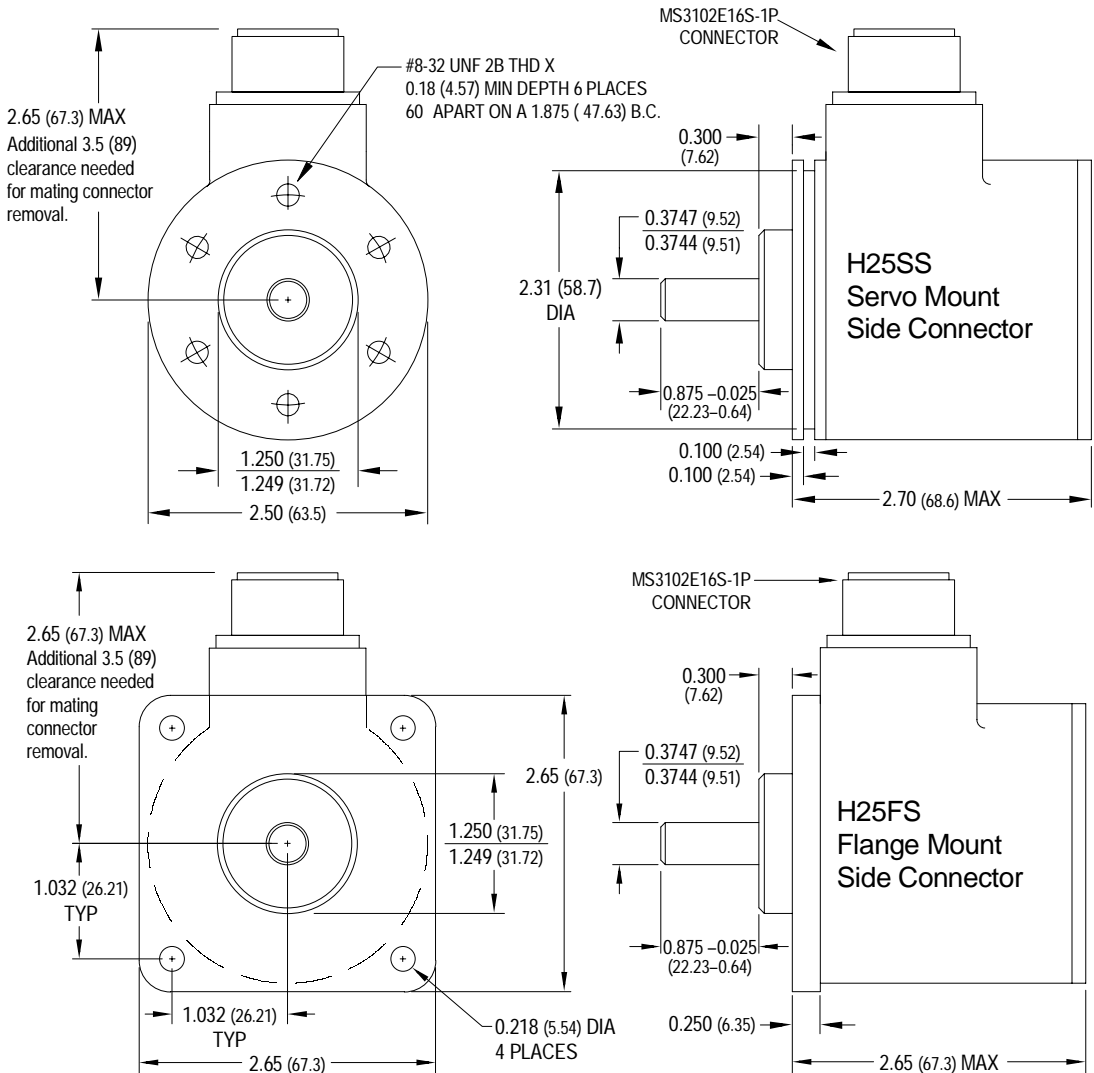


Figure 2.9 H25SS and H25SS Outline Drawing

Input Wiring

Input Connector

Figure 2.10 shows the pin out of the Input Connector and a simplified schematic of the Input 1. The schematics for the other inputs is identical. Note that pin one is at the top of the connector when plugged into the module, not at the bottom as it is with the Transducer Input Connector.

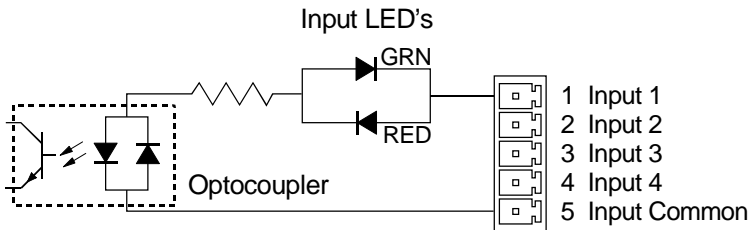


Figure 2.10 Input Connector Pin Out

Input LED's

There are eight LED's above the Input Connector that show the on/off status of the inputs. There are two LED's for each input. The LED that lights is dependent on how the inputs are wired, either as sinking or sourcing inputs.



Because the inputs share a single common, they must be all wired as the same type of input, either sinking or sourcing.

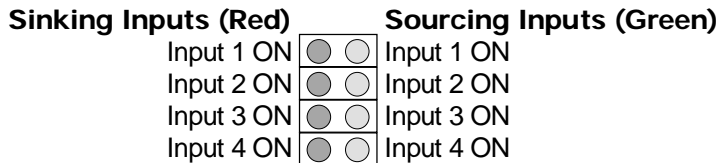


Figure 2.11 Input LED's

Input Wiring (continued)

Connector Wiring

Figure 2.12 shows how to wire the inputs as sourcing inputs. Wiring them as sinking inputs only involves switching the positive and negative power supply leads. Note that you cannot wire one input as a sourcing input and another as a sinking input. Because they share a common pin, they must all be wired as the same type.

The figure assumes that relays are used to activate the inputs. The note on setting the Input Active State parameters assumes that you want the limit switch output active when the relay is in its unpowered state. If you want the limit switch outputs active when the relays are powered, use the other state of the bit when programming the Input Active state parameters.

NOTE

Shielded cable should be used to help with noise immunity. Treat the shield as a signal carrying conductor and ground it *only* at the power supply. Do not ground the shield at junction boxes or the 2541 module. This will help to eliminate potential ground loops in your system.

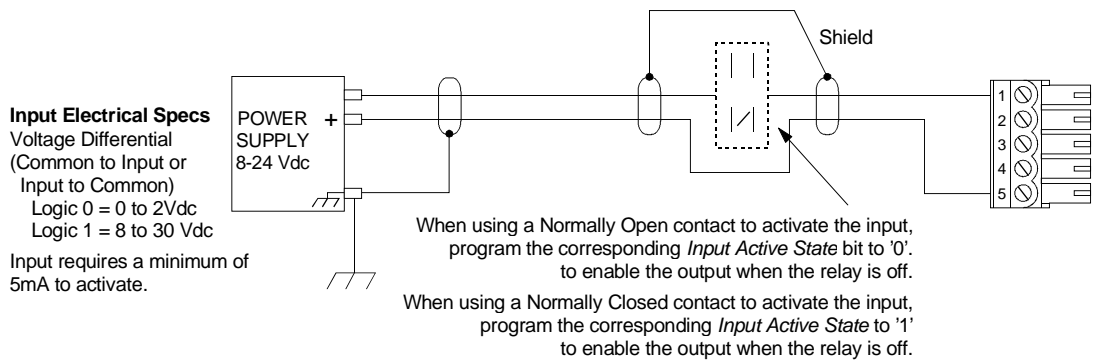


Figure 2.12 Input Wiring

Output Wiring

Output Connector

Figure 2.13 shows the pin out of the LS Output Connector and a simplified schematic of Output 1. The schematic for the other outputs is identical. Note that pin one is at the top of the connector, not at the bottom as it is with the Transducer Input Connector.

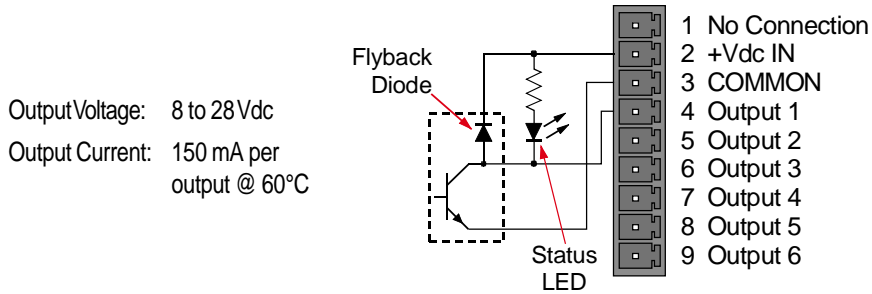


Figure 2.13 LS Output Connector Pin Out

The Flyback Diode is built-in protection for the driver against voltage spikes from mechanical relays or other inductive loads. However, you should still install a surge suppression device across any inductive load attached to the 2541. This will greatly decrease the amount of electrical noise generated by the load when it turns on and off. Note that your power supply must be attached to the +Vdc IN and COMMON terminals of the connector for the Flyback Diode to work properly.

The Status LED is one of the six numbered LED's on the front panel. It will turn on when the LS Output is on and your power supply is attached to the +Vdc IN and COMMON terminals of the connector.

ConnectorWiring

Figure 2.14 shows how to wire an output. The other five outputs are wired identically. Note that a single power supply must be used to power all of the outputs because they share power supply connections.

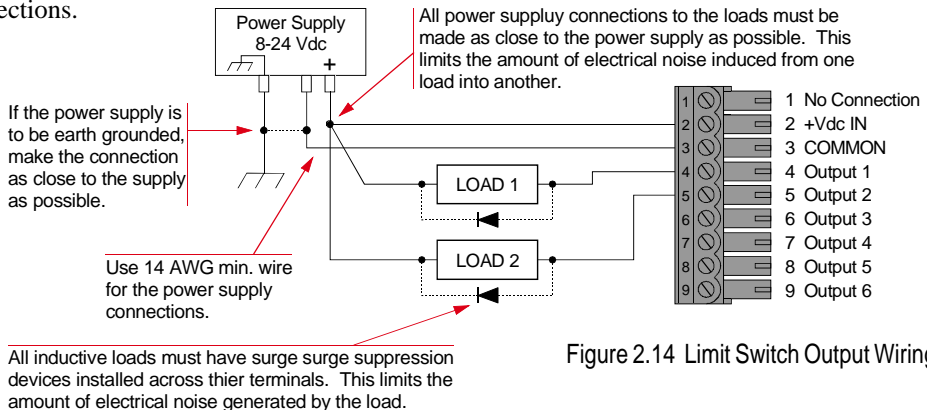


Figure 2.14 Limit Switch Output Wiring

Notes

BACKPLANE PROGRAMMING

A 2541 module communicates with the SLC processor through two 'M' files as well as the Output and Input Image Tables. The 2541 is configured with data stored in its M0 and M1 data files. The Output Image Table is used to quickly adjust limit switch setpoints and force the module's I/O on or off. The Input Image Table is used to transmit position, tachometer, and limit switch status as well as global error information. This chapter details how to use this data to configure and run the 2541 module.

File Addressing

In this chapter, file addresses are defined in the following manner:

I:X.n Input Image Table
O:X.n Output Image Table
M0:X.n M0 file
M1:X.n M1 file

Where: 'X' is the slot number of the 2541 and 'n' is the word number in the file. When referring to a specific bit in a word, the characters "/bb" will be appended where 'bb' is the bit address.

The M0 file has a total length of 120 words, and the M1 file has a total length of 650 words. If you are using AI software, you must use version 8.15+ to program the M file lengths correctly.

Programming Cycle

Programming changes are written to the module with a Programming Cycle. All parameters, except for I/O Forces, are programmed through Programming Cycles. Programming Cycles are controlled with a Transmit Bit and associated Acknowledge Bit. In order to simplify programming, the Programmable Parameters are broken down into two groups. Therefore, there are two Transmit / Acknowledge Bit pairs that control the three Programming Cycle that setup the module. A third Transmit / Acknowledge Bit pair controls the Limit Switch Increment / Decrement Programming Cycle.

A Programming Cycle consists of six steps.

- 1) Write the new data in the correct memory locations. The programming data is stored in one of the two M files or the Output Image Table.
- 2) Set the appropriate Transmit Bit. The 2541 will not act on the new programming data until the Transmit bit is set.
- 3) Once the 2541 is done with the programming data it will set the appropriate Acknowledge Bit and any necessary error bits.
- 4) Once your ladder logic sees the Acknowledge Bit set, check for any errors.
- 5) Reset the Transmit Bit after you've responded to any errors.
- 6) The 2541 responds by resetting the Acknowledge Bit. The Programming Cycle is complete.

Programming Groups

I/O Forces

I/O Forces are stored in the Output Image Table. The 2541 acts on these bits continuously. If one of these bits is set, the module will force the associated input or output within one processor scan time.

Setup Data: M0:X.0 – M0:X.19

All Transducer Setup Parameters and all Module Setup Parameters except for I/O Forces are stored in the M0 file between addresses M0:X.0 and M0:X.19. M0:X.0/15 is the Transmit Bit for this programming group. I:X.0/13 is the Acknowledge bit for this programming group.

Limit Switch Data: M1:X.0 – M0:X.629

All Limit Switch Setup Parameters are stored in the M1 file between addresses M1:X.0 and M1:X.629. M1:X.0/15 is the Transmit Bit for this programming group. I:X.0/15 is the Acknowledge bit for this programming group.

LS Increment / Decrement Data: O:X.0

This word in the Output Image Table give you the ability to increment or decrement limit switch setpoints while the machine is running to fine tune limit switch settings. O:X.0/15 is the Transmit Bit for the LS Increment / Decrement Data. I:X.0/12 is the Acknowledge Bit for the LS Increment / Decrement Data.

Error Handling

The 2541 stops accepting new parameters once it sets a programming error bit. How you respond to the error depends on your application. However, to reset the programming error in the 2541 you must go through a Programming Cycle with a Clear Errors bit set. Each programming group has a Clear Error bit that acts globally. Setting *any* of these bits will clear *all* of the errors in the module. Consider using the Clear Error bit in the Output Image Table. You do not need to write down any additional programming data when using this Clear Errors bit which give you the ability to write a single “Clear Errors” Programming Cycle that can be used at any time.

Input Image Table

Figure 3.1 shows the format of the Input Image Table data. I:X.0 contain Error and Acknowledge Bits. The other data words contain position and tachometer data as well as limit switch and Real Input status data.

		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	LSAck	0	SUAck	I/DAck	0	TachOv	MD2	MD1	TrFit	ModErr	MsgIgn	I/DSet	I/DNum	LSFit	0	SUFit	
Word 1	Machine Position Data																
Word 2	Tachometer Data (Scaled Value)																
Word 3	RESERVED: Set to zero.											LS Output Status LS6 LS1					
Word 4	RESERVED: Set to zero.																
Word 5	RESERVED: Set to zero.											Input Status IN4 IN1*					
Word 6	RESERVED: Set to zero.																
Word 7	RESERVED: Set to zero.																

Bit 0 = LS1, Bit 1 = LS2, Bit 4 = LS5, Bit 5 = LS6
 * Bit 0 = IN1, Bit 1 = IN2, Bit 2 = IN3, Bit 3 = IN4

Figure 3.1 Input Image Table Data Format

Status Bits

- SUErr:** Setup Error, I:X.0/00. Because parameter values are not stored in non-volatile memory, this bit is set on every power up. It is also set if there is an error in the setup programming data, M0:X.0 – M0:X.19, after a Programming Cycle tries to set these parameters. If this bit is set after a Programming Cycle, status bits in M0:X.100 – M0:X.109 show the exact error.
- LSErr:** Limit Switch Error, I:X.0/02. This bit is set if there is an error in the limit switch programming data, M1:X.0 – M1:X.629, after a Programming Cycle tries to set these parameters. Status bits in M1:X.630 – M0:X.649 show the exact error.
- I/DNum:** Inc/Dec Output Number Error, I:X.0/03. Set when the number of the Limit Switch output being incremented or decremented is invalid. Also set if you do not specify which setpoint, or both, of the setpoint pair you wish to change.
- I/DSet:** Inc/Dec Output Setpoint Error, I:X.0/04. Set when the limit switch output setpoint being incremented or decremented is invalid.

Input Image Table (continued)

Status Bits (continued)

- Msglgn:** Message Ignored, I:X.0/05. Set when you attempt to program any parameter, except I/O Forces, and a programming error exists.
- ModFlt:** Module Fault, I:X.0/06. The 2541 failed its power up self test. Cycle power to the module. If the fault remains, the 2541 must be returned to AMCI for repairs.
- TrFlt:** Transducer Fault, I:X.0/07. Set when there is a transducer fault. Most common causes are the transducer not being attached or faulty transducer cabling.
- MD1:** Motion Detect 1, I:X.0/08. Set when the transducer velocity, in RPM, is within the setpoints programmed into Motion Detector 1.
- MD2:** Motion Detect 2, I:X.0/09. Set when the transducer velocity, in RPM, is within the setpoints programmed into Motion Detector 2.
- TachOv:** Tachometer Overflow, I:X.0/10. Set when the scaled tachometer data in I:X.2 exceeds 32,767. Above this value, the SLC interprets the data as a negative value.
- I/Dack:** Limit Switch Increment /Decrement Acknowledge Bit, I:X.0/12.
- SUAck:** Setup Programming Acknowledge Bit, I:X.0/13.
- LSAck:** Limit Switch Programming Acknowledge Bit, I:X.0/15.

Output Image Table

The Output Image Table data is used to do the following:

- ▶ Word O:X.0 is used to increment or decrement limit switch setpoints. This gives you the ability to fine tune the setpoints while the machine is running.
- ▶ Words O:X.1 and O:X.3 are used to force any limit switch output on or off. You force an output by setting the appropriate bit. Force OFF bits take precedence over Force ON bits. For normal operation, these two words should equal 0000h.
- ▶ Words O:X.6 and O:X.7 are used to force the Real Inputs on or off. You force an input by setting the appropriate bit. Force OFF bits take precedence over Force ON bits. For normal operation, these two words should equal 0000h.

Output Image Table (continued)

Figure 3.2 shows the format of the Output Image Table data.

		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	I/DTMT	ClrErr	0	I/DSP	CgOFF	CgON	INC/DEC Setpoint Number				0	0	0	INC/DEC LS Number			
Word 1	RESERVED: Set to zero.											Force ON Bits LS6 LS1					
Word 2	RESERVED: Set to zero.																
Word 3	RESERVED: Set to zero.											Force OFF Bits LS6 LS1					
Word 4	RESERVED: Set to zero.																
Word 5	RESERVED: Set to zero.																
Word 6	RESERVED: Set to zero.											Force OFF IN4 IN1					
Word 7	RESERVED: Set to zero.											Force ON IN4 IN1					

Figure 3.2 Output Image Table Data Format

Status Bits

INC/DEC LS Number: O:X.0/02 – O:X.0/00. These three bits make up a binary number that is the number of the limit switch whose setpoints you want to change. The min/max. values are one and six. Setting these bits to a limit switch number that does not exist will result in an error. The error bit set is I/DNum, I:X.0/03.

INC/DEC Setpoint Number: O:X.0/09 – O:X.0/06. These four bits make up binary number that is the number of the setpoint pair you wish to adjust. Range of values is 1 to 9. Set these bits to 9 to change all of the setpoint pairs programmed on the output. Setting this number to 0, or greater than 9, or to a setpoint pair that is not programmed, will generate an error. The error bit set is I/DSet, I:X.0/04.

CgON: Change ON Setpoint, O:X.0/10. Set this bit to change the ON setpoint of the selected ON/OFF setpoint pair(s). This bit and the CgOFF bit can be set at the same time.

CgOFF: Change OFF Setpoint, O:X.0/11. Set this bit to change the OFF setpoint of the selected ON/OFF setpoint pair(s). This bit and the CgON bit can be set at the same time.

I/DSP: INC/DEC Setpoint, O:X.0/12. Set this bit to '0' to increment the selected setpoint(s). Set this bit to '1' to decrement the selected setpoint(s).

ClrErr: Clear Error Bit, O:X.0/14. When set to '1', the 2541 will clear all programming errors. It will also attempt to clear the transducer fault if one exists.

I/DTMT: Increment / Decrement Transmit Bit, O:X.0/15.

M0 File

The M0 File is broken down into two sections.

Setup Programming Data: M0:X.0 to M0:X.19. Used to preset the Machine Position as well as program all Transducer Setup Parameters and Module Setup Parameters except for the I/O Forces.

Setup Status Data: M0:X.100 to M0:X.109. Contains status data on the last Setup Programming Cycle.

M0 File / Setup Programming Data

Figure 3.3 shows the format of the Setup Programming Data. Word M0:X.0 contains bit value parameters, a Clear Errors bit and a transmit bit. The other words in the data contain the rest of the programmable parameters.

		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	SPTMT	0	0	0	0	0	0	0	0	0	TRsp	CDir	0	0	Preset	ClErr	
Word 1	Scale Factor (2 to 4,096)																
Word 2	Preset Value (0 to SF-1)																
Word 3	Machine Offset (0 to SF-1)																
Word 4	Motion Detector 1 Low RPM (0 to 32,767)																
Word 5	Motion Detector 1 High RPM (0 to 32,767)																
Word 6	Motion Detector 2 Low RPM (0 to 32,767)																
Word 7	Motion Detector 2 High RPM (0 to 32,767)																
Word 8	RESERVED: Must equal 000h													Input Active State			
Word 9	Tach Multiplier (0 to 1,100)																
Word 10	Tach Divisor (0 to 63, 0 only if Tach Mul. = 0)																
Word 11	Tach Decimal Point (0 to 3, Divide by 10 ^(DP))																
Words 12-19	RESERVED: Must equal 0000h																

In order to keep the Machine Position absolute, the Machine Offset must be set equal to the value stored in M0:X.101 before setting the Setup Data Transmit Bit.

Bit 0 = IN1, Bit 1 = IN2, Bit 2 = IN3, Bit 3 = IN4

Resetting the bit to '0' makes the input act like a normally closed relay. Setting the bit to '1' makes the input act like a normally open relay.

Figure 3.3 Setup Programming Data Format

M0 File / Setup Programming Data (continued)

Status Bits

- ClrErr: Clear Errors, M0:X.0/00. When set to '1', the 2541 will clear all programming errors. It will also attempt to clear the transducer fault if one exists.
- Preset: Preset Machine Position, M0:X.0/01. Set to '1' to preset the Machine Position to the Preset Value in word M0:X.2.
- CDir: Count Direction, M0:X.0/04. Set to '0' for CW increasing position count *when the transducer cable is wired as specified in this manual*. Set to '1' for CCW increasing position count. Note that is also possible to reverse count direction by reversing a pair of wires in the transducer cable.
- TResp: Tach Response, M0:X.0/05. Set to '0' for 504 mSec update time. Set to '1' for 120 mSec update time. This update time applies to the tachometer data reported over the backplane and the ON/OFF status of the motion detectors.
- SDTMT: Setup Data Transmit, M0:X.0/15.

M0 File / Setup Status Data

Figure 3.4 shows the format of the Setup Status Data. Word M0:X.100 contains detailed status bits of the last Setup Programming Cycle. A general error bit in the Input Image Table, SUErr, I:X.0/00, is set on any error in the Setup Programming Data. Your ladder logic should check this error bit first. If it is set, word M0:X.100 will set bits that help you pinpoint the error.

Word M0:X.101 is the calculated Machine Offset. This value changes every time the machine Position is preset. In order to keep the Machine Position absolute, you must copy this value into the Machine Offset word, M0:X.3, in the Setup Programming Data before performing a Setup Programming Cycle.

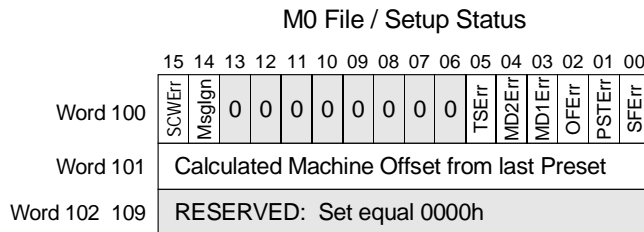


Figure 3.4 Setup Status Data Format

M0 File / Setup Status Data (continued)**Status Bits**

- SFErr: Scale Factor Error, M0:X.100/00. Set when the Scale Factor value is outside the range of 2 to 4,096.
- PSTErr: Preset Value Error, M0:X.100/01. Set when the Preset Value is outside the range of 0 to (SF-1).
- OFErr: Machine Offset Error, M0:X.100/02. Set when the Machine Offset value is outside the range of 0 to (SF-1).
- MD1Err: Motion Detector 1 Error, M0:X.100/03. Set if one or both Motion Detector 1 setpoints are outside the range of 0 to 32,767 or if the setpoint are equal but not zero.
- MD2Err: Motion Detector 2 Error, M0:X.100/04. Set if one or both Motion Detector 2 setpoints are outside the range of 0 to 32,767 or if the setpoint are equal but not zero.
- TSErr: Tachometer Scalars Error, M0:X.100/05. Set if the Tach Multiplier, Tach Divisor, or Tach Decimal Point are outside their programmable ranges.
- MsgIgn: Message Ignored, M0:X.100/14. Set when you attempt to program any parameter, except I/O Forces, and a programming error exists.
- SCWErr: Setup Command Word Error, M0:X.100/15. One or more of the reserved bits in M0:X.0 are set to '1'. These bits must always equal '0'.

M1 File / Limit Switch Programming Data

Figure 3.5 shows the format of the Limit Switch Programming Data. Word M1:X.0 contains a Clear Errors bit and the Limit Switch Transmit bit. The rest of the words are split into six blocks of nineteen words each. Each block programs one of the limit switch outputs.

Status Bits

ClrErr: Clear Errors, M1:X.0/00. When set to '1', The 2541 will clear all programming errors. It will also attempt to clear the transducer fault if one exists.

LSTMT: Limit Switch Transmit bit, M1:X.0/15.

		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	LSTMT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ClrErr
Word 1	RESERVED: Must equal 0000h																
Word 2-20	Limit Switch 1 Programming Block																
Word 21-39	Limit Switch 2 Programming Block																
Word 40-58	Limit Switch 3 Programming Block																
Word 59-77	Limit Switch 4 Programming Block																
Word 78-96	Limit Switch 5 Programming Block																
Word 97-115	Limit Switch 6 Programming Block																
Word 116-629	RESERVED: Must equal 0000h																

Figure 3.5 Limit Switch Programming Data

M1 File / Limit Switch Programming Data (continued)

Limit Switch Programming Block

The six blocks program the six limit switch outputs. The format of each block is identical. A single block is shown in figure 3.6.

M1 File / Limit Switch Data																
	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word N	0	Motion ANDing	0	0	0	0	0	0	0	0	0	0	0	0	LS Type	
Word N+1	ON Advance (-99.9 mS max. 0.1 mS Steps)															
Word N+2	OFF Advance (-99.9 mS max. 0.1 mS Steps)															
Word N+3	Normal: ON Setpoint 1				OR				Timed: ON Setpoint 1				OR			Pulsed: Leading Edge
Word N+4	Normal: OFF Setpoint 1								Timed: OFF Setpoint 1							Pulsed: Trailing Edge
Word N+5	Normal: ON Setpoint 2								Timed: Duration in mS							Pulsed: Pulse Quantity
Word N+6	Normal: OFF Setpoint 2								Timed: Not Used							Pulsed: ON Count
Word N+7	Normal: ON Setpoint 3								Timed: Not Used							Pulsed: Not Used
Word N+8	Normal: OFF Setpoint 3								Timed: Not Used							Pulsed: Not Used
Word N+9	Normal: ON Setpoint 4								Timed: Not Used							Pulsed: Not Used
Word N+10	Normal: OFF Setpoint 4								Timed: Not Used							Pulsed: Not Used
Word N+11	Normal: ON Setpoint 5								Timed: Not Used							Pulsed: Not Used
Word N+12	Normal: OFF Setpoint 5								Timed: Not Used							Pulsed: Not Used
Word N+13	Normal: ON Setpoint 6								Timed: Not Used							Pulsed: Not Used
Word N+14	Normal: OFF Setpoint 6								Timed: Not Used							Pulsed: Not Used
Word N+15	Normal: ON Setpoint 7								Timed: Not Used							Pulsed: Not Used
Word N+16	Normal: OFF Setpoint 7								Timed: Not Used							Pulsed: Not Used
Word N+17	Normal: ON Setpoint 8								Timed: Not Used							Pulsed: Not Used
Word N+18	Normal: OFF Setpoint 8								Timed: Not Used							Pulsed: Not Used

Figure 3.6 LS Programming Block Format.

Parameter Values

LS Type, M1:X.N/01 & M1:X.N/00. Sets the Limit Switch Type Parameter for the output.

Bit 1	Bit 0	
0	0	LS Output not used.
0	1	Pulse LS Output
1	0	Timed LS Output
1	1	Normal LS Output

Motion ANDing, M1:X.N/14 & M1:X.N/13. Sets the Motion ANDing Parameter for the output.

Bit 14	Bit 13	
0	0	Motion ANDing not used
0	1	AND with MD1
1	0	AND with MD2
1	1	RESERVED, Do not use.

M1 File / Limit Switch Programming Data (continued)**ParameterValues (continued)**

ON Advance, M1:X.N+1. Sets the value of the outputs ON Advance. Range is ± 99.9 mSec with 0.1 mSec resolution (± 999 counts)

OFF Advance, M1:X.N+2. Sets the value of the outputs OFF Advance. Range is ± 99.9 mSec with 0.1 mSec resolution. (-999 to +999)

The meaning of the remaining words depends on the type of output being programmed.

All ON / OFF Setpoints are programmable from 0 to SF-1.

Timed Output Duration, M1:X.N+5. Programmable to 9.999 seconds with 1 mSec resolution. (0 to 9,999)

Pulsed Leading/Trailing Edges, M1:X.N+3 & N+4. Setpoints that set the leading edge and trailing edge of the pulse train. Programmable from 0 to SF-1.

Pulsed Pulse Number, M1:X.N+5. The number of pulses in the pulse train.

Pulsed ON Count, M1:X.N+6. The number of counts each pulse is on. The difference between the Leading and Trailing Edge setpoints must be greater than or equal to $((\text{Pulse Qty} * \text{ON Count}) + (\text{Pulse Qty} - 1))$.

M1 File / Limit Switch Status Data

Figure 3.7 show the format of the Limit Switch Status Data. Word M1:X.630 contains detailed status bits on the last LS Programming Cycle. A general error bit in the Input Image Table, LSErr, I:X.0/02, is set on any error in the LS Programming Data. Your ladder logic should check this error bit first. If it is set, M1:X.630 will set bits that help you pinpoint the error.

When the error involves a limit switch, Word M1:X.631 contains the LS Number that has the error. If the error involves limit switch setpoints, Word M1:X.632 contain the number of the setpoint pair that has the error.

		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 630	LOWEr Misalign	0	0	0	0	0	0	LSDis	0	0	POErr	NTErr	TmdErr	AdvErr	OffErr	OnErr	
Word 631	Output Error Number																
Words 632	Setpoint Error Number																
Words 633-649	RESERVED: Set equal to 0000h																

Figure 3.7 LS Status Data

Status Bits

- OnErr:** ON Setpoint Error, M1:X.630/00. Set when an ON setpoint is outside the range of (0 to SF-1). Check Words M1:X.631 & 632 for Output and Setpoint numbers.
- OffErr:** OFF Setpoint Error, M1:X.630/01. Set when an OFF setpoint is outside the range of (0 to SF-1). Check Words M1:X.631 & 632 for Output and Setpoint numbers.
- AdvErr:** Advance Error, M1:X.630/02. Set when an Advance is outside the range of ± 999 . Check Word M1:X.631 for the Output number.
- TmdErr:** Timed Duration Error, M1:630/03. Set when an Timed Duration is outside the range of (0 to 9999). Check Word M1:X.631 for the Output number.
- NTErr:** Number of Timed Outputs Exceeded, M1:X.630/04. Set when you try to program more than four Timed outputs. Word M1:x.631 contains the Output number of the fifth limit switch programmed as a Timed output.
- POErr:** Pulsed Output Error, M1:X.630/05. There is an error with one or more of your Pulsed Output Parameters. The difference between the Leading and Trailing Edge setpoints is less than $((\text{Pulse Qty} * \text{ON Count}) + (\text{Pulse Qty} - 1))$.
- LSDis:** LS Disabled, M1:X.630/08. Set to '1' when the outputs are disabled because the 2541 has not been configured or a transducer fault exists.

M1 File / Limit Switch Status Data (continued)

Status Bits (continued)

MsgIgn: Message Ignored, M1:X.630/14. Set when you attempt to program LS Setup Parameters while an error exists.

LCWErr: LS Command Word Error, M1:X.630/15. Set under three conditions:

- 1) One or more of the reserved bits in M1:X.0 are set to '1'. They must always equal zero.
- 2) You set both Motion ANDing bits in the Limit Switch Programming Block to '1'. You cannot assign both motion detectors to a single limit switch.

AMCI

ADVANCED MICRO CONTROLS INC.

20 GEAR DRIVE, TERRYVILLE, CT 06786 T: (860) 585-1254 F: (860) 584-1973

amcicontrols.com



LEADERS IN ADVANCED CONTROL PRODUCTS