User Manual

7561
SSI Interface Module

AMCI 7500

RUN ◇
FAULT ◇

AMCI

Allen-Bradley

SLC 500 I/O

Module
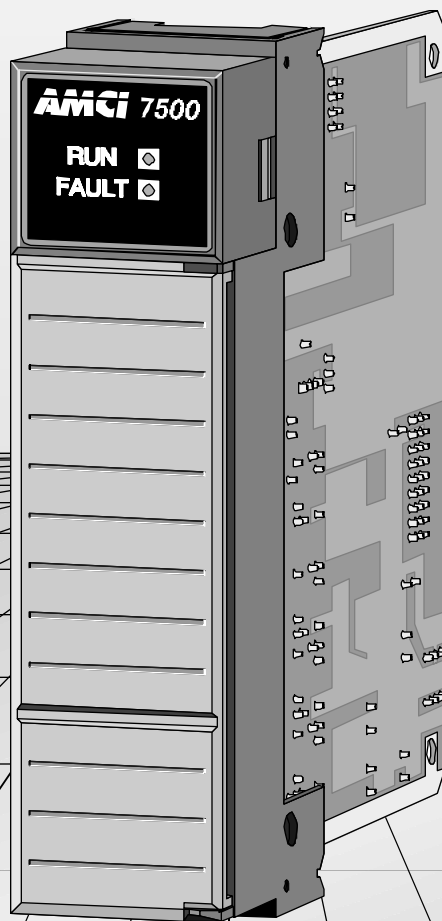
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ABOUT THIS MANUAL

Introduction

This manual explains the operation, installation, and programming of the 7561 SSI Interface Module for the Allen-Bradley SLC 500™ programmable controller systems. Designed specifically for linear displacement transducers that use the SSI protocol, the programmable features of the 7561 make it an efficient interface between any SSI transducer and the SLC 500 processor.

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

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

Revision Record

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

This manual, 940-55010, is the first release of the electronic version of this manual. It is the equivalent of the printed version, 940-05010. This manual corresponds to software revision 2. This software revision incorporates several new programmable features into the module that allow it to function as a general purpose SSI interface. Also, the format of the input and output data significantly changed from the first software revision.

ABOUT THIS MANUAL

Navigating Through This Manual

Bookmarks

The table of contents in the printed version of this manual has been entirely replaced with Acrobat™ bookmarks. To access the bookmarks, press the button here, or in the toolbar. The bookmarks will appear in a window to the left of the document. The bookmarks are multilevel, just like the table of contents in the printed version. Click on the arrows '▷' next to the bookmarks to expand or contract them. When you see the section you want to go to, click on the bookmark and the manual will jump to the correct page.

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INTRODUCTION

Overview

Utilizing licensed Allen-Bradley SLC500 I/O interface technology, the one slot 7561 SSI Interface Module accepts a single transducer input and plugs directly into the A-B SLC rack. The 7561 module reads and scales the data from any SSI transducer and also calculates the data's rate of change. The meaning of the *Data Value* and *Rate Of Change* information depends on the type of transducer attached to the 7561. A SSI pressure sensor reports a pressure value and the 7561 calculates the pressure change per second. A SSI position sensor reports a position value and the 7561 calculates the position change per second, which is the velocity, of the moving part.

Communicating through I/O registers assigned to the slot, the 7561 reports the Data Value, Rate Of Change, and actual SSI data to the SLC processor. The Data Value has a range of ±67,108,863 counts. The Rate of Change has a range from 0 to 67,108,863 counts per second.

One type of SSI transducer the 7561 can interface with is the linear displacement transducer (LDT). LDTs are non-contact, absolute linear measurement devices that offer high resolution and accuracy. The transducer tracks the absolute position of a magnet along its *waveguide*. LDTs can be manufactured with a waveguide length from 2 to 300 inches. There are two major manufacturers of SSI linear displacement transducers, Balluff and MTS. Presently, Balluff BTL-3 transducers offer a resolution and repeatability of up to 20 μm (0.0008") and an accuracy of up to 40 μm (0.0016"). MTS Temposonics III transducers offer a resolution and repeatability of up to 5 μm (0.0002") and an accuracy of up to 50 μm (0.002").

Figure 1.1 7561 Module

The SSI protocol defines a twenty five bit serial data stream from the transducer that is synchronized to clock pulses generated by the controller. In this case, the controller is the 7561 module. The cable length from the transducer to the controller dictates the maximum allowable clock frequency. In addition to the clock frequency, the SSI protocol specifies that all data is transmitted using RS-485 signals. However, the protocol does not specify the content, or format, of the data bits. The 7561 assumes the SSI data value is embedded somewhere in the twenty-five bits and that other information, such as error bits, may also be included.
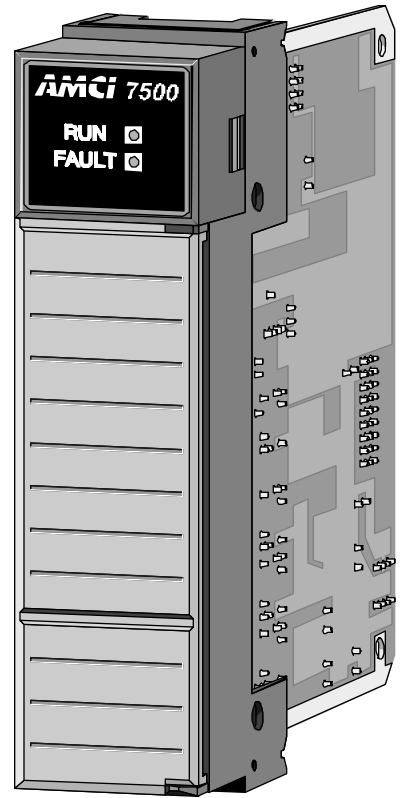
Overview (continued)

The 7561's *Programmable Parameters* are used to define where the SSI data is embedded in the bit stream and gives you the ability to scale this data. For example, assume that you are using a Balluff LDT that gives you one count per 20 μm. You can use the 7561 to scale this value to one count per 0.001" inch. The calculated Rate of Change is scaled to the same units as the Data Value. To continue the example, the Rate of Change (velocity), is scaled to thousandths of an inch per second. All parameter values are stored in non-volatile E²PROM memory.

Along with the scaled Data Value and Rate of Change information, the 7561 reports the actual SSI data to the SLC processor. This gives you the ability to use ladder logic to check the SSI data for any additional information it may contain, such as error bits.

SSI Protocol

Figure 1.2 shows how a 7561 module reads data from a SSI transducer. Note that the formal SSI definition considers Bit 25 to be a stop bit, which is always zero. However, AMCI is aware of some companies that are using Bit 25 as an information bit, either as part of the data or as an error bit. Therefore, AMCI reads and includes this bit value in the SSI data reported to the SLC processor.
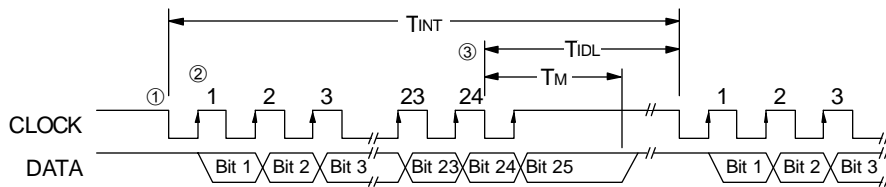
① The first falling edge of the clock signal latches the SSI data. Note: Some transducers latch the data at the end of the previous interrogation.

② The next 25 rising edges of the clock shift out the 25 data bits.

③ T_{INT} is the time between interrogations. T_{IDL} is the time between the end of the last interrogation and the start of the next. T_M is the time that Bit 25 is valid, which is typically 12 to 20 μS.The transducer must have new data available within the T_{IDL} time period if the system is to work properly. The table below gives the values of T_{INT} and T_M for the two different clock frequencies available with the 7561.

Clock$_{FRQ}$	T_{INT}	T_{IDL}
125 KHz	500μS	308μS
500 KHz	250μS	202μS

Figure 1.2 SSI Protocol

NOTE ▷ The formal SSI protocol definition includes a multi-word transfer capability. This is accomplished by holding the clock signal low for the T_M time period and restarting the clock. This signals the transducer to transfer additional bits of data instead of restarting at bit 1. The 7561 module does not support multi-word transfers.

Programmable Parameters

The 7561 module is setup by programming its *Programmable Parameters*. These parameters are broken down into two groups.

➢ **SSI Setup Parameters –** Five parameters that are used to extract the SSI data from the twenty-five bit stream. These parameters define the clock speed of the data transfer, the position and length of the SSI data within the bit stream, and the format of the data.

➢ **Data Setup Parameters –** Five parameters that affect the Data Value and Rate of Change information. These parameters allow you to scale the Data Value, preset it to a programmable count, and set the update time of the Rate of Change information.

SSI Setup Parameters

SSI Clock Frequency

This parameter allows you to set the SSI clock frequency to one of two values: 125 KHz or 500 KHz. The default value of 125 KHz will work in all applications. At this frequency, the 7561 updates the data to the processor every 500 μSec. At 500 KHz, the 7561 updates this data every 250 μSec. Therefore, it may be advantageous to increase the SSI clock frequency if you have a high speed application. Consult your transducer documentation to determine whether or not it will operate at 500 KHz. Remember that the maximum SSI clock frequency is dependent on the length of the transducer cable.

Number of Data Bits & MSB Number Parameters

As the examples show in figure 1.3, these two parameters tell the 7561 where the SSI data is embedded in the twenty-five bits. The Number of Data Bits parameter specifies the length of the data and the MSB Number parameter specifies the bit that starts the SSI data. The default value for the Number of Data Bits parameter is twenty-four. The default value of the MSB Number parameter is one.

SSI DATA BITS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

16 Bit Data Value   Number of Data Bits = 16
                          MSB Number =   9

20 Bit Data Value   Number of Data Bits = 20
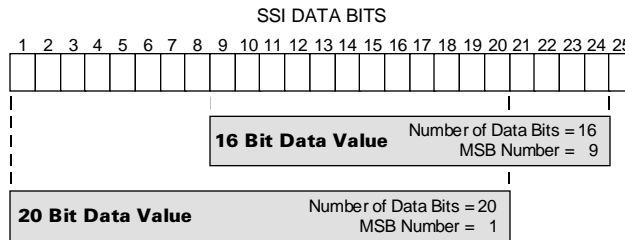   MSB Number =   1

Figure 1.3 Embedded Data Value

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

SSI Setup Parameters (continued)

Data Type

This parameter tells the 7561 to interpret the SSI data as a binary number or a gray code number. The default value is Binary.

Data Logic

This parameter is included to handle situations where the SSI data is reported with negative logic. If this parameter is set, the 7561 will assume the SSI data is reported with negative logic and will invert the data bits before performing any scaling.   The default value is positive logic. When this parameter is left at its default value, the 7561 will not invert the SSI data.

Data Setup Parameters

Once the 7561 has extracted the SSI data from the twenty-five bits, it uses the Data Setup Parameters to convert the raw SSI data into the Data Value it reports to the processor. The formula for determining the Data Value is:

Data Value = SSI Data $*$ (MUL / DIV) + LO

where: MUL = Scalar Multiplier
         DIV = Scalar Divisor
          LO = Linear Offset. The Linear Offset is an internal parameter that normally equals zero. The Linear Offset is changed when you preset the Data Value.

Scalar Multiplier & Scalar Divisor

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

Linear displacement transducers from Balluff and MTS have resolutions measured in μm/count. The 7561 can easily convert to a more familiar inch measurement system. The table below shows the Multiplier and Divisor values needed to convert from various metric resolutions to inch resolutions. For example, to convert data from a LDT with 5μm/count resolution to 0.0005"/count resolution, use a Multiplier of 50 and a Divisor of 127.

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

☐ = Desired resolution exceeds resolution of LDT.

Table 1.1 Scalar Values for Linear Measurement Conversion.

Data Setup Parameters (continued)

Preset Value

The Preset Value parameter gives you the ability to offset the Data Value. When you preset the Data Value, the 7561 calculates an internal parameter called the Linear Offset. The Linear Offset is the value needed to make the Data Value equal to the Preset Value. The default Preset Value is zero. Its range is ±33,554,432.

> **NOTE** ►
>
> 1) Programming this parameter does not change the Data Value. There is a separate command for presetting the Data Value to the Preset Value.
>
> 2) The 7561 will issue a Preset Error message if you attempt to program a Preset Value that is outside of its range.
>
> 3) Presetting the Data Value generates a *linear* offset. If you are using a rotary encoder and wish to preset the position, contact AMCI for assistance on developing the ladder logic needed to offset the Data Value in the SLC.

Count Direction

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

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

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

Data Setup Parameters (continued)

Count Direction (continued)

As an example, the following ladder logic segment reverses the count direction of a 3,600 count encoder. It uses the following registers:

> I:1.1,2: Holds the Data Value from the 7561. Assumes the 7561 is in slot 1.
>
> N7:20: Holds the number of encoder counts, which is 3,600 in this example.
>
> N7:21: Holds the combined Data Value.
>
> N7:22: Holds the reversed encoder count.

Because the Data Value can be greater than 32,767, it is transmitted to the processor in two words. This rung combines the two words and stores the value in N7:21. Note that if your encoder has less than 10,000 counts this rung can be replaced by a rung that copies I:1.2 to N7:21. Also note that the maximum encoder counts supported with this logic is 32,768.

```
                                                      ┌MUL──────────────┐
                                                      │MULTIPLY         │
                                                      │Source A:   I:1.1 │
                                                      │                0 │
                                                      │Source B:   10000 │
                                                      │                  │
                                                      │Dest:       N7:21 │
                                                      │                0 │
                                                      └─────────────────┘
                                                      ┌ADD──────────────┐
                                                      │ADD              │
                                                      │Source A:   N7:21 │
                                                      │                0 │
                                                      │Source B:    I:1.2 │
                                                      │             3500 │
                                                      │Dest:       N7:21 │
                                                      │             3500 │
                                                      └─────────────────┘
```

Reverse the count direction by subtracting the combined Data Value, N7:21, from the number of encoder counts that you stored in N7:20 and store the result in N7:22. This example assumes a 3,600 count encoder.

```
                                                      ┌SUB──────────────┐
                                                      │SUBTRACT         │
                                                      │Source A:   N7:20 │
                                                      │             3600 │
                                                      │Source B:   N7:21 │
                                                      │             3500 │
                                                      │Dest:       N7:21 │
                                                      │              100 │
                                                      └─────────────────┘
```

The zero count of the encoder is the same for either direction. Therefore, if the combined Data Value, N7:21, is zero, move a value of zero into the reversed count, N7:22. Register N7:22 is now ready to be used as the position value by the rest of the program.

```
┌EQU──────────────┐                                   ┌SUB──────────────┐
│EQUAL            │                                   │SUBTRACT         │
│Source A:   N7:21 │                                   │Source A:   N7:20 │
│              100 │                                   │             3600 │
│Source B:       0 │                                   │Source B:   N7:21 │
│                  │                                   │             3500 │
│                  │                                   │Dest:       N7:21 │
│                  │                                   │              100 │
└─────────────────┘                                   └─────────────────┘
```

Figure 1.4 Reversing Count Direction in Ladder Logic

Rate Update Time

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

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INSTALLATION

Power Requirements

The 7561 module draws its power from the I/O rack's +5Vdc supply. The maximum current draw is 0.215 amps. Therefore, the maximum current draw is 1.1 watt. Add this to the power 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 7561 module in any free slot, except for the processor slot of an expanded local rack, as long as power requirements are met.

1) Align the modules' 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.

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

Front Panel Description

Transducer Input Connector
Pin 1 at bottom

Figure 3.1
7651 Front Panel

Two LED's on the front panel shows the modules' operating status.

➤ **RUN –** This green LED is on when the module is operational.

➤ **FAULT –** This red LED is on when there is a module fault.

NOTE ☻ The 7561 considers all twenty-five SSI bits as data. Therefore, the 7561 cannot determine if there is a transducer error. If your SSI transducer has error bits embedded in the SSI data, your ladder logic should check these bits. They are available in the raw SSI data the 7561 transmits to the processor. If the transducer is not attached to the 7561, the SSI data will be all 1's. If you know that your SSI data can never be all 1's, use this as a check to see if the transducer is attached to the 7561.
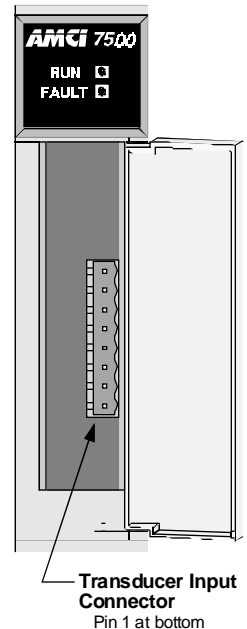
Module ID Code

All 7651's have an ID Code of 3535. This reserves 8 Input and 8 Output words for the module. When configuring the slot you can enter the 'SPIO CONFIG' menu and reduce the number of scanned Input and Output words to seven each. This will significantly decrease the access time for the module.

Compatible Transducers

The 7561 Module is compatible with any transducer that outputs serial data using the SSI protocol. The 7561 has been tested with both Balluff BTL-3 and MTS Temposonics III transducers.

Transducer Mounting

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

Transducer Power Supply

An external, isolated +24 Vdc supply is needed to power the SSI interface. The 7561 draws a maximum of 0.030 amps to power its opto-couplers. Add this to the current requirements of the transducer when sizing the +24 Vdc supply.

Transducer Cable Installation

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

➢ SSI signals are low voltage, low power signals. 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.

➢ The shields of the transducer cable must be grounded at the 7561 module *only!* When installing the cable, treat the shield as a conductor. Do not connect the shield to ground at any junction box or the transducer. This will eliminate ground loops that could damage the module or PLC.

Figure 3.2 is the pin-out of the 7561 Transducer Input Connector. The diagram also shows how to connect the external +24 Vdc supply to the module and color codes for transducer cables specified by Balluff and MTS.

Transducer Cable Installation (continued)

Module Connector
 AMCI Part #: MS-8
 Phoenix #:   MSTB2.5/8-ST-5.08

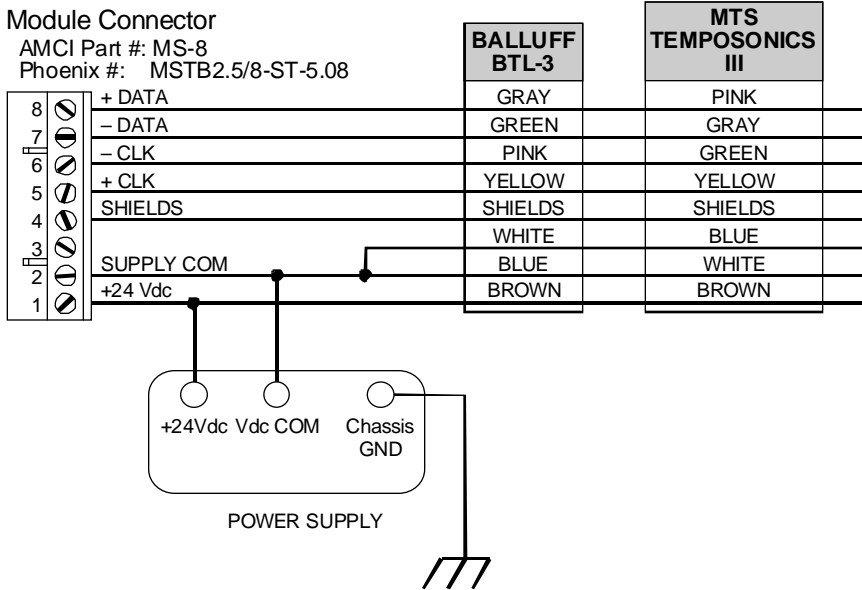| Pin	Signal	BALLUFF BTL-3	MTS TEMPOSONICS III
8	+ DATA	GRAY	PINK
7	– DATA	GREEN	GRAY
6	– CLK	PINK	GREEN
5	+ CLK	YELLOW	YELLOW
4	SHIELDS	SHIELDS	SHIELDS
3		WHITE	BLUE
2	SUPPLY COM	BLUE	WHITE
1	+24 Vdc	BROWN	BROWN

+24Vdc   Vdc COM   Chassis GND

POWER SUPPLY

Figure 3.2 7561 Connector Pin-out

Notes

BACKPLANE PROGRAMMING

A 7561 module communicates with the SLC processor through the Input and Output Image Tables. The Input Image Table is used transmit Status, Data Value, Rate of Change, and SSI data to the processor. The Output Image Table is used to setup the 7561 as well as adjust the Data Value from the processor. This chapter details the format of the data in the Input and Output Image Tables and how to program the 7561.

Data Addressing

Data addresses 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 7561 and 'n' in 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 Data Value can be preset, with a single Programming Cycle. Programming Cycles are controlled with the Transmit and Acknowledge Bits.

A Programming Cycle consists of six steps.

1) Write the new data in the correct Output Image Table words.
2) Set the Transmit Bit. The 7561 will not act on the new programming data until the Transmit bit is set.
3) Once the 7561 is done with the programming data it will set the 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 7561 responds by resetting the Acknowledge Bit. The Programming Cycle is now complete.

The 7561 checks the data is the order shown below.

1) Clear E²PROM Error
2) Number of Bits Parameter
3) MSB Number Parameter
4) Scalar Multiplier Parameter
5) Scalar Divisor Parameter
6) Preset Value Parameter
7) Rate Update Time Parameter
8) Preset Data Value to Preset Value

The SSI Clock Frequency, Data Logic, Data Type and Count Direction parameters are bit values that cannot be checked for errors. Both states of the bit are valid.

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 7561 accepts any changes.

Input Image Table

Figure 4.1 shows the format of the Input Image Table data. I:X.0 contains Error and Acknowledge bits. The other data words contain the Data Value, Rate of Change, and SSI data.
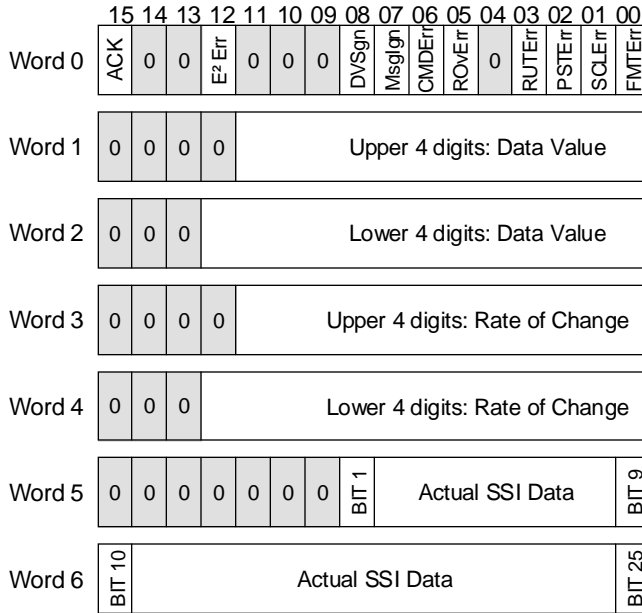

Figure 4.1 Input Image Table Data Format

Data Value and Rate of Change Format

The Data Value has a range of ±64,108,863 and the Rate of Change has a range of 0 to 64,108,863. Because the maximum number that will fit into one word is ±32,767, these two values are broken down into two words each. The Data Value sign bit is located at I:X.0/08 and is set to '1' if the Data Value is negative. For example, assume the Data Value equals –12,345,678. The number 1234 is transmitted in Input Word 1, the number 5678 is transmitted in the Input Word 2, and the sign bit, I:X.0/08, is set to '1'.

The Rate of Change information is the magnitude of the change only. It is a positive value regardless of the direction of change.

If your SLC processor supports floating point numbers, you can convert the Data Value or Rate of Change information with the following steps.

1) Floating Point Number = (Upper Word $*$ 10,000 + Lower Word)
2) For Data Value conversion only:
   If the sign bit = 1, then Floating Point Number = –1 $*$ Floating Point Number.

Input Image Table (continued)

Status Bits

FMTErr: Format Error, I:X.0/00. Set when there is an error with either the MSB Number or Number of Data Bits parameters. The MSB Number has a range of one to twenty-four. The Number of Data Bits parameter has a range of two to twenty-five. The sum of the two parameters cannot exceed twenty-six.

SCLErr: Scalar Error, I:X.0/01. Set when you attempt to program the Scalar Multiplier or Scalar Divisor parameters to a value outside of the range of 1 to 32,767.   It is also set when the desired ratio of the two would be greater than one.

PSTErr: Preset Error, I:X.0:02. Set if the Preset Value is set to a value outside its range of $\pm 33,554,432$.

RUTErr: Rate Update Time Error: I:X.0/03. Set if you attempt to program the Rate Update Time parameter to a value outside of its range of 1 to 1,000 milliseconds.

ROvErr: Rate Overflow Error: I:X.0/05. Set if the Rate of Change information exceeds 64,108,863 counts per second.

CMDErr: Command Error: I:X.0/06. Set under three conditions:

1) Your ladder logic attempts to program the module while the 7561 has a E²PROM memory fault.

2) No Command Bits, O:X.0/06–00, where set when the Program Cycle was initiated.

3) One or more of the bits specified as zero in Word O:X.0 or O:X.1 are set to one.

The Command Error bit is reset when valid instructions are sent to the 7561.

MsgIgn: Message Ignored: I:X.0/07. If an error bit is set, the error must be cleared by re-programming the incorrect parameter. This bit is set if you attempt to program a parameter with an incorrect value a second time.

DVSgn: Data Value Sign Bit: I:X.0/08. Set if the Data Value is negative.

E²Err: E²PROM Error: I:X.0/12. Set when there is a E²PROM memory error. This bit is set if the value of one or more parameters is corrupted in the E²PROM memory.

ACK: Acknowledge Bit, I:X.0/15. Set by the 7561 to acknowledge programming data from the processor. Error Bits in word I:X.0 are valid while this bit is set. The 7561 resets this bit after the processor resets the Transmit Bit.

Output Image Table

Figure 4.2 shows the format of the Output Image Table data. O:X.0 contains Command and Transmit bits. The other data words contain the values of the programmable parameters.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	TRMT	E² CLR	0	0	0	0	0	0	0	CntDir	PgmDir	RUT	PrstVal	Scalars	Format	PrstDV
Word 1	SSIClk	0	0	SSI Bit # of Data's MSB					DLogic	DType	0	Number of SSI Data bits			
Word 2	0	Scalar Multiplier														
Word 3	0	Scalar Divisor														
Word 4	PRESET SIGN	0	0	0	Upper 4 digits: Preset Value											
Word 5	0	0	0	Lower 4 digits: Preset Value												
Word 6	0	0	0	0	0	0	Velocity Update Time in mSec.									

Figure 4.2 Output Image Table Data Format

Command Bits

PrstDV: Preset Data Value, O:X.0/00. Set this bit to preset the Data Value to the programmed Preset Value. Note that you can program the Preset Value and preset the Data Value to the new Preset Value in a single Programming Cycle.

Format: Program Format Word, O:X.0/01. Set this bit to program the SSI Clock Frequency, MSB Number, Number of Data Bits, Data Logic and Data Type parameters. The new values for all of these parameters are stored in O:X.1.

Scalars: Program Scalars, O:X.0/02. Set this bit to program the Scalar Multiplier and Scalar Divisor parameters. The new value of the Scalar Multiplier is stored in word O:X.2 and the Scalar Divisor is stored in word O:X.3. The range of both values is 1 to 32,767 and the Scalar Multiplier must be less than or equal to the Scalar Divisor.

PrstVal: Program Preset Value, O:X.0/03. Set this bit to program the Preset Value to the value specified by words O:X.4 and O:X.5. Note that programming the Preset Value has no effect on the Data Value. To preset the Data Value, you must set the PrstDV bit, O:X.0/00.

Output Image Table (continued)

Command Bits (continued)

RUT: Program Rate Update Time, O:X.0/04. Set this bit to program the Rate Update Time to the value specified in word O:X.6. The valid range of the Rate of Change Update Time is 1 to 1,000 mSec.

PgmDIR: Program Count Direction, O:X.0/05. Set this bit to program the Count Direction parameter. The parameter value is stored in the Count Direction bit, O:X.0/06.

CntDir: Count Direction Value, O:X.0/06. When the Program Count Direction bit, O:X.0/05, is set, the 7561 programs the Count Direction based on this bit. When set to zero, the Count Direction is set to its default value of Positive. When this bit is set to one, the Count Direction is set to Negative.

E²CLR: Clear E²PROM Error, O:X.0/14. If there is a E²PROM error, setting this bit will clear the error and reset all of the parameters to their default values.

TRMT: Transmit Bit, O:X.0/15. A 0 → 1 transition on this bit initiates a Programming Cycle.

O:X.1: Format Word

Number of Data Bits, O:X.1/04–00. These five bits store the Number of Data Bits parameter. It valid range is two to twenty-five. Note that the 7561 will generate a 'Format Error' if the sum of the Number of Data Bits and MSB Number parameters exceeds twenty-six.

DType: Data Type Value, O:X.1/06. This bit stores the value of the Data Type parameter. When set to zero, the Data Type parameter is set to its default of Binary Data Type. When this bit is set to one, the Data Type parameter is set to Gray Code Data Type.

DLogic: Data Logic Value, O:X.1/07. This bit stores the value of the Data Logic parameter. When set to zero, the Data Logic parameter is set to its default of Positive Logic. When this bit is set to one, the Data Logic parameter is set to Negative Logic.

MSB Number, O:X.1/12–08. These five bits store the value of the MSB Number parameter. Its valid range is one to twenty-four. Note that the 7561 will generate a 'Format Error' if the sum of the Number of Data Bits and MSB Number parameters exceeds twenty-six.

SSIClk: SSI Clock Frequency, O:X.1/15. This bit stores the value of the SSI Clock Frequency parameter. When set to zero, the SSI Clock Frequency parameter is set to its default
of 125 KHz. When this bit is set to one, the SSI Clock Frequency parameter is set to 500 KHz.

Output Data Words (continued)

Preset Value Format

The Preset Value has a range of $\pm33,554,432$. Because the maximum number that will fit into one word is $\pm32,767$, the Preset Value is broken down into two words, O:X.4 and O:X.5. The Preset Value is transmitted in sign-magnitude format. Bit O:X.4/15 is the sign bit. For example, assume the Preset Value equals $-12,345,678$. First, set the data table radix to decimal. Enter the number 1234 in word O:X.4 and the number 5678 in word O:X.5. Next, switch the radix to binary and set Preset Value sign bit, O:X.4/15, to '1'.

Programming Example

Figure 3.3 is a three rung ladder logic example shows one way of programming the 7561 module. It is certainly not the only way of programming the module. The example uses the following addresses and assumes the module is located in slot 1 of the rack.

N:7.0/00: Manually set this bit to initiate data transfer to the 7561 module.

N:7.10–16: Holds the programming data to be written to the module.

O:1.0–6: Output Words of the 7561.

O:1.0/15: Address of the 7561 Transmit Bit.

I:1.0-6: Input Words of the 7561.

I:1.0/15: Address of the 7561 Acknowledge Bit.

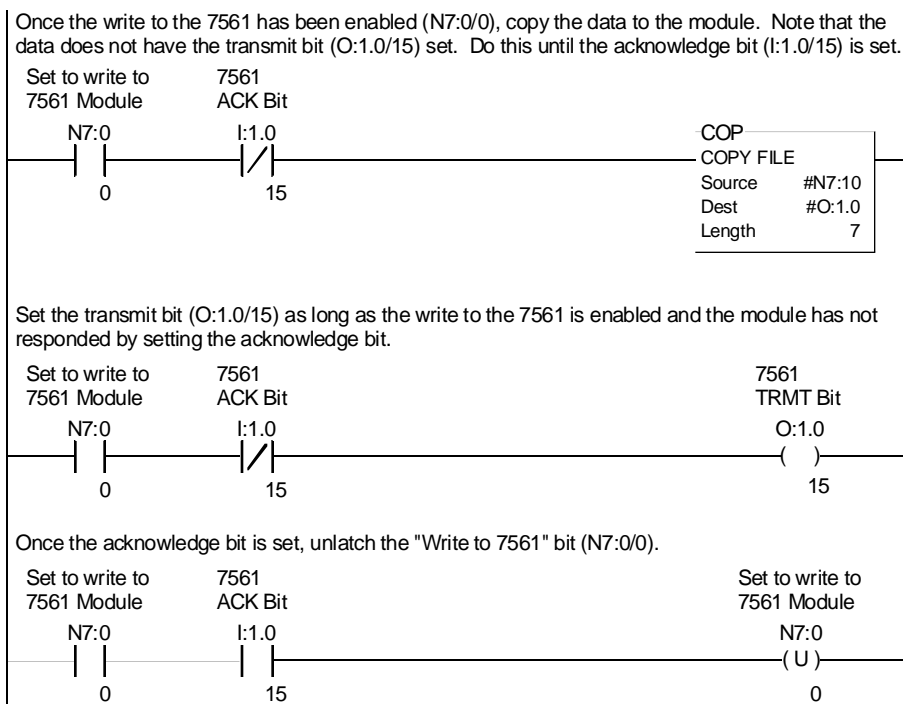Once the write to the 7561 has been enabled (N7:0/0), copy the data to the module. Note that the data does not have the transmit bit (O:1.0/15) set. Do this until the acknowledge bit (I:1.0/15) is set.

```
Set to write to       7561
7561 Module           ACK Bit
     N7:0              I:1.0                                    ┌─COP──────────────┐
  ───┤ ├──────────────┤/├──────────────────────────────────── │ COPY FILE        │
      0                 15                                      │ Source     #N7:10│
                                                               │ Dest        #O:1.0│
                                                               │ Length          7 │
                                                               └──────────────────┘
```

Set the transmit bit (O:1.0/15) as long as the write to the 7561 is enabled and the module has not responded by setting the acknowledge bit.

```
Set to write to       7561                                      7561
7561 Module           ACK Bit                                   TRMT Bit
     N7:0              I:1.0                                     O:1.0
  ───┤ ├──────────────┤/├─────────────────────────────────────( )───
      0                 15                                        15
```

Once the acknowledge bit is set, unlatch the "Write to 7561" bit (N7:0/0).

```
Set to write to       7561                                     Set to write to
7561 Module           ACK Bit                                  7561 Module
     N7:0              I:1.0                                     N7:0
  ───┤ ├──────────────┤ ├──────────────────────────────────────( U )───
      0                 15                                        0
```

Figure 3.3 Sample Ladder Logic Program

CAUTION The E²PROM is guaranteed for approximately 100,000 Programming Cycles before writing to it will cause a non-clearable E²PROM fault. Therefore, continuously presetting the Data Value or writing new parameters should be avoided. If you application requires you to continuously preset the Data Value, consider calculating and applying the required offset in the SLC program.

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