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MODICON
(MODBUS & MODBUS PLUS)
REFERENCE

IMPORTANT NOTES

1. READ ALL OF THE INFORMATION CONTAINED IN THIS MANUAL BEFORE YOU INSTALL THE PRODUCT.
2. The information contained in this manual applies to hardware and software version 1.0 or later.
3. This manual assumes a full working knowledge of the relevant PLC.

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Static, Inc.	(800-782-8424)	8000 Series bag
Charles Water	(617-964-8370)	CP-303 bag

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CONTENTS

Modbus

PREFACE

Read this preface to familiarize yourself with the rest of this Reference. This preface covers:

- who should use this guide
- what this Reference covers
- related documents
- terminal mode

Please read all the information in this reference before you install the product. The information contained in this reference applies to hardware and software version 1.0 or later.

Who Should Use This Reference

Use this Reference if you design, install, program, or maintain a control system that uses a Modbus or Modbus Plus network.

This reference assumes a full working knowledge of the relevant programmable controller (PLC).

You should have a basic understanding of Modbus and/or Modbus Plus products. If you do not, contact your local distributor for the proper training before using these products.

What This Reference Covers

This Reference covers the information needed to use the SOI-120 and SOI-260 operator interface products with a Modbus or Modbus Plus network. The Reference contains the information you need to install and program these products. It also provides troubleshooting help and information about the special operations that can be performed with the SOI-120 and SOI-260.

Related Documents

The following table lists related documents that may help you as you use these products:

Publication Number	Title
0300051	SOI-120 Operator Interface User Manual
0300050	SOI-260 Operator Interface User Manual
0300054	SOI-SPS Programming Software Manual

Terminal Mode

For information on each SOI's terminal mode, see the *SOI-120* and *SOI-260 Operator Interface User Manuals*.

In terminal mode, the SOI operates as a simple terminal: each key pressed on the SOI's keypad causes an ASCII character code to be sent out the SOI communications port. Displayable ASCII character codes sent into the communications port are displayed on the SOI screen.

CHAPTER 1: MODBUS CABLING & SPECIAL OPERATIONS

This chapter of the *Modicon PLC Reference* covers the cabling and communication parameters needed to use the SOI Communications Port and optional Printer Port (SOI-260 only).

These ports are used for uploading and downloading program files to and from a personal computer, as well as establishing communications with a PLC and a printer or other serial device.

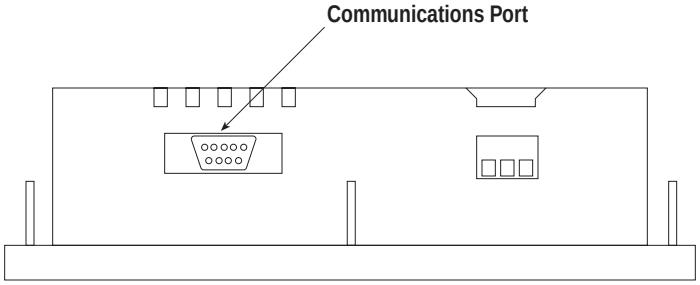


Figure 1.1 SOI-120 Communications Port.

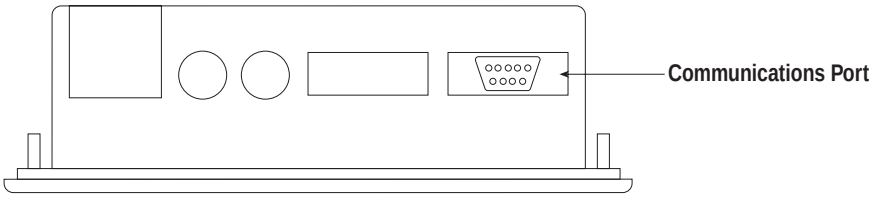


Figure 1.2 SOI-260 Communications Port.

This chapter also covers the SOI's Point-Access/Display (P-A/D) feature. The P-A/D feature gives you access to all unrestricted programmable controller address. With this access, addresses may be displayed and/or modified. This feature is extemely useful in start-up or debugging sessions or in regular programmable controller operations.

Using the Communications Port

The communications port may be used for:

- up/downloading application programs
- communicating with a PLC
- communicating with some other Modbus device

Up/Downloading Application Programs

The illustration below shows the up/download cable pin-outs for the RS-232 port. The diagrams indicate the required connections when building your own cable.

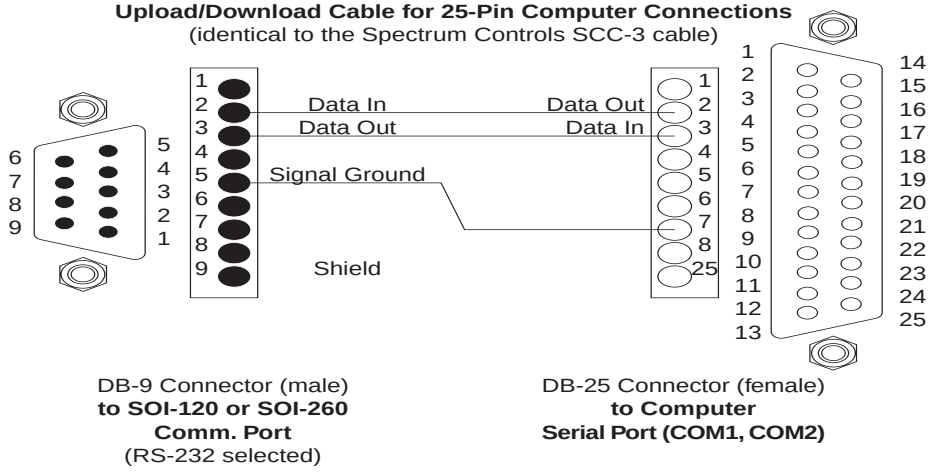


Figure 1.2 Upload/Download cable for 25-pin computer connections.

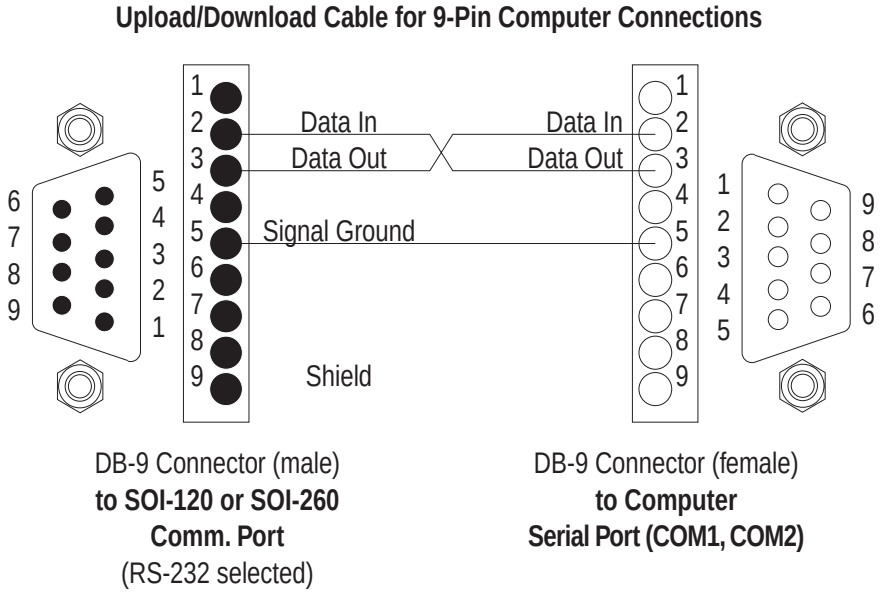


Figure 1.3 Upload/Download cable for 9-pin computer connections.

If you don't want to build your own cable, Spectrum Controls offers the SCC-3 cable for uploading and downloading application programs. The pin connections for the SCC-3 cable are identical to those shown in Figure 1.2. You may use the SCC-3 cable to connect the SOI-120's communications port or SOI-260's communications port or optional printer port to a personal computer. If your computer has a 9-pin communications port, you need a 25-to-9 pin adapter, shown in Figure 1.6. If you want to use the SOI-260's optional printer port for uploading and downloading applications, you also need a 9-pin female adapter, shown in Figure 1.7.

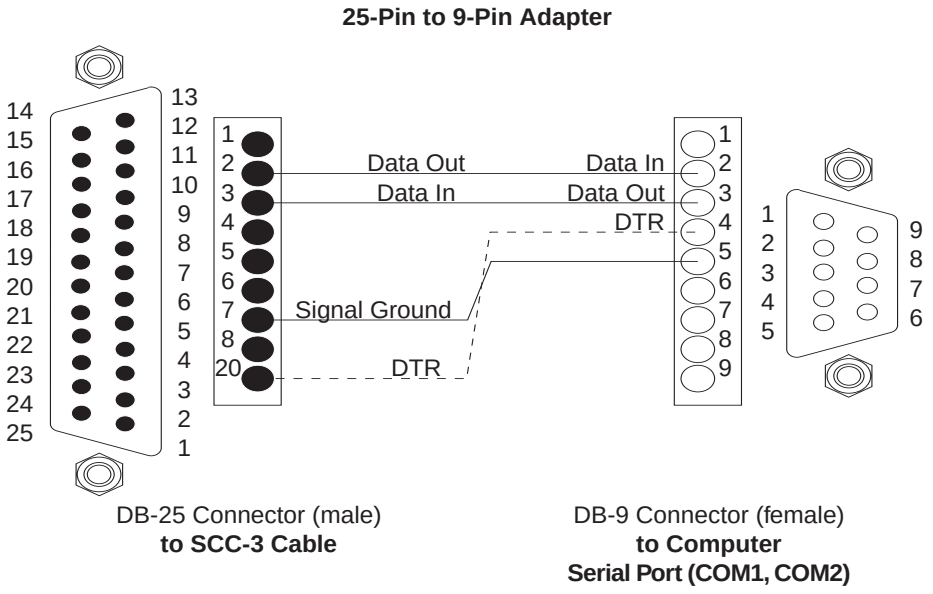


Figure 1.6 25-pin to 9-pin adapter.

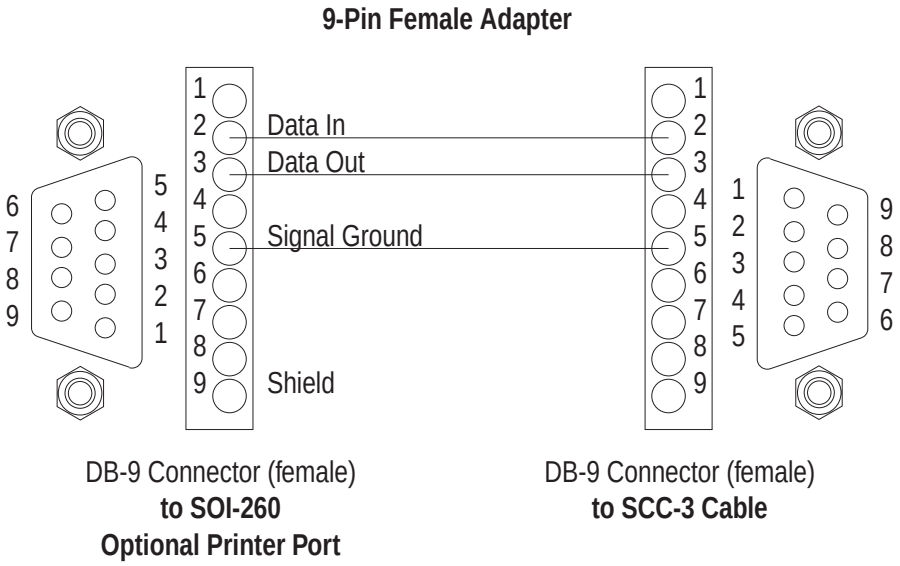
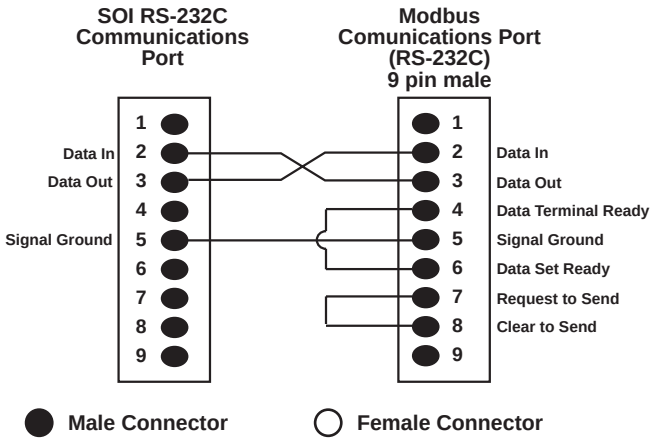


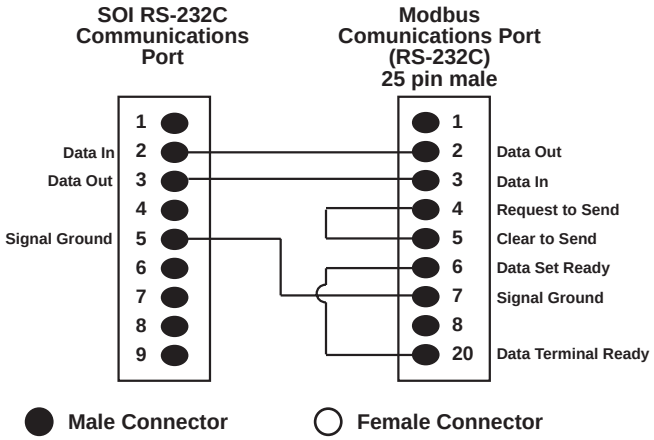
Figure 1.7 9-pin female adapter.

Communicating with a Modicon PLC

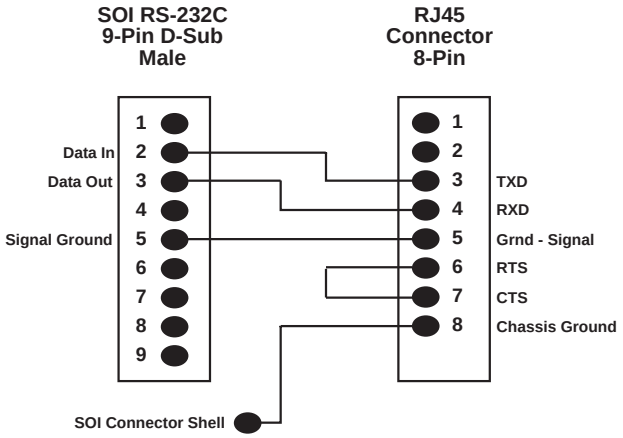
The SOI uses RS-232C connections between the SOI and the Modbus Communications port. The following illustrations show the connections from the SOI communications port to either a 9-pin Modbus port or a 25-pin Modbus port.

*Note: **The below cable diagrams support both the SOI-120 and SOI-260 products.***





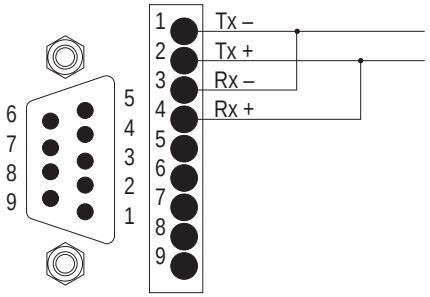
The illustration below shows the connections for a Modicon Micro PLC.



Communicating with 2-wire Modbus Devices

Some Modbus devices use 2-wire RS-485 connections. The cable diagram below shows the connections for a 2-wire RS-485 connection. When using a 2-wire RS-485 connection, you must set the communications port for RS-485 (see the *SOI-120* or *SOI-260 Operator Interface User Manual*) and you must enable 2-wire communications from the SOI-SPS programming software (see Chapter 2 in this Reference).

Communications Cable for 2-Wire RS-485 Connections



DB-9 Connector (male)
to SOI-260
Communications Port
(RS-485 mode)

Using the Printer Port (SOI-260 only)

The printer port has three basic functions:

- up/downloading application programs
- outputting printer forms
- accepting ASCII input

Up/Downloading Application Programs

The first function allows the printer port to be used for up/downloading application programs from a computer to the SOI. The following illustrations identify the cable pin-outs for the SOI communication port using the Spectrum Controls SCC-3 up/download cable (including adapters).

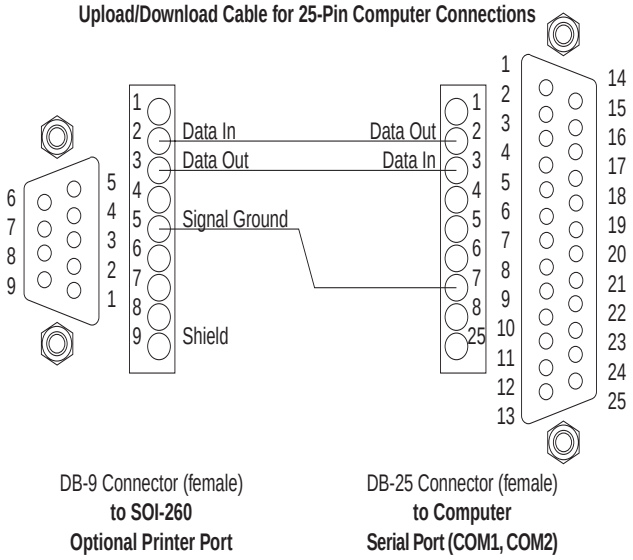


Figure 1.3 Upload/Download cable for 25-pin computer connections.

When using the SCC-3 cable for up/download through the printer port, a 9-to-9-pin female adapter must be used. A 9-to-9-pin female adapter is provided with the cable.

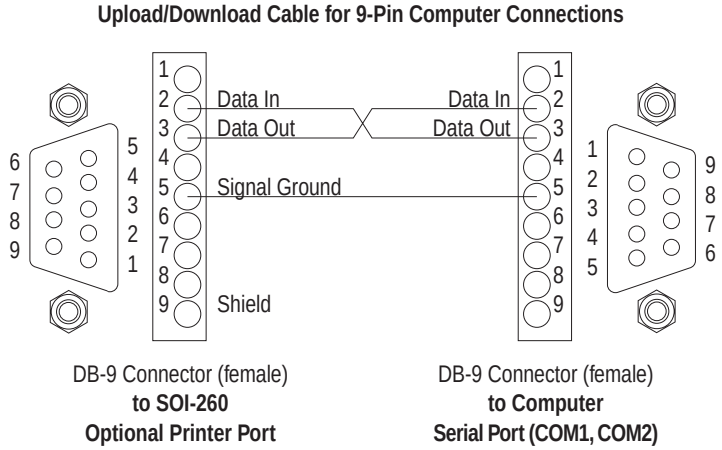


Figure 1.4 Upload/Download cable for 9-pin computer connections.

Outputting Printer Forms

The SOI-260's optional RS-232 printer port may also be used to output Printer Forms to a printer or other serial device, such as a large ASCII display unit. Printer forms are created in the SOI-SPS programming software and may include production reports, alarm messages, instructional text, etc.

Figure 1.11 illustrates the cabling needed.

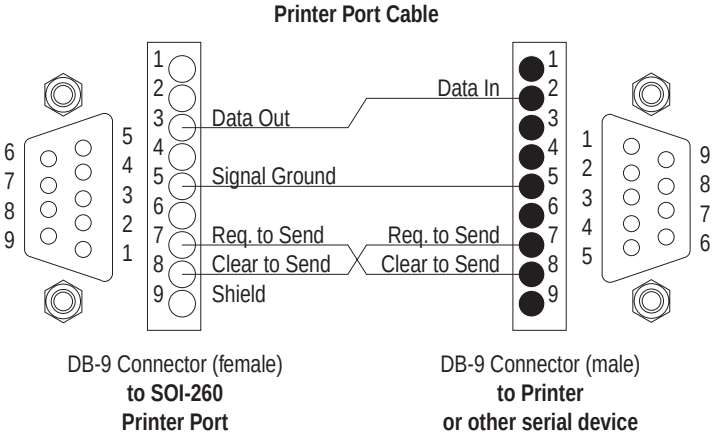


Figure 1.11 Printer port cable.

Accepting ASCII Input

The SOI-260's optional RS-232 printer port may also be used to accept ASCII data from a variety of devices, including bar code scanners. When using a scanner to read a bar code, the ASCII data is entered directly from the device into a standard data entry screen (created using the SOI-SPS programming software) on the SOI-260.

Note: ***If the SOI-260 recieves an odd number of characters from the scanner, the SOI-260 adds a Null character to create an even byte count. This facilitates word writes to the controller.***

If keypad entry is enabled, the operator can use it to enter data manually in the data entry field. The SOI-260 writes data to the controller when any of the following occurs:

- the SOI-260 receives an ASCII carriage return character
- the operator presses the SOI-260's Enter key
- the SOI-260 receives the maximum number of characters defined for that data entry field

For example, an operator can manually enter 2 characters and then scan a bar code containing 8 characters, with the last character being an ASCII carriage return. The SOI-260 then writes all 10 characters to the controller.

PLC Switch Settings

Special hardware switch settings are not normally required to establish communications between the SOI and the Modicon PLC. All SOI Operator Interface Products require DIP switch position 1 to be in the open or off state to establish communications with the PLC.

Point-Access/Display (P-A/D)

After pressing "MODE" (the mode key) on the SOI-120 or "F" (the function key) on the SOI-260, one of the menu items is labelled "Special". This menu item provides access to the *Point-Acess/Display (P-A/D) feature*.

CAUTION: The Point-Access/Display feature is a powerful tool. Its access should be restricted solely to authorized personnel. When using this feature, it is possible to change programmable controller data that may alter critical process control operations.

Note: After pressing "MODE" (SOI-120) or "F" (SOI-260), a Special Security Screen may be displayed (it has to be created with the SOI-SPS Programming Software). You must enter one of the three programmed security codes to continue to the Special Operations menu screen.

P-A/D on the SOI-120

When you access the P-A/D function, the Network Address Screen is displayed as follows (the MENU key will return you to the Function key menu):

```
Point Access/Display
1 CHG ADDR  2 BYPASS
```

- Enter 1 to edit the network address. The Address screen is then displayed. If you enter 2, the Address screen is not displayed. The address specified in the downloaded program file will then be used.

The Address screen appears as follows:

```
Enter address number
Address (1-255): 001
```

This screen allows you to enter the slave address that the P-A/D function is to access. This address may be different than that defined in the program file built by SOI-SPS. However, when you exit the P-A/D function the CPU address defined by the SOI-SPS program will be used.

*Note: **Modbus slave addressing may be configured within a range of 1 to 64. A 1 to 255 range is accepted here to provide support for Modbus Plus addressing when a Modbus to Modbus Plus bridge is used.***

Register Type Select Screen

The next screen that appears after you enter the slave address is the Register type Select screen (the MODE key will return you to the Address Screen):

```
Use PREV/NEXT & ENTER
COIL  000001-065535
```

- Press the PREV/NEXT keys to scroll to the next Register Type field.
- Press the ENTER key to select the register type that is currently displayed.

Bit Types

The following screen is presented for register selections of either Coils (0xxxxx) or Inputs (1xxxxx) types. Coil address selections, entry of addresses 000001 to 065535, produce the following screen.

```
000001-     CO      000001
065535   STATUS   OFF(0)
```

Input address selections, entry of addresses 100001 to 165535 will produce the following screen.

```
000001-      IN      000001
065535   STATUS   OFF(0)
```

Input addresses may only be monitored, not written or altered.

- Increment/decrement the number by pressing the F1 or F2 key.
- Press Enter to change the state fo the coils. Pressing enter again toggles the state ON or OFF. Note: for Input bits, you can't change the state. You can only read it.

Register Types, 16 bit

The display on the SOI-120 is a 2x20 character display and requires two different screens to access the Binary and Decimal/Hex fields. The following screens are displayed for Input Register selections, 300001 to 365535, or Holding Register selections, 400001 to 465535. Input Registers 300001 to 365535 are monitor only and cannot be modified.

When you select the Dec/Hex field, one of the following is displayed:

```
Point#    Decimal     Hex
300001     00000      0000
```

```
Point#    Decimal     Hex
400001     00000      0000
```

- Enter a new register address or increment/decrement the register address by pressing the F1 and F2 keys. When you press Enter, the Decimal and Hex equivalents for the data residing at the selected register is displayed in real time.

Note: The Hex field is for monitoring purposes only.

When you select the Binary field the following screen is displayed:

```
16...      HO400001      ...1
0000  0000   0000   0000
```

This screen allows you to monitor the Binary field.

Holding Registers 400001 to 465535 may be modified. When you select the Dec/Hex field the following screen is displayed:

```
Point#     Decimal     Hex
IN300001   00000       0000
```

- Increment/decrement the register address by pressing the F1 and F2 keys.
- Press the PREV or NEXT key to move to the fields to edit.
- To edit Decimal data, position the cursor at the decimal field and enter the new data.
- Press ENTER to load the new data into the displayed register.

Note: The Hex field is for monitoring purposes only.

When you select the Binary field the following screen is displayed:

```
16...          IN30001          ...1
0000   0000     0000    0000
```

- Increment/decrement the register address by pressing the F1 and F2 keys.
- Press the PREV or NEXT key to move to the fields to edit.
- To edit Binary data, position the cursor at the binary field and press ENTER. Press the + (plus) or - (minus) keys to toggle between 1 or 0 for Binary data, or enter the numeric value of 1 or 0 directly. Move left/right using the PREV or NEXT key.
- Press ENTER to load the new data into the displayed register.

Floating Point Registers

The following screen is displayed for Holding Register selections containing data in 32 bit floating point format. Two sequential holding register numbers are displayed.

```
POINTS   400001        400002
FP:              1.1234456E-30
```

- Enter the base register number (the middle number on the first line), or increment/decrement the base register (F1 or F2 key).
- Press the PREV or NEXT key to move to the fields to edit.

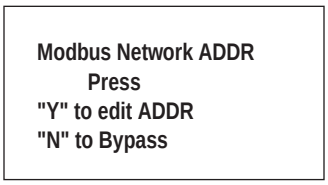
Note: To edit floating point data:

1. *Position the cursor at the mantissa field and enter the new mantissa.*
2. *Press ENTER, and then enter the exponent.*
3. *Press ENTER to load the new data into the displayed register.*

Only Holding Registers may be selected as Floating Point locations. The first line identifies the two registers used to determine the Floating Point data displayed on the second line. Floating Point numbers all comply with the IEEE754 standard.

P-A/D on the SOI-260

When you access the P-A/D function, the Network Address Screen is displayed as follows (the PREV MENU key will return you to the Function key menu):



- Enter *Y* to edit the network address. The Address screen is then displayed. If you enter *N*, the Address screen is not displayed. The address specified in the downloaded program file will then be used.

The Address screen appears as follows:

This screen allows you to enter the slave address that the P-A/D function is to access. This address may be different than that defined in the program file built by SOI-SPS. However, when you exit the P-A/D function the CPU address defined by the SOI-SPS program will be used.

Note: Modbus slave addressing may be configured within a range of 1 to 64. A 1 to 255 range is accepted here to provide support for Modbus Plus addressing when a Modbus to Modbus Plus bridge is used.

Register Type Select Screen

The next screen that appears after you enter the slave address is the Register type Select screen (the PREV MENU key will return you to the Function key menu):

```
Select Data Type
Use PREV/NEXT
Press enter to select
Coils          000001-065535
```

Note: The underlined data here indicates the data type and range field.

- Press the PREV/NEXT keys to scroll to the next Register Type field.
- Press the ENTER key to select the register type that is currently displayed.

Bit Types

The following screen is presented for register selections of either Coils (0xxxxx) or Inputs (1xxxxx). Coil address selections, entry addresses 000001 to 065535, produce the following screen.

```
CO          0XXXXX
Status: OFF(0)
Press ENTER key to
change Point state
```

Input address selections, entry addresses 100001 to 165535 will produce the following screen.

```
IN          1XXXXX
Status: OFF(0)
```

Input addresses may only be monitored, not written or altered.

- Enter the register number or increment/decrement the number by pressing the Y and N keys.

For Coils, when you press ENTER, the currently displayed point number's state will be changed to the opposite state and displayed.

Register Types, 16 bit

The following screen is displayed for Input Register selections, 300001 to 365535, or Holding Register selections, 400001 to 465535. Registers 300001 to 365535 are monitor only and do not support data modification. Register number entries other than 300001 to 365535 or 400001 to 465535 will be ignored.

```
Point      Decimal     Hex
H040001    bbbbb       cccc
16         Binary        1
dddd dddd dddd dddd
```

- Enter a new register address or increment/decrement the register address by pressing the Y and N keys. When you press ENTER, the Decimal, Hex, and Binary equivalents of the data residing at the selected register is displayed. The data is displayed in real time.

You can edit the Decimal or Binary data for selections of 400001 to 465535.

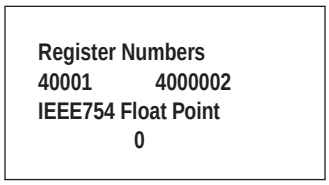
- Press the PREV or NEXT key to move to the fields to edit.

  To edit Decimal data, position the cursor at the decimal field and enter the new data. To edit Binary data, position the cursor at the binary field and press ENTER. Press the + (plus) or - (minus) keys to toggle between 1 or 0 for Binary data, or enter the numeric value of 1 or 0 directly. Move left/right using the PREV or NEXT key.

- Enter the data, and press ENTER to load the new data into the displayed register.

Floating Point Registers

The following screen is displayed for Holding Register selections containing data in 32 bit floating point format. Two sequential holding register numbers are displayed.



- Enter the base register number, left number on the second line, or increment/decrement the number (Y and N keys).

Only Holding Registers may be selected as Floating Point locations. The second line identifies the two registers used to determine the Floating Point data displayed on the fourth line. Floating Point numbers all comply with the IEEE754 standard.

CHAPTER 2: MODBUS PROGRAMMING

This chapter of the Modicon PLC Reference section addresses programming screen types, location definitions, and data formats used with the SOI-SPS programming software.

Supported PLC Registers

Register Types--Modbus

This section defines the register types supported by the SOI-SPS programming software for Modicon PLC applications. These point types are, by definition, bit and 16-bit register locations.

The SOI allows either 5-digit (traditional Modbus) or 6-digit (Quantum) addressing.

Data types	5-Digit (Modbus)	6-Digit (Quantum)
Coils (Discrete Outputs)	00001 to 08192	000001 to 065535
Inputs (Discrete Inputs)	10001 to 18192	100001 to 165535
Input Registers (16-bit Word)	30001 to 39999	300001 to 365535
Holding Registers (16-bit Word)	40001 to 49999	400001 to 465535
Holding Registers-Floating Point (32-bit Word)	40001 to 49999	400001 to 465535

Note: The PLC and its allocation determine the actual address range.

When using the SOI-SPS programming software, the software defaults to 5-digit (Modbus) addressing. If the user enters a 6-digit (Quantum) address, the software uses 6-digit (Quantum) addressing. If the user then enters a 5-digit (Modbus) address, the software returns to 5-digit (Modbus) addressing.

16-Bit Locations

Input Registers are reference only register types, data may not be written to these locations. Data from an Input Register location is comprised of 16 bits.

Holding Register location data may either be read from or written to. Holding Register data is comprised of 16 bits.

Single-Bit Locations

Inputs are reference only register types, data may not be written to these locations. Data from an Input location is a single bit data type.

Coil location data may either be read from or written to. Coil data is a single bit data type.

The specific address programming of the above supported register types is discussed later in this chapter.

Supported Data Formats

The data format selected for a particular Modicon PLC location must reflect the correct format as the data actually stored in that location. This is the only way you can ensure that correct, consistent information is displayed on the SOI products.

For example, selecting the 16-Bit Signed Integer format for location 40001 will display data in one way. Selecting the 16-Bit BCD format for the same location will display the data in another way. It is important to understand each data format and its characteristics.

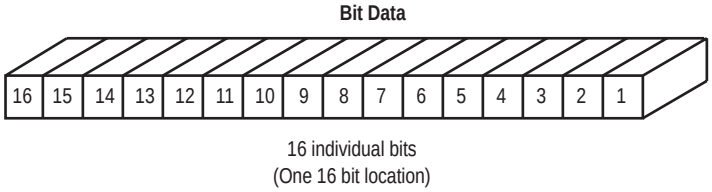
The following table illustrates all supported Data Formats, including the register types and ranges applicable to each format and whether the scaling feature may be applied to the format.

Data Format	Points	Range	Scaling
Bit	ALL	0,1,Y,N	N/A
16 Bit Signed Integer	3xxxxx or 4xxxxx	-32,768 to +32,767	YES
16 Bit Unsigned Integer	3xxxxx or 4xxxxx	0 to +65,535	YES
16 Bit BCD	3xxxxx or 4xxxxx	0 to +9,999	YES
16 Bit HEX	3xxxxx or 4xxxxx	0 to FFFF	NO
32 Bit Floating Point	4xxxxx	+/-1.2x10-38 to +/-3.4x1038	YES
32 Bit Unsigned Integer	3xxxxx or 4xxxxx	0 to +4,294,967,295	NO
32 Bit BCD	3xxxxx or 4xxxxx	0 to +99,999,999	NO
32 Bit HEX	3xxxxx or 4xxxxx	0 to FFFFFFFF	NO
ASCII	3xxxxx or 4xxxxx	20 chars (max.)	N/A

Bit data types may also be defined from 3xxxx and 4xxxx register locations as well as the Coil and Input locations. The bit number of the 3xxxx or 4xxxx register is defined as a bit 1-16 of the register.

The following descriptions define the above list of supported data formats for the Modicon PLC.

Bit

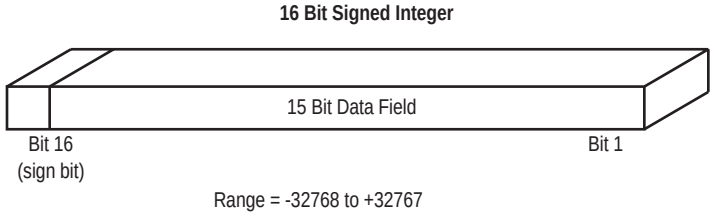


The PLC stores a binary (0 or 1) status for a bit location. The SOI will read a PLC bit location and determine whether the operational status of the bit is ON (1) or OFF (0). You can specify associated text to be displayed for either state of a specified bit. This description can be up to twenty characters.

For example, the OFF(0) state of a bit might display “Pump is OFF”, and the ON (1) state “Pump is ON”. SOI-SPS allocates enough screen characters for the longest of the two text strings. In this example, 11 characters would be allocated to display “Pump is OFF”.

- The fewer the characters used, the less memory is required. In the example above, displaying “OFF” (given the appropriate context) conveys the same information in 3 characters as “Pump is OFF” does with 11 characters.

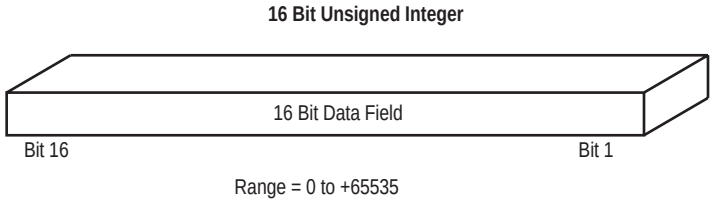
16-Bit Signed Integer



This data format displays a 16 bit register as a Signed Integer value. The 16th bit of the register is the sign bit and is set (1) for a negative and cleared (0) for a positive number.

- The 16 bit signed integer values have a range of -32768 to +32767. This data format may also be scaled to different engineering units.

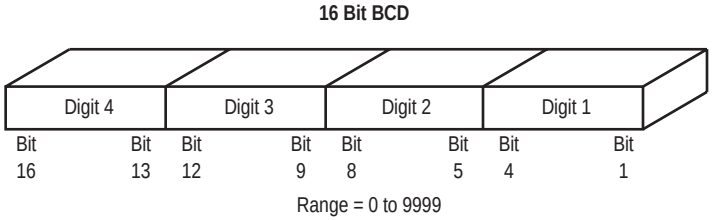
16-Bit Unsigned Integer



This data format displays a 16 bit register as an Unsigned Integer value. It represents a positive number by using the 16th bit as a data bit rather than a sign bit.

- The 16 bit Unsigned Integer values have a range of 0 to +65,535. This data format may also be scaled to different engineering units.

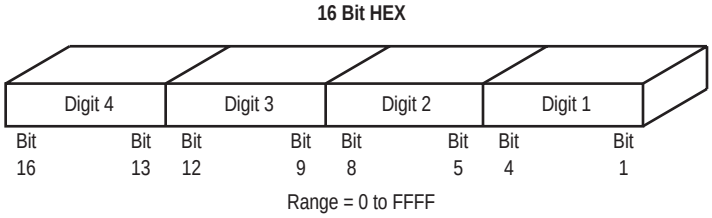
16-Bit BCD (Binary Coded Decimal)



This data format displays a 16 bit register location as a 4 digit Binary Coded Decimal value.

- The range for the 16 bit BCD selection is 0 to +9999. It may also be scaled to different engineering units.

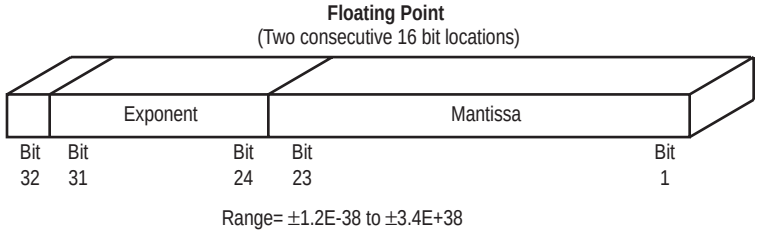
16-Bit HEX (Hexadecimal)



This data format displays a 16 bit register location as a 4 digit hexadecimal value.

- The range for the 16 bit HEX format is 0 to +FFFF. The Hexadecimal number system is defined as a base of 16 (0-9 and the characters A, B, C, D, E, F). This data format may not be scaled to different engineering units. It is used for display-only (non-entry) operations.

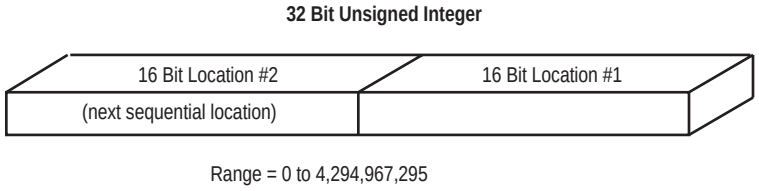
32-Bit Floating Point



This data format displays data located in two consecutive 16 bit register locations as a 32 bit floating point value. It uses a memory register plus the next higher register to form the 32 bit location. The range for the floating point value is =/-1.2 x 10-38 to =/-3.4 x 1038.

- The floating point format adheres to the ANSI/IEEE 754 standard. It may be scaled to different engineering units.

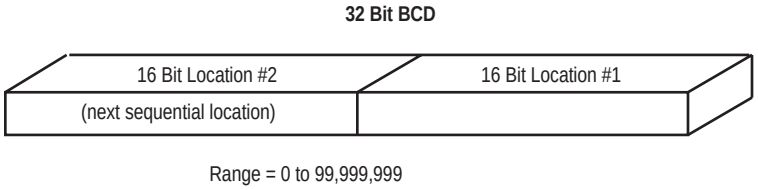
32-Bit Unsigned Integer



This data format displays data located in two consecutive 16 bit register locations as a 32 bit Unsigned Integer. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit unsigned Integer value is 0 to +4,294,967,295. It may not be scaled to different engineering units.

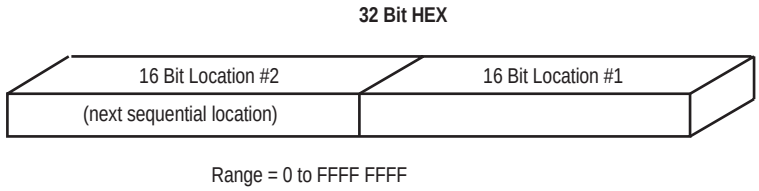
32-Bit BCD (Binary Coded Decimal)



This data format displays two consecutive 16 bit register locations as a 32 bit BCD value. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit BCD value is 0 to +99,999,999. It may not be scaled to different engineering units.

32-Bit HEX (Hexadecimal)

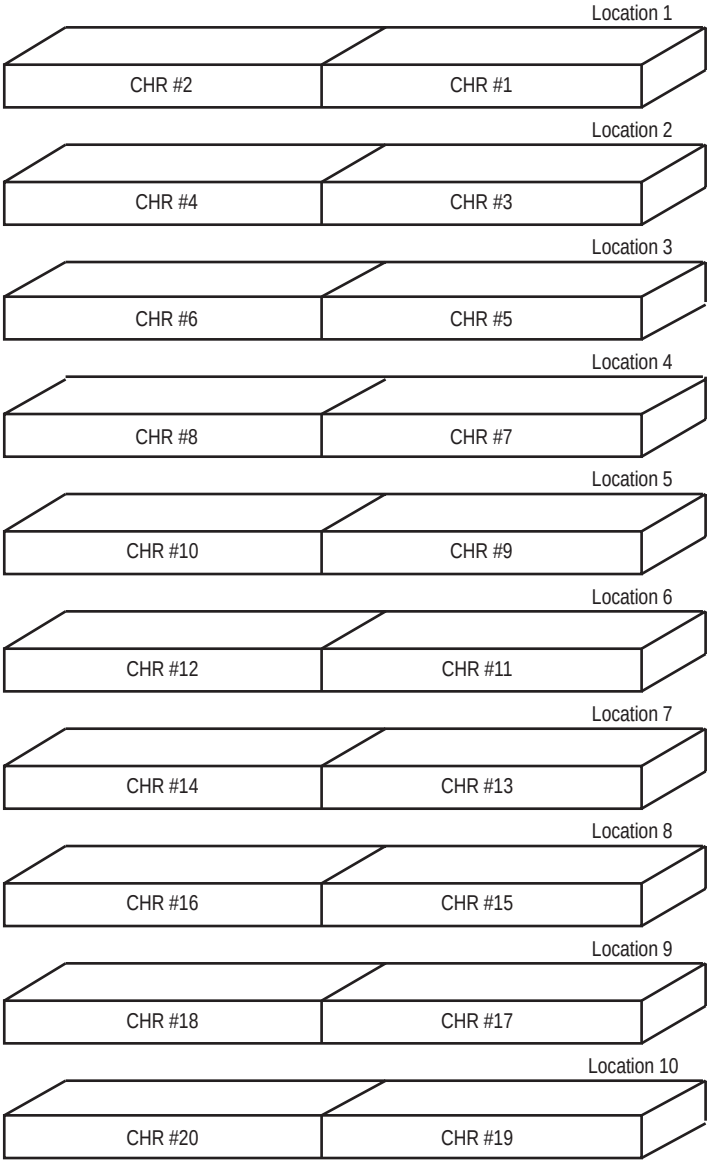


This data format displays two consecutive 16 bit register locations as a 32 bit HEX value. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit HEX value is 0 to FFFF FFFF. It may not be scaled to different engineering units. This data format is used for display-only (non-entry) operations.

ASCII

ASCII Data Field
Maximum 20 Characters-Ten 16 bit locations



ASCII data formats are fields up to 20 characters long. Each 16 bit location may contain two ASCII characters
(1 byte each). The lowest byte of the base address stores the first character, the highest byte stores the second character, the first byte of the next sequential location stores the third character, and so on. The data held in this range of address locations is expected to be an ASCII data format.

- The ASCII data format is very useful for PLC applications reading ASCII data from bar code readers or data collection terminals.

Screen Types and Their Supported Data Formats

Each SOI Screen type may or may not support all data formats. The following table lists each screen type and the associated data formats supported.

Screen Type	Data Formats Supported
Display, Alarm, & Printer Form	Bit 16-Bit Signed Integer 16-Bit Unsigned Integer 16-Bit BCD 16-Bit HEX 32-Bit Floating Point 32-Bit Unsigned Integer 32-Bit BCD 32-Bit HEX ASCII
Entry	Bit 16-Bit Signed Integer 16-Bit Unsigned Integer 16-Bit BCD 32-Bit Floating Point 32-Bit Unsigned Integer 32-Bit BCD ASCII Input (SOI-260 only)
Bargraph (SOI-260 only)	16-Bit Signed Integer 16-Bit BCD
Recipe	16-Bit Signed Integer 16-Bit Unsigned Integer 16-Bit BCD 32-Bit Floating Point 32-Bit Unsigned Integer 32-Bit BCD
Background Monitor (SOI-260 only)	Bit 16-Bit Signed Integer 16-Bit BCD

Note: The SOI-120 does not support Printer Forms, Bar Graph screens, or the Background Monitor feature.

Data Display and Entry Screen Parameters

When programming Data Display and Data Entry fields and positioning them on an SOI-120 or SOI-260 screen, each field must be defined according to its programmable controller memory location (address), data format, and other data parameters specific to the data format selected.

You are prompted for the register definitions at the Control Window. Each register definition is somewhat different, depending on the data format selected and whether the data field is a Data Display or Data Entry field.

The tables in the following two subsections list the applicable data formats and the Control Window prompts associated with each.

Data Display Screens

The data format selections available for Data Display screens are listed below and their parameters described.

Display Screen Parameter for: Bit Data	Description
Register Number	The programmable controller data location operand and address.
Bit Number	The Bit number if the register number designates a multiple bit location (a 16 bit data address, for example).
Text when Bit is OFF (0)	The 20 character text description to be displayed when the bit is in an OFF (0) state
Text when Bit is ON (1)	The 20 character text description to be displayed when the bit is in an ON (1) state.

Display Screen Parameter for: 16-Bit Unsigned Integer, 16-Bit Signed Integer & 16-Bit BCD Data	Description
Register Number	The programmable controller data location operand and address.
Digits Right of Decimal	The number of digits to be placed to the right of the decimal.
Digits Left of Decimal	The number of digits to be placed to the left of the decimal.
Leave Place for Sign (Y or N)	Leave a one character place for the polarity sign (+ or -) when the data is displayed.
Show Leading Zeros (Y or N)	Display any zeros to the left of the data.
Minimum Register Value	The minimum data value of the programmable controller location.
Maximum Register Value	The maximum data value of the programmable controller location.
Minimum Displayed Value	The minimum data value to be displayed. This value is displayed when the data in the programmable controller location is equal to the minimum register value. See Maximum Displayed Value, below, for a description of scaling.
Maximum Displayed Value	The maximum data value to be displayed. This value is displayed when the data in the programmable controller location is equal to the maximum register value. The range defined by the Minimum Displayed Value and the Maximum Displayed Value is proportionally scaled to the range of the minimum and maximum register values. If both ranges are equal then the scaling ratio is 1:1.
Minimum Bar Value	(Bar Graph Only) The minimum value of data to be displayed in the Bar Graph. This value must be greater or equal to the Minimum Displayed Value.
Maximum Bar Value	(Bar Graph Only) The maximum value of data to be displayed in the Bar Graph. This value must be less than or equal to the Maximum Displayed Value. The Minimum and Maximum bar graph values may be used to display a particular range or window of an overall range (Minimum and Maximum Displayed Values).

Display Screen Parameter for: 32-Bit Unsigned Integer & 32-Bit BCD Data	Description
Register Number	The programmable controller data location operand and address.
Digits Right of Decimal	The number of digits to be placed to the right of the decimal.
Digits Left of Decimal	The number of digits to be placed to the left of the decimal.
Show Leading Zeros (Y or N)	Display any zeros to the left of the data.

Note: For the 32-Bit BCD selections, scaling of data is not supported. The selected register number and the next higher sequential register number identify the locations defining the 32 bit data value.

Display Screen Parameter for: 16 -Bit HEX, 32-Bit HEX Data	Description
Register Number	The programmable controller data location operand and address.

Display Screen Parameter for: ASCII Data:	Description
Register Number	The programmable controller data location operand and address.
Character Count	The number of characters (2 characters for each 16 bit data location) to be displayed, up to a maximum of 20 characters. The initial byte of the location identified by the register number is displayed first, then the second byte, the first byte of the next higher sequential location, and so on. To display 20 characters, a sequential block of ten 16 bit locations is read by the SOI.

Data Entry Screens

The data format selections available for Data Entry screens are listed below and their parameters described.

Entry Screen Parameter for: Bit Data	Description
Register Number	The programmable controller data location operand and address.
Bit Number	The Bit number if the register number designates a multiple bit location (a 16 bit data address, for example). This selection is irrelevant if the register number refers to a Bit type address.
Input Data by Pressing '1'/'0' or 'Y'/'N' ? (Enter 1 or Y)	This parameter determines whether the operator will enter 1 or Y to set the defined bit location. If 1 is entered, 0 will clear the bit location. If Y is entered, N will clear the bit location.
Default Value ? Z = No Default (Enter 1,0,Y,N,Z)	This parameter defines the default value that is displayed at the data entry position of the SOI display. If a default value of Y is entered, a Y is displayed, and the operator is only required to press ENTER to set the bit location. An entry of Z defines no default value. If there is no default value programmed, and the operator presses the ENTER, no data is sent to the programmable controller.

Entry Screen Parameter for: 16-Bit Unsigned Integer, 16-Bit Signed Integer & 16-Bit BCD Data	Description
Register Number	The programmable controller data location operand and address.
Digits Right of Decimal	The number of digits to be placed to the right of the decimal.
Digits Left of Decimal	The number of digits to be placed to the left of the decimal.
Leave Place for Sign (Y or N)	Leave a one character place for the polarity sign (+ or -) when the data is displayed.
Minimum Register Value	The minimum data value of the programmable controller location.
Maximum Register Value	The maximum data value of the programmable controller location.
Minimum Entry Value	The minimum data value to be entered. When this value is entered the minimum register value is entered to the defined programmable controller location. See Maximum Entry Value, below, for a description of scaling.
Maximum Entry Value	The maximum data value to be entered. When this value is entered the maximum register value is entered to the defined programmable controller location. The range defined by the minimum entry value and the maximum entry value is proportionally scaled to the range of the minimum and maximum register values. If both ranges are equal then the scaling ratio is 1:1.
Low User Input Limit	The minimum entry value that an operator may enter. This value must be within the minimum and maximum entry values. If a value lower than this limit is entered the SOI will display an “Input Error” screen displaying the minimum and maximum entry limits.
High User Input Limit	The maximum entry value that an operator may enter. This value must be within the minimum and maximum entry values. If a value higher than this limit is entered the SOI will display an “Input Error” screen displaying the minimum and maximum entry limits.
Default Value	This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default value.

Entry Screen Parameter for: ASCII Data	Description
Register Number	The programmable controller data location operand and address.
Character Count	The number of characters (2 characters for each 16 bit data location) to be displayed, up to a maximum of 20 characters. The initial byte of the location identified by the register number is displayed first, then the second byte, the first byte of the next higher sequential location, and so on. To display 20 characters, a sequential block of ten 16 bit locations is read by the SOI.

32-Bit Floating Point Entry Screen Parameter	Description
Register Number	The PLC data location address.
Low User Input Limit	The minimum entry value that an operator may enter. This value must be within the range of +/- 1.2 x 10^{-38} to +/- 3.4 x 10^{38}. If a value lower than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.
High User Input Limit	The maximum entry value that an operator may enter. This value must be within the range of +/- 1.2 x 10^{-38} to +/- 3.4 x 10^{38}. If a value higher than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.
Default Value	This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default.

Note ***The defined register number and the next higher sequential number locations will define the data value.***

Note: ***To edit floating point data:***

1. ***Position the cursor at the mantissa field and enter the new mantissa.***
2. ***Press ENTER, and then enter the exponent.***
3. ***Press ENTER to load the new data into the displayed register.***

Entry Screen Parameter for: 32-Bit Unsigned Integer & 32-Bit BCD Data	Description
Register Number	The programmable controller data location operand and address.
Digits Right of Decimal	The number of digits to be placed to the right of the decimal.
Digits Left of Decimal	The number of digits to be placed to the left of the decimal.
Low User Input Limit	The minimum entry value that an operator may enter. This value must be within the range of 0 to +99,999,999. If a value lower than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.
High User Input Limit	The maximum entry value that an operator may enter. This value must be within the range of 0 to +99,999,999. If a value higher than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.
Default Value	This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default.

Note: For the 32-Bit BCD selections, scaling of data is not supported. The defined register number and the next higher sequential number locations will define the data value.

Modbus-Specific SOI Configuration Data

This section describes the Modicon PLC specific requirements that the SOI-SPS programming software supports. The programming information may be found at the SOI Configuration Data Menu in the SOI-SPS software.

Note: Refer to the SOI-SPS programming software manual for complete details on programming and additional information regarding the SOI configuration Data Menu. In addition, refer to the Modicon PLC operations manual for details on the specific PLC you are working with.

Time Synchronization (SOI-260 only)

The Real Time Clock of the SOI-260 may either be written to the Modicon PLC or synchronized with the PLC by utilizing the Write Time or Read Time selections respectively.

The Real Time Clock data will be written to the Modicon PLC in a batch of seven registers. These registers must be 4xxxx Holding Register locations. A base register is defined as the first of seven registers to hold the clock data:

- Base Day of Week, 1-7 (Sun=1)
- Base +1 Month, 1-12
- Base +2 Day of Month, 1-31
- Base +3 Year, (Tens, Units) ie; 1991 = 91
- Base +4 Hour, 0-23
- Base +5 Minutes, 0-59
- Base +6 Seconds, 0-59

The clock data will be synchronized on a 60-69 second interval. These seven locations should not be the actual clock location of the Modicon PLC as the SOI is not setting the PLC clock itself but simply providing a clock source to the PLC at a certain location.

PLC Hardware Parameters

The PLC Hardware Parameters menu option in the SOI Configuration Data menu lets you change the following parameters:

- CPU address
- comm. port setup
- advisor update rate
- turn-around delay
- two-wire enable/disable

To set the PLC Hardware Parameters, select SOI Configuration Data from the Edit File - Option Selection menu. At the SOI Configuration Data menu, select PLC Hardware parameters, and then select the desired parameter.

CPU Address

The CPU address is the slave address configured for the Modicon PLC. The SOI-SPS programming software requires this address to establish proper communications with the Modicon PLC.

The slave address for the Modicon PLC must be a decimal address.

Note: ***The Modbus slave address may be configured within a range of 1 to 64. A 1 to 255 range is acceptable to provide support for Modbus Plus addressing when a Modbus to Modbus Plus bridge is used.***

Communications Port Setup

The baud rate, data bits, and parity information entered must match the respective settings of the Modicon processor.

The Communications Port parameters have the following default values for the Modicon PLC:

- Baud Rate: 9600
- Data Bits: 8
- Parity: Even

Advisor Update Rate

The Advisor Update Rate determines how frequently the SOI reads the Advisor Register.

For more information on the SOI Advisor feature, see the *SOI-SPS Programming Software User Manual*.

Turn-Around Delay

The Turn-Around Delay determines how quickly the SOI responds to a message. When using the SOI with most programmable controllers, you should keep the turn-around delay time at its default setting (50 ms). When using the SOI with slower devices (such as some remote terminal units), you may need to increase the turn-around delay time.

Note: ***High Turn-Around Delay times (250 ms or more) can result in slow screen changes, recipe downloaads, etc.***

Two-Wire Enable/Disable

The SOI supports 2-wire RS-485 connections to devices that don't require full duplex operation (see Chapter 1 of this Reference for more information). This feature applies to RS-485 connections only. It does not apply to RS-232 connections.

CHAPTER 3: MODBUS TROUBLESHOOTING

This chapter of the *Modicon PLC Reference* provides solutions to possible problems with the SOI and its use with the Modicon processor.

This chapter also describes the Communication Error Codes specific to the Modbus communication protocol used for the Modicon processor and the SOI.

General Symptoms and Solutions

Typically any problems that occur involve communications between the SOI and the PLC. The most likely problem sources are the cabling and the communication parameters (baud rate, data bits, parity) involved. These parameters must be identical for both the SOI and the PLC. The cabling and the communications parameters are always the first things to check.

If the communications cabling and communications parameters are all correct, put the SOI in Self-Test Mode to rule out any non-functioning features of the SOI.

Note: ***Refer to the* SOI-120 *and* SOI-260 Users Manual *for information about the Self-Test Mode.***

The following screens messages indicate PLC-oriented problems displayed on the SOI.

Modicon PLC
Establishing Comm

Attempting to communicate to PLC

Action: Normal display when initiating communications with the PLC.

<PLC not found>

This message is displayed after a 2-second interval of attempting to establish communications with the PLC.

Action: Communications not established with the PLC. Check cabling and communications parameters to verify that the PLC matches those of the SOI. Perform the Self-Test function if the Comm port is suspected.

PLC not Responding
PLACE PLC ON LINE
Depress any key

Communication failure to respond to 16 attempts after initial communications were achieved.

Action: Check SOI-to-PLC cabling and PLC communication parameters.

COMM LOSS, Press Y

Communication with the PLC was lost after 16 attempts.

Action: Check SOI-to-PLC cabling and PLC operating conditions.

Comm ERROR PRESS Y
PLC error code: nnn

Received a PLC communication error code (nnn)

Action: Refer to Section 3.2, Communication Error Codes, and/or your PLC documentation for more information.

Communication Error Codes

Communication Error Codes appear on the SOI display as follows:

COMM ERROR PRESS "Y"
PLC Error Code: nn

where nn is a PLC Specific Error Code.

The Communication Error codes may seem cryptic. They do, however, offer valuable information when other symptoms either have not been discovered or have not been understood.

Note: For a complete list of error codes, consult the Modbus Communication Protocol Reference guide. PI-MBUS-300.

The Communication Error Codes specific to the Modbus communication protocol and the SOI are described below.

Code	Meaning
01	**Illegal Function** The message function received is not an allowable action for addressed slave. If a poll command was issued, indicates no program function preceded it.
02	**Illegal Data Address** The address referenced in the data field is not an allowable address for the addressed slave location.
03	**Illegal Data Value** The value referenced in the data field is not allowable in the addressed slave location.
04	**Failure in Associated Device** The slave's PC has failed to respond to a message or an abortive error occurred.
05	**Acknowledge** The slave PC has accepted and is processing the long duration program command. Issue a POLL PROGRAM COMPLETE message to find out when processing is finished. A poll message sent to the PC before it is finished will result in a rejected message response.
06	**Busy, Rejected Message** The message was received without error, but the PC is engaged in processing a long duration program command. Retransmit later, when the PC may be free.
07	**NAK-Negative Acknowledgment** The PROGRAM function just requested cannot be performed. Issue poll to obtain detailed device-dependent error information.
08	**Memory Parity Error** The Modbus read of extended memory checks memory bits being accessed. Retries should be attempted as the error might not recur. If all retries fail, service may be required.

Chapter 4: Modbus Plus Cabling & Special Operations

This chapter describes all communication aspects for Modbus Plus connections and includes communication port descriptions, cable diagrams, DIP switch settings, and basic Modbus Plus network information.

*Note: **The SOI-120 product does not support Modbus Plus communications.***

Communication Port Descriptions

First, we need to locate and describe the functionality of each communication port. There are many product options for the SOI-260 Modbus Plus product; however, there are only two basic hardware configurations.

Illustration 1 shows a standard SOI-260 Modbus Plus unit with two 9-pin female communication ports. The diagram is a bottom view with the SOI front plate face down. The top communication port is the Modbus Plus Communications port. The lower right communication port is used to up/download the application files from a computer.

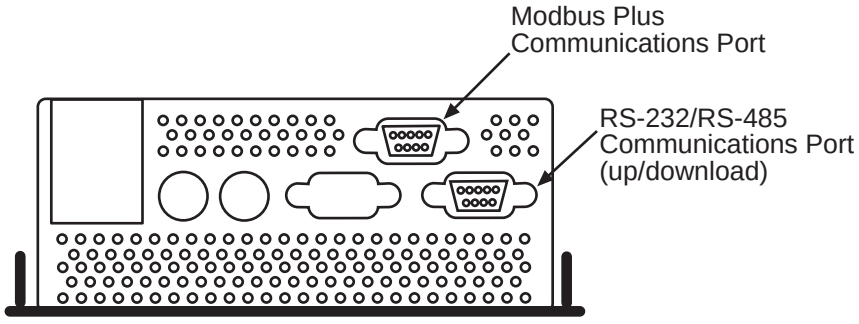


Figure 4.1

Illustration 2 shows an SOI-260 Modbus Plus unit with one 9-pin female communications port and one 9-pin male printer port. The top communication port is the Modbus Plus Communications port. The lower left communication port is the printer port. The printer port is used to up/download the application files from a computer and for connection to a printer to print application documents.

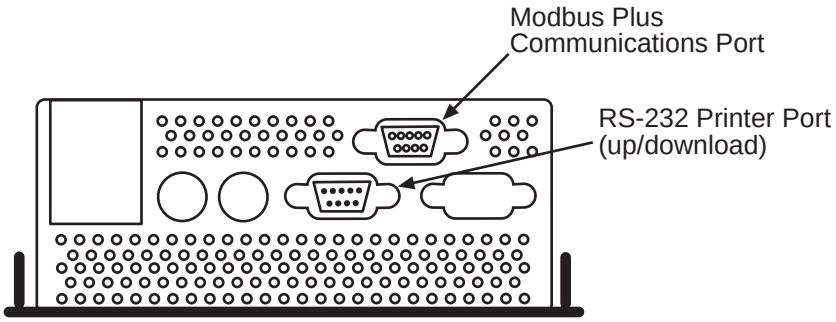
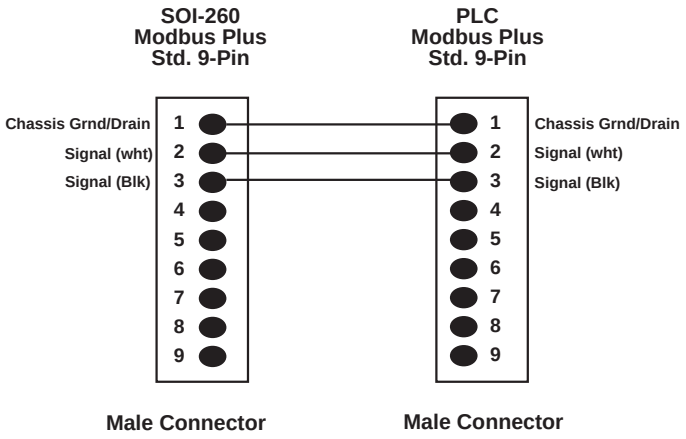


Figure 4.2

SOI to Modbus Plus Communications Port cabling

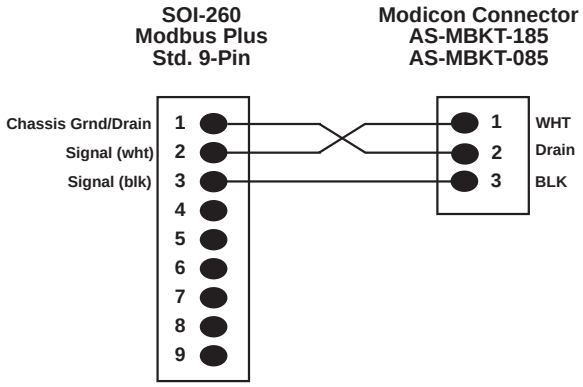
This section describes the SOI-260 to Modbus Plus communication cable requirements. Cable connections, distance, and terminations are key factors when connecting any product on the Modbus Plus Network. Below are cable connection pin-out configurations for making a cable.

Using standard 9-pin d-sub connectors



Note: When using standard D-sub connectors as the termination connector, a 120 ohm resister must be applied to connect pins 2 and 3 together.

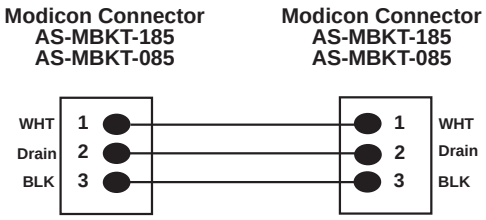
Using standard 9-pin d-sub and Modicon Modbus Plus connectors



Note: When using standard D-sub connectors as the termination connector, a 120 ohm resister must be applied to connect pins 2 and 3 together.

Note: When using the Modicon AS-MBKT connector kits, please refer to the Modicon Modbus Plus Network Planning and Installation Guide for detailed instructions

Using Modicon Modbus Plus connectors



Note: When using the Modicon AS-MBKT connector kits, please refer to the Modicon Modbus Plus Network Planning and Installation Guide for detailed instructions

As stated earlier, it is very important that all connectors are correctly installed for the product and Modbus Plus Network to function properly. Please refer to the Modicon *Modbus Plus Network Planning and Installation Guide* for detailed instructions.

SOI-260 Dip Switch Settings

The Modbus Plus Communications Network requires that each node on the network have its own unique address. The SOI-260 Modbus Plus unit has a Modbus Plus Address switch on the back. The address range is selectable from nodes 1 to 64 based on the positions of the switches. The table below identifies the node Address number and the DIP switch position it should be in for that Address. For example, if Address "10" is desired for the SOI, the DIP switch positions would be: 100100. Labels on the back of the SOI, next to the DIP switch, provide additional information for setting the switch positions.

Address	Switch Position SW2-1	SW2-2	SW2-3	SW2-4	SW2-5	SW2-6
1	0	0	0	0	0	0
2	1	0	0	0	0	0
3	0	1	0	0	0	0
4	1	1	0	0	0	0
5	0	0	1	0	0	0
6	1	0	1	0	0	0
7	0	1	1	0	0	0
8	1	1	1	0	0	0
9	0	0	0	1	0	0
10	1	0	0	1	0	0
11	0	1	0	1	0	0
12	1	1	0	1	0	0
13	0	0	1	1	0	0
14	1	0	1	1	0	0
15	0	1	1	1	0	0
16	1	1	1	1	0	0
17	0	0	0	0	1	0
18	1	0	0	0	1	0
19	0	1	0	0	1	0
20	1	1	0	0	1	0
21	0	0	1	0	1	0
22	1	0	1	0	1	0
23	0	1	1	0	1	0
24	1	1	1	0	1	0
25	0	0	0	1	1	0
26	1	0	0	1	1	0
27	0	1	0	1	1	0
28	1	1	0	1	1	0
29	0	0	1	1	1	0
30	1	0	1	1	1	0
31	0	1	1	1	1	0
32	1	1	1	1	1	0
33	0	0	0	0	0	1
34	1	0	0	0	0	1
35	0	1	0	0	0	1
36	1	1	0	0	0	1
37	0	0	1	0	0	1
38	1	0	1	0	0	1
39	0	1	1	0	0	1
40	1	1	1	0	0	1
41	0	0	0	1	0	1
42	1	0	0	1	0	1
43	0	1	0	1	0	1
44	1	1	0	1	0	1
45	0	0	1	1	0	1
46	1	0	1	1	0	1
47	0	1	1	1	0	1
48	1	1	1	1	0	1
49	0	0	0	0	1	1
50	1	0	0	0	1	1
51	0	1	0	0	1	1
52	1	1	0	0	1	1
53	0	0	1	0	1	1
54	1	0	1	0	1	1
55	0	1	1	0	1	1
56	1	1	1	0	1	1
57	0	0	0	1	1	1
58	1	0	0	1	1	1
59	0	1	0	1	1	1
60	1	1	0	1	1	1
61	0	0	1	1	1	1
62	1	0	1	1	1	1
63	0	1	1	1	1	1
64	1	1	1	1	1	1

Notes: (1) switches 7 and 8 are not used
(2) 1=open 0=closed

In addition to the SOI requiring a unique address, the Modicon PLC you are communicating to requires its own unique address. Please refer to the Modicon PLC owners manual for proper PLC switch settings.

Modbus Plus Network Communications

The SOI-260 Modbus Plus Operator Interface communicates as a node on the Modbus Plus network and supports the entire node Address range of 1-64 . To function properly, the SOI MUST have a valid and unique node Address. The following are operating characteristics for the SOI-260 Modbus Plus product:

- SOI-260 can communicate (be routed) up to 5 networks deep. Routing is set in the SPS programming software.
- SOI-260 communicates to "one" Modbus Plus device at a time.
- Multiple SOI's may communicate to "one" Modbus Plus device.
- A node Address label is supplied on the back of the SOI-260 for identification purposes.
- SOI-260 is fully compatible with Modicon Repeater, Bridge Plus and Bridge Multiplexer modules.
- SOI-260 will display error/function codes as conditions arise for troubleshooting assistance.
- SOI-260 currently does not support Global Data Broadcast.
- Cable connectors and terminators must be supplied by Modicon.

Note: For detailed information on programming, specifics on network routing, and illustrations, please refer to Chapter 5: Programming Modbus Plus, Routing Paths.

Note: For Modbus Plus Network parameters such as cable lengths, cable type, termination connectors, other Modbus Plus compatible products etc., please refer to the Modbus Plus Network Planning and Installation Guide for additional information.

Special Operations

P-A/D (Point-Access/Display)

The SOI-260 Modbus Plus product supports the P-A/D feature and may be accessed only through the Function Key.

After entering the Function Key, one of the menu selection items is called SPECIAL. The SPECIAL item must be selected to access P-A/D.

The P-A/D function gives you access to supported Modicon PLC registers. These registers may be displayed and modified.

This feature of the SOI is extremely useful in start-up or debugging sessions of SOI programs or regular PLC operations.

When in the P-A/D mode, pressing the Main Menu key will exit you to the SOI opening menu of the application program.

CAUTION: The Point-Access/Display function is a powerful tool. Its access should be restricted solely to authorized personnel. Using this function, it is possible to change PLC data that may alter critical process control operations.

Assuming that it exists in the program file, the first screen to be displayed is the Special Security Screen. You must then enter any one of the three programmed security codes to continue to the Point Access and Display function.

Note: If the Special Security Screen is not programmed the first screen displayed is the Network Address Screen.

Accessing P-A/D in the SOI-260 Modbus Plus

When you access the P-A/D function, you have the choice of editing the network addressing to access other PLCs on the network or you can directly access the registers of the "default" PLC. The "default" PLC means that the device node addresses for the SOI and PLC have been previously set in the SPS programming software, and when returning to the configuration screens (normal operation), the SOI will revert back to communicating to the "default" PLC.

The SOI has the ability of communicating to other PLCs on the Modbus Plus network in the P-A/D mode on a temporary basis, provided that the Network Address is changed to identify the NEW node Address. The Network Address Screen is displayed below and allows you to make the choice:

Note: The PREV MENU key will return you to the Function key menu

```
Modbus+ Network ADDR
  Press
"Y" to edit ADDR
"N" to Bypass
```

- Enter Y to edit the network address. The Address Routing screen is then displayed as shown below. If you enter N, the Address Routing screen is not displayed and assumes you want to access the default PLC registers.

The Address Routing Screen allows you to route to any Modbus Plus device on the network on a temporary basis. The SOI supports up to 5 Routing Path addresses. The screen below identifies the current Route, identifies the device node address that the SOI is talking to, and allows you to change the Routing Paths to access a different device on the network.

For example, the below screen indicates that the SOI is currently on Route Path 1 and is currently communicating to device address 15. If you wanted to change the Route path, you simply type in the desired Route Path number and press ENTER.

Note: Route Path always defaults to Path 1.

```
Routing Path (1-5)
1:15 2:00 3:00 4:00
5:00   Path: 1
Press ENTR to cont.
```

Once a new Route Path has been entered, a new device node address must be entered. The below screen identifies the SOI address (This Node:xx) and the new Path you have just selected (Path:xx), and is requesting that a new device node address be entered (Address:xx). To enter the desired node address, simply type in the new address and press ENTER.

Routing Path Address
This Node:___ (1-64)
Path: _ Address:__
Press ENTR to cont.

After you have selected a new device node address and have pressed ENTER, the following Route Path screen is displayed. This screen shows the current Route Paths that have been entered.

Route Paths
— — — — —
Press ENTR to cont.
or "Y" When Complete

If you are finished with the Route Addressing edits, press "Y" to access the registers in the "remote" PLC (the new device address you have just programmed). If you need to continue editing, press ENTR.

During the Route Path editing process, you may encounter the below error screen. This screen indicates that the ENTIRE route is not complete.

Routing Paths error
Check the full path

Press ENTR to cont.

The below screens would be an example of an incomplete Route Path.

```
Routing Path (1-5)
1:15 2:00 3:00 4:18
5:00   Path: 1
Press ENTR to cont.
```

```
          Route Paths
 15 00 00 18 00
Press ENTR to cont.
or "Y" When Complete
```

The Route Paths require that a device node address be programmed for each Path to be complete. In the above example, the desired Route Path terminates at Path 4. Route Path 5 does not require a device node address. To complete the Route Path, return to the Route Address screen and edit Paths 2 and 3 until the Route Paths are complete.

Once all Network Addressing is complete, press "Y" to access the registers in the "new" PLC (the new device address you have just programmed).

Register Type Select Screen

The next screen that appears after you enter the slave address is the Register type Select screen (the PREV MENU key will return you to the Function key menu):

```
Select Data Type
Use PREV/NEXT
Press enter to select
Coils          1-8192
```

Note: The underlined data here indicates the data type and range field.

- Press the PREV/NEXT keys to scroll to the next Register Type field.
- Press the ENTER key to select the register type that is currently displayed.

Bit Types

The following screen is presented for register selections of either Coils (0xxxx) or Inputs (1xxxx) types. Coil address selections, entry of addresses 00001 to 08192, produce the following screen.

```
CO     XXXX
Status: OFF(0)
Press ENTER key to
change Point state
```

Input address selections, entry of addresses 10001 to 18192 will produce the following screen without the last two lines.

```
IN     1XXXX
Status: OFF(0)
```

Input addresses may only be monitored, not written or altered. Register number entries other than 00001 to 08192 or 10001 to 18192 will be ignored.

- Enter the register number or increment/decrement the number by pressing the Y and N keys.

When you press ENTER the currently displayed point number's state will be changed to the opposite state and displayed.

Register Types, 16 bit

The following screen is displayed for Input Register selections, 30001 to 39999, or Holding Register selections, 40001 to 49999. Registers 30001 to 39999 are monitor only and do not support data modification. Register number entries other than 30001 to 39999 or 40001 to 49999 will be ignored.

```
Point          Decimal      Hex
H040001        bbbbb cccc
16             Binary   1
dddd dddd dddd dddd
```

- Enter a new register address or increment/decrement the register address by pressing the Y and N keys. When you press ENTER, the Decimal, Hex, and Binary equivalents of the data residing at the selected register is displayed. The data is displayed in real time.

You can edit the Decimal or Binary data for selections of 40001 to 49999.

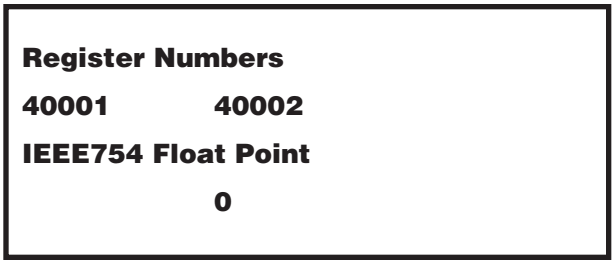
- Press the PREV or NEXT key to move to the fields to edit.

  To edit Decimal data, position the cursor at the decimal field and enter the new data. To edit Binary data, position the cursor at the binary field and press ENTER. Press the + (plus) or - (minus) keys to toggle between 1 or 0 for Binary data, or enter the numeric value of 1 or 0 directly.

- Enter the data, and press ENTER to load the new data into the displayed register.

Floating Point Registers

The following screen is displayed for Holding Register selections containing data in 32 bit floating point format. Two sequential holding register numbers are displayed.



- Enter the base register number, left number on the second line, or increment/decrement the number (Y and N keys).

Only Holding Registers may be selected as Floating Point locations. The second line identifies the two registers used to determine the Floating Point data displayed on the fourth line. Floating Point numbers all comply with the IEEE754 standard.

Chapter 5: Modbus Plus Programming

This chapter of the Modicon PLC Reference section addresses programming screen types, location definitions, supported PLC registers, and data formats used with the SOI-SPS programming software.

Supported PLC Registers

Register Types--Modbus Plus

This section defines the register types supported by the SOI-SPS programming software for Modicon PLC applications. These point types are, by definition, bit and 16 bit register locations.

Data types	Address	Range
Coils (Discrete Outputs)	0xxxx	00001 to 08192
Inputs (Discrete Inputs)	1xxxx	10001 to 18192
Input Registers (16 bit Word)	3xxxx	30001 to 39999
Holding Registers (16 bit Word)	4xxxx	40001 to 49999
Holding Registers-Floating Point (32 bit Word)	4xxxx	40001 to 49999

16 Bit Locations

Input Registers are reference only register types, data may not be written to these locations. Data from an Input Register location is comprised of 16 bits.

Holding Register location data may either be written or referenced. Holding Register data is comprised of 16 bits.

Single Bit Locations

Inputs are reference only register types, data may not be written to these locations. Data from an Input location is a single bit data type.

Coil location data may either be written or referenced. Coil data is a single bit data type.

The specific address programming of the above supported register types is discussed in Chapter 5.0, Programming for Modbus Plus applications.

Supported Data Formats

The data selected for a particular Modicon PLC location must reflect the same format as the data actually stored in that location. This is the only way you can ensure that correct, consistent information is displayed on the SOI products.

For example, selecting the 16 Bit Signed Integer format for location 40001 will display data in one way. Selecting the 16 Bit BCD format for the same location will display the data in another way. It is important to understand each data format and its characteristics.

The following table illustrates all Data Formats supported for the Modicon PLC, including the register types and ranges applicable to each format, and whether the scaling feature may be applied to the format.

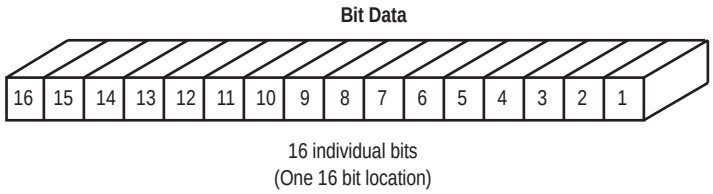
Data Format	Points	Range	Scaling
Bit	ALL	0,1,Y,N	N/A
16 Bit Signed Integer	3xxxx or 4xxxx	-32,768 to +32,767	YES
16 Bit Unsigned Integer	3xxxx or 4xxxx	0 to +65,535	YES
16 Bit BCD	3xxxx or 4xxxx	0 to +9,999	YES
16 Bit HEX	3xxxx or 4xxxx	0 to FFFF	NO
32 Bit Floating Point.	4xxxx	+/-1.2x10-38 to +/-3.4x1038	YES
32 Bit Unsigned Integer	3xxxx or 4xxxx	0 to +4,294,967,295	NO
32 Bit BCD	3xxxx or 4xxxx	0 to +99,999,999	NO
32 Bit HEX	3xxxx or 4xxxx	0 to FFFFFFFF	NO
ASCII	3xxxx or 4xxxx	20 chars (max.)	N/A

*Note: **The SOI-120 does not currently support the Floating Point data type.***

Bit data types may also be defined from 3xxxx and 4xxxx register locations as well as the Coil and Input locations. The bit number of the 3xxxx or 4xxxx register is defined as a bit 1-16 of the register.

The following descriptions define the above list of supported data formats for the Modicon PLC.

Bit

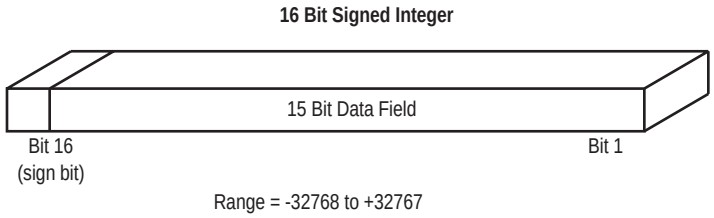


The PLC stores a binary (0 or 1) status for a bit location. The SOI will read a PLC bit location and determine whether the operational status of the bit is ON (1) or OFF (0). You can specify associated text to be displayed for either state of a specified bit. This description can be up to twenty characters.

For example, the OFF(0) state of a bit might display “Pump is OFF”, and the ON (1) state “Pump is ON”. SOI-SPS allocates enough screen characters for the longest of the two text strings. In this example, 11 characters would be allocated to display “Pump is OFF”.

- The fewer the characters used, the less memory is required. In the example above, displaying “OFF” (given the appropriate context) conveys the same information in 3 characters as “Pump is OFF” does with 11 characters.

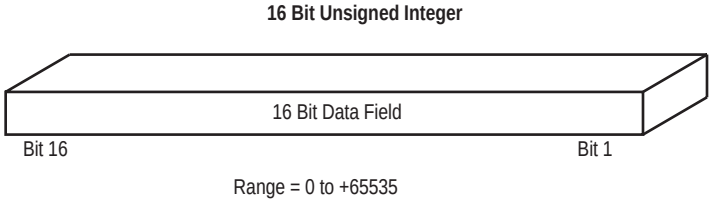
16 Bit Signed Integer



This data format displays a 16 bit register as a Signed Integer value. The 16th bit of the register is the sign bit and is set (1) for a negative and cleared (0) for a positive number.

- The 16 bit signed integer values have a range of -32768 to +32767. This data format may also be scaled to different engineering units.

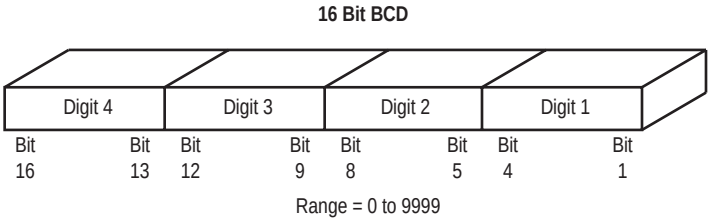
16 Bit Unsigned Integer



This data format displays a 16 bit register as an Unsigned Integer value. It represents a positive number by using the 16th bit as a data bit rather than a sign bit.

- The 16 bit Unsigned Integer values have a range of 0 to +65,535. This data format may also be scaled to different engineering units.

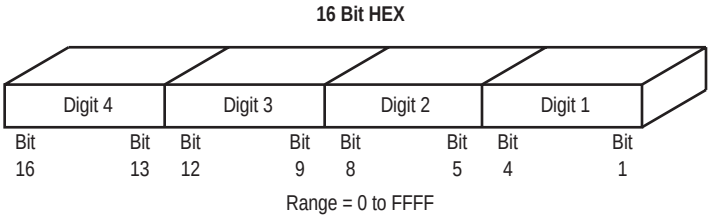
16 Bit BCD (Binary Coded Decimal)



This data format displays a 16 bit register location as a 4 digit Binary Coded Decimal value.

- The range for the 16 bit BCD selection is 0 to +9999. It may also be scaled to different engineering units.

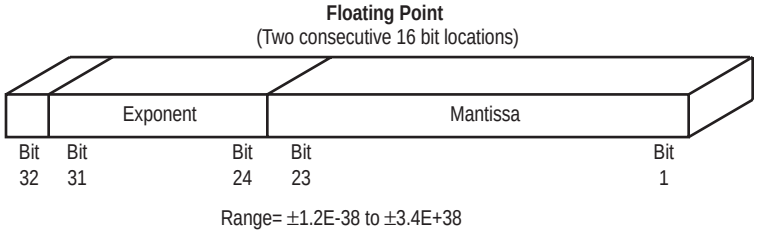
16 Bit HEX (Hexadecimal)



This data format displays a 16 bit register location as a 4 digit hexadecimal value.

- The range for the 16 bit HEX format is 0 to +FFFF. The Hexadecimal number system is defined as a base of 16 (0-9 and the characters A, B, C, D, E, F). This data format may not be scaled to different engineering units. It is used for display-only (non-entry) operations.

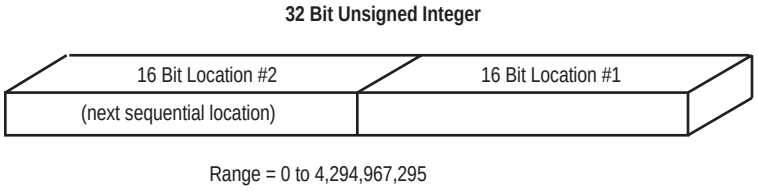
32 Bit Floating Point



This data format displays data located in two consecutive 16 bit register locations as a 32 bit floating point value. It uses a memory register plus the next higher register to form the 32 bit location. The range for the floating point value is =/-1.2 x 10-38 to =/-3.4 x 1038.

- The floating point format adheres to the ANSI/IEEE 754 standard. It may be scaled to different engineering units.

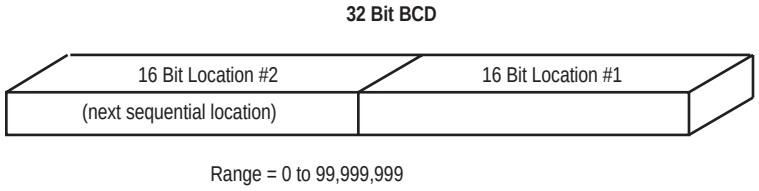
32 Bit Unsigned Integer



This data format displays data located in two consecutive 16 bit register locations as a 32 bit Unsigned Integer. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit unsigned Integer value is 0 to +4,294,967,295. It may not be scaled to different engineering units.

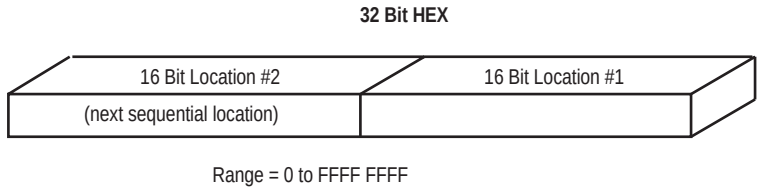
32 Bit BCD (Binary Coded Decimal)



This data format displays two consecutive 16 bit register locations as a 32 bit BCD value. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit BCD value is 0 to +99,999,999. It may not be scaled to different engineering units.

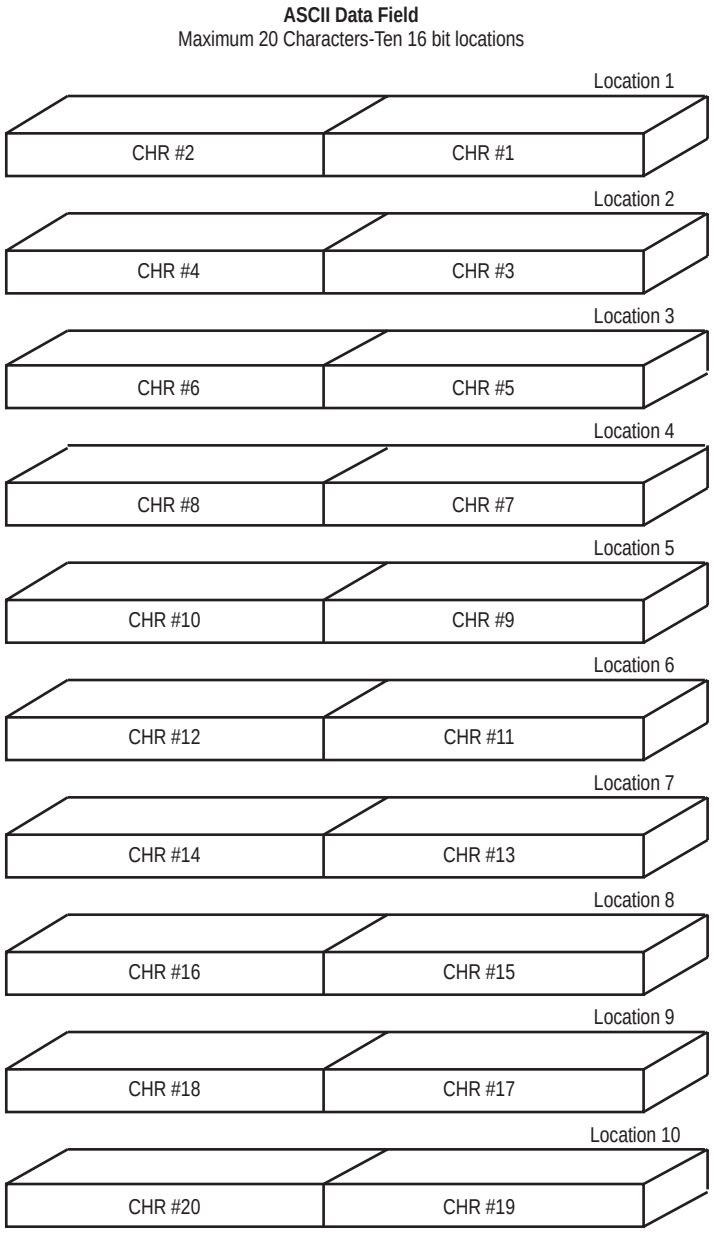
32 Bit HEX (Hexadecimal)



This data format displays two consecutive 16 bit register locations as a 32 bit HEX value. It uses a memory register plus the next higher register to form the 32 bit location. The High data value is stored in the first register and the Low data value is stored in the next sequential register location.

- The range for the 32 bit HEX value is 0 to +FF,FFF,FFF. It may not be scaled to different engineering units. This data format is used for display-only (non-entry) operations.

ASCII


ASCII Data Field
Maximum 20 Characters-Ten 16 bit locations
Location 1
CHR #2
CHR #1
Location 2
CHR #4
CHR #3
Location 3
CHR #6
CHR #5
Location 4
CHR #8
CHR #7
Location 5
CHR #10
CHR #9
Location 6
CHR #12
CHR #11
Location 7
CHR #14
CHR #13
Location 8
CHR #16
CHR #15
Location 9
CHR #18
CHR #17
Location 10
CHR #20
CHR #19

ASCII data formats are fields up to 20 characters long. Each 16 bit location may contain two ASCII characters
(1 byte each). The lowest byte of the base address stores the first character, the highest byte stores the second character, the first byte of the next sequential location stores the third character, and so on. The data held in this range of address locations is expected to be an ASCII data format.

- The ASCII data format is very useful for PLC applications reading ASCII data from bar code readers or data collection terminals.

Screen Types and Data Formats

Each SOI Screen type may or may not support all data formats. The following lists each screen type and the associated data formats supported.

Display, Alarm, and Printer Form Screens

Bit

16 Bit Signed Integer

16 Bit Unsigned Integer

16 Bit BCD

16 Bit HEX

32 Bit Floating Point

32 Bit Unsigned Integer

32 Bit BCD

32 Bit HEX

ASCII

Entry Screens

Bit

16 Bit Signed Integer

16 Bit Unsigned Integer

16 Bit BCD

32 Bit Floating Point

32 Bit Unsigned Integer

32 Bit BCD

Bargraph Screens

16 Bit Signed Integer

16 Bit BCD

Recipe Screens

16 Bit Signed Integer

16 Bit Unsigned Integer

16 Bit BCD

32 Bit Floating Point

32 Bit Unsigned Integer

32 Bit BCD

Background Monitor

Bit

16 Bit Signed Integer

16 Bit BCD

Register Definitions

When programming Data Display and Data Entry fields and positioning them on the SOI display, each field must be defined according to its PLC location, data format, and other data parameters specific to the data format selected.

You are prompted for the register definitions at the Control Window. Each register definition is somewhat different, depending on the data format selected and whether the data field is a Data Display or Data Entry field.

The following lists the applicable data formats and the Control Window prompts associated with each for Data Display and Data Entry screens.

Data Display Screens

The data format selections available for Data Display screens are listed below and their parameters described.

Bit

Register Number

The PLC data location address.

Bit Number

The Bit number if the register number designates a multiple bit location (a 16 bit data address, for example). This selection is irrelevant if the register number refers to a Bit type address.

Text when Bit is OFF (0)

The 20 character text description to be displayed when the bit is in an OFF (0) state

Text when Bit is ON (1)

The 20 character text description to be displayed when the bit is in an ON (1) state

16 Bit Signed Integer,
16 Bit Unsigned Integer,
16 Bit BCD (Binary Coded Decimal)
32 Bit Floating Point

Register Number

The PLC data location address.

Digits Right of Decimal (not present on 32 bit floating point)

The number of digits to be placed to the right of the decimal.

Digits Left of Decimal (not present on 32 bit floating point)

The number of digits to be placed to the left of the decimal.

Leave Place for Sign (Y or N) (not present on 32 bit floating point)

Leave a one character place for the polarity sign (+ or -) when the data is displayed.

Show Leading Zeros (Y or N) (not present on 32 bit floating point)

Display any zeros to the left of the data.

Minimum Register Value

The minimum data value of the PLC location.

Maximum Register Value

The maximum data value of the PLC location.

Minimum Displayed Value

The minimum data value to be displayed. This value is displayed when the data in the PLC location is equal to the minimum register value.

Maximum Displayed Value

The maximum data value to be displayed. This value is displayed when the data in the PLC location is equal to the maximum register value. The range defined by the Minimum Displayed Value and the Maximum Displayed Value is proportionally scaled to the range of the minimum and maximum register values. If both ranges are equal then the scaling ratio is 1:1.

Minimum Bar Value
(Bar Graph Only)

The minimum value of data to be displayed in the Bar Graph. This value must be greater or equal to the Minimum Displayed Value.

Maximum Bar Value
(Bar Graph Only)

The maximum value of data to be displayed in the Bar Graph. This value must be less that or equal to the Maximum Displayed Value. The Minimum and Maximum bar graph values may be used to display a particular range or window of an overall range (Minimum and Maximum Displayed Values).

32 Bit Unsigned Integer,
32 Bit BCD (Binary Coded Decimal)

Register Number

The PLC data location address.

Digits Right of Decimal

The number of digits to be placed to the right of the decimal.

Digits Left of Decimal

The number of digits to be placed to the left of the decimal.

Show Leading Zeros (Y or N)

Display any zeros to the left of the data.

*Note: **For the 32 Bit selections, scaling of data is not supported. The selected register number and the next higher sequential register number identify the locations defining the 32 bit data value.***

16 Bit HEX (Hexadecimal),
32 Bit HEX

Register Number

The PLC data location address.

ASCII

Register Number

The PLC data location address.

Character Count

The number of characters (2 characters for each 16 bit data location) to be displayed, up to a maximum of 20 characters. The initial byte of the location identified by the register number is displayed first, then the second byte, the first byte of the next higher sequential location, and so on. To display 20 characters, a sequential block of ten 16 bit locations is read by the SOI.

First Character in LSB or MSB

SPS provides the operator with the option of displaying either the MSB or LSB character first within the 16 bit data locations. Modbus ASCII strings are configured LSB first.

Data Entry Definitions

The data format selections available for Data Entry screens are listed below and their parameters described.

Bit

The data format selections available for Data Entry screens are listed below and their parameters described.

Register Number

The PLC data location address.

Bit Number

The Bit number if the register number designates a multiple bit location (a 16 bit data address, for example). This selection is irrelevant if the register number refers to a Bit type address.

Input Data by Pressing '1'/'0' or 'Y'/'N' ?
(Enter 1 or Y)

This parameter determines whether the operator will enter 1 or Y to set the defined bit location. If 1 is entered, 0 will clear the bit location. If Y is entered, N will clear the bit location.

Default Value ?
Z = No Default
(Enter 1,0,Y,N,Z)

This parameter defines the default value that is displayed at the data entry position of the SOI display. If a default value of Y is entered, a Y is displayed, and the operator is only required to press ENTER to set the bit location.

An entry of Z defines no default value. If there is no default value programmed, and the operator presses the ENTER, no data is sent to the PLC.

16 Bit Signed Integer,
16 Bit Unsigned Integer,
16 Bit BCD (Binary Coded Decimal)

Register Number

The PLC data location address.

Digits Right of Decimal

The number of digits to be placed to the right of the decimal.

Digits Left of Decimal

The number of digits to be placed to the left of the decimal.

Leave Place for Sign (Y or N)

Leave a one character place for the polarity sign (+ or -) when the data is displayed.

Minimum Register Value

The minimum data value of the PLC location.

Maximum Register Value

The maximum data value of the PLC location.

Minimum Entry Value

The minimum data value to be entered. When this value is entered the minimum register value is entered to the defined PLC location.

Maximum Entry Value

The maximum data value to be entered. When this value is entered the maximum register value is entered to the defined PLC location. The range defined by the minimum entry value and the maximum entry value is proportionally scaled to the range of the minimum and maximum register values. If both ranges are equal then the scaling ratio is 1:1.

Low User Input Limit

The minimum entry value that an operator may enter. This value must be within the minimum and maximum entry values. If a value lower than this limit is entered the SOI will display an “Input Error” screen displaying the minimum and maximum entry limits.

High User Input Limit

The maximum entry value that an operator may enter. This value must be within the minimum and maximum entry values. If a value higher than this limit is entered the
SOI will display an “Input Error” screen displaying the minimum and maximum entry limits.

Default Value

This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default value.

32 Bit Floating Point

Register Number

The PLC data location address.

Minimum Register Value

The minimum data value of the PLC location.

Maximum Register Value

The maximum data value of the PLC location.

Minimum Entry Value

The minimum data value to be entered. When this value is entered the minimum register value is entered to the defined PLC location.

Maximum Entry Value

The maximum data value to be entered. When this value is entered the maximum register value is entered to the defined PLC location. The range defined by the minimum entry value and the maximum entry value is proportionally scaled to the range of the minimum and maximum register values. If both ranges are equal then the scaling ratio is 1:1.

Low User Input Limit

The minimum entry value that an operator may enter. This value must be within the range of +/-1.175495 x 10^{-38} to +/-3.402823 x 10^{3}8. If a value lower than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.

High User Input Limit

The maximum entry value that an operator may enter. This value must be within the range of +/-1.175495 x 10^{-38} to +/-3.402823 x 10^{38}. If a value higher than this is entered, the SOI-200 will display an "Input Error" screen displaying the minimum and maximum entry limits.

Default Value

This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default.

*Note: **The defined register number and the next higher sequential number locations will define the data value.***

32 Bit Unsigned Integer,
32 Bit BCD (Binary Coded Decimal)

Register Number

The PLC data location address.

Digits Right of Decimal

The number of digits to be placed to the right of the decimal.

Digits Left of Decimal

The number of digits to be placed to the left of the decimal.

Low User Input Limit

The minimum entry value that an operator may enter. This value must be within the range of the data format selected. If a value lower than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.

High User Input Limit

The maximum entry value that an operator may enter. This value must be within the range of the data format selected. If a value higher than this is entered, the SOI will display an "Input Error" screen displaying the minimum and maximum entry limits.

Default Value

This parameter defines a default value that is displayed at the entry location of the display. An entry of Z defines no default.

*Note: **For the 32 Bit selections, scaling of data is not supported. The defined register number and the next higher sequential number locations will define the data value.***

SOI Configuration Data Menu

This section describes the Modicon PLC specific requirements that the SOI-SPS programming software supports. The programming information may be found at the SOI Configuration Data Menu in the SOI-SPS software.

*Note: **Refer to the SOI-SPS programming software manual for complete details on programming and additional information regarding the SOI configuration Data Menu. In addition, refer to the Modicon PLC operations manual for details on the specific PLC you are working with.***

Time Synchronization

The Real Time Clock of the SOI-260 may either be written to the Modicon PLC or synchronized with the PLC by utilizing the Write Time or Read Time selections respectively. These selections are located after selecting the Time Synchronization selection from the SOI Configuration Data menu.

The Real Time Clock data will be written to the Modicon PLC in a batch of seven registers. These registers must be 4xxxx Holding Register locations. A base register is defined as the first of seven registers to hold the clock data. These seven registers contain data as follows:

Base	Day of Week, 1-7 (Sun=1)
Base +1	Month, 1-12
Base +2	Day of Month, 1-31
Base +3	Year, (Tens, Units) ie; 1991 = 91
Base +4	Hour, 0-23
Base +5	Minutes, 0-59
Base +6	Seconds, 0-59

The clock data will be synchronized on a 60-69 second interval. These seven locations should not be the actual clock location of the Modicon PLC as the SOI is not setting the PLC clock itself but simply providing a clock source to the PLC at a certain location.

PLC Routing Paths

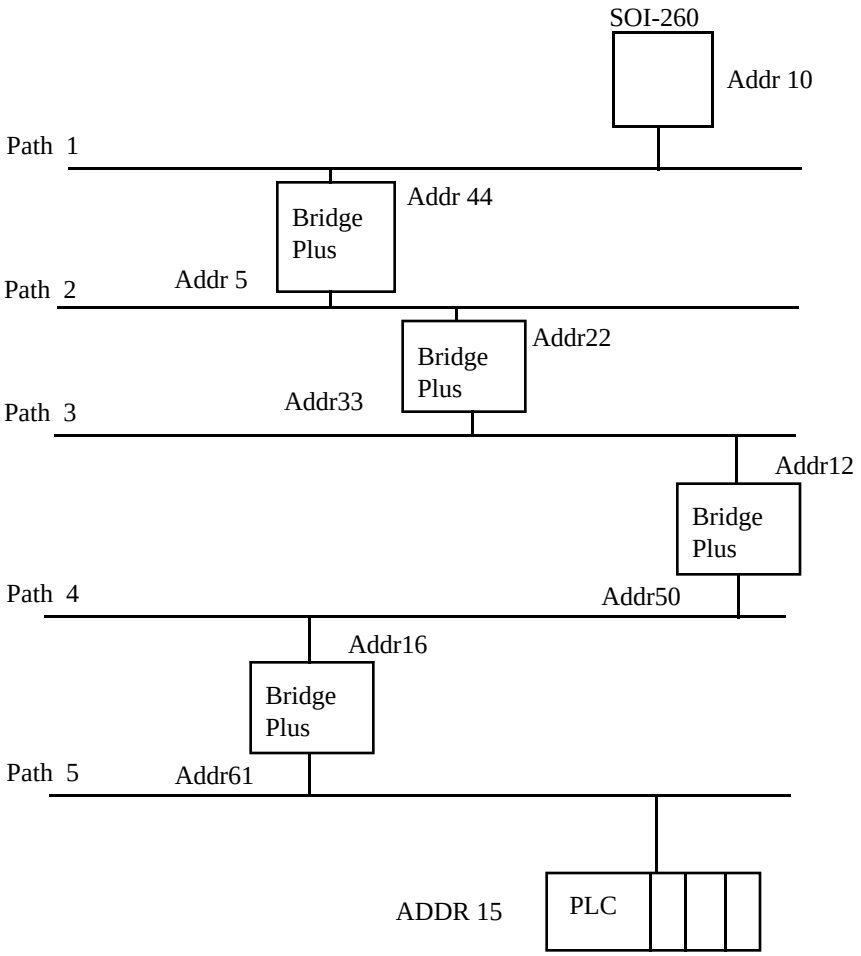
To access the PLC Routing Paths selection, you must first be in the SOI Configuration Data menu within the SPS programming software. Once in this menu screen, you must select: “PLC Hardware Parameters.” This will allow you to access the PLC Routing Paths. After selecting PLC Routing Paths, the computer screen will display:

Current Routing Paths:	1	0	0	0	0
Enter New Routing Paths:	1	0	0	0	0

This allows you to Route the SOI over the Modbus Plus network up to 5 Route Paths deep. For example, if the SOI is on network path 1 and you wanted to talk to a PLC on network path 5, you would program the paths with the device node address that you would be routing through in the Route Path position as well as the final destination address.

The Modbus Plus network below shows that an SOI-260 is on Route Path 1 and the PLC is on Route Path 5. To get the SOI to talk to the PLC, a new Route Path must be programmed. The new Route Path would look like this

Enter New Routing Paths: 44 22 12 16 15



Programming the Routing Address through the SPS programming software allows the SOI to communicate to the PLC on a permanent basis.

Note: To manually edit the Routing Paths with the SOI, please see the P-A/D section in Chapter 4 for detailed instructions.

Advisor Update Rate

The advisor update rate is the rate at which the SOI reads the Advisor register within the PLC. The Advisor Update Rate has a range from 1 to 12.5 seconds. The default value is 2 seconds.

Using the default value of 2 seconds means that every 2 seconds the SOI reads the Advisor register that is programmed in the PLC. The Advisor register in the PLC is typically used for calling up Alarm screens or "Hot" screens at any time by placing the desired screen number into the Advisor register. When the SOI sees a new screen number in the Advisor register, it displays that screen.

For detailed information on the Advisor register functionality, please refer to the Spectrum Controls SPS programming software manual.

Chapter 6: Modbus Plus Troubleshooting

This chapter provides troubleshooting information that may be symptomatic of operational problems with the SOI and its use with Modbus Plus communications.

Below is a description of the Communication Error Codes specific to the Modbus Plus communication protocol used for the Modicon processor and the SOI.

General Symptoms and Solutions

Under normal operations, typical problems that may be specific to a particular PLC will involve communications between the SOI and the PLC. The Modbus Plus communications protocol is different from other "software" protocols because the Modbus Plus protocol is derived from a proprietary chip set provided by Modicon. Thus, software and hardware error conditions may appear if a device is not functioning properly. Below are Communication Error Codes that will be displayed on the SOI if they occur. In addition to the communication error codes, a diagnostic LED is provided on the back of the SOI which provides the operating status of the Modbus Plus protocol.

If the communications cabling and communications parameters are all correct, perform the Self Test to rule out any non-functioning features of the SOI.

*Note: **Refer to the SOI-120 and SOI-260 Users Manual for information about the Self Test Mode.***

Communication Error Codes

The below error codes will be generated on the SOI display. These errors are generated by the Modbus Plus Interface. The below codes are shown how they would appear on the SOI, with a description of each error.

When the SOI-260 Modbus Plus interface crashes, the display shows:

```
<INTERFACE CRASHED!>

Press "Y" to Reset '
"ENTER" To Continue.
```

After reset is finished, the display shows:

```
<RESET FAILURE!>
XXXXXXXXXXXXXXXXXXX

Press "Y" to Reset
```

The second line of the above display contains the SYMBOLIC crash reason and the actual code received from the Modbus Plus interface. As an error code is displayed, the second line will identify the error. The errors are listed below:

SYMBOLIC	CODE	ERROR-TYPE	DESCRIPTION
IFCINTACT:	00H	none	interface operational
IFCTIMOUT:	01H	interface	2.0 sec interface timeout
BADIFCOPC:	02H	interface	bad interface opcode
IFCDATERR:	03H	interface	interface data error
IFCTSTERR:	04H	interface	interface test error
IFCDONERR:	05H	interface	interface xfer-done error
BADIFCPTH:	06H	interface	bad interface path
BADXFRSVR:	07H	interface	bad transfer state
BADXFRLEN:	08H	interface	bad transfer length
GLBDATLEN:	09H	interface	global-data length error
GLBDATADR:	0AH	interface	global-data address error
GLBDATPRS:	0BH	interface	global-data not present
CKSUMERR:	81H	fatal	prom checksum error
RAMDATERR:	82H	fatal	int-ram data test error
EXTDATERR:	83H	fatal	ext-ram data test error
EXTADRERR:	84H	fatal	ext-ram addr test error
BADCTINDX:	85H	fatal	bad confidence test index
EXT0EVENT:	86H	fatal	ext-int0 event error
EXT1EVENT:	87H	fatal	ext-int1 event error
DMA0EVENT:	88H	fatal	dma-int0 event error
COMMEVENT:	89H	fatal	comm-int event error
XMTNGEVNT:	8AH	fatal	xmit-no-good event error
RSPTOSVR:	8BH	fatal	no rsp timeout MAC-state
RSPTOIDLE:	8CH	fatal	no-rsp timeout MAC-idle
RCVOKSVAR:	8DH	fatal	receive-ok MAC-state
XMTOKSVAR:	8EH	fatal	transmit-ok MAC-state
NORCVBUF:	8FH	fatal	no receive buffer free
BADINXLEN:	90H	fatal	bad input-transfer length
RESBUFERR:	91H	fatal	reserved rcv-buf error
BADTCSVAR:	92H	fatal	bad trans-control state
BADWRKREQ:	93H	fatal	bad work request bit
OVFDATQUE:	94H	fatal	node-queue overflow
BADDATQUE:	95H	fatal	bad data-queue error
NOPATHERR:	96H	fatal	empty data-path error
BADPTHINX:	97H	fatal	bad path search index
BADDSPATH:	98H	fatal	bad data-slave path
BAD CODE :	??H	unknown	out of range code

The below error codes will be generated on the SOI display and are generated by the SOI operating system. The below codes are shown how they would appear on the SOI, with a description of each error. When a communication error occurs, the display shows:

XXXXXXXXXXXXXXXXXXX
YYYYYYYYYYYYYYYYYYY
ZZZZZZZZZZZZZZZZZZZZZZZZZ
Press "Y" to Reset

The first, second and third lines of the above display contain the communication error message and will show different data based on the fault that occurred. The errors are listed below:

Error Message	Error Description
'INVALID HEADER DATA.' 'bytes 0x000 to 0x00E'	This is a major error code that indicates that there is a problem with the Modbus+ Message header.
'INVALID MASTER PATH.' 'response byte 0x007 '	This error is a indication that the master communicaions path address located in location 0 of the Modbus+ Header is incorrect. values DM01-DM08 and PM81-PM88.
'PLC LISTEN-ONLY MODE' 'response byte 0x00F '	This error is a indication that the PLC that is being communicated with is in the Listen mode only. Check your PLC.
'MAJOR CODE MIS-MATCH' 'response byte 0x00F '	This indicates that Major Modbus function code transmitted does not match the Modbus Major fuction code echo back with the response from the peer processor.

'ROUTE FAIL RESPONSE.' 'index:0x addr: ' 'error:0x type:0x '	This is a indication that the message did not reach the PLC addressed or that the PLC is not connected or there is a unauthorized attempt to communicate with non-slave device. The valued in the displayed field is a bit map and is composed from these values. Remember that the resultant displayed value is a combination of the following: 0x01 no response received. 0x02 program access denied. 0x04 exception response received. 0x08 invalid node type in routing path. 0x10 slave rejected the modbus command. 0x20 initiated transaction forgotten by slave. 0x40 unexpected master output path received. 0x80 unexpected responsed received. The type field indicates the type of device that the Modbus+ received the error from. These values are as follows: 0x00 Unknown node type. 0x01 Standard PLC node. 0x02 Modbus bridge node. 0x03 PC Plus node. 0x04 Bridge Plus node.
'INVALID MAC-FUN CODE' 'response byte 0x004 '	This indicates that the MAC-fuction code of header byte 0x04 is unknown.
'RESPONSE TIMEOUT '	This indicates that there has been no response on the communications path that a previous message was sent to for over 12 seconds.
'CONFIG STAT FAILURE!'	This message indicates that the peer processor did not correctly return the quick interface test bytes correctly and we must assume that the peer processor hardware has failed.
'<MASTER CMD FAILURE>' 'Output Path Mismatch'	Master command-response path mismatch This message indicates that there is a mismatch between the master output path and the received master output path value.... Ref. header locations 0x00 and 0x07.

'<MASTER RSP FAILURE>' 'Route Paths Mismatch'	Master response routing path mismatch This message indicates that there is a mismatch between the data sent to the peer processor and the echoed data received from the peer processor.
'<INVALID SLAVE PATH>'	Something is wrong with the slave address ect. This message indicates that there is a error with the mac fuction code that was received with the get slave command.
'<MASTER RSP FAILURE>' 'Unexpected Response '	Unexpected command response. This message indicates that the response data that was echoed back from the peer processor does not match what was sent.
'<MASTER RSP FAILURE>' 'Max Buffer Size ' ' Exceeded! '	Max Buffer Size exceeded. This indicates that the message that was received from the peer processor has exceeded the size of the available input data buffer. This error should not occur under normal circumstances.
'< EXCEPTION ERROR >' 'Illegal function for ' 'addressed slave. '	Exception slave function. We are not talking to a PLC.
'< EXCEPTION ERROR >' 'Illegal data address'	Exception data address. Invalid data address. PLC ladder and Symbol tables must be checked.
'< EXCEPTION ERROR >' 'Illegal data value '	Exception data value. Illegal data value in the information field for the addressed slave.
'< EXCEPTION ERROR >' ' Busy try again ' ' later '	Exception busy. The PLC is busy.
'< EXCEPTION ERROR >' ' Error code out of ' ' range '	Error code out of range. Invalid error code.

Note: Many of the above error codes are solved by resetting the SOI unit (removing power). If an error occurs and a reset does not solve the problem, contact the factory for assistance.

Diagnostic LED

The diagnostic LED assists in troubleshooting situations. The diagnostic LED is not accessible to the user in normal operation; however, it may be viewed from the back of the SOI when troubleshooting. The below flashing patterns provide a unique condition based on the repetitiveness of the pattern.

Pattern	Meaning
Flash every 160 msec	The unit is working normally (successfully receiving and passing the network token). All units on the network should be flashing this pattern.
Flash every 1 sec	The unit is in the MONITOR_OFFLINE state, where it must monitor the network for 5 sec and is not allowed to transmit any packets onto the network. During this time, it hears all other active nodes on the network and builds the active station table.
2 flashes, off 2 sec	The unit is permanently in the MAC_IDLE never-getting-token state and is hearing other nodes on the network pass the token to themselves, but the token is never passed to this node. The unit may have a bad transmitter.
3 flashes, off 1.7 sec	The unit is not hearing any other nodes, so it is periodically claiming and winning the token and then finding no other node to pass it to. It could be that this unit is the only node on the network, there are no other active nodes on the network, or this unit has a bad receiver. In the latter case, this unit will periodically disrupt communication on the network.
4 flashes, off 1.4 sec	The unit had heard a valid packet that was sent from another node on the network that is using the same network address. The unit is now in the DUPLICATE_OFFLINE state, where it will remain passively monitoring the network until the duplicate node is not heard from for 5 sec.

Note: If it is determined that a problem exists based one of the above flashing patterns and a reset of the unit does not correct the problem, please consult the factory for assistance.

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