

# 16-Channel Universal Analog Input Module

(Catalog No. 140 AUI 040 00sc)

## Installation Instructions

Document No. 0300180-02 Rev. B



## PREFACE

+ *Note: Power, input and output (I/O) wiring must be in accordance with Class 1, Division 2 wiring methods [Article 501-4 (b) of the National Electrical Code, NFPA 70] and in accordance with the authority having jurisdiction.*

+ *Note: Peripheral equipment must be suitable for the location in which it is used.*



**WARNING**  
**ELECTROSTATICALLY SENSITIVE COMPONENTS**  
**EXPLOSION HAZARD**  
Substitution of components may impair suitability for Class 1, Division 2.

---



**WARNING**  
**EXPLOSION HAZARD**  
Do not disconnect equipment unless power has been switched off or the area is known to be non hazardous.

---



**WARNING**  
This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D or non-hazardous locations only.

---



**WARNING**  
**EXPLOSION HAZARD**  
When in hazardous locations, turn off power before replacing or wiring modules.

---



# Contents

Chapter 1 - OVERVIEW	7
1.1 ..... Inputs	8
1.2 ..... LEDs	9
1.3 ..... Related Publications	9
Chapter 2 - MODULE SETUP FOR MODSOFT	11
2.1 ..... General Information	11
2.2 ..... Installation of new run time files	11
2.3 ..... General information on data register usage and terminology:	12
2.4 ..... Zoom Screen Configuration	12
2.5 ..... 4X Register Configuration	15
Chapter 3 - MODULE SETUP FOR CONCEPT	17
3.1 ..... General Information	17
3.2 ..... Installation of new run time files	17
3.3 ..... General information on data register usage and terminology:	17
3.4 ..... Concept I/O Map Module Parameters:	18
3.5 ..... Spectrum I/O Configuration Utility	22
3.6 ..... SCIOCFG.EXE Installation:	22
Chapter 4 - MODULE CONFIGURATION AND STATUS	25
4.2 ..... Module status information (Register 3x+8)	26
4.3 ..... Channel Status (Registers 3x+ 0 through 3x+7)	28
Chapter 5 - INSTALLATION	31
5.1 ..... Field Wiring	33
5.2 ..... RTD Field wiring	33
5.3 ..... CJC Thermocouple Installation	34
Chapter 6 - APPLICATION NOTES	37
6.1 ..... General Application Tips	37
6.2 ..... Demultiplexing Channel Data - Autosequence Mode	37
6.3 ..... Using ladder to move data to a block of 16 consecutive registers	37
6.4 ..... Channel Update Rate	39
6.5 ..... System Resolution and Accuracy - Voltage /Current Modes	40
Chapter 7 - TROUBLESHOOTING	43
7.1 ..... General Information	43
Chapter 8 - SPECIFICATIONS	47
1.1 ..... Electrical Specifications	47
1.1A Table - Thermocouple Accuracy	48
1.2 ..... System Specifications	50
1.3 ..... Environmental Specifications	50



## Chapter 1

### OVERVIEW

The 140 AUI 040 00sc is a universal analog input module with 16 channels of input.

The module will accept voltage, current, resistance, thermocouple and RTD inputs. The voltage, current, resistance and thermocouple inputs are divided into four groups of four inputs each. RTD inputs are divided into 4 groups of 2 inputs each. Any combination of inputs may be used so long as they are configured on a group basis. Each input has 12.5V of isolation from the other inputs. All inputs have 1000V DC isolation channel-to-backplane.

This module has been designed for projects that include large quantities of analog and temperature inputs. Process control and data acquisition applications for industries such as utilities, waste water, oil and gas, food and beverage, and building automation are ideally suited for this module.

Input channels include over voltage circuit protection, over and under range detection and active notch filtering. The module has open circuit detection for thermocouple inputs and both open and short circuit detection for RTD inputs. The voltage mode of the module handles eight different voltage ranges and the current mode handles three current ranges. Eight types of thermocouple inputs are supported. Sixteen types of RTD inputs and four resistance input ranges are supported. You can configure the module to provide data in one of four data formats. Set up of the module is very simple through the use of configuration and status registers using Concept, Modsoft or Taylor programming software.

## 1.1 Inputs

The 16 Channels are separated into four groups of four. Each group can be configured for a different voltage, current range, resistance, thermocouple and RTD range. The ranges available are as follows:

### Current Ranges

- 4 to 20 mA, 0 to 20 mA,  $\pm 20$ mA

### Voltage Ranges:

- $\pm 0.05$ VDC,  $\pm 0.5$ VDC,  $\pm 2.0$ VDC,  $\pm 5$ VDC,  $\pm 10$ VDC, 0-10VDC, 0-5VDC, 1-5VDC

### Resistance Ranges

- 150, 490, 980, 3000 ohm

### Thermocouple Types

- Type J, K, T, E, R, S, B, N

### RTD Types

- 100, 200, 500 and 1K $\Omega$  Pt Alpha 385,  
100, 200, 500, and 1K $\Omega$  Pt Alpha 392,  
100, 200, 500, and 1K $\Omega$  Nickel,  
10 $\Omega$  Copper 426,  
120 $\Omega$  Nickel 672, 604 $\Omega$  Nickel/Iron 518.

The module can provide data to the PLC in the following formats:

- 12 bit (0 to 4095)
- signed 15 bit (-32768 to +32767)
- unsigned 16 bit (0 to 65535)
- DVM (0 to 10000)

Input Resistance           10M $\Omega$  nominal (Voltage)  
  250 $\Omega$  nominal (Current)

## 1.2 LEDs

The module has a front LED panel that includes 19 LEDs:

**Ready LED** - 1 Green LED indicates module's self test has passed and is ready to communicate.

**Active LED** - 1 Green LED indicates BUS communication is established between the module and the rack.

**Fault LED** - 1 Red LED indicates a module self test error, or fatal H/W error. A blink code will indicate the type of self test error. Count the number of blinks before a pause to determine the error code in the table below.

Blink #	Fault
1	ROM CRC Error
2	EEPROM Error
3	RAM Error
4	Autocal Error
5	Watchdog Timer Error
6	CPU Error
7	DPM Error

**Channel LED** - 16 Green LEDs indicates the channel is enabled and a valid input signal level is present. The LED is off if the channel is disabled. A blinking LED indicates that the channel has exceeded a range limit.

## 1.3 Related Publications

- *Modicon Modsoft Programmer User Manual*. 890 USE 115 00
- *Modicon TSX Quantum Automation Series Hardware Reference Guide*. 840 USE 100 00
- IEEE Std 518- 1977, *Guide for the Installation of Electrical Noise Inputs to Controllers from External Sources*
- IEEE Std 142- 1982, *Recommended Practice for Grounding of Industrial and Commercial Power Systems*
- *Noise Reduction Techniques in Electronic Systems*, by Henry W. Ott; published by Wiley-Interscience of New York in 1976





## Chapter 2 MODULE SETUP FOR MODSOFT

### 2.1 General Information

Six steps must be performed in order to fully configure the Quantum system in preparation for using the AUI 040 00sc:

Step 1: Modsoft programming software must be updated so that the 140 AUI 040 00sc is recognized in the software (see Section 2.2).

Step 2: Select the appropriate slot location using the Modsoft I/O map. Choose the first 3x and 4x level registers to be used in the system for the module's data, configuration and status information (see Section 2.3).

Step 3: Zoom screens for the module must be set to match application requirements (see Section 2.4).

Step 4: The 4x configuration register must be set to meet application requirements (see Section 4.1).

Step 5: Module status information is available to you. The various options must be understood and chosen to meet your application requirements (see Section 4.2 and Section 4.3).

Step 6: Ladder rungs must be written to demultiplex the incoming 8 data registers to 16 user selected data registers (see Section 6.3).

### 2.2 Installation of new run time files

If you are using the Modsoft programming software version 2.4 or 2.5, it is necessary to update the following runtime files in order for Modsoft to recognize your module. Versions prior to 2.4 are not supported. Version 2.6 and newer already include these updates.

LMSFDT.SYS	Zoom screens
GCNFTCOP.SYS	I/O Map module definitions
QUANTUM.SYS	Quantum help screens

This may be accomplished by first identifying the pathname where you have installed your Modsoft programming software and the drive letter of the floppy drive from which you intend to install. A typical pathname assuming installation of the C: drive is as follows:

C:\MODSOFT

The new runtime files required to use all versions of this module are supplied on the 3.5 inch MSDOS formatted floppy disk titled:

"Quantum Runtime Files," Spectrum Controls, Inc Part Number: 20500121-02

To install these files, operate your PC in MSDOS mode, perform the following command:

C:>\COPY A:\*.SYS C:\MODSOFT\RUNTIME

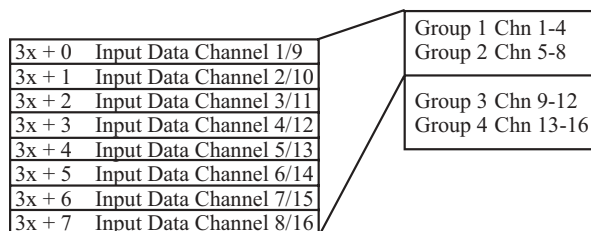
+ Note: This assumes you are installing from drive A: and that you have previously installed Modsoft in the directory C:\MODSOFT. If not, you must make the appropriate substitutions.

### 2.3 General information on data register usage and terminology:

A total of nine 3x level and one 4x level registers are used by the 140 AUI 040 00sc. After you have completed the runtime file installation, you can go to the I/O Map screen and choose the 140 AUI 040 00sc by selecting the desired slot, pressing <Shift + ?> which will display the modules available for configuration into that slot. For module specific help, press <ALT + H>. After selecting the module, you must set the first 3x and 4x level registers to be used. This will then automatically capture nine consecutive 3x level and one 4x level register for use by the module. The architecture for this 16-channel module is as follows:

4x	Configuration Word
3x + 0	Input Data Channel 1/9
3x + 1	Input Data Channel 2/10
3x + 2	Input Data Channel 3/11
3x + 3	Input Data Channel 4/12
3x + 4	Input Data Channel 5/13
3x + 5	Input Data Channel 6/14
3x + 6	Input Data Channel 7/15
3x + 7	Input Data Channel 8/16

The AUI 040 00sc multiplexes 16 channels of data into eight groups of two channels. Each group can be selected through the 4x Configuration Word or can automatically sequence through all four groups of channels.



### 2.4 Zoom Screen Configuration

For Zoom Screen operation, please refer to Modicon's Modsoft Programmer User Manual.

 Note: To enter zoom screens from the I/O map menu, highlight the module entry and press the keys <ALT - Z>.

Most of the module setup will be done through the Modsoft zoom screens. The zoom screen setup establishes the following parameters:

- Input Type
- Input Range
- Filter Frequency Selection
- Input Data Format
- Operational Mode

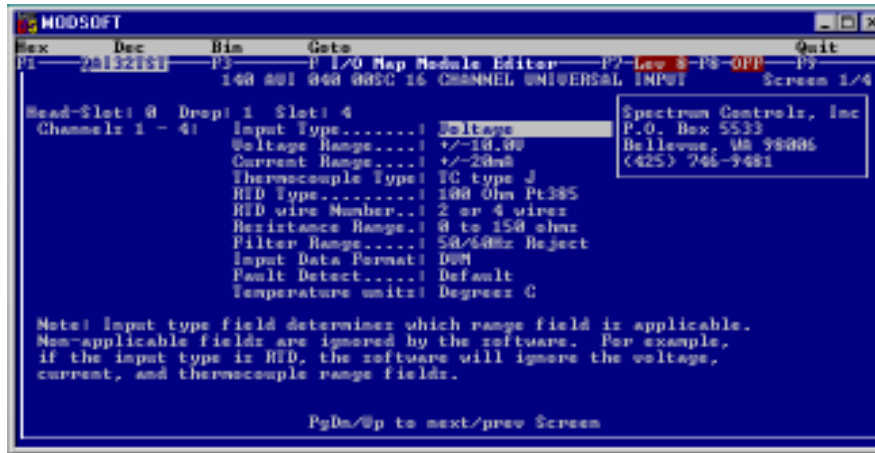


Figure 2.1

**Input Type:**

You have 5 input types to select from, one of the following input types may be selected for each of the four groups of four channels:

- Type: Voltage [default]
- Current
- Thermocouple
- RTD
- Resistance

**Input Range:**

Depending on the type of input selected, one of the following input ranges may be selected for each of the four groups of four channels:

Type: Voltage					
Bipolar Ranges (vdc)	-0.05 to +0.05	-0.50 to +0.50	-2.0 to +2.0	-5.0 to +5.0	-10.0 to +10.0
Unipolar Ranges (vdc)	0 to +5.0	+1.0 to +5.0	0 to +10.0		
Type: Current					
Ranges (mA)	-20.0 to +20.0	0 to +20.0	4.0 to 20.0		
Type: Thermocouple	Type J, K, T, E, R, S, B, N				
Type: RTD					
Pt 385	RTD 100ohm	RTD 200ohm	RTD 500ohm	RTD 1000ohm	
Pt 392	RTD 100ohm	RTD 200ohm	RTD 500ohm	RTD 1000ohm	
Cu 426	RTD 10ohm				
Ni 618	RTD 100ohm	RTD 200ohm	RTD 500ohm	RTD 1000ohm	
Ni 672	RTD 120ohm				
Ni/Fe 518	RTD 604ohm				
Type: RTD Cfg.	2/4 Wire 3 Wire				
Type: Resistance	150ohm	490ohm	980ohm	3000ohm	

### Filter Frequency Selection:

The Analog-to-Digital Conversion performs a filter function on the input signal. One of the following filter frequencies may be selected for each of the four groups of eight channels:

Rejection Type	Filter Freq.	Zoom Screen Name
50/60Hz Rejection	13.65Hz 3dB [default]	Reject 50/60Hz
High Noise Rejection	7.80 3dB	Reject 28Hz
Mid Range	209.6Hz 3dB	Reject 800Hz
High Speed	1676.8Hz 3dB	Reject 6.4kHz

### Input data format:

One of the following data formats may be selected for each of the four groups of four channels:

- Format: Digital Voltmeter [default]
- 12-bit Unsigned Format
- 16-bit Signed Format
- 16-bit Unsigned Format

 Note: The module's format selection must be compatible with the register format selected in Modsoft.

### Fault Detection:

One of the following detection formats may be selected for each of the four groups of four channels:

- Format: Default [Max on over-range, min on under-range]
- Max on Fault
- Min on Fault
- 0 on Fault

### Temperature Units:

One of the following unit formats may be selected for each of the four groups of four channels:

- Format: Degrees Celsius [default]
- Degrees Fahrenheit

### Calibration rate:

The Quantum module performs an on board system calibration at power up. The system calibration corrects for temperature drift of the Analog to Digital Convertor (ADC) and related circuitry. System calibration can be performed periodically based on the calibration rate selected below. This can affect the update time for the module. For installations where the ambient temperature surrounding the I/O rack can change relatively quickly, the user might consider going to a more frequent calibration selection in order to improve the accuracy of the reading being taken. The autocalibration schedule rate may be selected from the following:

- Once at power up only [default]
- Every 1 min
- Every 10 min
- Every 30 min

Selecting an autocalibration schedule rate is an exercise in tradeoffs. Performing autocalibration more frequently may result in greater accuracy due to variations caused by environmental factors such as temperature. This accuracy has a cost in the burden imposed by performing the calibration. The calibration time is a function of the filter frequency. Calibration times are listed below. The system cannot update the channel data while performing calibration. In addition, if multiple filter frequencies are selected, calibrations for each frequency and the execution time is cumulative. The worst case calibration time is when all filter frequencies are enabled (7.8, 13.6, 50/60 and 1677 Hz). The time is then the total for all four times listed below. Also, note that the channel enables have no effect on the auto calibration feature. If a filter frequency is enabled via the zoom screens, then the autocalibration is performed for the frequency.

Filter Freq.	16 Ch. Update Rate
7.8 Hz - 3db	1992 msec
13.6 Hz - 3bd	1168 msec
209.6 Hz - 3db	132 msec
1677 Hz - 3db	80 msec

## 2.5 4X Register Configuration

Refer to Chapter 4 for 4x register setting information.



## Chapter 3

### MODULE SETUP FOR CONCEPT

#### 3.1 General Information

Six steps must be performed in order to fully configure the Quantum system in preparation for using the AUI 040 00sc:

- Step 1: Concept programming software (Version 2.1 or newer) must be updated so that the 140 AUI 040 00sc is recognized in the software (see Section 3.2).
- Step 2: Select the appropriate slot location using the Concept I/O map editor. Choose the first 3x and 4x level registers to be used in the system for the module's data, configuration and status information (see Section 3.3).
- Step 3: Parameters for the module must be set to match application requirements (see Section 3.4).
- Step 4: The 4x configuration register must be set to meet application requirements (see Section 4.1).
- Step 5: Module status information is available to you. The various options must be understood and chosen to meet your application requirements (see Section 4.2 and Section 4.3).
- Step 6: Ladder rungs must be written to demultiplex the incoming 8 data registers to 16 user selected data registers (see Section 6.3).

#### 3.2 Installation of new run time files

*The 140 AUI 040 00sc is manufactured by Spectrum Controls, Inc. Follow the Concept installation procedure for outsourced modules. This requires the install disk provided with your module, which includes the following files (assuming drive A:):*

- A:\CONCEPT\SPECTRUM.MDC - Spectrum I/O for Quantum Module Definition file.
- A:\CONCEPT\SPECTRUM.HLP - Spectrum I/O for Quantum Help file.

*To update the Concept database with a new Spectrum I/O module:*

1. Insert the install disk into drive A:
2. Start the Concept Modconnect Tool (Modconf.exe).
3. Open the installation file "SPECTRUM.MDC"
4. Select the module to add or press the "Add All" button
5. Save the changes before exiting the Modconnect tool.

This will update the Concept database permanently unless you later undo the changes using the Modconnect Tool, or perform a new Concept software install.

#### 3.3 General information on data register usage and terminology:

A total of nine 3x level and one 4x level registers are used by the 140 AUI 040 00sc. After you have completed adding the modules to the Concept database using the Modconnect tool, you can add a module to a drop by using the Concept Configurator as follows:

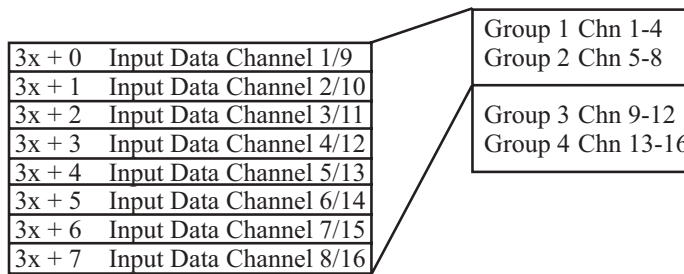
1. Open an existing or create a new project.
2. Select the Configurator from the project pulldown menu.
3. Select Configure then select the I/O map menu.
4. On the I/O map menu, press the EDIT button for the appropriate drop.
5. Push the button in the module select column for the appropriate slot.
6. Select the desired module from the list of available modules.
7. Enter the starting 3x register address (InRef). Nine registers are automatically allocated.
8. Enter the starting 4x register address (OutRef). One register is allocated.
9. Press the parameters button. (Refer to the SC Config Utility - Section 3.5)
10. Verify register values are correct for the desired behavior.



The register data formats are discussed in the following section.

4x	Configuration Word
3x + 0	Input Data Channel 1/9
3x + 1	Input Data Channel 2/10
3x + 2	Input Data Channel 3/11
3x + 3	Input Data Channel 4/12
3x + 4	Input Data Channel 5/13
3x + 5	Input Data Channel 6/14
3x + 6	Input Data Channel 7/15
3x + 7	Input Data Channel 8/16

The AUI 040 00sc multiplexes 16 channels of data into four groups of four channels. Each group can be selected through the 4x Configuration Word or can automatically sequence through all four groups of channels.



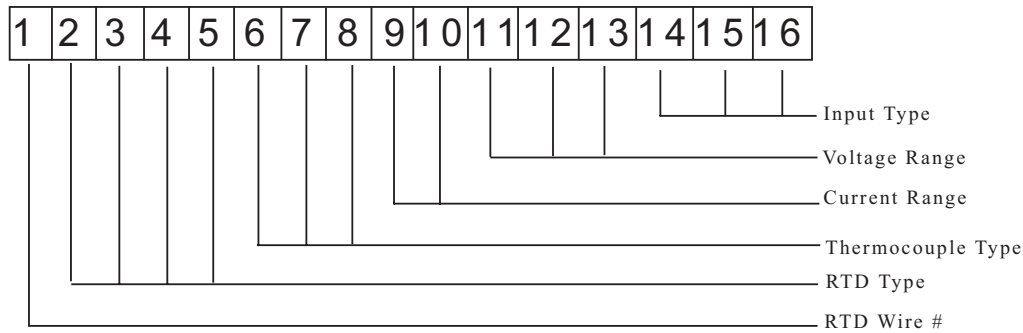
### 3.4 Concept I/O Map Module Parameters:

Concept programming software does not implement zoom screens for ModConnect partner modules and allows only direct editing of the I/O configuration parameters using 16 bit hex values. Spectrum Controls has provided a software utility to simplify the configuration process. Refer to Section 3.5 for details.

From the Concept main screen, highlight the “configure” pull-down menu and choose “I/O Map.” In the I/O Map screen insert the number for the correct “drop” and choose “edit.” Select the Spectrum Controls catalog number that you wish to use from the list presented. When the screen appears, representing the Spectrum module you have selected, highlight the parameters button. You must insert Hex values for registers #1, 2 and 3 to fully configure the module. The format that will instruct you on how to create the I/O map parameters is listed below. For each of the parameters listed we have provided a detailed explanation in Chapter 2. Please refer to detailed functional descriptions in the MODSOFT zoom screen discussions (Section 2.4). You must go through each of the options below to establish the correct pattern for each of these three registers. Once you have the bit pattern, then you can convert each to a four-digit Hex value that is used in the parameters screen.

#### Configuration Register 1

<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>
<b>Ch. 1-4</b>	<b>Ch. 5-8</b>	<b>Ch. 9-12</b>	<b>Ch. 13-16</b>
<b>Zoom +10</b>	<b>Zoom +12</b>	<b>Zoom +14</b>	<b>Zoom +16</b>



**Bit Selection Pattern: Input Type for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

Bit 14	Bit 15	Bit 16	Description
0	0	0	Voltage (Default)
0	0	1	Current
0	1	0	Thermocouple
0	1	1	RTD
1	0	0	Resistance
1	0	1	CJC
1	1	0	Not valid
1	1	1	Not valid

**Bit Selection Pattern: Voltage Range for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

Bit 11	Bit 12	Bit 13	Description
0	0	0	-0.05 to +0.05vDC
0	0	1	-0.50 to +0.50vDC
0	1	0	-2.00 to +2.00vDC
0	1	1	-5.00 to +5.00vDC
1	0	0	-10.0 to +10.0vDC *(default)
1	0	1	0 to +5.0vDC
1	1	0	1 to +5.0vDC
1	1	1	0 to +10.0vDC

**Bit Selection Pattern: Current Range for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

Bit 9	Bit 10	Description
0	0	-20 to +20mA
0	1	0 to +20mA
1	0	4 to +20mA
1	1	N/A

**Bit Selection Pattern: Thermocouple Type for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

Bit 6	Bit 7	Bit 8	Description
0	0	0	Thermocouple type J
0	0	1	Thermocouple type K
0	1	0	Thermocouple type T
0	1	1	Thermocouple type E
1	0	0	Thermocouple type R
1	0	1	Thermocouple type S
1	1	0	Thermocouple type B
1	1	1	Thermocouple type N

**Bit Selection Pattern: Voltage Range for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

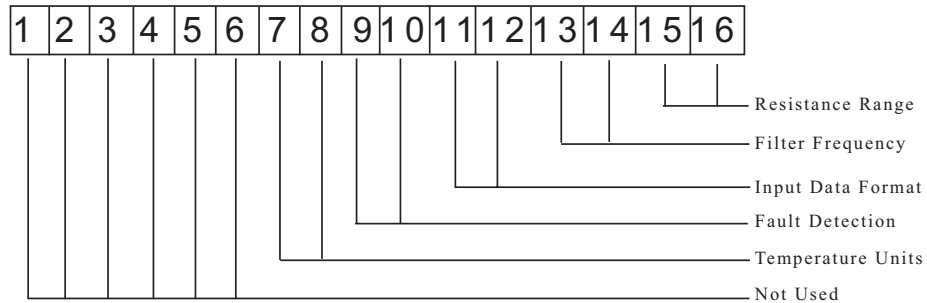
Bit 2	Bit 3	Bit 4	Bit 5	Description
0	0	0	0	RTD 100 ohm Pt 385
0	0	0	1	RTD 200 ohm Pt 385
0	0	1	0	RTD 500 ohm Pt 385
0	0	1	1	RTD 1000 ohm Pt 385
0	1	0	0	RTD 100 ohm Pt 392
0	1	0	1	RTD 200 ohm Pt 392
0	1	1	0	RTD 500 ohm Pt 392
0	1	1	1	RTD 1000 ohm Pt 392
1	0	0	0	RTD 10 ohm Cu 426
1	0	0	1	RTD 100 ohm Ni 618
1	0	1	0	RTD 200 ohm Ni 618
1	0	1	1	RTD 500 ohm Ni 618
1	1	0	0	RTD 1000 ohm Ni 618
1	1	0	1	RTD 120 ohm Ni 672
1	1	1	0	RTD 604 ohm Ni/Fe 518
1	1	1	1	Not used

**Bit Selection Pattern: RTD / Resistance Wires for Group 1, 2, 3, 4 - Zoom Register 1,3,5,7**

Bit 1	Description
0	2 or 4 Wire
1	3 Wire

**Configuration Register 2**

Group 1	Group 2	Group 3	Group 4
Ch. 1-4	Ch. 5-8	Ch. 9-12	Ch. 13-16
Zoom +11	Zoom +15	Zoom +17	Zoom +16



**Bit Selection Pattern: Input Resistance Range for Group 1, 2, 3, 4 - Zoom Register 2,4,6,8**

Bit 15	Bit 16	Description
0	0	150ohm (Default)
0	1	490ohm
1	0	980ohm
1	1	3000ohm

**Bit Selection Pattern: Input Filter Frequency for Group 1, 2, 3, 4 - Zoom Register 2,4,6,8**

Bit 13	Bit 14	Description
0	0	50/60Hz Rejection 13.65Hz 3db (Default)
0	1	High Noise Rejection 7.8Hz 3db
1	0	Mid Range Noise Rejection 209.6Hz 3db
1	1	High Speed 1676.8Hz 3db

**Bit Selection Pattern: Input Data Format for Group 1, 2, 3, 4 - Zoom Register 2,4,6,8**

Bit 11	Bit 12	Description
0	0	16 bit unsigned integer
0	1	DVM (Default)
1	0	12 bit unsigned integer
1	1	15 bit signed integer

**Bit Selection Pattern: Fault Detect for Group 1, 2, 3, 4 - Zoom Register 2,4,6,8**

Bit 9	Bit 10	Description
0	0	Disabled
0	1	Max. on Fault (Default)
1	0	Mi.n. on Fault
1	1	0 on Fault

**Bit Selection Pattern: Temperature Units for Group 1, 2, 3, 4 - Zoom Register 2,4,6,8**

Bit 8	Description
0	Degrees Celcius (Default)
1	Degrees Farenheight

Once you have established the correct bit pattern for each of these three registers, you can convert each to a four digit Hex value that is used in the parameters screen. A Hex conversion table follows:

0	0	0	0	=	0
0	0	0	1	=	1
0	0	1	0	=	2
0	0	1	1	=	3
0	1	0	0	=	4
0	1	0	1	=	5
0	1	1	0	=	6
0	1	1	1	=	7
1	0	0	0	=	8
1	0	0	1	=	9
1	0	1	0	=	A
1	0	1	1	=	B
1	1	0	0	=	C
1	1	0	1	=	D
1	1	1	0	=	E
1	1	1	1	=	F

### 3.5 Spectrum I/O Configuration Utility

“SCIOCFG.EXE” is a utility provided on the install disk under the typical pathname “A:\CONCEPT\SCIOCFG.EXE”. “SCIOCFG.EXE” is intended to help users configure Spectrum I/O when using Concept. This tool is intended to make the configuration of I/O modules supplied by Spectrum Controls easy to accomplish when using Concept.

Version 2.1 of the Concept programming software introduced the tool for importing ModConnect module definition files into the Concept database. This allows Concept users to configure ModConnect I/O such as the 140 AUI 040 00sc. However, Concept V2.1 does not provide a means for ModConnect I/O developers to design their own I/O configuration menus. Instead, Concept provides a generic interface where the user must enter configuration parameters in hexadecimal values. The Spectrum I/O modules are designed to be feature rich with an efficient use of registers. This requires the user to be intimately aware of the initialization parameters structure in order to perform simple I/O configuration changes. Simply stated, users can calculate the correct hexadecimal values for the configuration parameters but it is a tedious task, SCIOCFG is designed to relieve the user of this burden.

SCIOCFG presents the user with user friendly selection lists using standard Windows interfaces. SCIOCFG also automatically constrains all parameters to legal values during the data entry process.

SCIOCFG may be run in one of two modes, stand alone mode, or synchronous mode. In the stand alone mode, the user configures the data for a given module as desired. SCIOCFG then presents the parameters in hexadecimal values so the user may then manually transfer this data to Concept at a later time.

In the synchronous mode, SCIOCFG runs in the background waiting for the user to select the generic I/O parameters configuration menu for any one of the modules supported. When this occurs, SCIOCFG reads the data from the Concept generic I/O parameter configuration menu, and activates the appropriate I/O parameter configuration menu. When the user clicks on the SCIOCFG OK button, the new data is sent back to Concept.

### 3.6 SCIOCFG.EXE Installation:

SCIOCFG.EXE is a 32-bit Windows program requiring Windows 95 or newer. Installation of SCIOCFG.EXE is simple. Copy the SCIOCFG.EXE file from the installation disk to the desired directory. Then you may add a shortcut to the windows desktop or add the program to the windows taskbar using standard windows techniques.

e.g. From a DOS window:

```
C:\>MDC:\SCIOCFG  
C:\>COPY A:\CONCEPT\SCIOCFG.EXE C:\SCIOCFG
```

To add a shortcut:

1. Place the mouse cursor on an open area of the windows desktop.
2. Click the right mouse button.
3. Select the “New” option.
4. Select the “Shortcut” option.
5. Enter the full install pathname. E.G. C:\SCIOCFG\SCIOCFG.EXE

+ Note :The user may optionally configure SCIOCFG to always run in either the stand alone mode or the synchronous mode. To do this, place a space in one of the following strings immediately after the full pathname:

```
NO_SYNC  
SYNC_WITH_CONCEPT  
E.G. C:\SCIOCFG\SCIOCFG.EXE SYNC_WITH_CONCEPT
```

6. Name as desired.
7. Activate the “Finish” button.

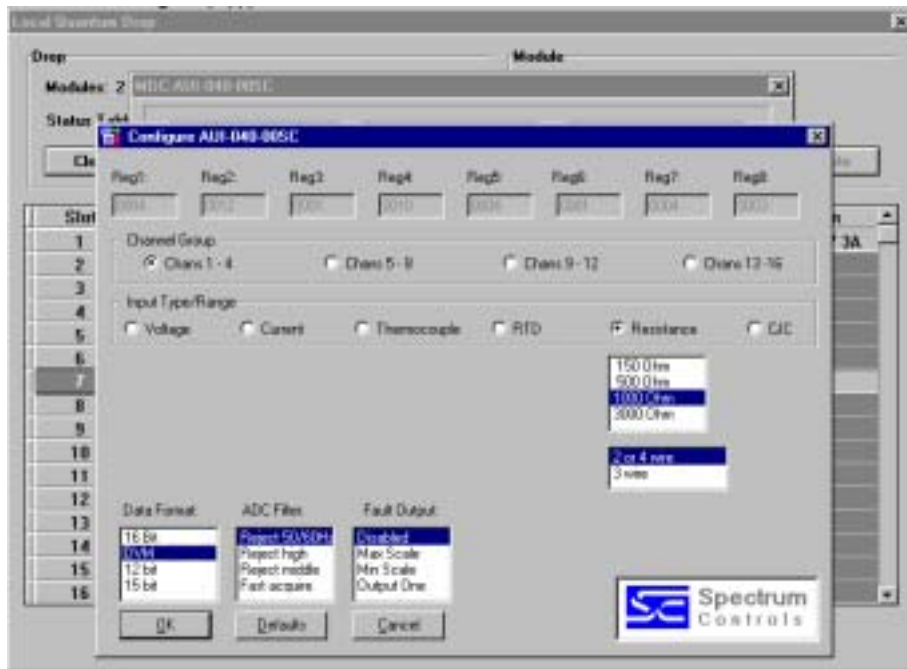
To add to Windows Programs Selections or a Folder:

1. Click and hold the left mouse button on the taskbar start button.
2. Select “Settings, “Taskbar” and release the mouse button.
3. Select the “Start Menu Programs” tab index.
4. Press the Add button.
5. Choose an existing folder (perhaps the Concept programming folder) or create a new folder to hold SCIOCFG.EXE.
6. Add SCIOCFG.EXE as described for adding shortcuts step 5.

SCIOCFG EXE is ready to run.

The SCIOCFG.EXE should be running as a background task, whenever Concept software is being used to change the configuration registers of the 140 AUI 040 00sc series of modules. Start SCIOCFG.EXE by double clicking on the SCIOCFG.EXE icon, then start Concept software.

Figure 3.1 SC Config Utility Screen

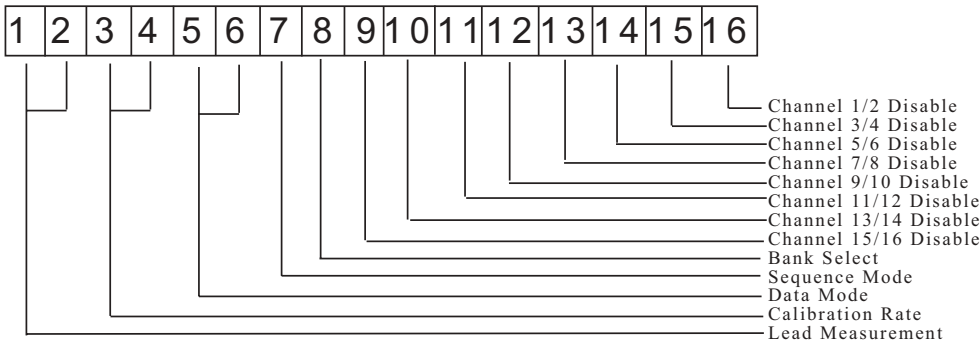




# Chapter 4 MODULE CONFIGURATION AND STATUS

The 140 AUI 040 00sc uses a total of nine 3x level and one 4x level registers. After Modsoft (Section 2.3) or Concept (Section 3.3) software is installed, additional configuration and status registers are set as follows:

## 4.1 Configuration word format (Register 4x)



### 4x Lead Resistance Measurement: Bits 1-2

This applies only when the module interfaces 3 wire RTDs. These two bits determine how frequently the module will measure the RTD lead wire resistance. It is unlikely lead resistance will change much over time. Reading the lead resistance effectively doubles the update time for RTD measurements

Bit 1	Bit 2	Mode
0	0	Equal to calibration rate
0	1	On power up only
1	0	Every 3-wire RTD reading
1	1	Not Allowed

### 4x Calibration Mode: Bits 3-4

These two bits are used to select a desired calibration interval.

Bit 3	Bit 4	Mode
0	0	On power up only
0	1	Every Minute
1	0	Every 10 Minutes
1	1	Every 30 Minutes

### 4x Data Input Mode: Bits 5-6

The module continuously outputs a group of eight registers worth of data. The data for a given group can be paged between two modes. These are the standard channel input data and channel status data.

Bit 5	Bit 6	Input Modes
0	0	Input Data
0	1	Status Data 1
1	0	Not Used
1	1	Status Data 2





3x+8 Not Used: Bits 1, 2

3x+8 EEPROM Error: Bit 3

An onboard re-writable memory error has occurred. Contact your technical support representative.

3x+8 ROM Failure: Bit 4

A read only memory error has occurred. Contact your technical support representative.

**3x+8 Data Mode Echo: Bits 6,5**

The Module continuously outputs a bank of eight registers worth of data. The data for a given bank can be paged between 2 modes. These are the standard channel input data and channel status data.

3x+8 Sequence Mode Echo: Bits 7

When in Auto Sequence Mode, the module ignores the channel bank select in the 4X-configuration word, and instead sequences through both banks automatically. The values in the eight data registers belong to the bank identified in the status word bank ID (3X+8 bit 1). The user must set aside 16 registers as a permanent image of the channel data. During run time, the ladder need only determine the current bank for the eight data registers (3x+0 through xx+7) in order to determine where the data should be copied into the 16-channel register image.

When in Manual Sequence Mode the module reads only the eight channels identified by the Bank Select Bits.

3x+8 Bank Select Echo: Bits 8

This bit is used to show the selected bank channels. This will indicate individual bank selection when the Auto Sequence mode is not used. The bank select is used for multiplexing out the Modules input data and status data. The channel Status Mode disables the normal data input mode and reports the status on the selected bank of 8 channels. The channel status bits echo back the selected input range data format and error status.

**3x+8 RAM Failure: Bits 9**

A random access memory error has occurred. Contact your technical support representative.

**3x+8 Watchdog Error: Bits 10**

A watchdog timeout error occurred. Contact your technical support representative.

**3x+8 CPU Error: Bits 11**

A central processing unit error has occurred. Contact your technical support representative.

**3x+8 CJC Error: Bits 12**

A cold junction compensation error has occurred. Check your onboard CJC sensor connections. These are found on the terminal block.

3x+8 Broken Input Mode: Bits 13

Check your input connections for continuity.

3x+8 Configuration Error: Bit 14

An illegal configuration was attempted. When this occurs configuration will not be accepted by the module and this flag will be set. By using 4x register bits 1 and 2 to set the module to "status" individual channels flags can be checked to determine which channel or group is incorrect.

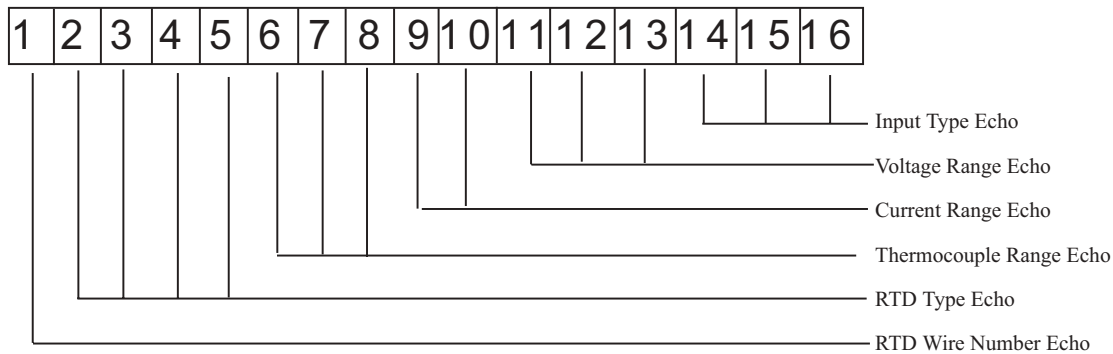
3x+8 Out of Range Error: Bits 15-16

These two bits indicate that an over or under range condition exists on at least one channel within the group. Bits 1-2 correspond to two groups of eight channels each. When an Out of Range Flag is set, the Channel Status mode (see Section 4.3) can be enabled to report which channel is out of range.

+ Note: An over range error indicates that a channel input is a value greater than or equal to the maximum for the range selected for that channel group. An under range error indicates that a channel input is a value less than or equal to the minimum for the selected range.

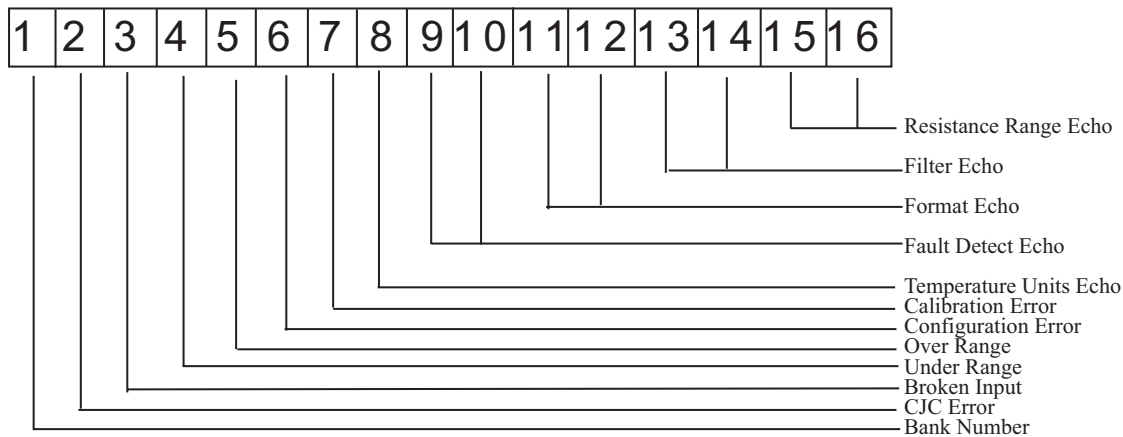
### 4.3 Channel Status (Registers 3x+ 0 through 3x+7)

(Registers 3x+ 0 through 3x+7) **Status Mode 1:**



- 3x+0 . . . 7 RTD Wire Number Echo: Bit 1
- 3x+0 . . . 7 RTD Type Echo: Bits 2-5
- 3x+0 . . . 7 Thermocouple Range Echo: Bits 6-8
- 3x+0 . . . 7 Current Range Echo: Bits 9-10
- 3x+0 . . . 7 Voltage Range Echo: Bits 11-13
- 3x+0 . . . 7 Input Type Echo: Bits 14-16

(Registers 3x+ 0 through 3x+7) **Status Mode 2:**



- 3x+0 . . . 7 Bank Number: Bit 1
- 3x+0 . . . 7 CJC Error Echo: Bit 2
- 3x+0 . . . 7 Broken Input Echo: Bit 3
- 3x+0 . . . 7 Under Range Flag: Bit 4

This is a nonfatal under range flag. The bit is set to “1” when an input value is read within one count of the minimum range value. When the input value is within normal limits the flag is automatically reset to “0.”

**3x+0 . . . 7 Over Range Flag: Bit 5**

This is a nonfatal over range flag. The bit is set to “1” when an input value is read within one count of the maximum range value. When the input value is within normal limits the flag is automatically reset to “0.”

**3x+0 . . . 7 Configuration Error Flag: Bit 6**

The calibration error flag is a fatal error. When the flag is set to “1” there is a configuration mismatch. Configuration errors include any illegal configuration, such the selection of an unsupported format or filter option, or configurations that must be the same for all channels within a group of channels.

**3x+0 . . . 7 Calibration Error Flag: Bit 7**

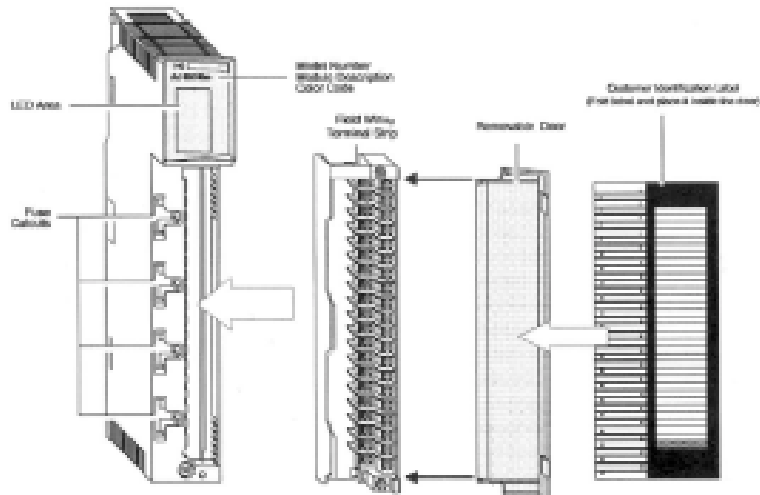
The calibration error flag is a fatal error. When the flag is set to “1” the ADC cannot calibrate within specifications.

**3x+0 . . . 7 Temperature Units Echo: Bit 8****3x+0 . . . 7 Fault Detect Echo: Bits 9-10****3x+0 . . . 7 Format Echo: Bit 11-12****3x+0 . . . 7 Filter Echo: Bit 13-14****3x+0 . . . 7 Resistance Range Echo: Bit 15-16****RTD Fault Detection**

The module can detect both RTD open circuits and shorts. This works as follows:

- Open positive excitation. The S/W will read positive full scale. This will be flagged as a bad input. Reading will default to the full-scale value for the range selected. Note that S/W can detect an over-range which is not an open input.
- Open negative excitation. Reading will be 0. This will cause the reading to be flagged as a bad input. Value read will be negative full scale for the range selected.
- Open high signal. The module switches in the reference voltage prior to reading the RTD voltage. This charges the filter capacitor downstream of the input multiplexer. If the input is open, This capacitance will charge the filter capacitor upstream of the multiplexer input. This will cause the reading to eventually go to positive full scale and will be flagged as a bad input as it is when there is an open positive excitation. Note that this capacitive charging process may take several updates. This method is not designed to instantly flag an open wire, but to ensure it will eventually “float” high enough to be an obvious fault. Because of input range limitations, this method does not apply to the 3000 ohm resistance range or the 1000 ohm RTD ranges.
- Open low signal. If this wire opens, it will cause the input voltage read to float. If the input voltage drifts too high or too low, a fault will be detected. Unlike the open hi signal, there is no technique implemented to detect this type of fault.

## Chapter 5 INSTALLATION



+ *Note: When field wiring the I/O modules, the maximum wire size that should be used is 1-14 AWG or 2-16 AWG; the minimum size is 20 AWG.*

+ *Note: The field wiring terminal block (Modicon # 140 XTS 002 00) or the 140 CFA040 00 40 pin Cablefast Terminal block must be ordered separately. (The terminal block includes the removable door label.)*

+ *Note: Power, input and output (I/O) wiring must be in accordance with Class 1, Division 2 wiring methods [Article 501-4 (b) of the National Electrical Code, NFPA 70] and in accordance with the authority having jurisdiction.”*

+ *Note: Peripheral equipment must be suitable for the location in which it is used.*



**WARNING**  
**ELECTROSTATICALLY SENSITIVE COMPONENTS**  
**EXPLOSION HAZARD**  
Substitution of components may impair suitability for Class 1, Division 2.

---



**WARNING**  
**EXPLOSION HAZARD**  
Do not disconnect equipment unless power has been switched off or the area is known to be non hazardous.

---



**WARNING**  
This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D or non-hazardous locations only.

---



**WARNING**  
**EXPLOSION HAZARD**  
When in hazardous locations, turn off power before replacing or wiring modules.

---

Before installing the module, you should:

- Configure all of the appropriate zoom screen, configuration and other necessary set up according to Chapters 2 and 3.
- Field wire the module's terminal block for your application.

For field wiring, use shielded, twisted-pair cable (such as Belden 9418 for voltage and current applications), and ground each cable's shield wire at one end only. At the opposite end of each cable, tape the exposed shield wire to insulate it from electrical contact. A good shield wire ground is a rack assembly mounting bolt or stud.

## 5.1 Field Wiring

+ Note: In the process of wiring the modules, route all signal wires as far as possible from potential sources of electrical noise, such as motors, transformers, etc., (especially ac devices). As a general rule, allow 15.2 cm (6 in) of separation for every 120V of power. Signal wires must never share the same conduit with ac wiring. Also, when you must route signal wires past ac wiring, do so at right angles.

Figure 5.1 - Field Wiring - Voltage, Current, Thermocouple Inputs

Group	Signal Name	Pin #	Signal Name	Group
	<b>CJC 1 HI (+)</b>	<b>2 1</b>	1 IN HI (+)	1
	<b>CJC 1 LO (-)</b>	<b>4 3</b>	1 IN LO (-)	1
1	2 IN HI (+)	6 5	3 IN HI (+)	1
1	2 IN LO (-)	8 7	3 IN LO (-)	1
1	4 IN HI (+)	10 9	5 IN HI (+)	2
1	4 IN LO (-)	12 11	5 IN LO (-)	2
2	6 IN HI (+)	14 13	7 IN HI (+)	2
2	6 IN LO (-)	16 15	7 IN LO (-)	2
2	8 IN HI (+)	18 17	<b>SHIELD 1</b>	
2	8 IN LO (-)	20 19	<b>SHIELD 2</b>	
	<b>SHIELD 3</b>	<b>22 21</b>	9 IN HI (+)	3
	<b>SHIELD 4</b>	<b>24 23</b>	9 IN LO (-)	3
3	10 IN HI (+)	26 25	11 IN HI (+)	3
3	10 IN LO (-)	28 27	11 IN LO (-)	3
3	12 IN HI (+)	30 29	13 IN HI (+)	4
3	12 IN LO (-)	32 31	13 IN LO (-)	4
4	14 IN HI (+)	34 33	15 IN HI (+)	4
4	14 IN LO (-)	36 35	15 IN LO (-)	4
4	16 IN HI (+)	38 37	<b>CJC 2 HI (+)</b>	
4	16 IN LO (-)	40 39	<b>CJC 2 LO (-)</b>	

## 5.2 RTD Field wiring

RTDs may be wired using 2/4 wire or 3 wire configurations.

Figure 5.2 - Field Wiring - RTD Inputs

Group	RTD Signal	Pin #	RTD SIGNAL	Group
		<b>2 1</b>	EXCIT 1 Hi	1
		<b>4 3</b>	EXCIT 1 Lo	1
1	RTD 1 IN (+)	6 5	EXCIT 2 Hi	1
1	RTD 1 IN (-)	8 7	EXCIT 2 Lo	1
1	RTD 2 IN (+)	10 9	EXCIT 3 Hi	2
1	RTD 2 IN (-)	12 11	EXCIT 3 Lo	2
2	RTD 3 IN (+)	14 13	EXCIT 4 Hi	2
2	RTD 3 IN (-)	16 15	EXCIT 4 Lo	2
2	RTD 4 IN (+)	18 17		
2	RTD 4 IN (-)	20 19		
		<b>22 21</b>	EXCIT 5 Hi	3
		<b>24 23</b>	EXCIT 5 Lo	3
3	RTD 5 IN (+)	26 25	EXCIT 6 Hi	3
3	RTD 5 IN (-)	28 27	EXCIT 6 Lo	3
3	RTD 6 IN (+)	30 29	EXCIT 7 Hi	4
3	RTD 6 IN (-)	32 31	EXCIT 7 Lo	4
4	RTD 7 IN (+)	34 33	EXCIT 8 Hi	4
4	RTD 7 IN (-)	36 35	EXCIT 8 Lo	4
4	RTD 8 IN (+)	38 37		
4	RTD 8 IN (-)	40 39		

### 5.3 CJC Thermocouple Installation

When using thermocouples it is necessary to install the supplied Cold Junction Compensation thermocouples to meet temperature accuracy specification. There are two CJC sensors, one located on the top of the terminal block, the second located at the bottom of the terminal block. The CJC sensors are premounted on a small circuit board to ease installation. To install the sensors unscrew terminal pairs 2/4 and 37/39 and slide the CJC sensors under the screws. Tighten the screws to no more than 10 lbs. in. of torque.

Group	Signal Name	Pin #	Signal Name	Group
	<b>CJC 1 HI (+)</b>	<b>2 1</b>	1 IN HI (+)	1
	<b>CJC 1 LO (-)</b>	<b>4 3</b>	1 IN LO (-)	1
1	2 IN HI (+)	6 5	3 IN HI (+)	1
1	2 IN LO (-)	8 7	3 IN LO (-)	1
1	4 IN HI (+)	10 9	5 IN HI (+)	2
1	4 IN LO (-)	12 11	5 IN LO (-)	2
2	6 IN HI (+)	14 13	7 IN HI (+)	2
2	6 IN LO (-)	16 15	7 IN LO (-)	2
2	8 IN HI (+)	18 17	<b>SHIELD 1</b>	
2	8 IN LO (-)	20 19	<b>SHIELD 2</b>	
	<b>SHIELD 3</b>	<b>22 21</b>	9 IN HI (+)	3
	<b>SHIELD 4</b>	<b>24 23</b>	9 IN LO (-)	3
3	10 IN HI (+)	26 25	11 IN HI (+)	3
3	10 IN LO (-)	28 27	11 IN LO (-)	3
3	12 IN HI (+)	30 29	13 IN HI (+)	4
3	12 IN LO (-)	32 31	13 IN LO (-)	4
4	14 IN HI (+)	34 33	15 IN HI (+)	4
4	14 IN LO (-)	36 35	15 IN LO (-)	4
4	16 IN HI (+)	38 37	<b>CJC 2 HI (+)</b>	
4	16 IN LO (-)	40 39	<b>CJC 2 LO (-)</b>	

Insert CJC #1 here.



Insert CJC #2 here.







## Chapter 6

### APPLICATION NOTES

#### 6.1 General Application Tips

The following is a list of do's and don'ts that should be observed in your applications.

- Select the appropriate 140 AUI 040 00sc from the I/O map selection screen.
- Configure the module using your programming software, make appropriate use of Configuration and Status registers as outlined in Chapters 2 through 4.
- Ensure correct units of measure are selected for data type.
- Use the lowest filter frequency setting possible for your application, this ensures the most stable and accurate readings.
- Configure the 4x Register.
- Check that the Green Ready LED is lit when the module is powered up and has completed its self test.
- Check that the Green Active LED is lit when data is being transferred to the Quantum CPU.

#### 6.2 Demultiplexing Channel Data - Autosequence Mode

The autosequence mode of operation is intended to simplify the demultiplexing of channel data from the eight input registers into storage for the 16 channels. The autosequence mode is enabled under the following conditions:

- Input Mode = Data Mode (Configuration Word Bits 5 & 6 = 0)

In the autosequence mode, the group select bits in the configuration word are ignored. Instead, the module samples channel data in groups of eight (8), presents the data to the PLC and then scans the next group automatically. The ladder logic then reads the status word to determine which data is being presented and copies the data to the appropriate storage locations for those channels.

The module update rate is determined by the number of channels enabled and the filter frequencies selected. For example, if all 16 channels are enabled and the filter frequency for all groups is 50/60 Hz, then the cycle time for a full set of 16 channels is 16 x 73 msec or 1.168 seconds.

It takes two ladder logic scans of the eight registers to see all 16 channels. These two scans must be completed at least twice as fast as the module update time to ensure no data is missed. In the example above the ladder scan time would need to run at 1.168 sec/8 or 146 msec or faster to ensure no data is missed.

Refer to Section 6.4 Channel Update Rate for channel update times.

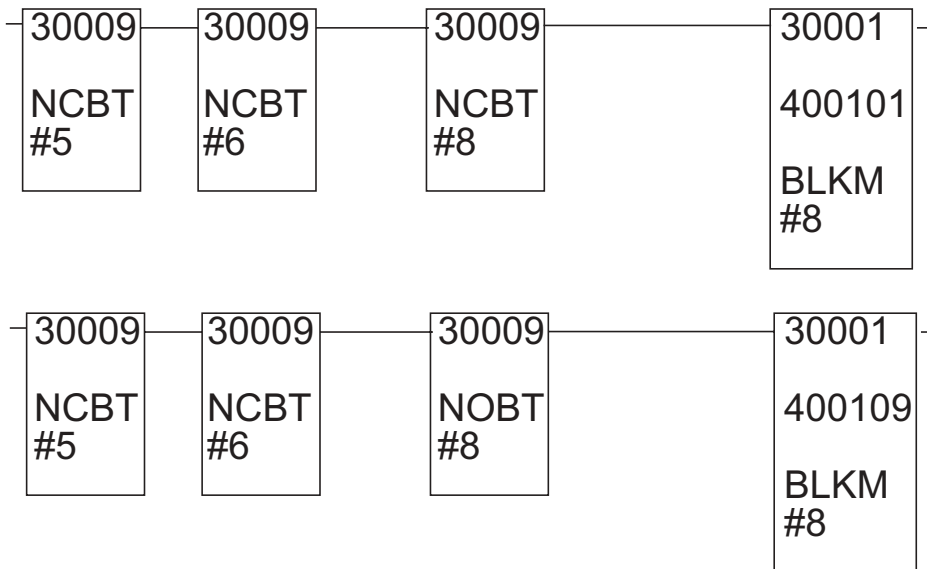
#### 6.3 Using ladder to move data to a block of 16 consecutive registers

The following ladder logic shows how to move data from the 8 multiplexed input words to a block of 16 output words starting at location 400101 with the autosequence mode disabled. This example file for use only with Modsoft programming software can be formed on the install disk shipped with your module. The file is under the A:\Programs subdirectory. To install:

1. Insert the install disk into drive A:
2. Copy A:\Programs\QAI32\_AC.\* C:\Modsoft\Programs
3. Select File QAI32\_AC under Modsoft to run.

The I/O map is as follows: (Manual Mode)

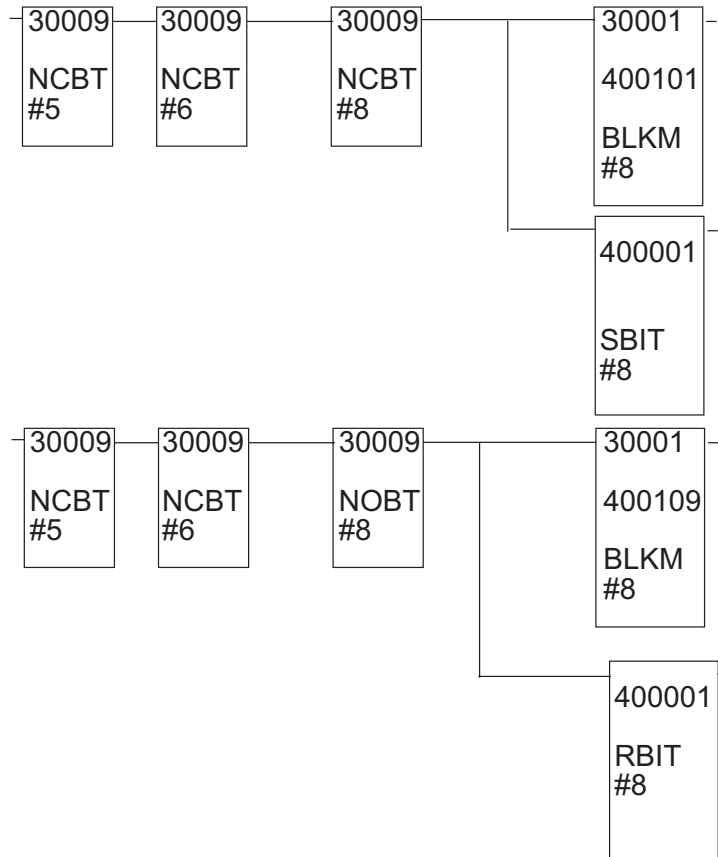
Rack Slot Module	Input Ref	Output Ref	Description
1 03 AUI 040 00	3000001-3000009	4000001-4000001	AUI04000 AN IN 16CH



The following ladder logic shows how to move data from the 8 multiplexed input words to a block of 32 output words starting at location 400101 using the autosequence mode. This example file for use only with Modsoft programming software can be formed on the install disk shipped with your module. The file is under the A:\Programs subdirectory. To install:

1. Insert the install disk into drive A:
2. Copy A:\Ladder\Q16 Universal\LAD\_MM\_AC.\* C:\Modsoft\Programs
3. Select File LAD\_MM\_AC under Modsoft to run. The I/O map is as follows:

Rack Slot	Module	Input Ref	Output Ref	Description
1	03 AUI 040 00	3000001-3000009	4000001-400001	AUI04000 AN IN 16CH



#### 6.4 Channel Update Rate

The module's channel update rate is determined by the filter frequency selection. A lower filter frequency takes longer to update each channel. The following table shows the single channel update rate and 16 channel update rate for each filter frequency.

Filter	1 channel Update Time	16 channel Update time
7.8 Hz	124 ms	1990 ms
13.65 Hz	73 ms	1168 ms
209.6 Hz	7.6 ms	122 ms
1667 Hz	4.7 ms	76 ms

+ Note: Channel update time is the time required for the module to acquire an input sign and update the module's data registers. The scan rate of the Quantum system will vary with application ladder and system configuration.

+ When using RTDs add 3ms per channel. For 3-wire DTR configurations double the update time of wire resistance is measured every cycle.

+ When using thermocouples the CJC calibration time will increase scan times by 150ms and channel update times by 1ms.

+ Note: Periodic system calibration will also effect channel update times for one scan cycle.

### 6.5 System Resolution and Accuracy - Voltage /Current Modes

The system resolution listed below is the smallest input signal change that the ADC can detect. The resolution level is affected by the filter frequency selected.

The resolution levels for the voltage mode and current mode apply to the full scale input ranges.

System accuracy is the total error between an actual input signal level and the module output data value. System accuracy is effected by external wiring, signal noise, filter frequency, calibration, temperature, and output data formats. The table below lists that system accuracy verses temperature.

Temp	Voltage Mode	Current Mode
25°C Typical	±0.03% ± 6 mV	±0.05% ±10µA
60°C Max	±0.05% ±10mV	±0.10% ± 20µA

+ Note: Accuracy calculations are based on the full scale current and voltage input range. These are 0 to 20 mA and ±10V respectively.

### 6.6 Range and Data Format Selection

Each of the module's input ranges can be viewed in one of the four data in formats below. The table shows the minimum and maximum values are equal to the under range and over range trip points.

Range	Signed 16 bit*		Unsigned 16 bit		Unsigned 12 bit		DVM	
	Min	Max	Min	Max	Min	Max	Min	Max
+/-0.05V	-32,767	32,767	0	65,535	0	4,095	-5,000	5,000
+/-0.5V	-32,767	32,767	0	65,535	0	4,095	-5,000	5,000
+/-2.0V	-32,767	32,767	0	65,535	0	4,095	-2,000	2,000
+/-5.0V	-32,767	32,767	0	65,535	0	4,095	-5,000	5,000
+/-10.0V	-32,767	32,767	0	65,535	0	4,095	-10,000	10,000
0..5V	-32,767	32,767	0	65,535	0	4,095	0	5,000
1..5V	-32,767	32,767	0	65,535	0	4,095	1,000	5,000
0..10V	-32,767	32,767	0	65,535	0	4,095	0	10,000
+/-20mA	-32,767	32,767	0	65,535	0	4,095	-2,000	2,000
0..20mA	-32,767	32,767	0	65,535	0	4,095	0	2,000
4..20mA	-32,767	32,767	0	65,535	0	4,095	400	2,000
Resistance 150 ohm 2/4 wire	-32,767	32,767	0	65,535	0	4,095	0	1,500
Resistance 150 ohm 3 wire	-32,767	32,767	0	65,535	0	4,095	0	1,500
Resistance 500 ohm 2/4 wire	-32,767	32,767	0	65,535	0	4,095	0	5,000
Resistance 500 ohm 3 wire	-32,767	32,767	0	65,535	0	4,095	0	5,000
Resistance 1000 ohm 2/4 wire	-32,767	32,767	0	65,535	0	4,095	0	10,000
Resistance 1000 ohm 3 wire	-32,767	32,767	0	65,535	0	4,095	0	10,000
Resistance 3000 ohm 2/4 wire	-32,767	32,767	0	65,535	0	4,095	0	30,000
Resistance 3000 ohm 3 wire	-32,767	32,767	0	65,535	0	4,095	0	30,000

Range	Signed 16 bit**		Unsigned 16 bit		Unsigned 12 bit		DVM deg C		DVM deg F	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
RTD Pt 385	-32,767	32,767	0	65,535	0	4,095	-2,000	8,500	3,280	15,620
RTD Pt 385	-32,767	32,767	0	65,535	0	4,095	-2,000	8,500	3,280	15,620
RTD Pt 385	-32,767	32,767	0	65,535	0	4,095	-2,000	8,500	3,280	15,620
RTD Pt 385	-32,767	32,767	0	65,535	0	4,095	-2,000	8,500	3,280	15,620
RTD Pt 3916	-32,767	32,767	0	65,535	0	4,095	-2,000	6,600	3,280	11,660
RTD Pt 3916	-32,767	32,767	0	65,535	0	4,095	-2,000	6,600	3,280	11,660
RTD Pt 3916	-32,767	32,767	0	65,535	0	4,095	-2,000	6,600	3,280	11,660
RTD Pt 3916	-32,767	32,767	0	65,535	0	4,095	-2,000	6,600	3,280	11,660
RTD Nickel 618	-32,767	32,767	0	65,535	0	4,095	-600	2,500	-760	3,560
RTD Nickel 618	-32,767	32,767	0	65,535	0	4,095	-600	2,500	-760	3,560
RTD Nickel 618	-32,767	32,767	0	65,535	0	4,095	-600	2,500	-760	3,560
RTD Nickel 618	-32,767	32,767	0	65,535	0	4,095	-600	2,500	-760	3,560
RTD Copper 426	-32,767	32,767	0	65,535	0	4,095	1,000	2,600	1,480	5,000
RTD Nickel 672	-32,767	32,767	0	65,535	0	4,095	-800	2,600	1,120	5,000
RTD Nickel/Iron 518	-32,767	32,767	0	65,535	0	4,095	1,000	2,000	1,480	3,920
Thermocouple type J	-32,767	32,767	0	65,535	0	4,095	-2,100	7,600	-3,460	14,000
Thermocouple type K	-32,767	32,767	0	65,535	0	4,095	-2,700	13,700	-4,540	24,980
Thermocouple type T	-32,767	32,767	0	65,535	0	4,095	-2,700	4,000	-4,540	7,520
Thermocouple type E	-32,767	32,767	0	65,535	0	4,095	-2,700	10,000	-4,540	18,320
Thermocouple type R	-32,767	32,767	0	65,535	0	4,095	0	17,680	320	32,140
Thermocouple type S	-32,767	32,767	0	65,535	0	4,095	0	17,680	320	32,140
Thermocouple type B	-32,767	32,767	0	65,535	0	4,095	3,000	18,200	5,720	32,667*
Thermocouple type N	-32,767	32,767	0	65,535	0	4,095	0	13,000	320	23,720

\* Thermocouple Type B readings are clipped at 32,767 counts for the DVM and degF scales. Readings above 32,767 are flagged as an over-range error.

\*\* Same as 15bit + sign.

## 6.7 RTD and Thermocouple inputs.

Thermocouples convert temperature to very small voltages. The Quantum Universal module's specifications for thermocouple inputs assume the 50/60 Hz filter setting or the low speed (7.8 Hz 3dB, 28Hz stop freq) filter is being used. These two filter settings are recommended for thermocouple inputs. Using the two faster filter settings will provide a faster update rate, but with noise and accuracy degradation.

RTDs are resistance temperature detectors. RTDs convert temperature to resistance levels which the quantum universal measures. In some cases the resistance change per degree is very small. The accuracy specifications assume the 50/60 Hz filter or the low speed filter (7.8Hz 3db) is being used. These two filter settings are recommended for RTD inputs.

Recommended filter settings for RTD and thermocouple inputs are listed below.

Filter	J, K, T, E, N Thermocouple inputs	S, B, N Thermocouple inputs	RTD Inputs
Reject 50/60Hz	Recommended	Recommended	Recommended
Reject 28Hz	Recommended	Recommended	Recommended
Reject 800 Hz	Some accuracy degradation	Not recommended	Minimal accuracy degradation
Reject 6400Hz	Do not use	Do not use	Not recommended

Thermocouples and RTDs are linearized per the following standards:

Thermocouple: per NIST, ITS-90

RTD:

Pt 385: IEC751-1983

Pt 392: JISC1604-1989

Ni 618: DIN 43760

Ni 672: MINCO Application Aid #18, Date 5/90 Type Ni

Cu 426: SAMA RC21-4-1966

Ni/Fe 518: MINCO Application Aid #18, Date 5/90 Type Ni-Fe

RTDs use a switched current source to measure resistance. The settling time for this source has been set so that RTD inputs will operate properly with a cable length of up to 1000 feet.

Thermocouple inputs require cold junction compensation to acquire accurate data. Thermistors perform cold junction compensation by measuring the temperature of the terminal block where the thermocouple wire connects to the terminals. The two CJC headers measure this temperature at the top and bottom of the terminal block and software interpolates the temperature for all points inbetween. As a simple rule of thumb, the less temperature difference between the top and the bottom of the terminal block, the more accurate the cold junction compensation will be. To achieve the best results it is recommended the module be kept away from any significant source of heat. The CJC headers have been designed for easy installation into the Quantum universal terminal block as shown in section 5.3. However these thermistors can be installed to a remote location to provide remote CJC compensation if necessary.

To meet specified accuracy the module should be mounted vertically and the terminal block door should be closed.



## Chapter 7 TROUBLESHOOTING

### 7.1 General Information

Review of the Module Setup Procedures in Section 2.1 is recommended prior to following the troubleshooting steps below to help isolate the problem. The troubleshooting guide lists a variety of possible problems. Step through each item on the list and verify whether or not the module is working. If a particular step is not working, follow the corrective action listed.

#### **STEP 1: Check module power and self test.**

**VERIFY:** The controller module's READY and RUN LED's are on.

**CORRECTIVE ACTION:**

- Insure that the rack's power supply is connected properly and its PWR OK LED is on.
- Place the controller in run mode by using the Modsoft Start Command.
- If the rack's power will not come up, or the system will not go into run mode, refer to the Quantum Automation Series Hardware Reference Guide for more information.

#### **STEP 2: Check module power and self test.**

**VERIFY:** The module's green READY LED is on. This indicates that the module has power and has completed its functional self test.

**CORRECTIVE ACTION:**

- Check rack power, and reinstall the module in the rack.

#### **STEP 3: Check the module's fault LED.**

**VERIFY:** The module's red FAULT LED is off. This LED indicates a module hardware error.

**CORRECTIVE ACTION:**

- The module has a fatal hardware error. Contact your local distributor or Spectrum Controls Customer Satisfaction Group listed at the back of this manual.

The module has a front LED panel that includes 19 LEDs:

#### **Ready LED -**

1 Green LED indicates module's self test has passed and is ready to communicate.

#### **Active LED -**

1 Green LED indicates BUS communication is established between the module the rack.

### **Fault LED -**

1 Red LED indicates a module self test error, or fatal H/W error. A blink code will be defined that will indicate the type of self test error. Count the number of blinks before a pause to determine the error code in the table below.

#### Fault LED Blink Code

Blink #	Fault
1	ROMCRC Error
2	EEPROM Error
3	RAM Error
4	Autocal Error
5	Watchdog Timer Error
6	CPU Error
7	DPM Error

### **Channel LED -**

32 Green LEDs indicates the channel is enabled and a valid input signal level is present. The LED is off if the channel is disabled. A blinking LED indicates that the channel has exceeded a range limit.

### **STEP 4: Check the module's communication status.**

VERIFY: The module's green ACTIVE LED is on. This indicates that the module is communicating properly with the rack.

#### CORRECTIVE ACTION:

- Set the rack into run mode.
- Reinstall the module in the rack.

### **STEP 5: Check the module's health status.**

VERIFY: The module is reported as healthy in the Modsoft I/O map Screen. Check to make sure that the module description, slot location, and register assignments are correct. Also, verify that the module is recognized and reported as healthy. If an asterisk is present before the module's name, then the module is not recognized by the rack.

#### CORRECTIVE ACTION:

- Reinstall the module in the rack.
- Reselect the module in the I/O Map using the <Shift + ?> key. If the module is not listed, install the Modsoft Runtime files included with your module.

### **STEP 6: Check the module's register operation.**

VERIFY: The 4X configuration word and the 3X+8 Status word are setup properly. As a quick check, disable all ladder programming and set the 4X register to 0000 Hex and verify that the 3X+8 Status register cycles through the values 0000, 0001, 0010, and 0011 Hex.

**CORRECTIVE ACTION:**

- Check steps 1 through 6 above and then call Spectrum Controls Customer Satisfaction at (425) 746-9481.





- Filter Frequencies 7.8, 13.65, 209.6, 1676 3dB
- Resolution 24 bit Sigma Delta ADC
- Data Formats DVM (both °C and °F), 16 bit unsigned, 12 bit unsigned, 16 bit signed
- Conversion Type Sigma Delta ADC
- Analog Input Conversion Rate **Input Channel Update Time (V, I, TC, RTD 4wire) estimated**

Filter	1 Channel	16 Channels
7.8Hz	124ms	1992ms
13.65 Hz	73ms	1168ms
209.6Hz	7.6ms	122ms
1.677kHz	4.7ms	76ms

- + Note: Channel update time is the time required for the module to acquire an input sign and update the module’s data registers. The scan rate of the Quantum system will vary with application ladder and system configuration.
- + When using RTDs add 3ms per channel. For 3-wire DTR configurations double the update time of wire resistance is measured every cycle.
- + When using thermocouples the CJC calibration time will increase scan times by 150ms and channel update times by 1ms.
- + Note: Periodic system calibration will also effect channel update times for one scan cycle.

- Normal Mode Rejection 64.5 dB, 50 Hz, 60 Hz with 50/60 Hz rejection filter selection  
88dB with high noise rejection setting.
- Common Mode Rejection 96dB 50 Hz, 60 Hz with 50/60 Hz filter selected.  
120dB with high noise rejection setting.
- Input Resistance > 10M Ohm Voltage/Thermocouple/RTD  
=250 Ohm Current

### 1.1A Table - Thermocouple Accuracy

Table 1.1A shows Thermocouple Accuracy at Selected Temperatures in degrees Celsius below and illustrates how accuracy of thermocouple input changes over the temperature range. This is caused by a non-linear slope the thermocouples exhibit which is “steep” (10s of microvolts per degree) at high temperatures and “flat” (microvolts per degree) at low temperatures. Thus the accuracy tends to be very good at high temperatures and remains fairly good until about –100 degrees C (depending on thermocouple type) where it becomes worse. The accuracy table below assumes that the module is mounted in a vertical orientation and the terminal block door is closed.

#### Thermocouple Accuracy at Selected Temperatures in degrees Celsius

TC Type	Temp	Typ	Max	Temp	Typ	Max	Temp	Typ	Max	Temp	Typ	Max	Temp	Typ	Max
<b>J</b>	<b>-210</b>	2.5	4.5	<b>-200</b>	2.5	4.1	<b>-100</b>	1.1	2.1	<b>275</b>	0.9	1.7	<b>760</b>	0.8	1.7
<b>K</b>	<b>-270</b>	17	24	<b>-200</b>	2	4.8	<b>-100</b>	1.2	2.5	<b>550</b>	1	2.0	<b>1370</b>	1.1	3.0
<b>T</b>	<b>-270</b>	13.5	20	<b>-200</b>	5.8	10	<b>-100</b>	1.6	2.8	<b>65</b>	0.9	1.7	<b>400</b>	0.7	1.4
<b>E</b>	<b>-270</b>	13	18.5	<b>-200</b>	5.5	10	<b>-100</b>	1.2	2.2	<b>365</b>	0.8	1.4	<b>1000</b>	1	1.9
<b>R</b>	<b>0</b>	2.3	5.6							<b>885</b>	1	2.7	<b>1768</b>	1.1	3.3
<b>S</b>	<b>0</b>	3.5	5.6							<b>885</b>	1.7	3.0	<b>1768</b>	1.8	3.5
<b>B</b>	<b>300</b>	3.9	10.8	<b>600</b>	2.2	5.6				<b>1060</b>	1.5	3.2	<b>1820</b>	1.4	3.1
<b>N</b>	<b>0</b>	0.9	2.1							<b>650</b>	0.8	1.8	<b>1300</b>	1.1	2.3

### 1.1B Table - Thermocouple Accuracy

Table 2 Thermocouple Accuracy per temperature range below shows the accuracy of thermocouple inputs over a range of temperatures.

**Table 2 Thermocouple Accuracy per temperature range**

TC	Range 1 (deg C)		Range 2 (deg C)		Range 3 (deg C)		typ/max	CJC accuracy
	Range	Spec	Range	Spec	Range	Spec		
J	-100 to +760	1.1	-200 to -100	2.5			<b>typ</b>	0.7 deg C
K	-100 to 1370	1.2	-200 to -100	2	-270 to -200	19	<b>typ</b>	0.7 deg C
T	-100 to 400	1.6	-200 to -100	5.8	-270 to -200	15.5	<b>typ</b>	0.7 deg C
E	-100 to 1000	1.2	-200 to -100	5.5	-270 to -200	14.5	<b>typ</b>	0.7 deg C
R	0 to 1768	2.3					<b>typ</b>	0.7 deg C
S	0 to 1768	3.5					<b>typ</b>	0.7 deg C
B	600 to 1820	2.2	300 to 600	2.2			<b>typ</b>	10 deg C
N	0 to 1300	0.9					<b>typ</b>	0.7 deg C
J	-100 to +760	2.1	-210 to -100	4.8			<b>max</b>	1.25 deg C
K	-100 to 1370	3.0	-200 to -100	4.8	-270 to -200	24	<b>max</b>	1.25 deg C
T	-100 to 400	2.8	-200 to -100	10	-270 to -200	20	<b>max</b>	1.25 deg C
E	-100 to 1000	2.2	-200 to -100	10	-270 to -200	18.5	<b>max</b>	1.25 deg C
R	0 to 1768	5.6					<b>max</b>	1.25 deg C
S	0 to 1768	5.6					<b>max</b>	1.25 deg C
B	600 to 1820	4.6	300 to 600	10.8			<b>max</b>	40 deg C
N	0 to 1300	2.3					<b>max</b>	1.25 deg C

### 1.1B Table - RTD Accuracy

RTD Type	Resistance ( $\Omega$ )	Range (deg C)	Range (deg F)	Typical Acc. (deg C)	Max Error (deg C)
RTD 385 Alpha	100	-200 to +850	-328 to +1562	0.5	1.6
RTD 385 Alpha	200	-200 to +850	-328 to +1382	0.5	1.6
RTD 385 Alpha	500	-200 to +850	-328 to +1562	0.5	1.6
RTD 385 Alpha	1000	-200 to +850	-328 to +1562	0.5	1.6
RTD 3916 Alpha	100	-200 to +630	-328 to +1166	0.4	1.3
RTD 3916 Alpha	200	-200 to +630	-328 to +1166	0.4	1.3
RTD 3916 Alpha	500	-200 to +630	-328 to +1166	0.4	1.3
RTD 3916 Alpha	1000	-200 to +630	-328 to +1166	0.4	1.3
RTD Nickel 618	100	-60 to +180	-76 to +356	0.2	0.6
RTD Nickel 618	200	-60 to +180	-76 to +356	0.2	0.6
RTD Nickel 618	500	-60 to +180	-76 to +356	0.2	0.6
RTD Nickel 618	1000	-60 to +180	-76 to +356	0.2	0.6
RTD Copper 426	10	-100 to +260	-148 to +500	0.3	0.9
RTD Nickel 672	120	-80 to +260	-112 to +500	0.2	0.6
RTD Nickel/Iron	518/604	-100 to +200	-148 to +392	0.2	0.6

**1.1C Table - Resistance Accuracy**

Resistance	Range (Ω)	Accuracy (Ω)	Max Error(Ω)
150	0 to 150	0.1	0.2
450	0 to 500	0.2	0.7
950	0 to 1000	0.5	1.4
3000	0 to 3000	1.5	4.4

**1.1D Table - Voltage & Current Accuracy**

Voltage/Current Range	Accuracy (%FS)	
	Typ (25C)	Max (temp)
+/-50mV	0.025	0.05
+/- 0.5V	0.025	0.05
+/-2V	0.025	0.05
+/- 5V	0.025	0.05
10V	0.05	0.10
0 to 20mA	0.10	0.20
4 to 20mA	0.10	0.20
+/-20mA	0.05	0.10

- CJC Accuracy <math>\leq \pm 1.3^{\circ}\text{C}</math>
- Calibration Modules will be factory-calibrated, then stored in EEPROM. Software controlled auto-calibration will occur periodically.
- Maximum Overvoltage +/-20 VDC continuous +/-14VDC CJC Inputs
- Maximum Overcurrent 28 mA continuous
- Isolation Voltage 1000VDC terminal block to backplane +/-12.5VDC channel to channel
- Backplane Current draw 550mA @ 5VDC
- Thermal Dissipation 2 W
- External DC Power Required No

**1.2 System Specifications**

Specification	Description
Data Registers:	
Output (4X)	1 Configuration Registers
Input (3X)	9 registers; 8 input registers, 1 status register
Zoom	4 configuration registers
LED Indicators	A standard 16 channel LED array will be used
1 Green LED	Ready. Module has passed self-test and is ready to communicate.
1 Red LED	Fault: Indicates module self-test error or fatal HW error.
16 Green LED	Input point status.
Terminal Block	Standard 40 pin Quantum connector #43502767
Wire Size	1-14AWG, or 2-16AWG wires
Interface	Quantum standard ASIC and dual-port SRAM BIU
Compatibility	
Hardware	All Modicon Quantum Racks and all current MPUs



Software	Modsoft V2.X, Concept Vx.x Compatibility with zoom screen configuration menu.
Dimensions	Single Quantum Slot, Standard Enclosure, plastic, Terminal Block and LED array.
Weight	1lbs (452g) max.

### 1.3 Environmental Specifications

Environmental tests are run in accordance with the standards specified or in accordance to IPA2000/3000 or equal compliance.

Test Description	Standard	Class/Limit
<b>Mechanical</b>		
Vibration of Unpackaged Products	IEC 68-2-6	5g @ 10-500Hz per
Shock of Unpackaged Products	Operating	
	Non Operating	30g peak acceleration, 11(+/-1)ms pulse width
		50g peak acceleration, 11(+/-1)ms
<b>Temperature / Humidity</b>		
Operating Temperature		0 to 60 C (32 to 131F) minimum
Storage Temperature		-40 to 85 C
Humidity-Temperature	IEC 68-2-3	0 to 95% RH non condensing @ 60 degree C
Altitude		2000 Meters fully operational
<b>Electrical</b>		
Electrostatic Discharge	IEC 801-2	
Surge Transient Susceptibility		
Radiated EMI Susceptibility	IEC 801-3	
Dielectric Withstand		
Conducted EMI Susceptibility		
Conducted Emissions	CISPR 11	Class A
Electrical Fast Transient	IEC 801-4	
Radiated Emissions	CISPR 11	Class A
Surge Impulse	IEC 801-5	
Conducted Immunity	IEC 801-6	
Fast Surge Immunity	EN61000-4-5	
Voltage Dropouts: (Variation & Dips)	EN61000-4-11	

Reference: SA IAP 2000 Mechanical Environmental Specifications #043 500021 Rev: 1.02



## Notice

The products and services described in this publication are useful in a wide variety of applications. Therefore, the user and others responsible for applying the products and services described herein are responsible for determining their acceptability for each application. While efforts have been made to provide accurate information within this publication, Spectrum Controls assumes no responsibility for the accuracy, completeness, or usefulness of the information contained herein. Under no circumstances will Spectrum Controls be responsible or liable for any damages or losses, including indirect or consequential damages or losses, arising out of either the use of any information contained within this publication or the use of any product or service referenced herein. No patent liability is assumed by Spectrum Controls with respect to the use of any of the information, products, circuits, programming, or services referenced herein. The information contained in this publication is subject to change without notice.

## Limited Warranty

Spectrum Controls warrants that its products are free from defects in material and workmanship under normal use and service, as described in Spectrum Controls literature covering this product, for a period of 1 year. Spectrum Controls obligations under this warranty are limited to replacing or repairing, at its option, at its factory or facility, any product which shall, in the applicable period after shipment, be returned to the Spectrum Controls facility, transportation charges prepaid, and which after examination is determined, to the satisfaction of Spectrum Controls, to be thus defective. This warranty shall not apply to any such equipment which shall have been repaired or altered except by Spectrum Controls or which shall have been subject to misuse, neglect, or accident. In no case shall Spectrum Controls liability exceed the purchase price. The aforementioned provisions do not extend the original warranty period of any product which has either been repaired or replaced by Spectrum Controls.

## Declaration Of Conformity

<i>Declaration of Conformity</i>	
<i>Application of Council Directive(s)</i>	89/336/EEC Electromagnetic Compatibility
<i>Standard(s) to which Conformity is Declared</i>	EN50081-2:1993, EN61000-6-2:1999, EN61010-1:1993, EN61131-2:1995
<i>Manufacturer's Name</i>	Spectrum Controls Inc.
<i>Manufacturer's Address</i>	2700 Richards Road Southeast Bellevue, Washington 98005 U.S.A.
<i>Importer's Name</i>	Spectrum Controls Inc.
<i>Importer's Address</i>	2700 Richards Road Southeast Bellevue, Washington 98005 U.S.A.
<i>Type Of Equipment</i>	Schneider Automation TSX Quantum
<i>Model No.</i>	140 Series
<i>I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)</i>	
<i>Date Of Issue:</i> <u>7/2/02</u>	
<i>Place:</i> Bellevue, Washington U.S.A.	Bruce M. Wanta (Name)
	Chairman (Position)
	SPN: 0300170-02 Rev B.0



The Schneider Alliances logo is a trademark of Schneider Electric.  
© 2000-2004 Spectrum Controls, Inc. All rights reserved.  
Printed in U.S.A.  
Specifications subject to change without notice.  
Owners Guide 0300180-02 Rev. B 2/16/04

**Corporate Headquarters:**

P.O. Box 5533  
Bellevue, Washington 98006  
**Tel: (425) 746-9481**  
Fax: (425) 641-9473



**Web Site:** <http://www.spectrumcontrols.com>  
**E-Mail:** [spectrum@spectrumcontrols.com](mailto:spectrum@spectrumcontrols.com)