# QRIO

## Installation and Programming Manual

This Manual describes the QRIO module, an Allen-Bradley® RIO Scanner for the Modicon Quantum PLC.

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NR&D
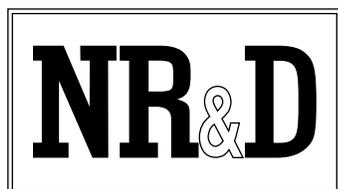
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# 1
# Introduction

The Niobrara QRIO  is a TSX Quantum® compatible module that acts as an Allen-Bradley Remote I/O Scanner.  The QRIO connects A/B Remote I/O devices to a Modicon Quantum PLC, transparently placing the RIO devices' Discrete I/O into the Modicon PLC's 4x, 3x, 1x, or 0x memory.  The QRIO also allows access to Block Transfer I/O and Block Transfer Messaging via the Quantum's MSTR instruction.

The QRIO has two RIO ports, referred to hereafter as Port 1 and Port 2.  The RIO ports have detachable three-terminal connectors, included with the module.  An RJ45 RS-232 serial port is also provided for Hot Standby operation, troubleshooting, and firmware downloading.

The QRIO must be used in the local Quantum PLC processor rack.  The module is configured as an NOE-771-00 in the PLC and the Ethernet I/O Scanner table is used to define operating parameters and configuration of the A-B Discrete I/O.

Module Number
Module Description
Color Code

**140**
**QRIO**
**A-B RIO HEAD**

Fault
Active    REM I/O 1
Ready    REM I/O 2
Run

TX0  TX1  TX2
RX0  RX1  RX2

LED Area

Removable Door

RS-232
Serial Port

RIO Port 1

RIO Port 2

2
1 SH
1

2
2 SH
1
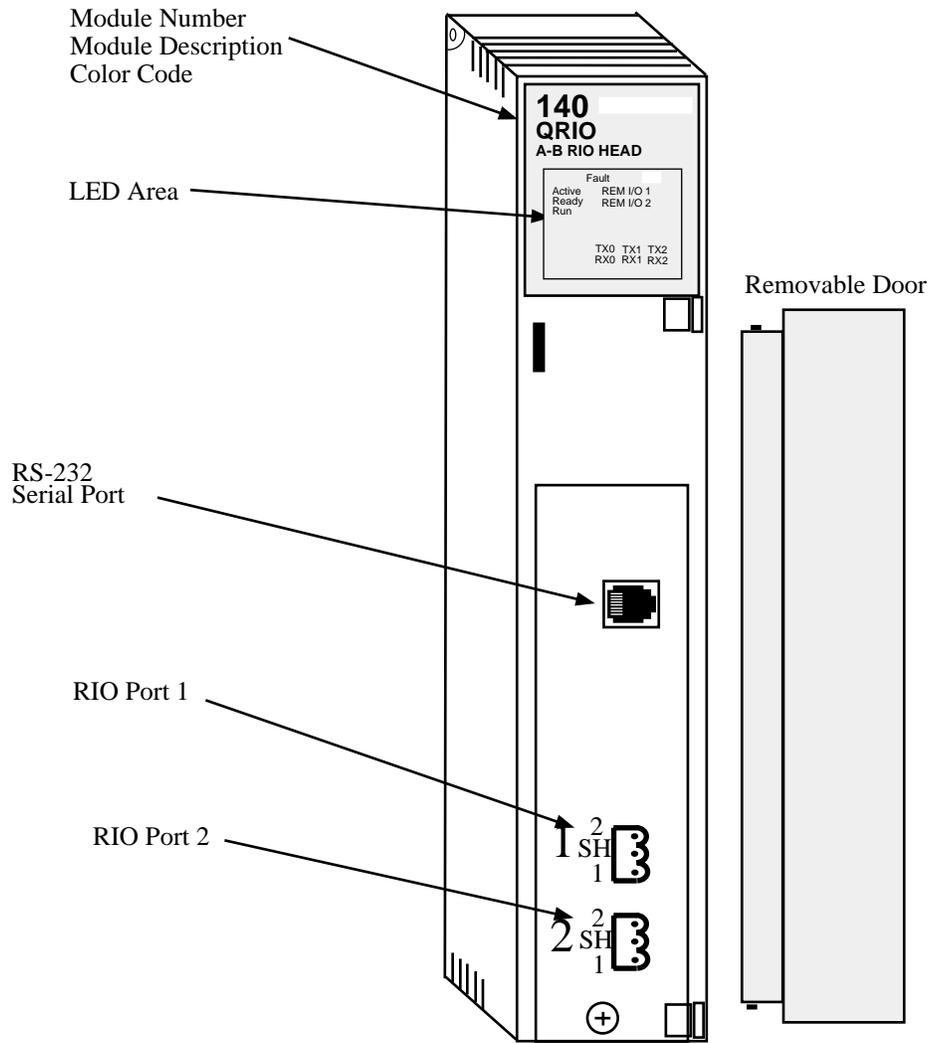
**Figure 1-1   QRIO Front Panel**

# 2
# Installation

## QRIO Installation

Mount the QRIO in an available slot in the PLC's register rack. Secure the screw at the bottom of the module. Like all Quantum modules, the QRIO may be hot-swapped. The QRIO operates as an "OPTION" communication module and thus must be installed in the PLC's rack and not in a Remote or DIO rack. The maximum number of supported "OPTION" modules varies with the PLC model (2 to 6) so the user should check the Modicon specifications to see how many QRIOs may be used in a single PLC system.

## Serial Connections to the QRIO

### Ports 1 and 2 RIO

The Remote I/O networks are connected to Ports 1 and/or 2 of the QRIO. The standard A/B 1770-CD cable (Belden 9463) connects with the blue wire to Pin 1, White (Clear) wire to pin 2, and the bare shield to the SH. Standard A/B wiring conventions should be followed including the proper terminating resistors at each end of the daisy-chain. (See Table 2-1) The QRIO supports the "Expanded Node Capability" which allows up to 32 adapters on the RIO link using the 82 ohm terminators.

**Table 2-1    Remote I/O Specifications**

| Communication Rate | Maximum Distance (feet) | Termination Resistor Value (Standard Node Capability) | Termination Resistor Value (Expanded Node Capability) |
|---|---|---|---|
| 57.6 kbits/sec | 10,000 | 150 ohm 1/2W | 82 ohm 1/2W |
| 115.2 kbits/sec | 5,000 | 150 ohm 1/2W | 82 ohm 1/2W |
| 230.4 kbits/sec | 2,500 | 82 ohm 1/2W | 82 ohm 1/2W |

**NOTE:** Extended node capability can only be used if all adapters on the RIO daisy-chain support the feature. If any node fails to support the extended node capability then the maximum number of physical nodes is limited to 16.
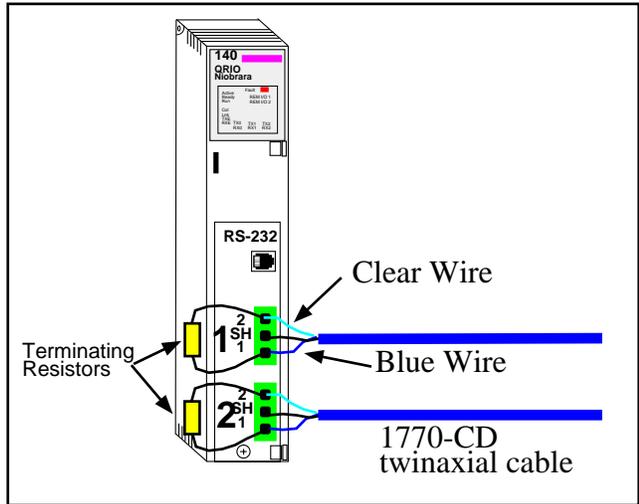
**Figure 2-1   Remote I/O Connections**

## Hot Standby Operation

QRIO's with a firmware date of 26 September 2007 or later are capable of supporting Quantum Hot Standby operation under all programming software systems. This provides a means of controlling RIO networks from redundant PLCs. If the primary PLC experiences a failure, the secondary rack will take over operation of the process, and almost seamlessly take over RIO operation. To accomplish this, the redundant QRIO's must be linked together by their serial ports, as well as linking the proper RIO Port of both modules to each other. Figure 2-2 describes the cabling necessary to connect the two serial ports together. This is most easily accomplished by connecting a Niobrara MM1 to a Niobrara MM3, and connecting the RJ45 plugs to the QRIO jacks.
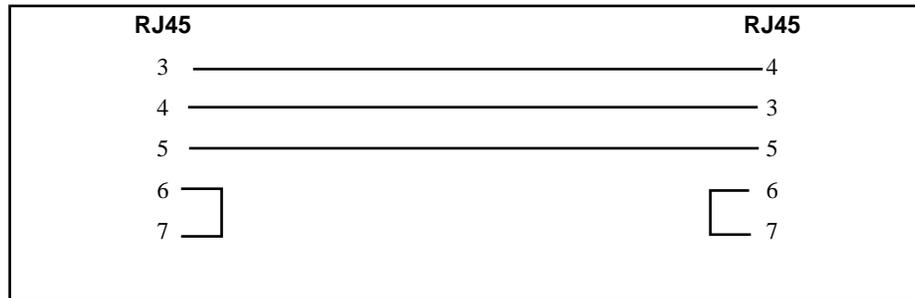


**Figure 2-2 QRIO RS-232 Crossover Cable (MM1 to MM3)**

Figure 2-3 shows the connection of the redundant RIO ports.
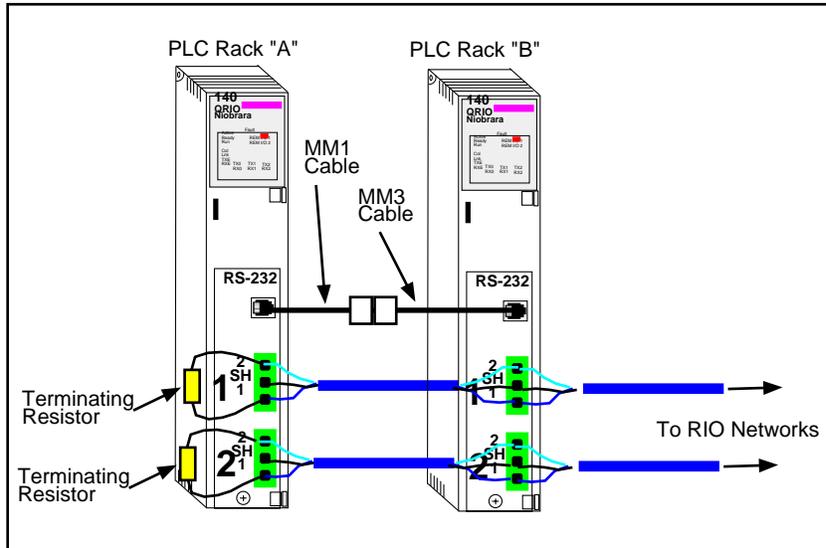
**Figure 2-3   Hot Standby Remote I/O Connections**

# Loading Firmware into the QRIO

Niobrara may release new firmware for the QRIO from time to time.  This section covers the procedure for upgrading the module.

The QRIO must use the qrio.fwl firmware included in the QRIO_SETUP.EXE file. Run this setup file from the Niobrara CD or from www.niobrara.com before starting the download process.

Firmware download is as follows:

1    Remove the module form the rack.

2    Move the RUN/LOAD switch on the back of the module to LOAD.

3    Replace the module in the rack and apply power.

4    Only the 3 light should be on.

5    Connect the PC to QRIO RS-232 with a MM1 cable.

6    From the Windows' Start button select:
         "Start, Programs, Niobrara, QRIO, FWLOAD QRIO Firmware"
     Verify that the file to load is qrio.fwl.
     Also verify that the proper PC serial port is selected.

7    Press the "Start Download" button.  The download will only take a few minutes and it will notify the user when finished.

8    Remove the module from the rack and change the switch back to RUN.
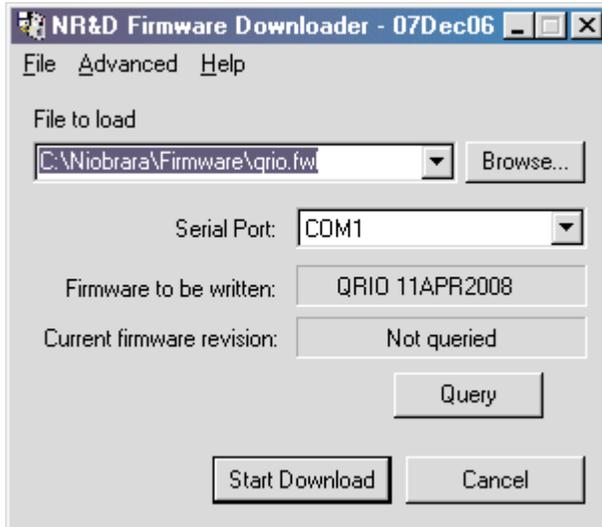
**Figure 2-4   FWLOAD of QRIO Firmware**

## RS-232 to the Personal Computer

The RS-232 port of the QRIO is used to load new firmware into the module.  The Niobrara MM1 cable is used for this connection.  This cable pinout is shown in Figure 2-6. Pin 1 is the bottom pin of the RJ-45 socket (See Figure 2-5).
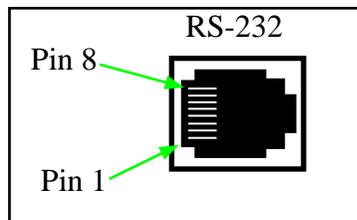


**Figure 2-5   RS-232 Socket**
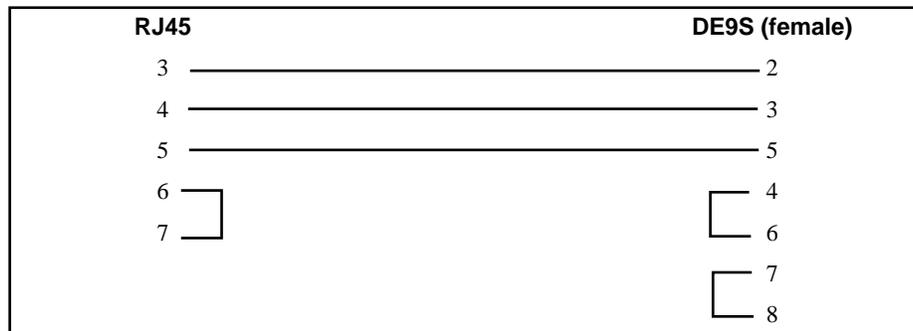


**Figure 2-6 QRIO  to RS-232 PC Port (9-pin) (MM1 Cable)**
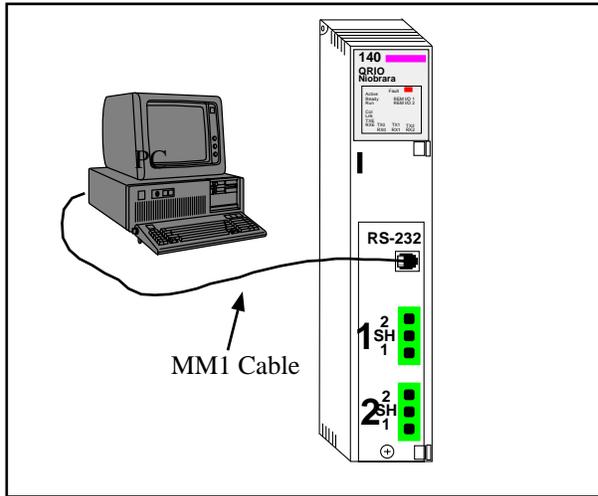
**Figure 2-7   FWLOAD serial connection**

# 3
# Operation

## RIO Discrete Operation

### Discrete

A-B Remote I/O is divided into groups and logical racks. A group consists of a pair of input and output words (16-bit). A collection of groups forms a logical rack. A full logical rack is 8 groups numbered 0-7. RIO Adapters are configured in even numbers of groups. If an adapter's size is greater than 8 groups, then it also takes up the next logical rack address.

### Logical Rack

The Rack Number defines the starting logical rack address of an adapter. An adapter will take up the declared rack number, and successive rack numbers to satisfy the number of groups assigned to that adapter.

## PLC I/O Scanner Configuration

The QRIO uses the NOE I/O Scanner configuration to set the baud rate of both RIO ports, the PLC location of the Health and Diagnostic Blocks, and the information for the A-B Discrete I/O. This setup may be done in Concept, ProWORX, or Unity Pro. The QRIO must be added in the I/O Map as an NOE-771-00. The QRIO then may have its Ethernet I/O Scanner configured.

**Specify IP Address** - Check this box.

**IP Address** - Sets the baud rates of the two RIO ports. Table 3-1 describes the meanings of each byte. An IP Address of 3.1.2.1 would set port 1 = 230.4kbps and port 2 = 115.2 kbps.

**Table 3-1    QRIO IP Address Settings**

| IP Address byte | Description | Meaning |
|---|---|---|
| First | Bitrate for Port 1 | 1 = 57.6 kbps<br>2 = 115.2 kbps<br>3 = 230.4 kbps |
| Second | Reserved | Set to 1 |
| Third | Bitrate for Port 2 | 1 = 57.6 kbps<br>2 = 115.2 kbps<br>3 = 230.4 kbps |
| Fourth | Reserved | Set to 1 |

**Subnet Mask** - Reserved. Set the Subnet Mask to 255.255.255.0.

**Gateway** - Reserved. Set the default gateway to 1.1.1.1.

**Framing** - Reserved. Set to ETHERNET II.

**Health Block** - This is the starting 3x register or 1x coil of the 128 bits of status for the I/O Scanner.  Used exactly as in the NOE I/O Scanner.

**Diagnostic Block** - This is the starting 3x or 4x register for the 128 register block of diagnostic codes.  Each entry in the I/O Scanner has a matching diagnostic register.  Table 3-2 gives the meanings of the diagnostic codes in hexadecimal.

**Table 3-2    Diagnostic Codes**

| Diagnostic Code (Hex) | Meaning |
|---|---|
| 0000 | No Errors |
| F001 | Device not yet polled. |
| E001 | No reply from Device at Rack/Group. |
| E02x | Device Rack Size does not match I/O Scan configuration.  Device configured for "x" words. |
| E031 | I/O Scan Entry bad: Read Ref Master address invalid |
| E032 | I/O Scan Entry bad: Write Ref Master address invalid |
| E033 | I/O Scan Entry bad: Read and Write Ref Master addresses invalid |
| E034 | I/O Scan Entry bad: Size out of Range (last byte of IP Address) |
| E035 | I/O Scan Entry bad: Read Ref Master address invalid and Size out of Range |
| E036 | I/O Scan Entry bad: Write Ref Master address invalid and Size out of Range |
| E037 | I/O Scan Entry bad: Read and Write Ref Master addresses invalid and Size out of Range |
| E044 | Port number (first drop in IP Address) is out of range (must be 1 or 2) |
| E045 | Rack and/or Group is out of range |
| E1xx | Configuration duplicates device in line xx |

**Slave IP Address** - The first byte sets the QRIO port number for the slave.  The second byte is the logical rack number of the slave.  The third byte is the group number of the slave.  The fourth byte is the number of words of discrete I/O in the slave.  For example, an IP Address of 1.10.4.2 would be a slave on QRIO port 1 set to logical rack 10, group 4, with 2 words of I/O.

**Table 3-3  Slave IP Address Settings**

| IP Address byte | Description | Meaning |
|---|---|---|
| First | QRIO Port number of Slave | 1 = Port 1<br>2 = Port 2 |
| Second | Rack Number of Slave | |
| Third | Group Number of Slave | 0, 2, 4, or 6 |
| Fourth | Number of words of Discrete I/O in Slave | 2. 4. 6. or 8 |

**Unit ID** - Ignored by QRIO. Set to 0.

**Health Timeout** - Ignored by QRIO. Set to 0.

**Rep Rate** - Ignored by QRIO. Set to 0.

NOTE: Unity Pro may complain that the Ethernet bandwidth of the NOE may be exceeded when set to 0. Set the value to 1000 to bypass this warning.

**Read Ref Master** - Location in PLC for Input data to appear.  This will be a 4x register number or a 0x coil.  The 0x Coil must be on a word boundary (a multiple of 16 plus 1).

**Read Ref Slave** - Reserved. Set to 400001.

**Read Length** - Reserved. Set to 1 if inputs are used otherwise set to 0. The actual number of words transferred is set by the last byte of the IP Address. It is common practice to set this value to the number of words transferred.

**Last Value (Input)** - Input data either zeroed or frozen on loss of communication with slave.  Same function as NOE.

**Write Ref Master** - This is the PLC location that holds the starting register for a given block of data and may be either a 4x register or 0x coil.  The 0x coil must be on a word boundary (a multiple of 16 plus 1).

**Write Ref Slave** - Reserved.  Set to 400001.

**Write Length** - Reserved. Set to 1 if outputs are used or 0 otherwise. The actual number of words transferred is set by the last byte of the IP Address. It is common practice to set this value to the number of words transferred.

**Table 3-4    I/O Scanner Example**

| | Slave IP Addr | Unit ID | Health Tout | Rep Rate | Read Ref Master | Read Ref Slave | Read Len | Last Value | Write Ref Master | Write Ref Slave | Write Len | Diag. Code | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **X** | **Specify IP** | | | | | IP Address | | 3.1.2.1 | Subnet | | 255.255.255.0 | | |
| | | | | | | Gateway | | 1.1.1.1 | Framing | | Ethernet II | | |
| **Master Module (slot)** | | Slot 5: 140-NOE-771-00 | | | | | | | | | | | |
| **Health Block** | | 300123 | | | | | | | | | | | |
| **X** | **Diagnostic Block** | 300501 | | | | | | | | | | | |
| | **Slave IP Addr** | **Unit ID** | **Health Tout** | **Rep Rate** | **Read Ref Master** | **Read Ref Slave** | **Read Len** | **Last Value** | **Write Ref Master** | **Write Ref Slave** | **Write Len** | **Diag. Code** | **Description** |
| 1 | 2.2.0.2 | 1 | 0 | 0 | 100065 | 400001 | 2 | Set to 0 | 000065 | 400001 | 2 | E001 | |
| 2 | 1.3.0.2 | 2 | 0 | 0 | 300103 | 400001 | 2 | Hold | 400103 | 400001 | 2 | 0000 | |
| 3 | 1.7.0.8 | 3 | 0 | 0 | 300110 | 400001 | 8 | Hold | 400110 | 400001 | 8 | 0000 | |
| 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | |

The example in Table 3-4 shows a QRIO in Slot 5 with Port 1 set to 230.4kbps and Port 2 set to 115.2kbps. The Health Block is in input registers 300123-300??. The Diagnostic Block is in registers 300501-300628.

Slave 1 is connected to Port 2, Logical Rack 2, Group 0, with 2 words of I/O. The input bits should show up in 100065-10097 and the output coils are from 000065-00097. The slave is not responding to the QRIO as shown by the Diagnostic Code E001 and thus the input coils are zeroed.

Slave 2 is connected to Port 1, Logical Rack 3, Group 0, with 2 words of I/O. The input words are in 300103 and 3000104 while the output words are from 4000103 and 400104. The slave is online with a Diagnostic Code of 0000. When the device goes offline, the inputs will be held at their last value.

Slave 3 is connected to Port 1, Logical Rack 7, Group 0, with 8 words of I/O. The input words are in 300110 and 3000117 while the output words are from 4000110 and 400117. The slave is online with a Diagnostic Code of 0000. When the device goes offline, the inputs will be held at their last value.

**NOTE:** It is beneficial to group all Discrete Outputs together in the PLC's memory. The QRIO must read these outputs on every PLC scan. The module does optimize its reads to issues as few as possible to the PLC. Grouping the Discrete Outputs together will minimize the impact of the QRIO on the PLC's scan time.

# RIO Analog Operation

Block Transfer can be used to pass additional I/O ("Block Transfer I/O") or to read and write parameters from an intelligent RIO slave device. Both operations are accomplished using the MSTR function block. The MSTR's Control Block is nine words long, and is described in Table 3-5.

The QRIO will support up to 16 simultaneous MSTR blocks. Care must be taken to properly sequence the MSTR blocks if more than sixteen are required. Each MSTR should be latched in until success or failure breaks the connection to power, and initiates the next MSTR. An example of latching in the MSTR is provided in Figure 3-1.
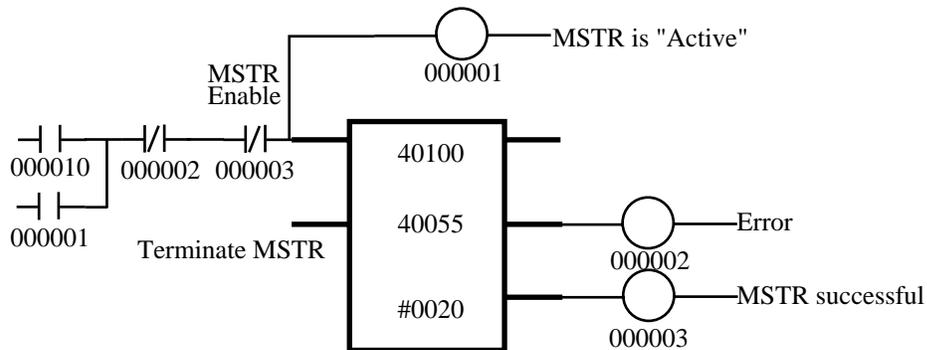


**Figure 3-1 Sample MSTR**

**Table 3-5 MSTR Control Block**

| Register | Use | Description |
|---|---|---|
| Displayed | Opcode | 1 = Write, 2 = Read |
| First implied | Error Status | Feedback from Option. |
| Second implied | Length | Number of words transferred |
| Third implied | Reserved | Set to zero. |
| Fourth implied | Slot Number/ RIO Port Number | High byte = Option Slot # Low byte = 1 or 2 to indicate QRIO port number. |
| Fifth implied | Interface Rack | Logical Rack number of Slave device. |
| Sixth implied | Interface Group | Group number of slave device. (0, 2, 4, or 6) |
| Seventh implied | [Module Group] | For Block Transfer with modules in an ASB rack, Group # of module. Otherwise, always set to zero. |
| Eighth implied | [Module Number] | For Block Transfer with modules in an ASB with 2-slot addressing (0 or 1). Otherwise, always set to zero. |

The 7th and 8th implied words are only used when the intelligent module is in a rack connected to the RIO network by an ASB interface. In all other cases, both words should be set to zero. For messaging to a module in an ASB rack, "Interface Rack" will be set to the Logical Rack number into which the module in question is mapped. This may differ from the Logical Rack number with which the ASB rack starts, as the rack may occupy more than one logical rack. For example, an ASB in a 16-slot rack that is configured for 1-slot addressing will occupy two logical racks. If the ASB were configured as rack 4, messaging to an Analog Input module in slot 16 would use values (5, 0, 7, 0) for (Interface Rack, Interface Group, Module Group, and Module Number). The same hardware configured for 1/2-slot addressing would use numbers (4, 0, 7, 1).

The following errors may be reported by an MSTR function block:

**Table 3-6    MSTR Error Codes**

| Diagnostic Code (Hex) | Meaning |
|---|---|
| 0000 | Successful |
| 1001 | Abort |
| 2002 | Control Block changed while MSTR Active |
| 2013 | Data Block outside 4x Registers |
| 7001 | Timeout |
| 701x | Bad Control Block word x |
| 7011 | Unsupported Opcode |
| 7012 | Data Block too long |
| 7014 | Incorrect Port number |
| 7016 | Invalid Group number |
| 7017 | Invalid Module Group number |
| 7018 | Invalid Module number |
| 7021 | No such device on network |
| 7022 | Drop number too large |
| 7025 | Reply's internal checksum incorrect |
| 7030 | Command word for target device is nonzero* |
| 7040 | Buffer shortage** |
| 90xx | xx = Number of words the device offered for a block transfer |

*The Least significant byte of the first output word of Discrete I/O assigned to the slave device must remain zero; it is reserved for handshaking for the Block Transfer.

**A Buffer shortage is caused by rapidly enabling MSTR's directed to a non-existent RIO slave device, or devices that are not responding. The error condition may be caused by a different MSTR than the one receiving this error.

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# 4

# Examples

</div>

## Example 1: 1791 Block I/O

This example shows a system with 1791-24B8 and 1791-16AC I/O blocks. The 1791 series I/O reserve two words for inputs and two words for outputs (used or not). The 1791-24B8 has 24 bits of input and 8 bits of output. The 1791-16AC has 16 bits of input and 16 bits of output.  The blocks are both configured for Logical Rack 1 with the 24B8 set to Group 0 and the 16AC set to Group 2. The DIP switch settings are shown in Table 4-1.
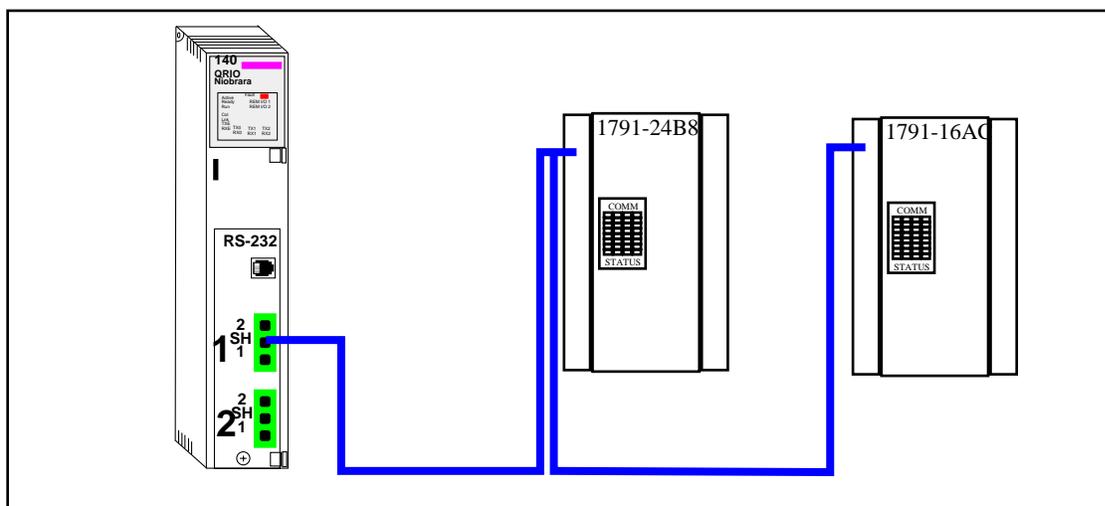


**Figure 4-1   Block I/O Example**

**Table 4-1   DIP Switches on I/O Blocks**

| DIP Switch | 1791-24B8 | 1791-16AC |
|---|---|---|
| SW2-8 | 0 - OFF (Not Used) | 0 - OFF (Not Used) |
| SW2-7 | 0 - OFF (Slow Filter) | 0 - OFF (Slow Filter) |
| SW2-6 | 0 - OFF (Not Last Rack) | 1 - ON (Last Rack) |
| SW2-5 | 0 - OFF (Processor Restart) | 0 - OFF (Processor Restart) |
| SW2-4 | 0 - OFF (Reset Outputs) | 0 - OFF (Reset Outputs) |
| SW2-3 | 0 - OFF (Non-Completed Rack) | 0 - OFF (Non-Completed Rack) |
| SW2-2 | 0 - OFF (115.2K Baud) | 0 - OFF (115.2K Baud) |
| SW2-1 | 1 - ON (115.2K Baud) | 1 - ON (115.2K Baud) |
| | | |
| SW1-8 | 0 - OFF | 0 - OFF |
| SW1-7 | 0 - OFF | 0 - OFF |
| SW1-6 | 0 - OFF | 0 - OFF |
| SW1-5 | 0 - OFF | 0 - OFF |
| SW1-4 | 0 = OFF | 0 = OFF |
| SW1-3 | 1 = ON (Rack 1) | 1 = ON (Rack 1) |
| SW1-2 | 0 - OFF (Group 0) | 0 - OFF (Group 2) |
| SW1-1 | 0 - OFF (Group 0) | 1 - ON (Group 2) |

**Table 4-2   Block I/O Scanner Example**

| X | Specify IP | | | | IP Address | 2.1.1.1 | Subnet | 255.255.255.0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Gateway | 1.1.1.1 | Framing | Ethernet II | | | | |
| Master Module (slot) | | Slot 3: 140-NOE-771-00 | | | | | | | | | | |
| Health Block | | 300123 | | | | | | | | | | |
| X | Diagnostic Block | 300501 | | | | | | | | | | |
| | Slave IP Addr | Unit ID | Health Tout | Rep Rate | Read Ref Master | Read Ref Slave | Read Len | Last Value | Write Ref Master | Write Ref Slave | Write Len | Diag. Code | Description |
| 1 | 1.1.0.2 | 0 | 0 | 0 | 300001 | 400001 | 2 | Set to 0 | 400001 | 400001 | 2 | 0000 | 1791-24B8 |
| 2 | 1.1.2.2 | 0 | 0 | 0 | 300003 | 400001 | 2 | Set to 0 | 400003 | 400001 | 2 | 0000 | 1791-16AC |
| 3 | | | | | | | | | | | | | |

The example in Table 4-2 shows the QRIO in Slot 3 with Port 1 set to 115.2kbps and Port 2 set to 57.6kbps (IP Address Setting).  The Health Block is in input registers 300123-300130.  The Diagnostic Block is in registers 300501-300628.

Slave 1 is connected to QRIO Port 1, Logical Rack 1, Group 0, with 2 words of I/O. The input words will be in 300001 and 300002 and the outputs are in 400001 and 400002. This slave is the 1791-24B8 and it physically has 24 bits of input. The inputs "G" 10-17 and 00-07 will be placed in register 300001 and "G+1" 00-07 will be in

register 300002. The eight outputs will come from register 400001. (See Table 4-3.) Register 400002 is reserved and should be set to a value of zero.

Slave 2 is connected to QRIO Port 1, Logical Rack 1, Group 2, with 2 words of I/O. This slave is the 1791-16AC which has 16 inputs and 16 outputs and are referenced from registers 300003 and 400003. Registers 300004 and 400004 are reserved and set to 0. (See Table 4-3.)

NOTICE: The A-B bits are represented in octal notation.

**Table 4-3    Register Bit Alignments**

| Quantum Register | Quantum Register Bits | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 msb | 14 | 13 | 12 | 11 | 10 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 lsb |
| 300001 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 300002 | Not used by block I/O, set to 0. | | | | | | | | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 300003 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 300004 | Not used by block I/O, set to 0. | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 400001 | Not used by block I/O, set to 0. | | | | | | | | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 400002 | Not used by block I/O, set to 0. | | | | | | | | | | | | | | | |
| 400003 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 400004 | Not used by block I/O, set to 0. | | | | | | | | | | | | | | | |

## Example 2: 1747-ASB SLC 500 I/O

This example shows a system with a 1747-ASB Remote I/O Adapter module in a rack of SLC500 I/O. The 1747-ASB series adapter is configured by DIP switches which set the logical rack number, logical group number, baud rate, etc. In this example, the SLC  rack contains four 16-bit input cards and five 16-bit output cards.  Thus 10 (must be an even number) words of I/O are required which means that the adapter will need to span two logical racks.  The DIP switch settings are shown in Table 4-4.
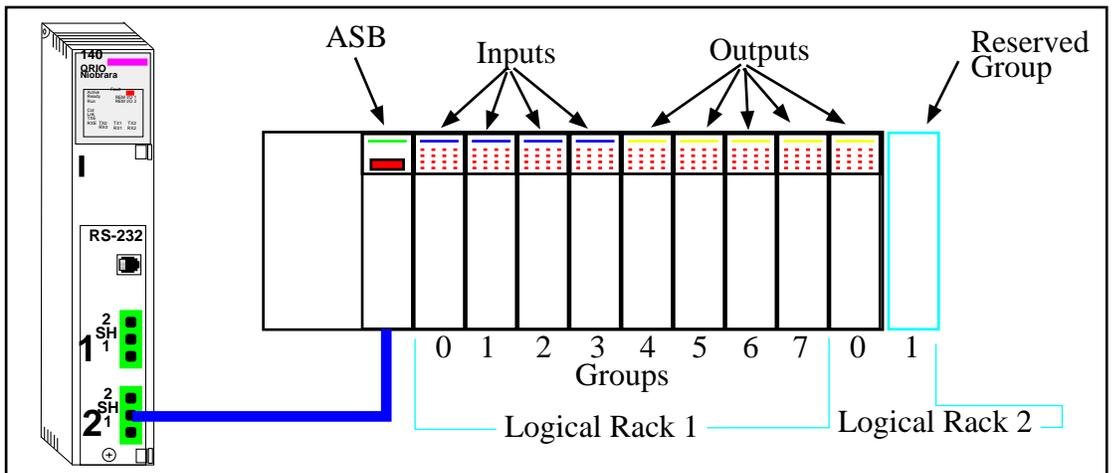


**Figure 4-2   SLC I/O Example**

**Table 4-4    DIP Switches on SLC ASB**

| DIP Switch | Meaning | DIP Switch | Meaning | DIP Switch | Meaning |
|---|---|---|---|---|---|
| SW3-1 | 0-OFF (Hold Last State) | SW2-1 | 1=ON (115.2K) | SW1-1 | 1-ON (Logical Rack 1) |
| SW3-2 | 1-ON (Processor Restart Lockout) | SW2-2 | 0=OFF (115.2K) | SW1-2 | 1-ON (Logical Rack 1) |
| SW3-3 | 1-ON (Link Response) | SW2-3 | 0=OFF (Complementary) | SW1-3 | 1-ON (Logical Rack 1) |
| SW3-4 | 1-ON (Last Chassis) | SW2-4 | 1-ON (Reserved must be on) | SW1-4 | 1-ON (Logical Rack 1) |
| SW3-5 | 1-ON () | SW2-5 | 1-ON (Logical size = 10) | SW1-5 | 1-ON (Logical Rack 1) |
| SW3-6 | 0-OFF (Non-Completed Rack) | SW2-6 | 0-OFF (Logical size = 10) | SW1-6 | 0-OFF (Logical Rack 1) |
| SW3-7 | 1-ON (115.2K Baud) | SW2-7 | 1-ON (Logical size = 10) | SW1-7 | 1-ON (Starting Group 0) |
| SW3-8 | 1-ON (115.2K Baud) | SW2-8 | 1-ON (Logical size = 10) | SW1-8 | 1-ON (Starting Group 0) |

**Table 4-5    SLC I/O Scanner Example**

| X | Specify IP | | | | IP Address | 1.1.2.1 | Subnet | 255.255.255.0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Gateway | 1.1.1.1 | Framing | Ethernet II | | | | |
| Master Module (slot) | | Slot 3: 140-NOE-771-00 | | | | | | | | | | |
| Health Block | | 300123 | | | | | | | | | | |
| X | Diagnostic Block | 300501 | | | | | | | | | | |
| | Slave IP Addr | Unit ID | Health Tout | Rep Rate | Read Ref Master | Read Ref Slave | Read Len | Last Value | Write Ref Master | Write Ref Slave | Write Len | Diag. Code | Description |
| 1 | 2.1.0.8 | 0 | 0 | 0 | 300001 | 400001 | 8 | Set to 0 | 400001 | 400001 | 8 | 0000 | |
| 2 | 2.2.0.2 | 0 | 0 | 0 | 300009 | 400001 | 2 | Set to 0 | 400009 | 400001 | 2 | 0000 | |
| 3 | | | | | | | | | | | | | |

The example in Table 4-5 shows the QRIO in Slot 3 with Port 1 set to 57.8kbps and Port 2 set to 115.2kbps (IP Address Setting).  The Health Block is in input registers 300123-300130.  The Diagnostic Block is in registers 300501-300628.

The ASB is connected to QRIO Port 2, Starting Logical Rack 1, Group 0, with 10 words of I/O.  The input words will be in 300001-300010 and the outputs are in 400001 and 400010.

The layout of the SLC rack is such that all of the input cards are in the first four groups and the output are in the next 5 groups.  The number of total groups must be even so 10 groups must be used (8 in rack 1 and 2 in rack 2). Each group consists of both inputs and outputs so they must be reserved even when they are not used.

NOTE: The bit numbers on SLC I/O are numbered 0-15 in normal IEC fashion where bit 0 is the least significant bit.

**Table 4-6    Discrete I/O Register Alignment**

| Quantum Register | A-B Module | Logical Rack/Group | Physical Slot in PLC Rack |
|---|---|---|---|
| 300001 | Slot 1 (16-bit Input) | Rack 1 / Group 0 | 1 |
| 300002 | Slot 2 (16-bit Input) | Rack 1 / Group 1 | 2 |
| 300003 | Slot 3 (16-bit Input) | Rack 1 / Group 2 | 3 |
| 300004 | Slot 4 (16-bit Input) | Rack 1 / Group 3 | 4 |
| 300005 | Slot 5 (Not used, Outputs) | Rack 1 / Group 4 | 5 |
| 300006 | Slot 6 (Not used, Outputs) | Rack 1 / Group 5 | 6 |
| 300007 | Slot 7 (Not used, Outputs) | Rack 1 / Group 6 | 7 |
| 300008 | Slot 8 (Not used, Outputs) | Rack 1 / Group 7 | 8 |
| 300009 | Slot 9 (Not used, Outputs) | Rack 2 / Group 0 | 9 |
| 300010 | Slot 10 (Not used) | Rack 2 / Group 1 | 10 |
| | | | |
| 400001 | Slot 1 (Not Used, Inputs) | Rack 1 / Group 0 | 1 |
| 400002 | Slot 2 (Not Used, Inputs) | Rack 1 / Group 1 | 2 |
| 400003 | Slot 3 (Not Used, Inputs) | Rack 1 / Group 2 | 3 |
| 400004 | Slot 4 (Not Used, Input)s | Rack 1 / Group 3 | 4 |
| 400005 | Slot 5 (16-bit, Output) | Rack 1 / Group 4 | 5 |
| 400006 | Slot 6 (16-bit, Output) | Rack 1 / Group 5 | 6 |
| 400007 | Slot 7 (16-bit, Output) | Rack 1 / Group 6 | 7 |
| 400008 | Slot 8 (16-bit Output) | Rack 1 / Group 7 | 8 |
| 400009 | Slot 9 16-bit Output) | Rack 2 / Group 0 | 9 |
| 400010 | Slot 10 (Not Used) | Rack 2 / Group 1 | 10 |

## Example 3: 1771-ASB PLC-5 (and PLC-2) I/O

This example shows a system with a 1771-ASB Remote I/O Adapter module in a rack of PLC-5 and PLC-2 I/O. The 1771-ASB series adapter is configured by DIP switches which set the logical rack number, logical group number, baud rate, etc. In this example, the PLC rack contains four 16-bit input cards, one 16-bit output card, three 8-bit input cards, five 8-bit output cards, two four channel analog output cards, and one eight channel analog input card. Thus 16 words of I/O are required which means that the adapter will need to span two logical racks. Each slot in the rack will require one word of discrete I/O. The 8-bit cards map their I/O to the least significant byte of the word. The analog cards will require block transfer messages using MSTR commands. The DIP switch settings for the ASB in PLC-5 mode are shown in Table 4-7.

### Discrete I/O Operation

The Quantum PLC is a Unity processor and the I/O Scanner table is shown in Table 4-8. The QRIO in Slot 5 of the Unity Processor with Port 1 set to 115.2kbps and Port 2 set to 230.4kbps (IP Address Setting). The Health Block is in input registers %IW1-%IW8.

The ASB is connected to QRIO Port 2, Starting Logical Rack 8, Group 0, with 16 words of I/O. The input words will be in %MW101-%MW116 and the outputs are in %MW201-%MW216.

NOTE: The bit numbers on PLC I/O are numbered 0-15 in normal IEC fashion where bit 0 is the least significant bit

NOTE: The eight bit cards only use the least significant byte of the word.
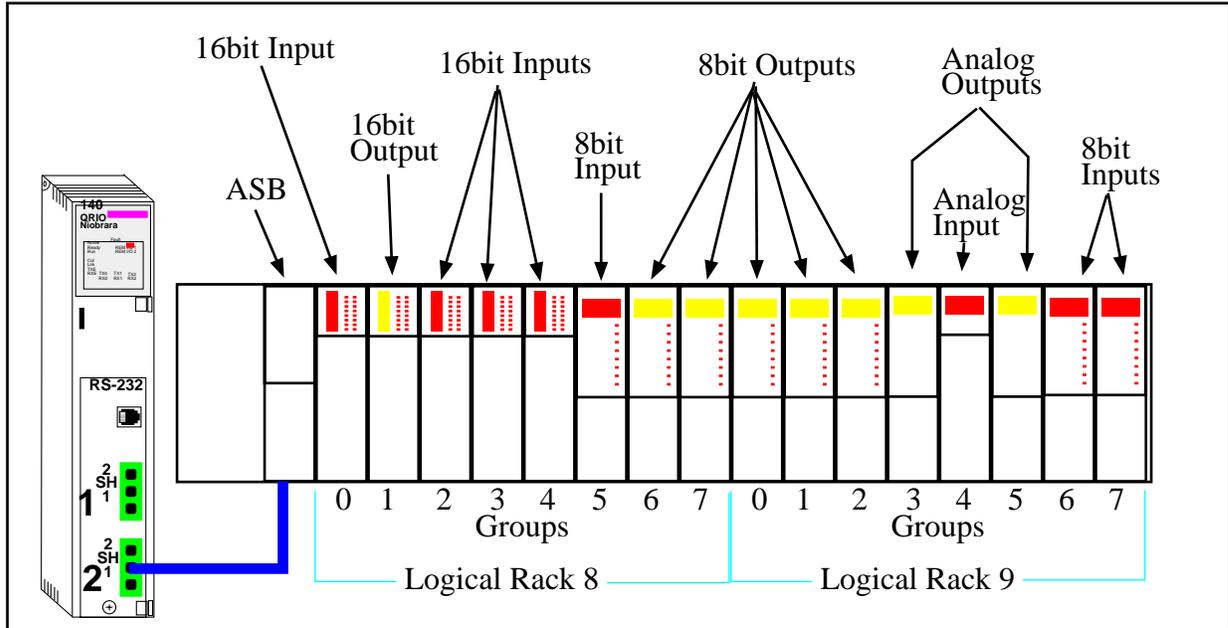


**Figure 4-3   PLC I/O Example**

**Table 4-7    DIP Switches on PLC-5 ASB**

| Switch | SW2 1 | SW1 2 | SW1 3 | SW1 4 | SW1 5 | SW1 6 | SW1 7 | SW1 8 | | SW2 1 | SW2 2 | SW2 3 | SW2 4 | SW2 5 | SW2 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Setting | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 0 | 1 | 0 | 0 | 0 | 0 |
| Description | Logical Rack 8 | | | | | | First Group 0 | | | 230.4K Baud | Always OFF | Scan All Slots | Link Response OFF | Always OFF | |

**Table 4-8    PLC-5 I/O Scanner Example**

| Model Family TCP/IP 10/100 | | | Module Address Rack 1     Module 5 | | Module Utilities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Module IP Address IP Address     Subnetwork Mask 2.1.3.1        0.0.0.0 | | | | Gateway Address 0.0.0.0 | | | | | | | | |
| IP Configuration | | | IO Scanning | | | | | | | | | |
| I/O Scanner configuration | | | | | | | | | | | | |
| Health Block (%I/%IW) | | | %IW1 | | | Repetitive Rate Step | | 10 | | | | |
| | Slave IP Addr | Unit ID | Health Tout | Rep Rate | RD Master Object | RD Slave Index | Read Len | Last Value (Input) | WR Master Object | WR Slave Index | WR Len | Description |
| 1 | 2.8.0.8 | 0 | 0 | 0 | %MW101 | 0 | 8 | Hold | %MW201 | 0 | 8 | |
| 2 | 2.9.0.8 | 0 | 0 | 0 | %MW109 | 0 | 8 | Hold | %MW209 | 0 | 8 | |
| 3 | | | | | | | | | | | | |

**Table 4-9    Discrete I/O Register Alignment**

| Quantum Register | A-B Module | Logical Rack/Group | Physical Slot in PLC Rack |
|---|---|---|---|
| %MW101 | Slot 1 (16-bit Input) | Rack 8 / Group 0 | 1 |
| %MW102 | Slot 2 (Not Used, 16-bit Output) | Rack 8 / Group 1 | 2 |
| %MW103 | Slot 3 (16-bit Input) | Rack 8 / Group 2 | 3 |
| %MW104 | Slot 4 (16-bit Input) | Rack 8 / Group 3 | 4 |
| %MW105 | Slot 5 (16-bit Input) | Rack 8 / Group 4 | 5 |
| %MW106 | Slot 6 (8-bit Input) | Rack 8 / Group 5 | 6 |
| %MW107 | Slot 7 (Not Used, 8-bit Output) | Rack 8 / Group 6 | 7 |
| %MW108 | Slot 8 (Not used, 8-bit Output) | Rack 8 / Group 7 | 8 |
| %MW109 | Slot 9 (Not used, 8-bit Output) | Rack 9 / Group 0 | 9 |
| %MW110 | Slot 10 (Not used, 8-bit Output)) | Rack 9 / Group 1 | 10 |
| %MW111 | Slot 11 (Not used, 8-bit Output)) | Rack 9 / Group 2 | 11 |
| %MW112 | Slot 12 (Not used, Analog Output)) | Rack 9 / Group 3 | 12 |
| %MW113 | Slot 13 (Analog Input)) | Rack 9 / Group 4 | 13 |
| %MW114 | Slot 14 (Not used, Analog Output)) | Rack 9 / Group 5 | 14 |
| %MW115 | Slot 15 (8-bit Input) | Rack 9 / Group 6 | 15 |
| %MW116 | Slot 16 (8-bit Input) | Rack 9 / Group 7 | 16 |
| | | | |
| %MW201 | Slot 1 (Not Used, 16-bit Input) | Rack 8 / Group 0 | 1 |
| %MW202 | Slot 2 (16-bit Output) | Rack 8 / Group 1 | 2 |
| %MW203 | Slot 3 (Not Used, 16-bit Input) | Rack 8 / Group 2 | 3 |
| %MW204 | Slot 4 (Not Used, 16-bit Input) | Rack 8 / Group 3 | 4 |
| %MW205 | Slot 5 (Not Used, 16-bit Input) | Rack 8 / Group 4 | 5 |
| %MW206 | Slot 6 (Not Used, 8-bit Input) | Rack 8 / Group 5 | 6 |
| %MW207 | Slot 7 (8-bit Output) | Rack 8 / Group 6 | 7 |
| %MW208 | Slot 8 (8-bit Output) | Rack 8 / Group 7 | 8 |
| %MW209 | Slot 9 (8-bit Output) | Rack 9 / Group 0 | 9 |
| %MW210 | Slot 10 (8-bit Output)) | Rack 9 / Group 1 | 10 |
| %MW211 | Slot 11 (8-bit Output)) | Rack 9 / Group 2 | 11 |
| %MW212 | Slot 12 (Analog Output)) | Rack 9 / Group 3 | 12 |
| %MW213 | Slot 13 (Not Used, Analog Input)) | Rack 9 / Group 4 | 13 |
| %MW214 | Slot 14 (Analog Output)) | Rack 9 / Group 5 | 14 |
| %MW215 | Slot 15 (Not Used, 8-bit Input) | Rack 9 / Group 6 | 15 |
| %MW216 | Slot 16 (Not Used, 8-bit Input) | Rack 9 / Group 7 | 16 |

NOTE: The analog input and output cards have discrete input and output words assigned through the I/O Scanner table.  These discrete words are used by the QRIO with the MSTR command to control the block data transfers to the cards.  It is important to not write values to these words from the user program directly.

**Analog Input Operation**

Figure 4-4 shows a section of Function Block Diagram used to read the analog data from the 1771-IFE card in physical slot 13. A 500mS timer triggers the MSTR to read

the data.  The control block for this MSTR is Analog_In_CB and is shown in Table 4-4. The data block for this MSTR is Analog_In_DB and is shown in Table 4-11.
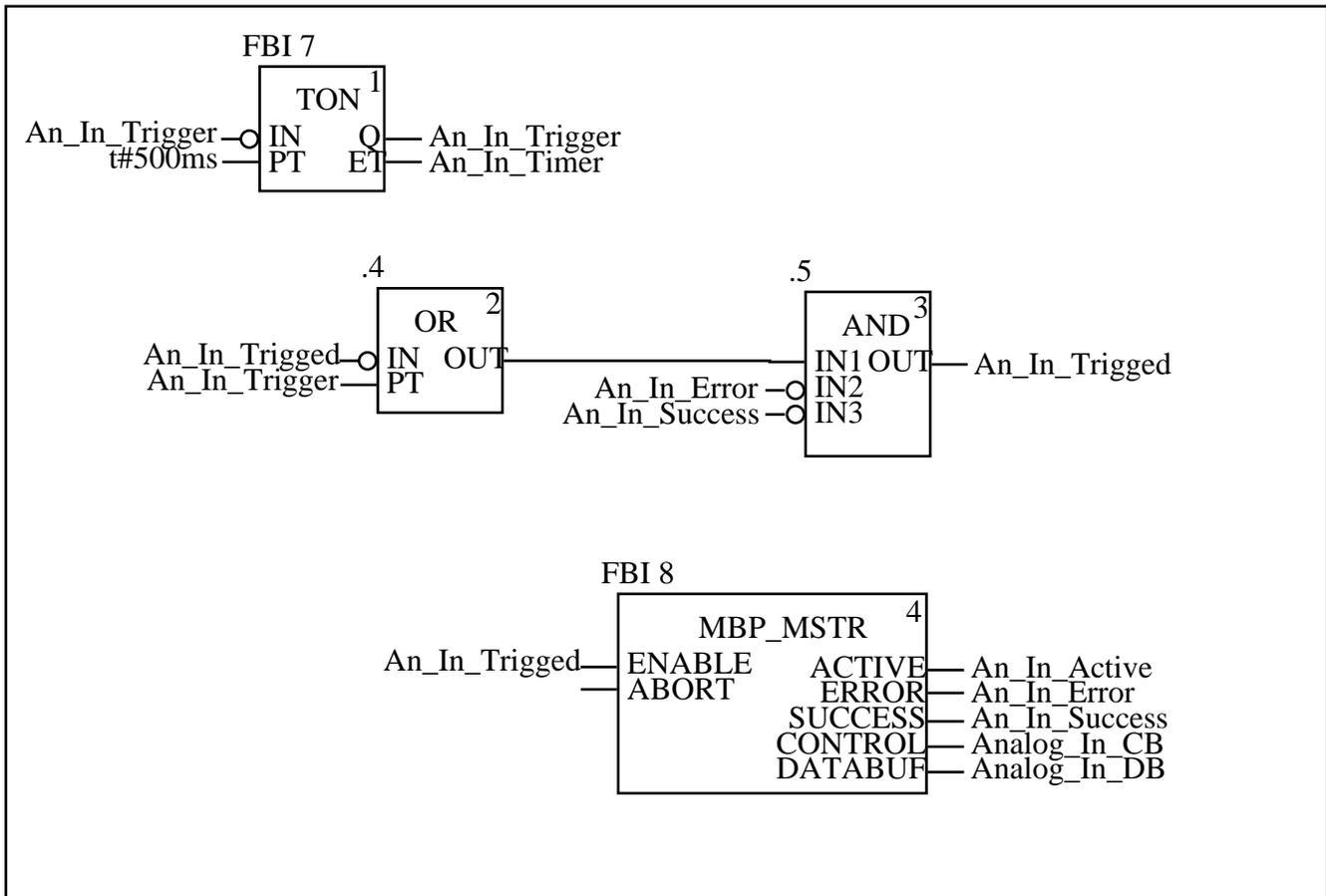


**Figure 4-4   Analog In Data Read MSTR**

**Table 4-10   Analog_In_CB**

| Name | Type | Address | Value | Comment |
|---|---|---|---|---|
| Analog_In_CB | CB_Type | %MW1800 | | |
|     Analog_In_CB[0] | WORD | %MW1800 | 2 | Read |
|     Analog_In_CB[1] | WORD | %MW1801 | | Error Code |
|     Analog_In_CB[2] | WORD | %MW1802 | 20 | Length |
|     Analog_In_CB[3] | WORD | %MW1803 | 0 | |
|     Analog_In_CB[4] | WORD | %MW1804 | 16#0502 | Slot/Port |
|     Analog_In_CB[5] | WORD | %MW1805 | 9 | Logical Rack |
|     Analog_In_CB[6] | WORD | %MW1806 | 0 | |
|     Analog_In_CB[7] | WORD | %MW1807 | 4 | Group |
|     Analog_In_CB[8] | WORD | %MW1808 | 0 | |

The MSTR control Block Analog_In_CB shows the opcode of 2 for a read and a length of 20 words for the query.   The QRIO is in Quantum slot 5 and the message is to be sent out port 2 to logical rack 9 group 4.

**Table 4-11  Analog_In_DB**

| Name | | | Type | Address | Value | Comment |
|---|---|---|---|---|---|---|
| Analog_In_DB | | | QRIO_1771_IFE_Data | %MW1750 | | |
| | Diag | | WORD | %MW1750 | 0 | |
| | Underrange | | WORD | %MW1751 | | |
| | Overrange | | WORD | %MW1752 | | |
| | Polarity | | WORD | %MW1753 | | |
| | Channel | | ARRAY[0..15] OF WORD | %MW1754 | | |
| | | Channel[0] | WORD | %MW1754 | | |
| | | Channel[1] | WORD | %MW1756 | | |
| | | Channel[2] | WORD | %MW1757 | | |
| | | Channel[3] | WORD | %MW1758 | | |
| | | Channel[4] | WORD | %MW1758 | | |
| | | Channel[5] | WORD | %MW1759 | | |
| | | Channel[6] | WORD | %MW1760 | | |
| | | Channel[7] | WORD | %MW1761 | | |
| | | Channel[8] | WORD | %MW1762 | | |
| | | Channel[9] | WORD | %MW1763 | | |
| | | Channel[10] | WORD | %MW1764 | | |
| | | Channel[11] | WORD | %MW1765 | | |
| | | Channel[12] | WORD | %MW1766 | | |
| | | Channel[13] | WORD | %MW1767 | | |
| | | Channel[14] | WORD | %MW1768 | | |
| | | Channel[15] | WORD | %MW1769 | | |

The data block for the read MSTR is Analog_In_DB and is populated on the success-ful completion of each block transfer. The actual analog data from each of the 16 ana-log inputs on this card shows up in the Analog_In_DB.Channel array.

Figure 4-5 shows a section of function blocks for the MSTR used to write the configu-ration to the analog input card in physical slot 13.  This analog card is a model 1771-IFE which features up to 39 words of write block for configuration.  The last two words are used for calibration and this example only sends 37 words during the con-figuration write. This configuration must be sent every time the module is powered up and is triggered by the bit Analog_In_DB.Diag being true.  This is bit 0 of the first word of the read data (Analog_In_DB.Diag).
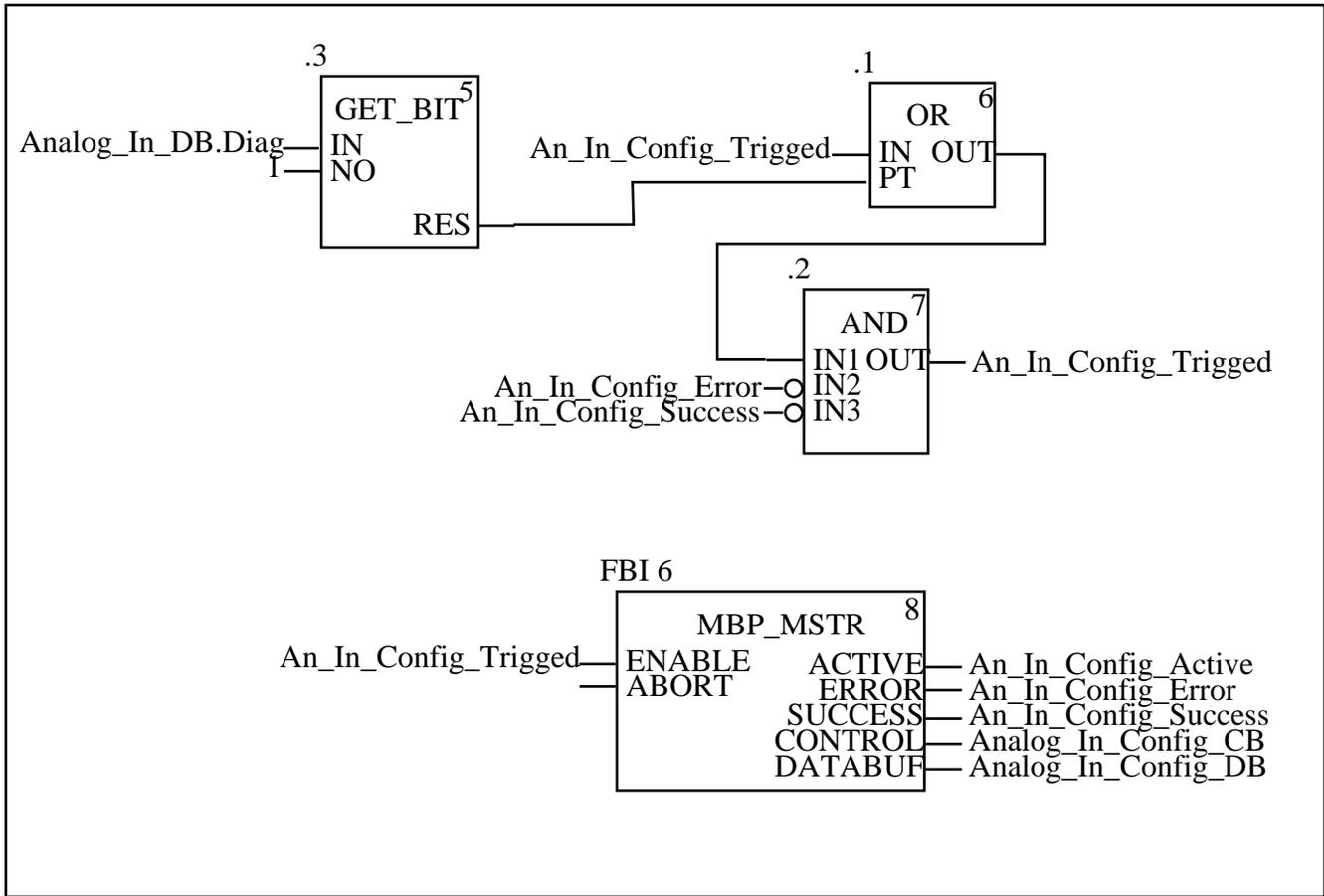
**Figure 4-5   Analog In MSTR Write for Configuring the Card**

**Table 4-12   Analog_In_Config_CB**

| Name | | Type | Address | Value | Comment |
|---|---|---|---|---|---|
| Analog_In_Config_CB | | CB_Type | %MW1820 | | |
| | Analog_In_Config_CB[0] | WORD | %MW1820 | 1 | Write |
| | Analog_In_Config_CB[1] | WORD | %MW1821 | | Error Code |
| | Analog_In_Config_CB[2] | WORD | %MW1822 | 37 | Length |
| | Analog_In_Config_CB[3] | WORD | %MW1823 | 0 | |
| | Analog_In_Config_CB[4] | WORD | %MW1824 | 16#0502 | Slot/Port |
| | Analog_In_Config_CB[5] | WORD | %MW1825 | 9 | Logical Rack |
| | Analog_In_Config_CB[6] | WORD | %MW1826 | 0 | |
| | Analog_In_Config_CB[7] | WORD | %MW1827 | 4 | Group |
| | Analog_In_Config_CB[8] | WORD | %MW1828 | 0 | |

The MSTR control Block Analog_In_Config_CB shows the opcode of 1 for a write and a length of 37 words for the message.   The QRIO is in Quantum slot 5 and the message is to be sent out port 2 to logical rack 9 group 4.

**Table 4-13  Analog_In_Config_DB**

| Name | | | Type | Address | Value | Comment |
|---|---|---|---|---|---|---|
| Analog_In_Config_DB | | | QRIO_1771_IFE_Config | %MW1700 | | |
| | Range1 | | WORD | %MW1700 | 0 | |
| | Range2 | | WORD | %MW1701 | 0 | |
| | Format | | WORD | %MW1702 | 16#0500 | |
| | Sign1 | | WORD | %MW1703 | 0 | |
| | Sign2 | | WORD | %MW1703 | 0 | |
| | ChannelsConfig | | QRIO_1771_IFE_ChannelsConfig | %MW1705 | | |
| | | ChannelsConfig[0] | QRIO_1771_IFE_ChannelConfig | %MW1705 | | |
| | | | Min | WORD | %MW1705 | 0 | |
| | | | Max | WORD | %MW1706 | 4096 | |
| | | ChannelsConfig[1] | QRIO_1771_IFE_ChannelConfig | %MW1707 | | |
| | | ChannelsConfig[2] | QRIO_1771_IFE_ChannelConfig | %MW1709 | | |
| | | ChannelsConfig[3] | QRIO_1771_IFE_ChannelConfig | %MW1711 | | |
| | | ChannelsConfig[4] | QRIO_1771_IFE_ChannelConfig | %MW1713 | | |
| | | ChannelsConfig[5] | QRIO_1771_IFE_ChannelConfig | %MW1715 | | |
| | | ChannelsConfig[6] | QRIO_1771_IFE_ChannelConfig | %MW1717 | | |
| | | ChannelsConfig[7] | QRIO_1771_IFE_ChannelConfig | %MW1719 | | |
| | | ChannelsConfig[8] | QRIO_1771_IFE_ChannelConfig | %MW1721 | | |
| | | ChannelsConfig[9] | QRIO_1771_IFE_ChannelConfig | %MW1723 | | |
| | | ChannelsConfig[10] | QRIO_1771_IFE_ChannelConfig | %MW1725 | | |
| | | ChannelsConfig[11] | QRIO_1771_IFE_ChannelConfig | %MW1727 | | |
| | | ChannelsConfig[12] | QRIO_1771_IFE_ChannelConfig | %MW1729 | | |
| | | ChannelsConfig[13] | QRIO_1771_IFE_ChannelConfig | %MW1731 | | |
| | | ChannelsConfig[14] | QRIO_1771_IFE_ChannelConfig | %MW1733 | | |
| | | ChannelsConfig[15] | QRIO_1771_IFE_ChannelConfig | %MW1735 | | |

The data block for the write MSTR is Analog_In_Config_DB.

## Analog Output Operation

Figure 4-6 shows a section of function blocks for the MSTR used to write the data and configuration to the analog output card in physical slot 12. This analog card is a model 1771-OFE which features 4 words of analog output and 9 words of configuration. The control block for the MSTR is Analog_Out_CB with an opcode of 1 for the write and length of 13. The QRIO slot number is 05 and the port number is 1. The slave logical rack is 9 and the logical group is 3 to correspond to physical slot 12.
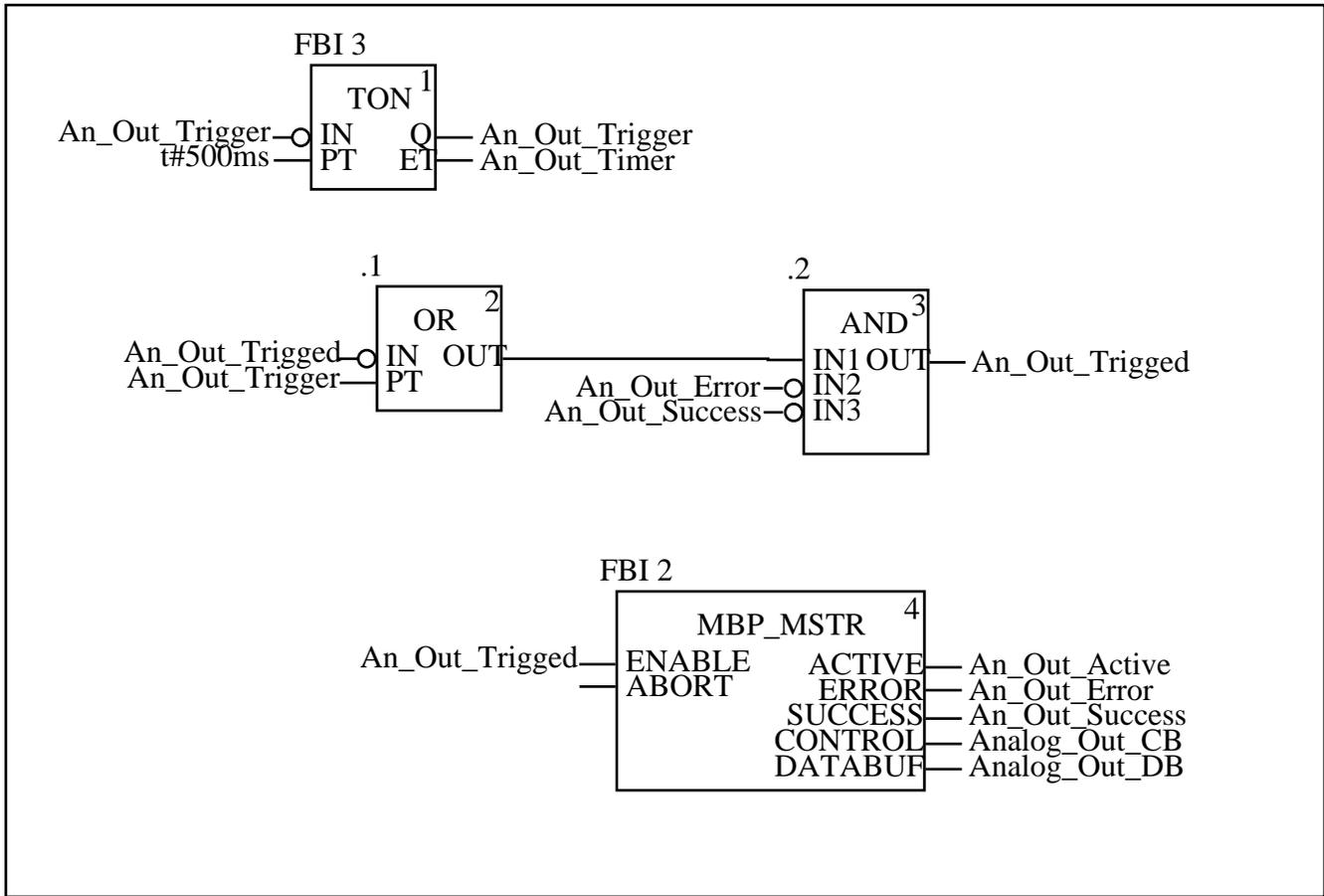
**Figure 4-6   Analog Out Data WRITE MSTR**

**Table 4-14   Analog_Out_CB**

| Name | | Type | Address | Value | Comment |
|---|---|---|---|---|---|
| Analog_Out_CB | | CB_Type | %MW1900 | | |
| | Analog_Out_CB[0] | WORD | %MW1900 | 1 | Write |
| | Analog_Out_CB[1] | WORD | %MW1901 | | Error Code |
| | Analog_Out_CB[2] | WORD | %MW1902 | 13 | Length |
| | Analog_Out_CB[3] | WORD | %MW1903 | 0 | |
| | Analog_Out_CB[4] | WORD | %MW1904 | 16#0502 | Slot/Port |
| | Analog_Out_CB[5] | WORD | %MW1905 | 9 | Logical Rack |
| | Analog_Out_CB[6] | WORD | %MW1906 | 0 | |
| | Analog_Out_CB[7] | WORD | %MW1907 | 3 | Group |
| | Analog_Out_CB[8] | WORD | %MW1908 | 0 | |

**Table 4-15 Analog_Out_DB**

| Name | Type | Address | Value | Comment |
|------|------|---------|-------|---------|
| Analog_Out_DB | QRIO_1771_OFE | %MW1900 | | |
| Channel0Data | WORD | %MW1900 | | |
| Channel1Data | WORD | %MW1901 | | |
| Channel2Data | WORD | %MW1902 | | |
| Channel3Data | WORD | %MW1903 | | |
| Config | WORD | %MW1904 | 16#8000 | |
| Ch1Min | WORD | %MW1905 | 0 | |
| Ch1Max | WORD | %MW1906 | 4096 | |
| Ch2Min | WORD | %MW1907 | 0 | |
| Ch2Max | WORD | %MW1908 | 4096 | |
| Ch3Min | WORD | %MW1909 | 0 | |
| Ch3Maxq q" | WORD | %MW1910 | 4096 | |
| Ch4Min | WORD | %MW1911 | 0 | |
| Ch4Max | WORD | %MW1912 | 4096 | |

## Example 4: Kistler-Morse SVS 2000

The Kistler-Morse SVS 2000 load cell system supports an optional Allen-Bradley RIO PCB. The SVS 2000 system may be operated in either Discrete or Block transfer modes. It requires 1/4 rack (2 words In and Out) and is easily configured through the front panel LCD for Rack Address, Rack Size, Last Rack, Baud Rate, and Starting Quarter. Figure 4-7 shows a simple example with a QRIO connected via port 2 to two SVS 2000 indicators. The first unit is configured for Discrete mode while the second is set for Block transfer.
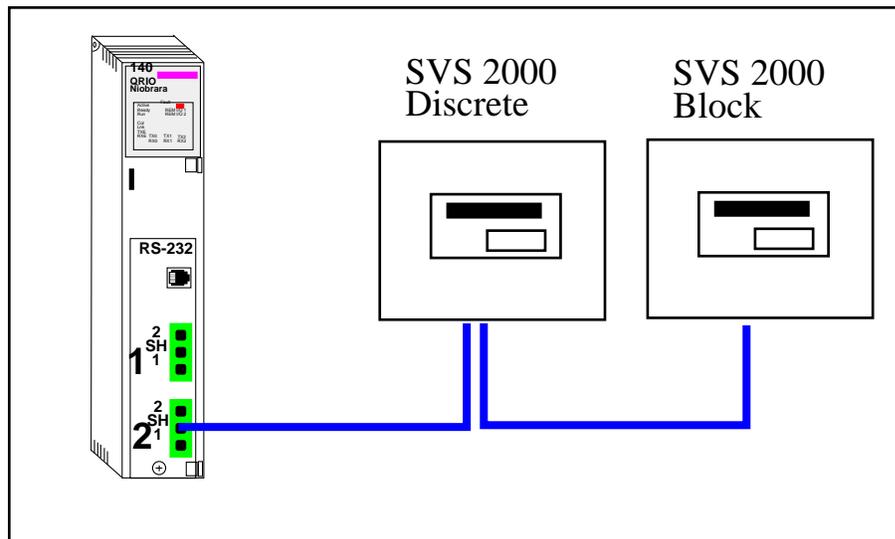


**Figure 4-7   SVS 2000 Example**

**Table 4-16  Discrete Device Configuration**

| Parameter | Value |
|---|---|
| Operation Mode | Discrete |
| Rack Address | 3 |
| Rack Size | 1/4 |
| Last Rack | No |
| Baud Rate | 57.6 |
| Starting Quarter | 1st |

**Table 4-17  Block Device Configuration**

| Parameter | Value |
|---|---|
| Operation Mode | Block |
| Rack Address | 3 |
| Rack Size | 1/4 |
| Last Rack | Yes |
| Baud Rate | 57.6 |
| Starting Quarter | 2nd |

**Table 4-18  I/O Scanner Example**

| IP Address | Unit ID | Rep Rate | Time out | Read | | | Write | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Local | Remote | Count | Local | Remote | Count |
| 2.3.0.2 | 0 | 0 | 0 | 30010 | 400001 | 2 | 41001 | 400001 | 2 |
| 2.3.2.2 | 0 | 0 | 0 | 30012 | 400001 | 2 | 41003 | 400001 | 2 |

The IP Address sets the QRIO port number, Rack, Group, and number of words. The port number is either 1 or 2. The Rack number matches the setting in the SVS 3000. The Group number is 0=1st starting 1/4, 2=2nd starting 1/4, 4=3rd starting 1/4, and 6=4th starting 1/4. The word size will always be 2.

If the slave were connected to QRIO port 1, rack 5, and 4th 1/4 then the IP Address would be set to 1.5.6.2.

In the example above, both devices are configured for Rack 3 with 1/4 rack (2 words) per device.  The Discrete slave is set for the first quarter of the rack (words 0&1) while the Block slave is set for the second quarter (words 2&3).

### Discrete Transfer Operation

The simple solution for communicating with the SVS 2000 is to use the Discrete Transfer mode. The Discrete mode involves no extra ladder logic. The I/O Scanner entry of two words in and two words out provides the entire interface for the PLC. The configuration for the first SVS is shown in Table 4-16. The I/O Scanner entry above places the input data in PLC registers 3x0010 and 11 and the output data in 4x0101 and 102.

**Table 4-19  Discrete Register Mapping**

| PLC Register | Device Word | Description |
|---|---|---|
| 3x0010 | Input 0 | Command Echo (bits 0, 1, 2), Polarity (bit 3), Error Status (bit 4) |
| 3x0011 | Input 1 | Return Data |
| 4x1001 | Output 0 | Command |
| 4x1002 | Output 1 | Unused |

The Commands are written to Output word 0 and are echoed to the first 3 bits of Input word 0. A summary of the commands is shown in Table 4-20. (See the KM A-B RIO Interface Manual for SVS 2000 for more details.)

Load the command value into Output word 0, this command will be echoed into Input word 0 along with other status bits for polarity and status bits (3 and 4). The data will be delivered into Input word 1.

For example, if 4x1001 = 1 and 4x1002 = 0 and there are no errors then 3x0010 = 1 and 3x0011 = 71 (71 pounds).  As long as the command value is loaded into Output word 0 then then Input word 1 will show the scale reading and is continuously up-dated. If the reading were -71 pounds then Input word 0 = 9 and Input word 1 = 71.

**Table 4-20  Discrete Transfer Commands**

| Command Value | Description |
|---|---|
| 0 | Null Command |
| 1 | Gross Weight |
| 2 | Net Weight |
| 3 | Reserved |
| 4 | Reserved |
| 5 | A-B Revision Report |
| 6 | Tare |
| 7 | Status |

## Block Transfer Operation

The Block Transfer operation involves more programming in the PLC. The I/O Scanner entry of two words in and out is still required but these four words are not used within the PLC program. One MSTR is needed to write the command/data and one MSTR is needed to read the data.

**NOTE:** The KM A-B RIO Interface Manual for SVS 2000 provides a complete listing of all Block Transfer commands and should be referenced for more information.

The Write MSTR must be triggered at least once to load a valid command to the SVS 2000. The Read MSTR may be continuously triggered to read the data. The command code is provided in the read data to verify the type of data returned.

The register count of the MSTR will be 2 for both the read and write.

**Table 4-21MSTR Control Block**

| Register | Use | Description |
|---|---|---|
| Displayed | Opcode | 1 = Write, 2 = Read |
| First implied | Error Status | Feedback from Option. |
| Second implied | Length | Number of words transferred Set to 2 |
| Third implied | Reserved | Set to zero. |
| Fourth implied | Slot Number/ RIO Port Number | High byte = Option Slot # Low byte = 1 or 2 to indicate QRIO port number. |
| Fifth implied | Interface Rack | Logical Rack number of Slave device. |
| Sixth implied | Interface Group | Group number of slave device. 0 = first 1/4 2 = second 1/4 4 = third 1/4 6 = fourth 1/4 |
| Seventh implied | [Module Group] | Set to zero. |
| Eighth implied | [Module Number] | Set to zero. |

# 5
# LED Panel

The QRIO display includes a number of lights that are useful for troubleshooting. Most of these lights will flash briefly while the QRIO is booting and then should assume their normal states.

- Active - This light will be on when the QRIO is able to communicate with the Quantum CPU across the backplane.

- Ready - This light will be on when the QRIO has successfully booted and operating normally.

- Run - This light is on (solid) when the Quantum PLC is in run mode. If the QRIO is in the secondary rack of a Hot Standby system and the PLC is in run then the Run light will blink on the secondary QRIO.

- Lnk - This light will only be on while the QRIO is in firmware download mode.

- Fault - This light has multiple meanings.

  — On (Solid) when the PLC is in run and both the REM I/O1 and/or REM I/O2 lights are off indicates that the QRIO is not configured or there is a problem with the I/O Scanner table for its slot.

  — Flashing or on solid when the PLC is in run and either/or REM I/O1 and REM I/O2 is on indicates that one or both RIO network(s) is experiencing a communications problem. Inspecting the TX1/RX1 and TX2/RX2 lights should give an indication as to which port is having the problem.

- REMI/O1 and REMI/O2- These lights indication that Port1 and/or Port 2 is configured and attempting to poll slaves.

- TX0 - This light flashes very briefly as the QRIO sends a message from the RS-232 serial port.

- RX0 - This light flashes briefly as the QRIO receives a message from the RS-232 serial port.

- TX1 - This light flashes very briefly as the QRIO sends a message to the Port 1 network.
- RX1 - This light flashes briefly as the slaves on Port 1 reply to the QRIO.
- TX2 - This light flashes very briefly as the QRIO sends a message to the Port 2 network.
- RX2 - This light flashes briefly as the slaves on Port 2 reply to the QRIO.

# 6

# Connector Pinouts

## RIO ports on QRIO (Screw Terminal)
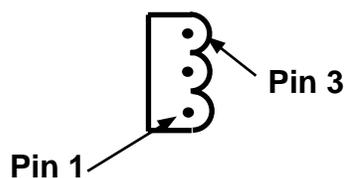


**Figure 6-1   RS-232 Port RJ45**

**Table 6-1    RS-232 Pinout**

| Pin | Function | Notes |
|-----|----------|-------|
| 1 | 1 | Connect Blue wire |
| 2 | SHLD | Connect shield wire |
| 3 | 2 | Connect White (Clear) wire |

# RS-232 port on QRIO (RJ45 socket)

**Pin 8**

**Pin 1**
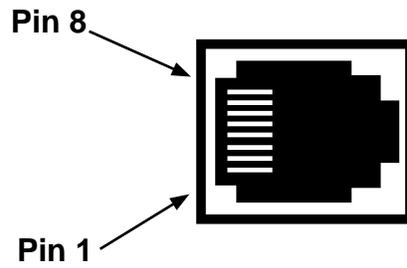
**Figure 6-2  RS-232 Port RJ45**

**Table 6-2   RS-232 Pinout**

| Pin | Function | Notes |
|---|---|---|
| 1 | +5VDC | From Quantum Power Supply |
| 2 | DSR | Not used |
| 3 | TX | Transmit |
| 4 | RX | Receive |
| 5 | SG | Signal Ground |
| 6 | RTS | Push to Talk Request To Send |
| 7 | CTS | CTS must be high to transmit |
| 8 | Frame Ground | |