QUCM EIM Valve Controller

Installation and Programming Manual

This Manual describes the QUCM application for interfacing EIM Valve Actuators to a Modicon Quantum PLC system.

Effective: 29 May, 2005

Niobrara Research & Development Corporation
P.O. Box 3418 Joplin, MO 64803 USA

Telephone: (800) 235-6723 or (417) 624-8918
Facsimile: (417) 624-8920
www.niobrara.com

Modicon and Quantum are trademarks of Schneider Electric.

Subject to change without notice.

Contents

Figures

Tables

1
Introduction

The Niobrara QUCM is a TSX Quantum® compatible module that is capable of running multiple applications for performing communication translations between serial protocols. This document covers an application provides a Modbus RTU serial ring network for controlling EIM valve actuators. Both serial ports of the QUCM-O are connected to a closed ring of actuators and the QUCM can determine if the ring is complete and which valves are accessible from either port of the QUCM. This network topology allows for the breaking of the network in one location and still providing control of all of the actuators.

The QUCM-O may be used in the local Quantum PLC processor rack an support up to 128 actuators. The module is configured as an NOE-771-01 in the PLC and the I/O Scanner table is used to define the actuators to be polled. The QUCM-O may also be used in a remote rack as an I/O module for communicating with up to 14 actuators. In this case the QUCM is configured by Holding registers assigned to the QUCM's slot.

The application, "qucm_redundant_app1.qcm" is compiled and loaded into Application 1 of the QUCM-O. The application includes multiple threads for simultaneously servicing both serial ports.

Both serial ports of the QUCM are be used to connect to the actuator network. The Niobrara DDC2I isolated RS-232<>RS-485 converter is recommended to connect the QUCM to the 2-wire RS-485 network. This converter provides optical isolation between the Quantum PLC and the actuator network. A Niobrara MM1 cable is needed to load the application into the QUCM.

2
Installation

QUCM Installation

Mount the QUCM in an available slot in the register rack. Secure the screw at the bottom of the module.

Serial Connections to the QUCM-OE

Port 1 to DDC2I to Valves

The serial port of the QUCM-O must be switched to RS-232. The Niobrara cable MM0 is used to connect to the DDC2I. This cable is included with the DDC2I

Standard 2-wire twisted pair cable should be used from the Green Connector on the DDC2I to the first Valve "A" port. This cable pinout is shown in Figure 2-1.

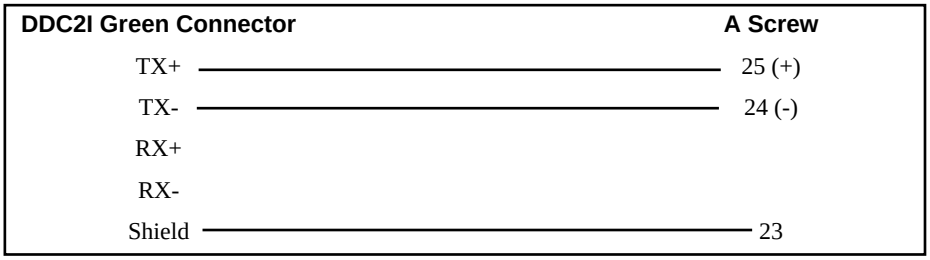

Figure 2-1 DDC2I to "A" port RS-485 2-wire cable

Port 2 to DDC2I to Valves

The serial port of the QUCM-O must be switched to RS-232. The Niobrara cable MM0 is used to connect to the DDC2I. This cable is included with the DDC2I

Standard 2-wire twisted pair cable should be used from the Green Connector on the DDC2I to the first Valve "A" port. This cable pinout is shown in Figure 2-2.

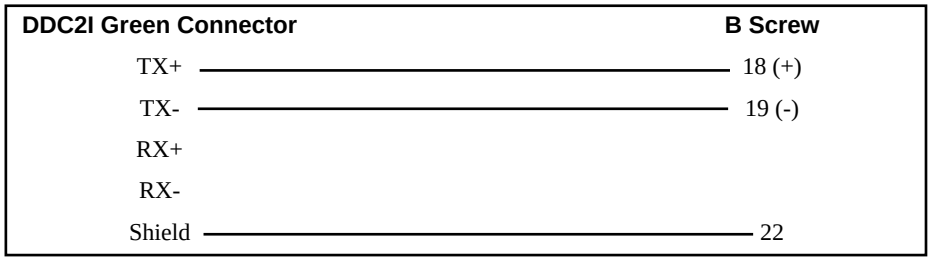

Figure 2-2 DDC2I to "B" port RS-485 2-wire cable

DDC2I DIP Switch Settings

The DDC2I DIP switches must be configured for 2-wire Slave with Termination but no Bias. Only switch 6 will be OFF. The valve will provide the bias for the 2-wire segment. The settings are the same for both DDC2Is.

Table 2-1 DDC2I DIP Switch Settings

Switch	Description	Position
1	4/2 wire	ON
2	4/2 wire	ON
3	4/2 wire	ON
4	Master/Slave	ON
5	Termination	ON
6	Bias	OFF

Valve Configuration and Wiring

The valves should be configured for "E>Net Ring". Refer to the appropriate EIM document for proper DIP switch configuration and wiring diagrams.

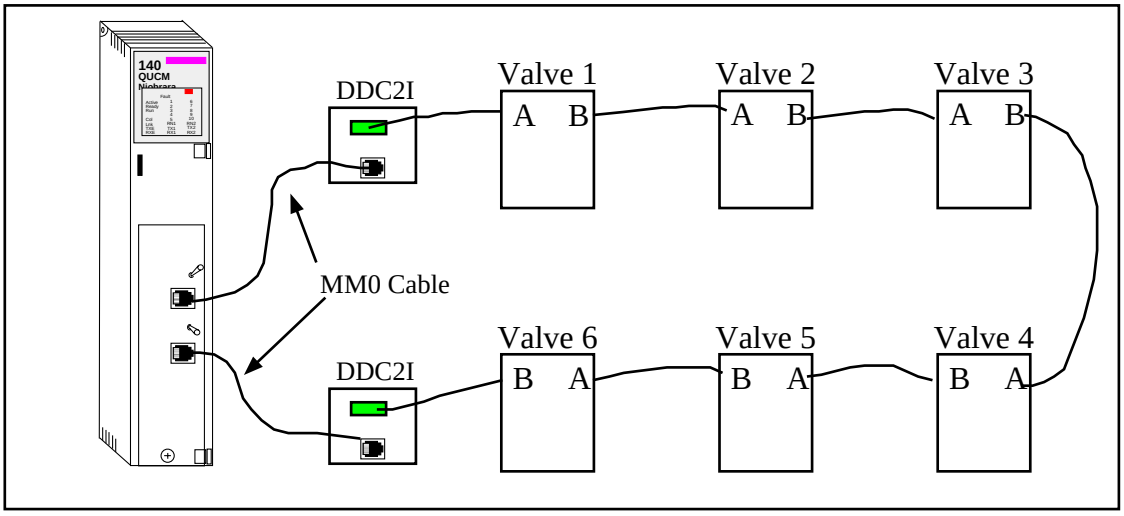

Figure 2-3 Typical E>Net Ring system setup

Port 1 to the Personal Computer

A physical connection must be made from the personal computer to the QUCM in order load the QUCM application program.. This link may be a serial connection from a COM port on the personal computer to the RS-232 port on the QUCM-O. The Niobrara MM1 cable may be used for this connection. This cable pinout is shown in Figure 2-5.

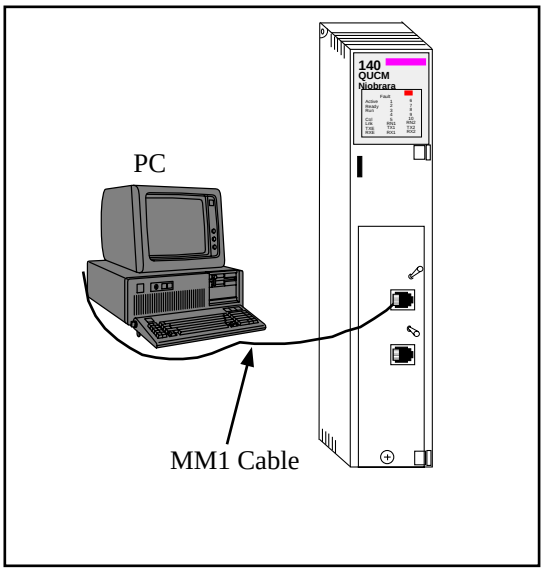

Figure 2-4 PC Connection to QUCM-O serial port

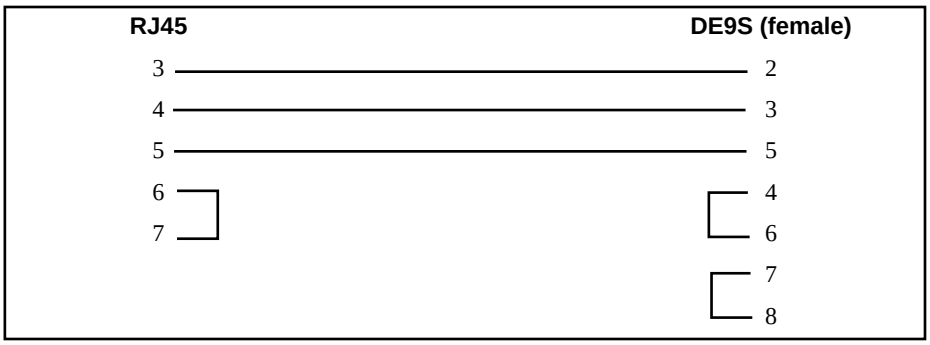

Figure 2-5 QUCM-O to RS-232 PC Port (9-pin) (MM1 Cable)

Loading the Applications into the QUCM

The QUCM-O must use the qucmtcpl.fwl firmware included in the QUCM_SETUP.EXE file. This firmware is dated 13May2005 or later.

FWLOAD QUCM Firmware Update.

Firmware upload 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. (The Link and RX E-net lights may be on if the E-net port is connected and there is traffic.)

5 Connect the PC to QUCM Port 1 with a MM1 cable.. Make sure that Port 1 is set to RS232 mode with the slide switch below the port.

6 From the Windows' Start button select:
"Start, Programs, Niobrara, QUCM, FWLOAD QUCM Firmware"
Verify that the file to load is qucmtcpl.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 2-6 FWLOAD of QUCM Firmware

QLOAD Application 1

1 Application 1 and 2 Switches must be in HALT.

2 Press "Start, Programs, Niobrara, QUCM, Apps, EIM, QLOAD EIM Application 1"

3 Verify that the file to load is qucm_eim_app1.qcc

4 Select the Modbus Serial Tab

5 Verify the proper PC's com port is selected.

6 Verify the the baud rate is 9600, 8 bits, Even parity and ASCII is NOT checked..

7 Select the Application 1 Radio Button.

8 Press the Start Download button. QLOAD will open a progress window to show the status of the download.

After downloading the application, move switch 1 to RUN and the RN1 should come on. If the QUCM is to be used in the local PLC rack with the I/O Scanner setup then make sure that the switch 2 is set for either RUN or HALT. If the QUCM is to be used in a remote or local rack as I/O then set switch 2 to MEM PROT.

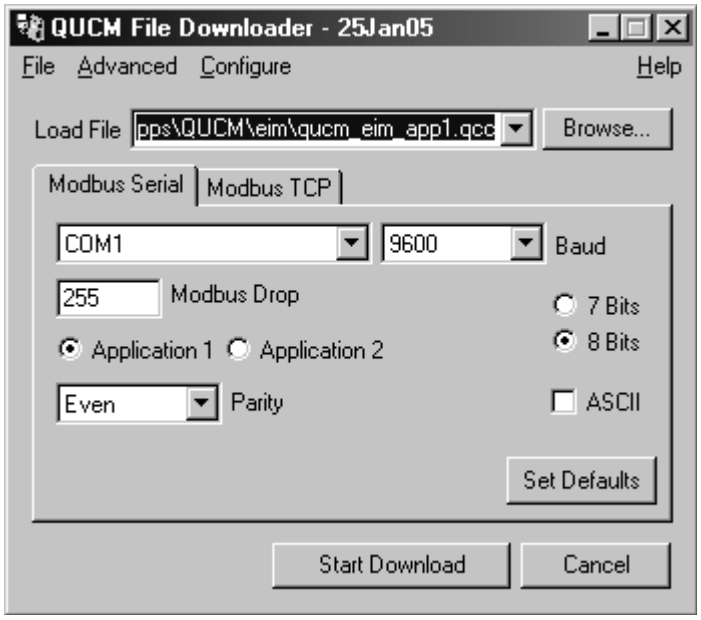

Figure 2-7 QLOAD of Application 1

PLC Configuration

PLC Local Rack Setup

The QUCM must be added in the I/O Map as an NOE-771-01. The QUCM then may have its Ethernet I/O Scanner configured.

Specify IP Address - Check this box.

IP Address - Set the IP Address of the QUCM.

Subnet Mask - Set the Subnet Mask of the QUCM.

Gateway - Set the default gateway for the QUCM.

Framing - Normally this would be set for ETHERNET II.

Health Block - This is the starting 3x register or 1x coil of the 128 bits of status for QUCM port 1. Port 2's 128 bits start immediately after Port 1.

In the example below the health block for Port 1 is in 300123-300130 and Port 2 is 300131-300138.

Diagnostic Block - This setting is ignored by the QUCM. Leave blank.

Slave IP Address - This setting is ignored by the QUCM. Leave 0.0.0.0.

Unit ID - This is the Modbus slave address of an actuator. The valid range is 1-254.

The QUCM reserves the special ID=0 for serial port configuration parameters.

Health Timeout - Ignored for normal entries.

This is the baud rate for ID=0. Valid baud rates are 1200, 2400, 4800, 9600, 19200, 38400. The default is 19200.

Rep Rate - Ignored in normal entries.

This is the serial port parity for ID=0. Valid settings are 0=NONE, 1=EVEN, 2=ODD. The default is NONE.

Read Ref Master - This is the PLC register for the read data from the valves. It may be a 0x, 1x, 3x, or 4x address. The data from valve register 400007 (see Table 2-4 for bit description) will be placed in this register while the value from valve register 400015 will be placed in this register plus 1.

This is the timeout value for ID=0. Enter the value in mS as a 4x register. For example, 400500 would provide a timeout of 500mS.

Read Ref Slave - This is the register in the valve actuator for the start of the read. This value must be 400007.

This it the retry count for ID=0. Enter the count as a 4x register. For example, 40004 would provide 4 retires before the valve is marked offline.

Read Length - This is the number of words read from the valve. This value must be 2. The QUCM looks at the Read Ref Slave and if it is 400007 and the Read Length is 2 then the QUCM actually reads a block of registers from 7 to 15 but only reports the data from 7 and 15 to the PLC.

This ignored for ID=0 but must be set to 1 for Concept.

Last Value (Input) - This can be set to zero the input if the device is offline or to hold the last data.

Ignored on ID=0.

Write Ref Master - This is the PLC location that holds the analog value for the valve. The valve range is 0-4095 where 0=closed and 4095=open.

Ignored on ID= 0.

Write Ref Slave - This is the 4x register in the valve for the analog setpoint and should be set to 400012.

Ignored on ID=0.

Table 2-2 I/O Scanner Example

X	Specify IP					IP Address		206.223.51.145		Subnet	255.255.255.0
						Gateway		206.223.51.1		Framing	Ethernet II
	Master Module (slot)		Slot 5: 140-NOE-771-01								
	Health Block		300123								
	Diagnostic Block										
	Slave IP Address	Unit ID	Health Tout	Rep Rate	Read Ref Master	Read Ref Slave	Read Len	Last Value	Write Ref Master	Write Ref Slave	Write Count
1	0.0.0.0	1	0	0	400101	40007	2	Hold	400201	400012	1
2	0.0.0.0	2	0	0	400103	40007	2	Hold	400202	400012	1
3	0.0.0.0	3	0	0	400105	40007	2	Hold	400203	400012	1
4	0.0.0.0	4	0	0	400107	40007	2	Hold	400204	400012	1
5	0.0.0.0	5	0	0	400109	40007	2	Hold	400205	400012	1
6	0.0.0.0	6	0	0	400111	40007	2	Hold	400206	400012	1
7	0.0.0.0	0	9600	1	400050	40003	1	Hold			0
8											
9											

PLC Remote Rack Setup

The QUCM is controlled by 32 4x outputs from the PLC and provides 32 3x inputs to the PLC as shown in Table 2-3.

4x0001 - This is the bitmap of the 14 possible slaves to poll. It is in 984 style where bit 1 is the msb of the word. To enable a slave to be polled simply set the slave's bit ON.

4x0002 - This is the reply timeout in mS for both ports. The valid rage is 50-5000. Any other value will set 500.

4x0003 - This is the baud rate for both ports. Valid entries are 1200, 2400, 4800, 9600, 19200, or 38400. The any other value will set 19200.

4x0004 - This value sets the parity for both ports. 0=NONE, 1=EVEN, 2=ODD. Any other value sets NONE.

4x0005 through 4x0018 - These are the setpoint values for the 14 possible valves. The PLC should load a value 0 to close the valve or up to 4095 to fully open the valve.

4x0019 through 4x0032 - These are the slave addresses for the 14 possible valves to poll. The valid range is 1-255.

Table 2-3 I/O Register Map

PLC Output	Description		PLC Input	Description
4x0001	Bitmap of slaves to poll (984 style) 1-14		3x0001	QUCM Runtime Status (normally x8000 hex)
4x0002	Reply timeout (in mS)		3x0002	QUCM Halt Register or slave being polled
4x0003	Baud Rate (1200, 2400, 4800, 9600, 19200, 38400)		3x0003	Port 1 status of slaves (984 style) bits 1-14
4x0004	Parity 0=NONE, 1=EVEN, 2=ODD		3x0004	Port 2 status of slaves (984 style) bits 1-14
4x0005	Slave 1 Register 12 (0-4095)		3x0005	Slave 1 Register 400007
4x0006	Slave 2 Register 12 (0-4095)		3x0006	Slave 1 Register 400015
4x0007	Slave 3 Register 12 (0-4095)		3x0007	Slave 2 Register 400007
4x0008	Slave 4 Register 12 (0-4095)		3x0008	Slave 2 Register 400015
4x0009	Slave 5 Register 12 (0-4095)		3x0009	Slave 3 Register 400007
4x0010	Slave 6 Register 12 (0-4095)		3x0010	Slave 3 Register 400015
4x0011	Slave 7 Register 12 (0-4095)		3x0011	Slave 4 Register 400007
4x0012	Slave 8 Register 12 (0-4095)		3x0012	Slave 4 Register 400015
4x0013	Slave 9 Register 12 (0-4095)		3x0013	Slave 5 Register 400007
4x0014	Slave 10 Register 12 (0-4095)		3x0014	Slave 5 Register 400015
4x0015	Slave 11 Register 12 (0-4095)		3x0015	Slave 6 Register 400007
4x0016	Slave 12 Register 12 (0-4095)		3x0016	Slave 6 Register 400015
4x0017	Slave 13 Register 12 (0-4095)		3x0017	Slave 7 Register 400007
4x0018	Slave 14 Register 12 (0-4095)		3x0018	Slave 7 Register 400015
4x0019	Slave 1 Modbus Address (1-255)		3x0019	Slave 8 Register 400007
4x0020	Slave 2 Modbus Address (1-255)		3x0020	Slave 8 Register 400015
4x0021	Slave 3 Modbus Address (1-255)		3x0021	Slave 9 Register 400007
4x0022	Slave 4 Modbus Address (1-255)		3x0022	Slave 9 Register 400015
4x0023	Slave 5 Modbus Address (1-255)		3x0023	Slave 10 Register 400007
4x0024	Slave 6 Modbus Address (1-255)		3x0024	Slave 10 Register 400015
4x0025	Slave 7 Modbus Address (1-255)		3x0025	Slave 11 Register 400007
4x0026	Slave 8 Modbus Address (1-255)		3x0026	Slave 11 Register 400015
4x0027	Slave 9 Modbus Address (1-255)		3x0027	Slave 12 Register 400007
4x0028	Slave 10 Modbus Address (1-255)		3x0028	Slave 12 Register 400015
4x0029	Slave 11 Modbus Address (1-255)		3x0029	Slave 13 Register 400007
4x0030	Slave 12 Modbus Address (1-255)		3x0030	Slave 13 Register 400015
4x0031	Slave 13 Modbus Address (1-255)		3x0031	Slave 14 Register 400007
4x0032	Slave 14 Modbus Address (1-255)		3x0032	Slave 14 Register 400015

3x0001 - This is the runtime status of the QUCM application. If the application is running then only bit 1 (msb) will be set. If the application halts then the reason for the halt will be displayed in this register. Consult the QUCM user manual for the meaning of the halt code.

3x0002 - This register normally shows the slave being polled and it will cycle quickly between 1 and 14. If 3x0001 shows a halt code then this register will show the QUCM source code line number for the halt.

3x0003 - This register shows the bitmap of active devices polled by QUCM port 1 in 984 style (bit 1 is msb). If Port 1 receives responses from a slave then that slave's bit will be ON.

3x0004 - This register shows the bitmap of active devices polled by QUCM port 2 in 984 style (bit 1 is msb). Normally this register is zero because Port 1 is polling all of the slaves. If Port 2 no longer sees the queries from Port 1 then it will attempt to communicate with the slaves that Port 1 can't see. When Port 2 receives replies from slaves then it will turn on the appropriate bits in 3x0004. By comparing 3x0003 and 3x0004 the user can see where a break in the loop occurs.

3x0005, 7, 9, 11, 13, 15, 17, 19, 23, 25, 27, 29, and 31 - These registers provide the value from the valve's register 4x0007. This is the bitmap of Inputs 16-31 as shown in Table 2-4 (in 984 style).

3x0006, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 32 - These registers provide the value from the valve's register 4x0015. This is the analog position of the valve in 12-bit. 0=closed. 4095=open.

Table 2-4 Valve register 7 bitmap

Valve 4x0007	Bit Description
1 (msb)	Unit alarm (all alarms OR'ed)
2	reserved for host (always 0)
3	Actuator fail alarm
4	Local ESD alarm
5	Phase monitor alarm
6	Motor overload alarm (Motor thermal)
7	Power monitor alarm
8	Valve stall alarm (valve not moving)
9	Close torque alarm (TSC)
10	Open torque alarm (TSO)
11	Selector Switch Remote/Auto
12	Selector Switch Local/Manual
13	Closing Status (valve moving close)
14	Opening Status (valve moving open)
15	Close Limit Switch (LSC)
16 (lsb)	Open Limit Switch (LSO)

3

Examples

Example 1 - I/O Scanner

Figure 3-1 shows a QUCM in the Processor Rack slot 5 with a ring of 6 valves. Each valve is set for slave address 11 through 16 and is configured for 19200 baud, NONE parity.

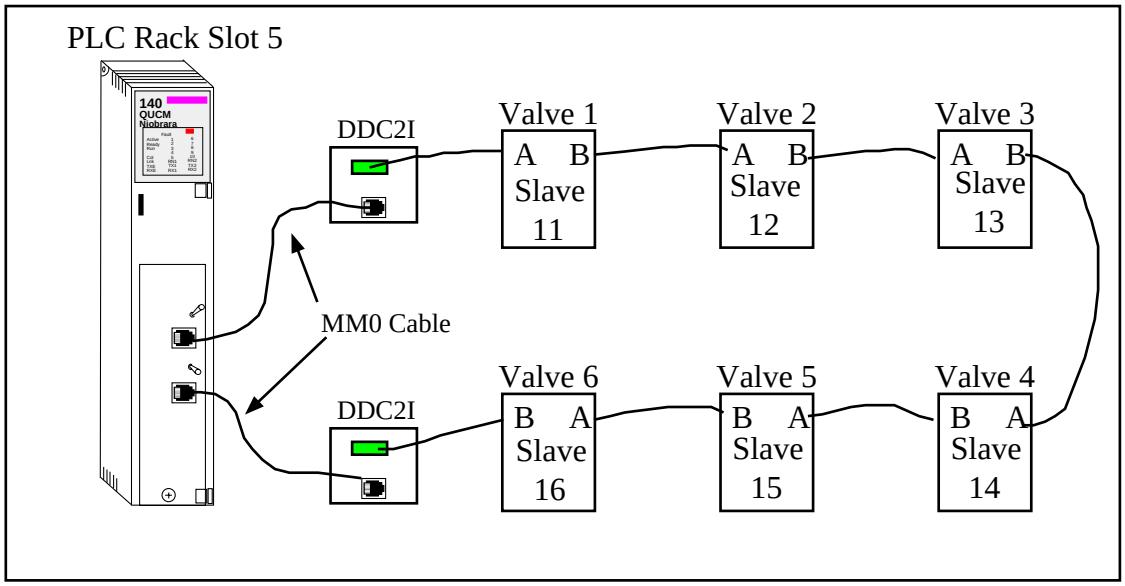

Figure 3-1 Example 1 with QUCM in PLC Processor Rack

Table shows the I/O Scanner configuration for this system. Entries 1 through 6 are the polls for the valves. Entry 7 sets the communication parameters for the QUCM. Table 3-2 gives some possible valve positions and the PLC register values that correspond to these conditions.

Table 3-1 I/O Scanner Example

X	Specify IP					IP Address		206.223.51.145		Subnet	255.255.255.0
						Gateway		206.223.51.1		Framing	Ethernet II
	Master Module (slot)		Slot 5: 140-NOE-771-01								
	Health Block		300123								
	Diagnostic Block										
	Slave IP Address	Unit ID	Health Tout	Rep Rate	Read Ref Master	Read Ref Slave	Read Len	Last Value	Write Ref Master	Write Ref Slave	Write Count
1	0.0.0.0	11	0	0	400101	40007	2	Hold	400201	400012	1
2	0.0.0.0	12	0	0	400103	40007	2	Hold	400202	400012	1
3	0.0.0.0	13	0	0	400105	40007	2	Hold	400203	400012	1
4	0.0.0.0	14	0	0	400107	40007	2	Hold	400204	400012	1
5	0.0.0.0	15	0	0	400109	40007	2	Hold	400205	400012	1
6	0.0.0.0	16	0	0	400111	40007	2	Hold	400206	400012	1
7	0.0.0.0	0	19200	0	400250	40003	1	Hold			0
8											
9											

Table 3-2 Possible Valve Status and PLC Values

Valve	Status	PLC Output Register (dec)	PLC Input Register (dec)	PLC Input Register (hex)
1 (slave 11)	Closed, No alarms	400201 = 0	400101 = 2 400102 = 0	400101 = 0002 400102 = 0000
2 (slave 12)	Open, No alarms	400202 = 4095	400103 = 1 400104 = 4095	400103 = 0001 400104 = 0FFF
3 (slave 13)	Closing, No alarms	400203 = 0	400105 = 8 400106 = 2012	400105 = 0008 400106 = 0840
4 (slave 14)	Opening, No alarms	400204 = 4095	400107 = 16 400108 = 1021	400107 = 0010 400108 = 03FD
5 (slave 15)	1/2 Opened, No alarms	400205 = 2048	400109 = 0 400110 = 2048	400109 = 0000 400110 = 0800
6 (slave 16)	Partially Opened, Stalled.	400206 = 4095	400111 = 33024 400112 = 4000	400111 = 8100 400112 = 0FA0

Table 3-3 shows the Health Status registers in the PLC when all 6 slaves are online with QUCM port 1. Table 3-4 shows the Health Status when the cable between slaves 13 and 14 is cut leaving slaves 11, 12, and 13 on QUCM port 1 and slaves 14, 15, and 16 on QUCM Port 2.

Table 3-3 Health Registers with all devices online

PLC Register	Description	Value (hex)	Value (bin)
300123	Port 1 - Slaves 1-16	FC00	1111 1100 0000 0000
300124	Port 1 - Slaves 17-32	0000	0000 0000 0000 0000
300125	Port 1 - Slaves 33-48	0000	0000 0000 0000 0000
300126	Port 1 - Slaves 49-64	0000	0000 0000 0000 0000
300127	Port 1 - Slaves 65-80	0000	0000 0000 0000 0000
300128	Port 1 - Slaves 81-96	0000	0000 0000 0000 0000
300129	Port 1 - Slaves 97-112	0000	0000 0000 0000 0000
300130	Port 1 - Slaves 113-128	0000	0000 0000 0000 0000
300131	Port 2 - Slaves 1-16	0000	0000 0000 0000 0000
300132	Port 2 - Slaves 17-32	0000	0000 0000 0000 0000
300133	Port 2 - Slaves 33-48	0000	0000 0000 0000 0000
300134	Port 2 - Slaves 49-64	0000	0000 0000 0000 0000
300135	Port 2 - Slaves 65-80	0000	0000 0000 0000 0000
300136	Port 2 - Slaves 81-96	0000	0000 0000 0000 0000
300137	Port 2 - Slaves 97-112	0000	0000 0000 0000 0000
300138	Port 2 - Slaves 113-128	0000	0000 0000 0000 0000

Table 3-4 Health Registers with Cable break between slaves 13 and 14

PLC Register	Description	Value (hex)	Value (bin)
300123	Port 1 - Slaves 1-16	E000	1110 0000 0000 0000
300124	Port 1 - Slaves 17-32	0000	0000 0000 0000 0000
300125	Port 1 - Slaves 33-48	0000	0000 0000 0000 0000
300126	Port 1 - Slaves 49-64	0000	0000 0000 0000 0000
300127	Port 1 - Slaves 65-80	0000	0000 0000 0000 0000
300128	Port 1 - Slaves 81-96	0000	0000 0000 0000 0000
300129	Port 1 - Slaves 97-112	0000	0000 0000 0000 0000
300130	Port 1 - Slaves 113-128	0000	0000 0000 0000 0000
300131	Port 2 - Slaves 1-16	1C00	0001 1100 0000 0000
300132	Port 2 - Slaves 17-32	0000	0000 0000 0000 0000
300133	Port 2 - Slaves 33-48	0000	0000 0000 0000 0000
300134	Port 2 - Slaves 49-64	0000	0000 0000 0000 0000
300135	Port 2 - Slaves 65-80	0000	0000 0000 0000 0000
300136	Port 2 - Slaves 81-96	0000	0000 0000 0000 0000
300137	Port 2 - Slaves 97-112	0000	0000 0000 0000 0000
300138	Port 2 - Slaves 113-128	0000	0000 0000 0000 0000

Example 2 - Remote Rack

Figure 3-2 shows another setup with the QUCM-O in a remote PLC rack with PLC registers 300101-300132 and 400101-400132 assigned to it. Six valves are attached with Modbus Slave addresses 21 through 26 at 9600 baud, EVEN parity.

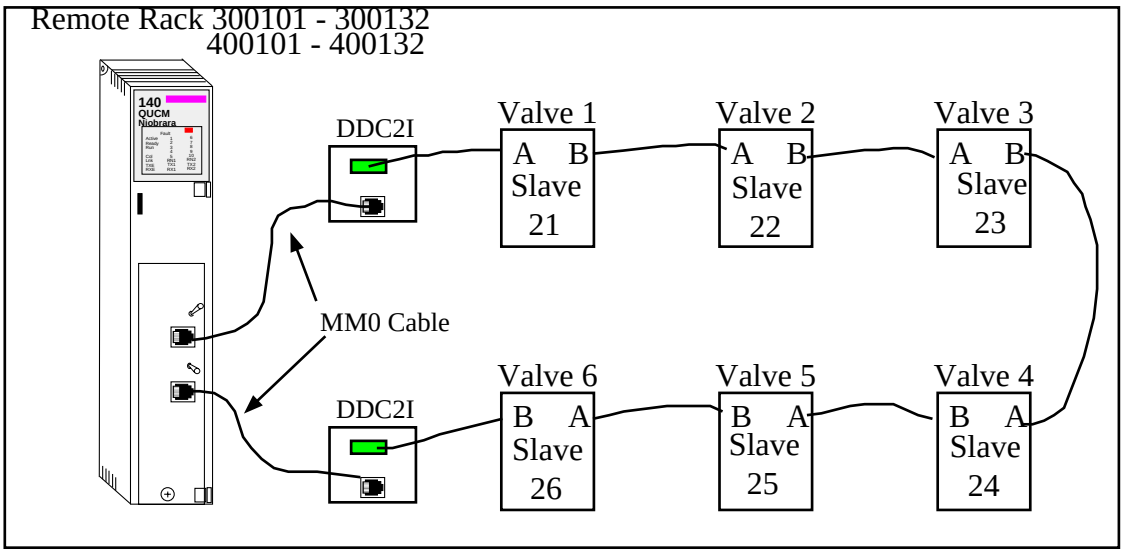

Figure 3-2 Example 1 with QUCM in Remote Rack

Table 3-5 shows the PLC register data for an online system with some valves open and closed.

Table 3-5 Example 2 I/O Register Map with all slaves online Port 1

PLC Output	Description	Value (dec)		PLC Input	Description	Value (dec)
40101	Bitmap of slaves to poll	64512		30101	QUCM Runtime Status	32768
40102	Reply timeout	500		30102	slave being polled	4
40103	Baud Rate	9600		30103	Port 1 status of slaves	64512
40104	Parity	1		30104	Port 2 status of slaves	0
40105	Slave 1 Register 12	0		30105	Slave 1 Register 400007	2
40106	Slave 2 Register 12	4095		30106	Slave 1 Register 400015	0
40107	Slave 3 Register 12	2100		30107	Slave 2 Register 400007	1
40108	Slave 4 Register 12	0		30108	Slave 2 Register 400015	4095
40109	Slave 5 Register 12	4095		30109	Slave 3 Register 400007	0
40110	Slave 6 Register 12	4095		30110	Slave 3 Register 400015	2100
40111	Not used	0		30111	Slave 4 Register 400007	2
40112	Not Used	0		30112	Slave 4 Register 400015	0
40113	Not Used	0		30113	Slave 5 Register 400007	1
40114	Not Used	0		30114	Slave 5 Register 400015	4095
40115	Not Used	0		30115	Slave 6 Register 400007	1
40116	Not Used	0		30116	Slave 6 Register 400015	4095
40117	Not Used	0		30117	Not Used	0
40118	Not Used	0		30118	Not Used	0
40119	Slave 1 Modbus Address	21		30119	Not Used	0
40120	Slave 2 Modbus Address	22		30120	Not Used	0
40121	Slave 3 Modbus Address	23		30121	Not Used	0
40122	Slave 4 Modbus Address	24		30122	Not Used	0
40123	Slave 5 Modbus Address	25		30123	Not Used	0
40124	Slave 6 Modbus Address	26		30124	Not Used	0
40125	Not Used	0		30125	Not Used	0
40126	Not Used	0		30126	Not Used	0
40127	Not Used	0		30127	Not Used	0
40128	Not Used	0		30128	Not Used	0
40129	Not Used	0		30129	Not Used	0
40130	Not Used	0		30130	Not Used	0
40131	Not Used	0		30131	Not Used	0
40132	Not Used	0		30132	Not Used	0