QUCM Limitorque Controller

Installation and Programming Manual

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

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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 Limitorque® valve actuators. Both serial ports of the QUCM-OE 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 ring network topology allows for the breaking of the network in one location and still providing control of all of the actuators.

The QUCM-OE may be used in the local Quantum PLC processor rack and support up to 127 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-OE 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 Ethernet port of the QUCM-OE provides a web server for troubleshooting of the system.

The application, "qucm_limitorque_app1.qcm" is compiled and loaded into Application 1 of the QUCM-OE. 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.

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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-OE must be switched to RS-232. The Niobrara cable MM0 is used to connect to the DDC2I. This cable is included with the DDC2I.

Limitorque wiring standard must be followed to ensure proper serial communication. Belden 3074F, 3105A, or 9841 shielded 2-wire twisted pair cable is recommended from the Green Connector on the DDC2I to the first Valve "A1" port. This cable pinout is shown in Figure 2-1.

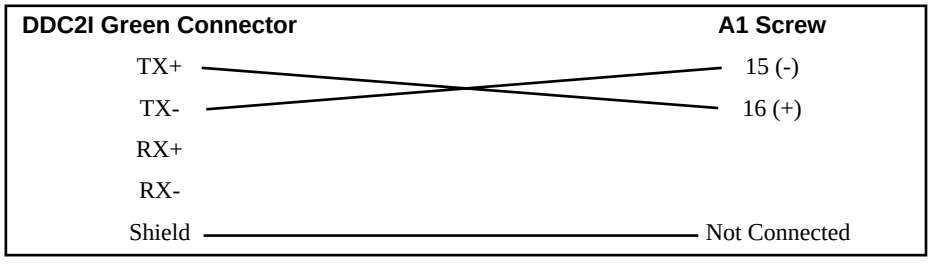


Figure 2-1 DDC2I to "A1" port RS-485 2-wire cable

Port 2 to DDC2I to Valves

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

The Limitorque wiring standard must be followed to ensure proper serial communication. Belden 3074F, 3105A, or 9841 shielded 2-wire twisted pair cable is recom-

mended from the Green Connector on the DDC2I to the first Valve "A2" port. This cable is shown in Figure 2-2.

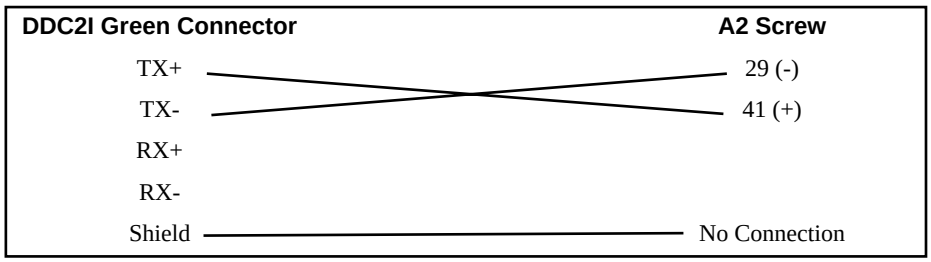


Figure 2-2 DDC2I to "A2" port RS-485 2-wire cable

DDC2I DIP Switch Settings

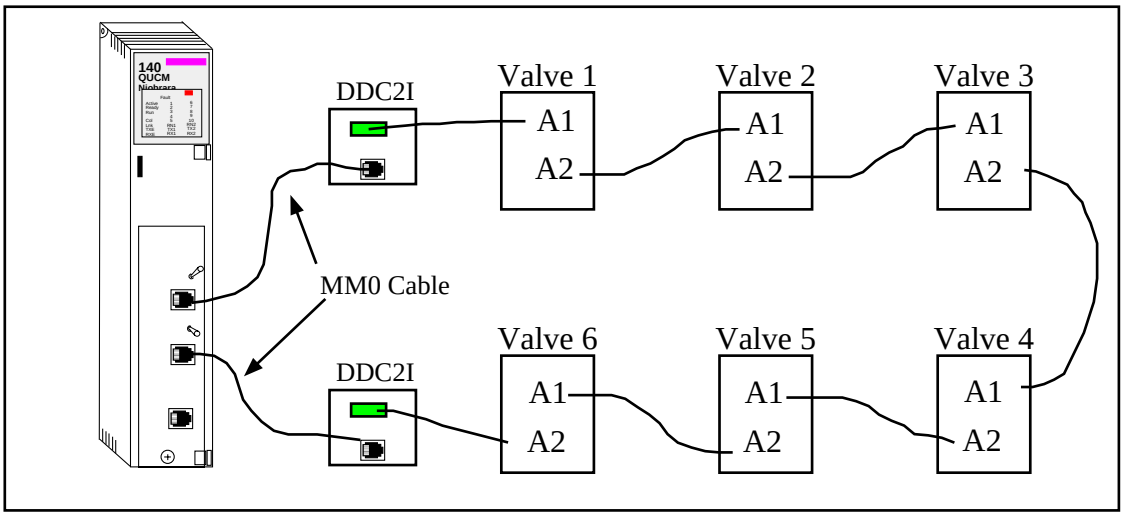
The DDC2I DIP switches must be configured for 2-wire Slave with Termination but no Bias. Only switch 6 will be OFF. The valve will provide the bias for the 2-wire segment. The settings are the same for both DDC2Is.

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

Refer to the appropriate Limitorque document for proper actuator configuration and wiring diagrams.



Typical RS-485 wiring 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-OE. The Niobrara MM1 cable may be used for this connection. This cable pinout is shown in Figure 2-4.

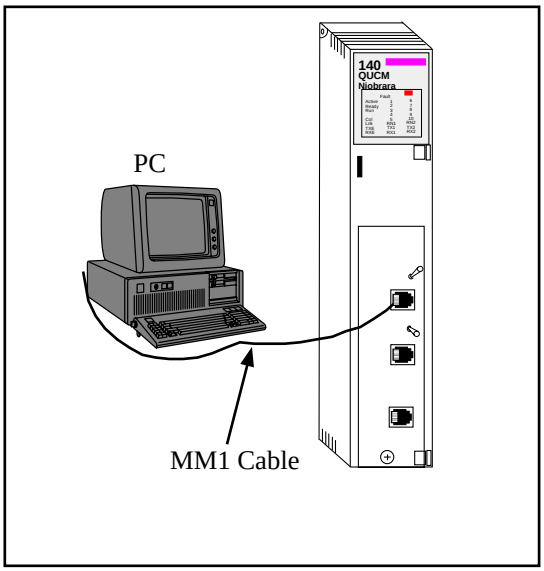


Figure 2-3 PC Connection to QUCM-O serial port

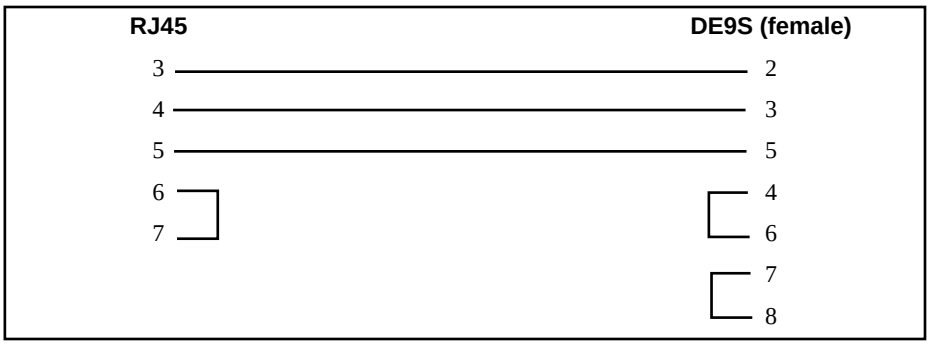


Figure 2-4 QUCM-O to RS-232 PC Port (9-pin) (MM1 Cable)

Loading the Applications into the QUCM

The QUCM-OE must use the qucmtcpl.fwl firmware included in the QUCM_SETUP.EXE file. This firmware is dated 14Nov2006 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 RS-232 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 2-5 FWLOAD of QUCM Firmware

QLOAD Application 1

1 Application 1 and 2 Switches must be in HALT.

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

3 Verify that the file to load is qucm_limitorque_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 light 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 to HALT. If the QUCM is to be used in a remote or local rack as I/O then set switch 2 to MEM PROT.

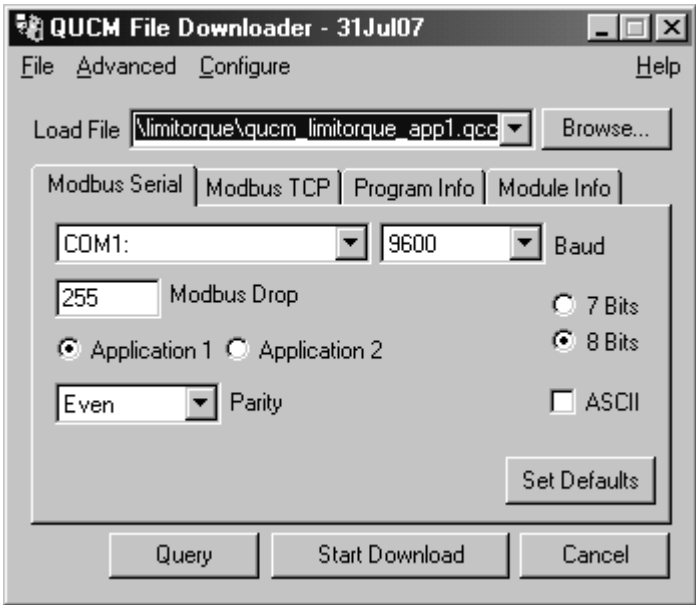


Figure 2-6 QLOAD of Application 1

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. Four additional words of data follow Port 2's bits including: the most recent valve polled, status of the QUCM, the scan time of the Primary Port in ms, and the scan time of the Secondary Port in ms. The bit-map of the QUCM Status register is shown in Table 2-2.

In the example below the health block for Port 1 is in 300123-300130 and Port 2 is 300131-300138. The most recent valve polled is in 300139. The QUCM status is in 300140. The scan times for the Primary and Secondary ports are in 300141 and 300142.

Table 2-2 QUCM Status Bit Descriptions

Bit	Description
16 (lsb)	On when Write Enable is Active in QUCM.
15	On when QUCM waiting on PLC to turn Write Enable bit off
14	On when ring broken.

Diagnostic or Device Control Block - This setting is the starting 4x register or 0x coil of the 128 bits that may be used to disable any I/O Scanner entry. Setting a corresponding bit to an I/O Scanner entry will disable the polling of that entry. Entry 1 (serial port setup parameters) is ignored by the QUCM.

Slave IP Address - This setting is ignored by the QUCM. Leave 0.0.0.0 or 1.1.1.1 if needed.

Unit ID - This is the Modbus slave address of an actuator. The valid range is 1-250.

NOTE: The QUCM reserves the special ID=0 for serial port configuration parameters. This entry must be the first entry in the I/O Scanner Table.

Health Timeout - Ignored for normal entries.

This is the serial port timeout value in milliseconds for ID=0. The valid range is 50<=timeout<=2000. Values outside this range result in a 500mS timeout.

Rep Rate - Ignored in normal entries.

This is the baud rate for ID=0. Valid baud rates are 1200, 2400, 4800, 9600, 19200, or 38400. Any other value results in a baud rate of 9600.

Read Ref Master (**Read To**) - 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 400005 will be placed in this register with the values from valve registers 400006 through 400012 in the following 7 plc registers.

This value is the PLC Write Enable Register for ID=0. The PLC must clear and then set the least significant bit in this register to allow the QUCM to send writes to the valves.

Read Ref Slave (**Read From**) - This is the register in the valve actuator for the start of the read. This value is normally 400008.

This it the parity for the serial port for ID=0. A register number of 400001 indicates parity = NONE, 400002 = EVEN, 400003 = ODD. In Unity, the values are 0, 1, and 2.

Read Length - This is the number of words read from the valve. This value is normally 7. 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 is the maximum retry count for ID=0. If the maximum retry count is greater than 10 then it is set to a value of 3.

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 0-100 where 0=closed and 100=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 400008. The valid command values are shown in Table 2-4.

Ignored on ID=0.

Write Count - This is the number of registers writing to the valve for the analog setpoint and should be set to 1.

Ignored on ID=0.

Table 2-3 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	1.1.1.1	0	500	9600	400400	40001	3	Hold	400001	400001	0
2	1.1.1.1	1	0	0	400002	40008	7	Hold	400101	400001	1
3	1.1.1.1	2	0	0	400009	40008	7	Hold	400102	400001	1
4	1.1.1.1	3	0	0	400016	40008	7	Hold	400103	400001	1
5	1.1.1.1	4	0	0	400023	40008	7	Hold	400104	400001	1
6	1.1.1.1	5	0	0	400030	40008	7	Hold	400105	400001	1
7	1.1.1.1	6	0	0	400038	40008	7	Hold	400106	400001	1
8											0

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 2-5.

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. Bit 1 = slave 1, bit 2= slave 2, etc. The least significant bit (bit 16) of this word is the PLC write enable bit. This bit must be toggled to 0 when 3x0001.15 is ON and then to 1 and left on when 3x0001.16 is ON to allow the QUCM to write to the slaves.

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 9600.

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 valid command values are shown in Table 2-4.

Table 2-4 Valve Commands

Command Values (decimal)	Description
0	Null Command (no action
256	Open
512	Stop
768	Close
1024	Reset processor
1280	Start Network ESD
1536	Stop Network ESD
19200-19300	Move-To % Open position (19200=0%Closed, 19300=100% Open)

4x0019 through 4x0032 - These are the slave addresses for the 14 possible valves to poll. The valid range is 1-250.

Table 2-5 I/O Register Map

PLC Output	Description		PLC Input	Description
4x0001	Bitmap of slaves to poll (984 style) 1-16		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 13-0
4x0004	Parity 0=NONE, 1=EVEN, 2=ODD		3x0004	Port 2 status of slaves (984 style) bits 13-0
4x0005	Slave 1 Setpoint (Register 1)		3x0005	Slave 1 Position (Register 8)
4x0006	Slave 2 Setpoint (Register 1)		3x0006	Slave 1 Status (Register 9)
4x0007	Slave 3 Setpoint (Register 1)		3x0007	Slave 2 Position (Register 8)
4x0008	Slave 4 Setpoint (Register 1)		3x0008	Slave 2 Status (Register 9)
4x0009	Slave 5 Setpoint (Register 1)		3x0009	Slave 3 Position (Register 8)
4x0010	Slave 6 Setpoint (Register 1)		3x0010	Slave 3 Status (Register 9)
4x0011	Slave 7 Setpoint (Register 1)		3x0011	Slave 4 Position (Register 8)
4x0012	Slave 8 Setpoint (Register 1)		3x0012	Slave 4 Status (Register 9)
4x0013	Slave 9 Setpoint (Register 1)		3x0013	Slave 5 Position (Register 8)
4x0014	Slave 10 Setpoint (Register 1)		3x0014	Slave 5 Status (Register 9)
4x0015	Slave 11 Setpoint (Register 1)		3x0015	Slave 6 Position (Register 8)
4x0016	Slave 12 Setpoint (Register 1)		3x0016	Slave 6 Status (Register 9)
4x0017	Slave 13 Setpoint (Register 1)		3x0017	Slave 7 Position (Register 8)
4x0018	Slave 14 Setpoint (Register 1)		3x0018	Slave 7 Status (Register 9)
4x0019	Slave 1 Modbus Address (1-250)		3x0019	Slave 8 Position (Register 8)
4x0020	Slave 2 Modbus Address (1-250)		3x0020	Slave 8 Status (Register 9)
4x0021	Slave 3 Modbus Address (1-250)		3x0021	Slave 9 Position (Register 8)
4x0022	Slave 4 Modbus Address (1-250)		3x0022	Slave 9 Status (Register 9)
4x0023	Slave 5 Modbus Address (1-250)		3x0023	Slave 10 Position (Register 8)
4x0024	Slave 6 Modbus Address (1-250)		3x0024	Slave 10 Status (Register 9)
4x0025	Slave 7 Modbus Address (1-250)		3x0025	Slave 11 Position (Register 8)
4x0026	Slave 8 Modbus Address (1-250)		3x0026	Slave 11 Status (Register 9)
4x0027	Slave 9 Modbus Address (1-250)		3x0027	Slave 12 Position (Register 8)
4x0028	Slave 10 Modbus Address (1-250)		3x0028	Slave 12 Status (Register 9)
4x0029	Slave 11 Modbus Address (1-250)		3x0029	Slave 13 Position (Register 8)
4x0030	Slave 12 Modbus Address (1-250)		3x0030	Slave 13 Status (Register 9)
4x0031	Slave 13 Modbus Address (1-250)		3x0031	Slave 14 Position (Register 8)
4x0032	Slave 14 Modbus Address (1-250)		3x0032	Slave 14 Status (Register 9)

3x0001 - This is the runtime status of the QUCM application. If the application is running then 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. Bit 16 is cleared and Bit 15 is set when the QUCM is booted to indicate to the PLC that the QUCM is not allowing writes to the valves. When bit 15 is set, the PLC must clear bit 16 of 4x register 1. When the QUCM sees bit 16 cleared from the PLC then it will clear bit 15 and set bit 16. The PLC

must then set bit 16. Writes are enabled by the QUCM when both QUCM bit 16 and PLC bit 16 are both set ON.

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). 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 4x00008. This is the analog position feedback for the actuator and is scaled from 0 (closed) to 100 (open).

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 4x00009. The meanings of this bit-mapped status register are shown in Table 2-6.

Table 2-6 Valve register 9 bitmap

Valve 4x0007	Bit Description
0 (lsb)	Valve fully OPEN
1	Valve full CLOSE
2	Stopped in Mid-Travel
3	Opening
4	Closing
5	Valve Jammed
6	NOT in remote
7	Combined Fault
8	Thermal Overload Fault
9	Future Implementation
10	Channel A Fail
11	Channel B Fail
12	Open Torque Switch Fault
13	Close Torque Switch Fault
14	Valve Manually Moved
15 (msb)	Phase Error

4

Operation

This application allows for two different types of PLC interaction from the QUCM. I/O Scanner (Option Mode) operation is used when the QUCM is located in the PLC rack and switch 2 is set to HALT. I/O Mode is used when the QUCM is located in a Remote Rack and the card is treated as a QUCM I/O card with 32 words in and out. Switch 2 is in MEM PROT for I/O mode operation.

The QUCMpolling scheme is identical for both configurations. The QUCM gathers a list of attached valves from the PLC and attempts to communicate with each of these valves. The network of valves is arranged to form a closed ring from QUCM port 1 back to port 2.

Complete Ring Operation

The normal polling with a complete network ring consists of one of the QUCM ports acting as the Primary while the other acts as the Secondary. The Primary port steps through the list of attached valves and tries to communicate with each of these valves in order. The valves are designed with two serial ports: A1 and A2. Messages received on one port are repeated out the second port. Replies generated by a given valve are transmitted out both of its ports. The result is that every message sent by the QUCM Primary port is received by the Secondary port and every message sent by a valve is received by both ports of the QUCM. The QUCM can instantly determine if the ring is complete because the Secondary port should always hear the messages from the Primary as well as replies from the valves.

To guarantee that both ports of the QUCM are fully operational, the QUCM switches Primary and Secondary on every scan through the list of slaves. LEDs 1 and 2 give a visual indication of which port is primary at any given time.

Non-responding Valve - Complete Ring

When the Primary port of the QUCMfails to receive a reply from a valve yet the Secondary port heard the Primary request then the QUCM knows that the ring is still complete but the target valve may just be offline. If the target valve was online during

the last scan then the Primary port will attempt to communicate with this valve until the maximum number of retries is exhausted (usually set to 3 attempts). If the valve was offline on the last attempt then the Primary port does not retry and proceeds to the next valve in the polling list.

Incomplete Ring

When the Primary port sends a message and the Secondary port does not receive this message or the valve reply then the ring is broken. The Primary port continues on its normal retry procedure and will start marking valves offline if they do not reply. As valves are marked offline, the Secondary port starts polling these offline valves to see if it can communicate with them. As the Secondary port receives replies from valves it can reach, it will mark them online and the Primary port will stop trying to poll these valves. If at any time either the Primary or Secondary ports hear commands from the other port then the ring is now complete and normal polling is resumed.

I/O Scanner Operation

The QUCM switch 2 is set to HALT and its slot in the PLC is configured as an NOE-771-01. The I/O Scanner table in the PLC is used to configure the QUCM for its IP Address, serial port settings, and list of valves to poll. The normal poll is an 8 register read from remote register 9 in the valve. These registers are shown in Table 4-1. (See the Limitorque documentation for more information about these registers.)

Table 4-1 Valve Status Regsiters

Valve Regsiter	Description
8	Scaled Valve Position (0-100) 0=Closed, 100=Open
9	Status Register (See Table 2-6)
10	Fault Register
11	Digital Outputs
12	Digital Inputs 1
13	Digital Inputs 2
14	Timers and Analog Channels
15	User Faults

Writes to the valves are only allowed after a handshake with the PLC is completed. This handshake through the Write Enable Register (Read To Register in I/O Scanner ID=0 entry) in the PLC and the QUCM Status Register (second register after the end of Port 2 128 bits of status). When the QUCM boots, it clears QUCM Status Regsiter bit 16 (lsb) and sets bit 15. When the PLC sees bit 15 on then it clears bit 16 (lsb) of its Wriet Enable Reigster. When the QUCM sees bit 16 of the WER cleared then it clears Status bit 15 and sets bit 16. When the PLC sees bit 16 of the QUCM Status ON then it sets bit 16 of the WER. Writes are enabled by the QUCM when both the QUCM Status bit 16 and the WER bit 16 are on. At this point the QUCM will send a write to each valve forcing the setpoint to the value provided by the PLC. After the initial setpoints are written, the QUCM will only send writes to individual valves on a change of state of the setpoint in the PLC.

The Diagnostic or Device Control Block group of registers in the PLC may be used to disable individual I/O Scan entries. The bit numbering for these 8 words is the same as the health status bits. Setting a bit disables the corresponding entry. The bit for I/O Scanner Entry 1 (serial port setup) is ignored by the QUCM.

Example 1 - I/O Scanner

Figure 4-1 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.

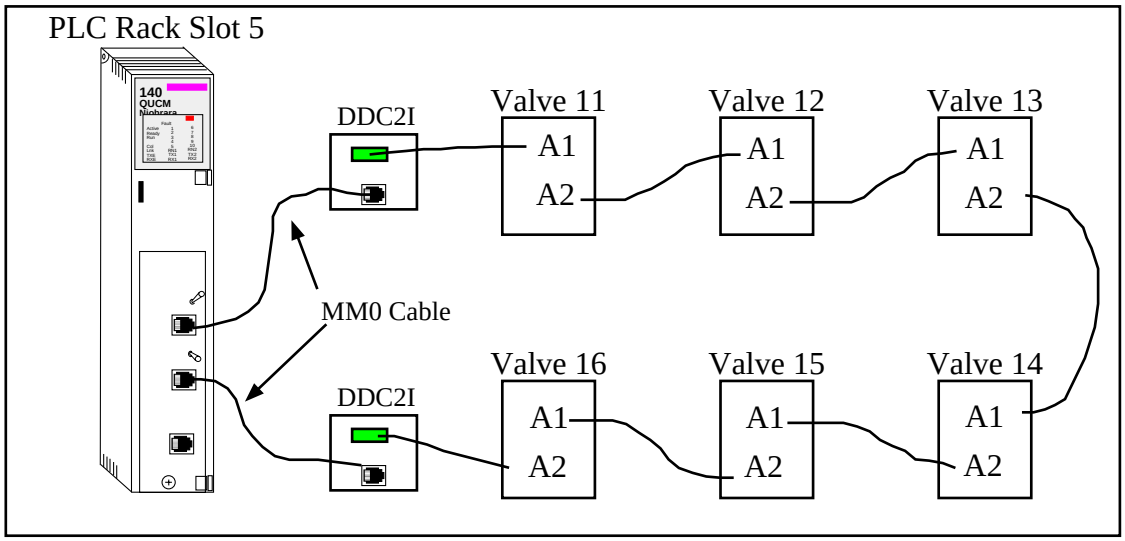


Figure 4-1 Example 1 with QUCM in PLC Processor Rack

Table 4-1 shows the I/O Scanner configuration for this system. Entries 2 through 7 are the polls for the valves. Entry 1 sets the communication parameters for the QUCM. Table 4-3 gives some possible valve positions and the PLC register values that correspond to these conditions.

Table 4-2 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	1.1.1.1	0	500	19200	400001	40400	3	Hold			
2	1.1.1.1	11	0	0	400101	40008	7	Hold	400201	400001	1
3	1.1.1.1	12	0	0	400109	40008	7	Hold	400202	400001	1
4	1.1.1.1	13	0	0	400116	40008	7	Hold	400203	400001	1
5	1.1.1.1	14	0	0	400123	40008	7	Hold	400204	400001	1
6	1.1.1.1	15	0	0	400130	40008	7	Hold	400205	400001	1
7	1.1.1.1	16	0	0	400137	40008	7	Hold	400206	400001	1

Table 4-3 Possible Valve Status and PLC Values

Valve	Status	PLC Output Register (dec)	PLC Input Register (dec)	PLC Input Register (hex)
2 (slave 11)	Closed, No alarms	400201 = 768	400101 = 0 400102 = 2	400101 = 0000 400102 = 0002
3 (slave 12)	Open, No alarms	400202 = 256	400103 = 100 400104 = 1	400103 = 400104 = 0001
4 (slave 13)	Closing, No alarms	400203 = 512	400105 = 45 400106 = 16	400105 = 400106 = 0010
5 (slave 14)	Opening, No alarms	400204 = 256	400107 = 16 400108 = 8	400107 = 0010 400108 = 0008
6 (slave 15)	1/2 Opened, No alarms	400205 = 19250	400109 = 50 400110 = 4	400109 = 0032 400110 = 0004
7 (slave 16)	Partially Opened, Valve Jammed.	400206 = 256	400111 = 83 400112 = 32	400111 = 0053 400112 = 0020

Table 4-4 shows the Health Status registers in the PLC when all 6 slaves are online with QUCM port 1. Table 4-5 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 4-4 Health Registers with all devices online

PLC Register	Description	Value (hex)	Value (bin)
300123	Port 1 - Entries 1-16	FE00	1111 1110 0000 0000
300124	Port 1 - Entries 17-32	0000	0000 0000 0000 0000
300125	Port 1 - Entries 33-48	0000	0000 0000 0000 0000
300126	Port 1 - Entries 49-64	0000	0000 0000 0000 0000
300127	Port 1 - Entries 65-80	0000	0000 0000 0000 0000
300128	Port 1 - Entries 81-96	0000	0000 0000 0000 0000
300129	Port 1 - Entries 97-112	0000	0000 0000 0000 0000
300130	Port 1 - Entries 113-128	0000	0000 0000 0000 0000
300131	Port 2 - Entries 1-16	FE00	1111 1110 0000 0000
300132	Port 2 - Entries 17-32	0000	0000 0000 0000 0000
300133	Port 2 - Entries 33-48	0000	0000 0000 0000 0000
300134	Port 2 - Entries 49-64	0000	0000 0000 0000 0000
300135	Port 2 - Entries 65-80	0000	0000 0000 0000 0000
300136	Port 2 - Entries 81-96	0000	0000 0000 0000 0000
300137	Port 2 - Entries 97-112	0000	0000 0000 0000 0000
300138	Port 2 - Entries 113-128	0000	0000 0000 0000 0000
300139	Most Recently Polled Entry	0003	
300140	QUCM Status	0001	
300141	Primary Port Scan Time	028E	
300142	Secondary Port Scan Time	0029	

Table 4-5 Health Registers with Cable break between slaves 13 and 14

PLC Register	Description	Value (hex)	Value (bin)
300123	Port 1 - Entries 1-16	F000	1111 0000 0000 0000
300124	Port 1 - Entries 17-32	0000	0000 0000 0000 0000
300125	Port 1 - Entries 33-48	0000	0000 0000 0000 0000
300126	Port 1 - Entries 49-64	0000	0000 0000 0000 0000
300127	Port 1 - Entries 65-80	0000	0000 0000 0000 0000
300128	Port 1 - Entries 81-96	0000	0000 0000 0000 0000
300129	Port 1 - Entries 97-112	0000	0000 0000 0000 0000
300130	Port 1 - Entries 113-128	0000	0000 0000 0000 0000
300131	Port 2 - Entries 1-16	8E00	1000 1110 0000 0000
300132	Port 2 - Entries 17-32	0000	0000 0000 0000 0000
300133	Port 2 - Entries 33-48	0000	0000 0000 0000 0000
300134	Port 2 - Entries 49-64	0000	0000 0000 0000 0000
300135	Port 2 - Entries 65-80	0000	0000 0000 0000 0000
300136	Port 2 - Entries 81-96	0000	0000 0000 0000 0000
300137	Port 2 - Entries 97-112	0000	0000 0000 0000 0000
300138	Port 2 - Entries 113-128	0000	0000 0000 0000 0000
300139	Most Recently Polled Entry	0003	
300140	QUCM Status	0005	
300141	Primary Port Scan Time	028E	
300142	Secondary Port Scan Time	0029	

Remote Rack I/O Operation

Switch 2 on the QUCM in MEM PROT sets the application to I/O backplane mode for operation in a Quantum Remote Rack. The PLC traffic cop must be configured for QUCM operation with 32 words in and 32 words out. The serial polling operation in I/O mode is the same as I/O Scanner mode. The difference to the PLC is that only 14 slaves may be configured and only data from registers 8 and 9 in the valves is presented.

The PLC Write Enable handshake occurs between QUCM 4x0001.16 and 3x0001.15 and 3x0001.16. The QUCM will set 3x0001.15 when booted. When this bit is high, the PLC should lower 4x0001.16. As 4x0001.16 is lowered, the QUCM will clear bit 15 and set bit 16. This should cause the PLC to set bit 16 and then all writes are enabled.

QUCM 3x0001.14 is the ring broken bit.

Example 2 - Remote Rack

Figure 4-2 shows another setup with the QUCM-OE 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, NONE parity.

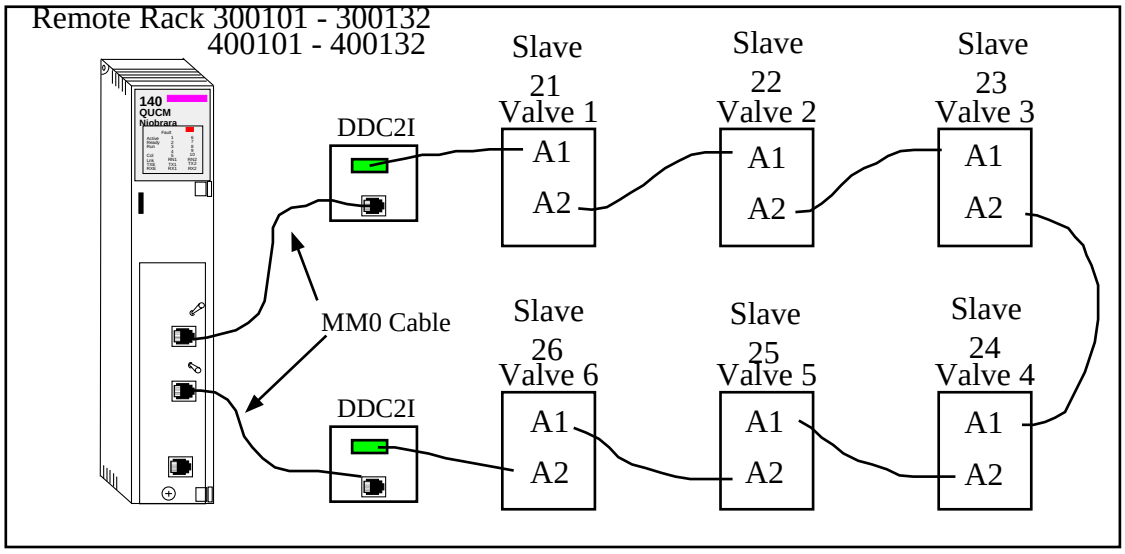


Figure 4-2 Example 1 with QUCM in Remote Rack

Table 4-6 shows the PLC register data for an online system with some valves open and closed.

Table 4-6 Example 2 I/O Register Map with all slaves online

PLC Output	Description	Value (dec)		PLC Input	Description	Value (dec)
40101	Bitmap of slaves to poll	64513		30101	QUCM Runtime Status	32773
40102	Reply timeout	500		30102	slave being polled	4
40103	Baud Rate	9600		30103	Port 1 status of slaves	64512
40104	Parity	0		30104	Port 2 status of slaves	64512
40105	Slave 1 Register 1	768		30105	Slave 1 Register 400008	2
40106	Slave 2 Register 1	267		30106	Slave 1 Register 400009	0
40107	Slave 3 Register 1	19265		30107	Slave 2 Register 400008	1
40108	Slave 4 Register 1	768		30108	Slave 2 Register 400009	100
40109	Slave 5 Register 1	256		30109	Slave 3 Register 400008	4
40110	Slave 6 Register 1	256		30110	Slave 3 Register 400009	65
40111	Not used	0		30111	Slave 4 Register 400008	0
40112	Not Used	0		30112	Slave 4 Register 400009	2
40113	Not Used	0		30113	Slave 5 Register 400008	100
40114	Not Used	0		30114	Slave 5 Register 400009	1
40115	Not Used	0		30115	Slave 6 Register 400008	100
40116	Not Used	0		30116	Slave 6 Register 400009	1
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

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Troubleshooting

LED Descriptions

There are 10 numberd LEDs at the top of the QUCM which are used to give diagnostic information concerning this application.

- LED 1 - Port 1 Primary - This light is on when QUCM port 1 is the primary polling port with port 2 acting as the secondary port.
- LED 2 - Port 2 Primary - This light is on when QUCM port 2 is the primary polling port and port 1 is the secondary port.
- LED 3 - Secondary Port Polling - This light is on when the secondary port is actively polling. This usually means that the ring is broken.
- LED 4 - Ring Broken - This light is on when the QUCM determines that the ring is broken.
- LED 5 - Writes Enabled - This light is on when the QUCM is enabled to send writes to the valves. The handshaking of th ewrite enable bits must be completed by the PLC before the QUCM is allowed to write data to the valves.
- LED 6 - Valve Moving - This light is on when at least one valve is moving. The QUCM sends additional polling messages to moving valves to give the PLC a more precise indication of the valve position. This additional polling lengthens the loop polling times.
- LED 7 - QUCM Waiting on PLC Rack Comms - This light is on while the QUCM is waiting on proper communication to occur with the PLC through the backplane.
- LED 8 - Reading PLC Configuration - This light is on while the QUCM is gathering its configuration from the PLC.
- LED 9 - Valid Configuration - This light is on when the QUCM has a valid configuration from the PLC. It flashes slowly if the configuration is faulty.

- LED 10 - QUCM in Option Mode - Switch 2 must be in Halt for this light to be on. It indicates that the QUCM is emulating an NOE-771-01 and the QUCM must be in the local PLC rack its configuration comes from the I/O Scanner Config Extension for its slot.

Web Server

This application includes a built-in Web server when running in a QUCM-OE. Simply point a Web browser (such as IE or FireFox) to the QUCM's IP Address. Multiple pages of QUCM configuration, PLC setup data, statistics, and help information may be viewed.

Telnet Server

A debugging Telnet server is included in this application. This server listens on TCP port 23 and may be used to provide information to Niobrara engineers. This server should only be used for temporary testing purposes only as it greatly impacts the normal scan time of polling the valves.

Modbus/TCP Server

A Modbus/TCP server is included in this application. Up to 3 simultaneous Modbus/TCP connections may be used at the same time. This server listens on TCP port 502. The Modbus Index (Slave Address) of a message sent to this server is used to determine exactly which device data is presented.

Table 5-1 Modbus/TCP Index List

Index	Target
0	PLC if the QUCM is in Option Backplane Mode (I/O Scanner)
1 through 14	Slave #1 through #14 if the QUCM is in I/O backplane mode.
2 through 128	Slave #2 through #128 if the QUCM is in Option Backplane Mode.
255	The QUCM itself.

It is highly recommended that the QUCM's internal Modbus/TCP server TCP port be set to 503. This will prevent interferrence between the application's Modbus/TCP server and the QUCM's operating system's server.