DUCM TCP MUX

Installation and Programming Manual

This manual describes the DUCM application for interfacing a number of TCP masters with devices that can only have a single master device. Currently supporting Modbus and ION protocols over TCP/IP.

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1 Introduction

The Niobrara DUCM is a Din Rail Mount compatible module that is capable of running an application for performing communication translations between serial and Ethernet protocols. This document covers an application that allows a number of TCP masters to interface with devices that can only have a single master device.

Through a user created routing table the application will take all messages received from the TCP masters and act as the master to all downstream devices. This application currently supports the Modbus and ION protocols over TCP/IP.

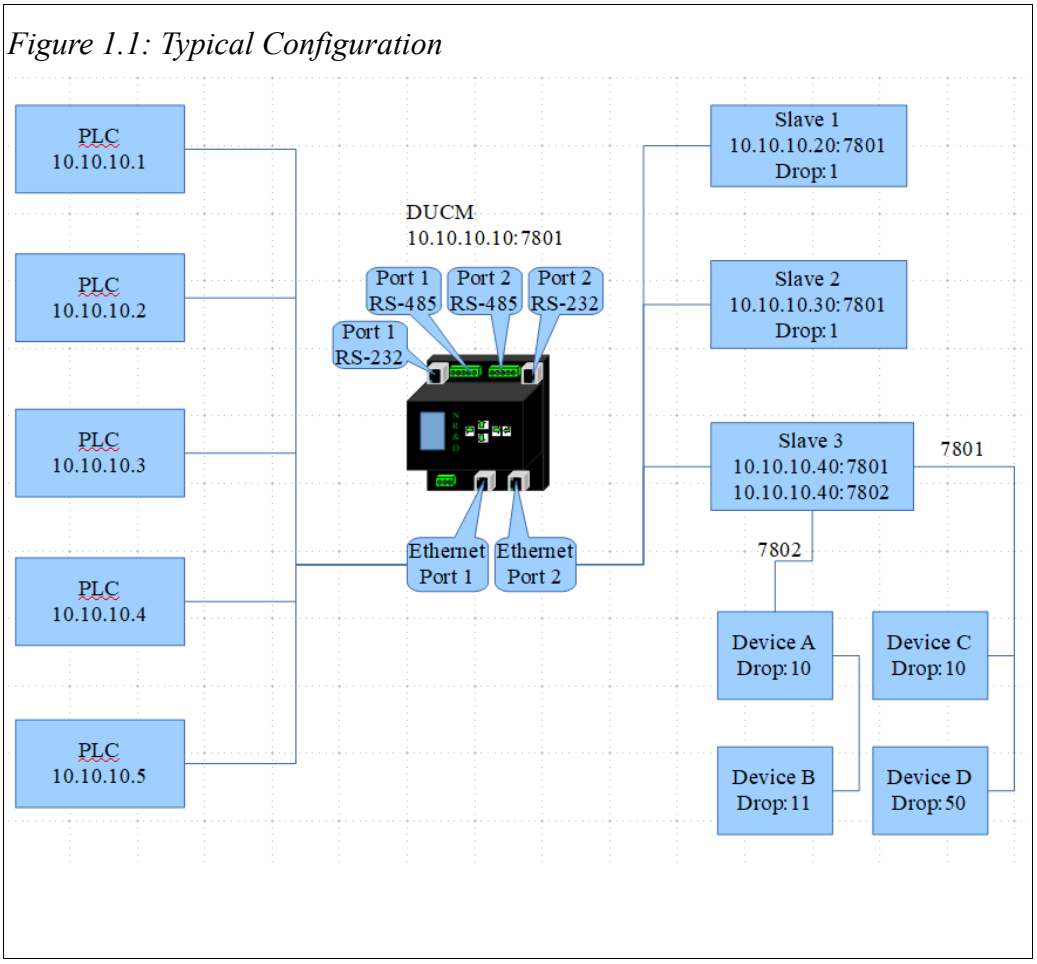
The Ethernet ports on the DUCM can be used to connect to it to a network and accessed over that.

The DUCM requires 24 VDC power supply and needs a minimum 6W.

When ordered as the kit contains:

- DUCM - Preloaded with TCP MUX application
- TR121ST - 110 VAC wall transformer for DUCM (no connector)

Figure 1.1: Typical Configuration



2 Installation

Installation of the DUCM should go quickly, with the necessary materials. The following items are necessary:

- DUCM +102
- Power source for DUCM (use NR&D part TR121ST or available power)
- Cabling between DUCM and Ethernet network may be built or purchased

The following may be used:

- DIN rail for mounting

Module Installation

1. Mount the DUCM on a DIN rail. The DIN rail should be Earth-grounded for the DUCM serial ports' transient suppression.
2. Supply power to the DUCM; The supplied NR&D's TR121ST may be used, or any available power source of minimum 6W 9-30 Volts DC.

DUCM Application Configuration

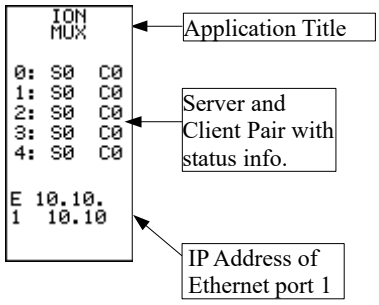
Connect the DUCM to the Ethernet network. The default settings for the DUCM are shown in Table 2.1.

Table 2.1: DUCM Default Application Settings

Application Mode (TCP)
ION (Default)
Modbus

These settings may be modified by using the front panel and LCD screen on the DUCM. When the application starts it defaults to acting as an ION MUX. The front panel screen displays information about the status of the program state for the DUCM.

Figure 2.1: Splash screen



To set up port parameters use the up, down, right, and enter keys to select Menu, Config, UCM, Serial, Port # then select the Mode, Slave address, Baud rate, Parity, Data bits from the lists to match the settings of the Modbus master.

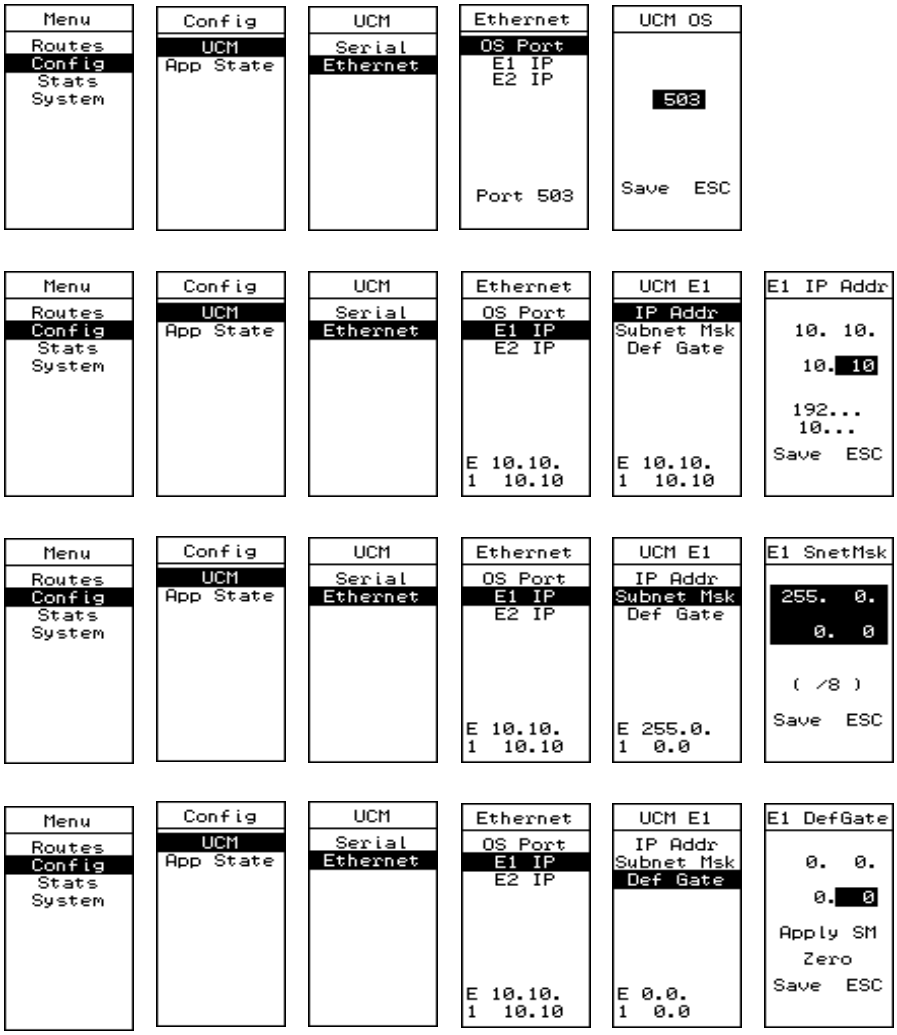
The default settings of the DUCM Ethernet ports are shown below.

Table 2.2: DUCM Default Ethernet Port Settings

Setting	Port 1	Port 2
IP Address	10.10.10.10	10.10.10.11
Subnet Mask	255.0.0.0	255.0.0.0
Default Gateway	0.0.0.0	0.0.0.0

To set up port parameters use the up, down, right, and enter keys to select Menu, Config, UCM, Ethernet, E# IP then select the IP Addr, Subnet Msk, Def Gate from the lists to match the desired settings. The default port number for the Operating System is 503, while the port number for the application itself is 502.

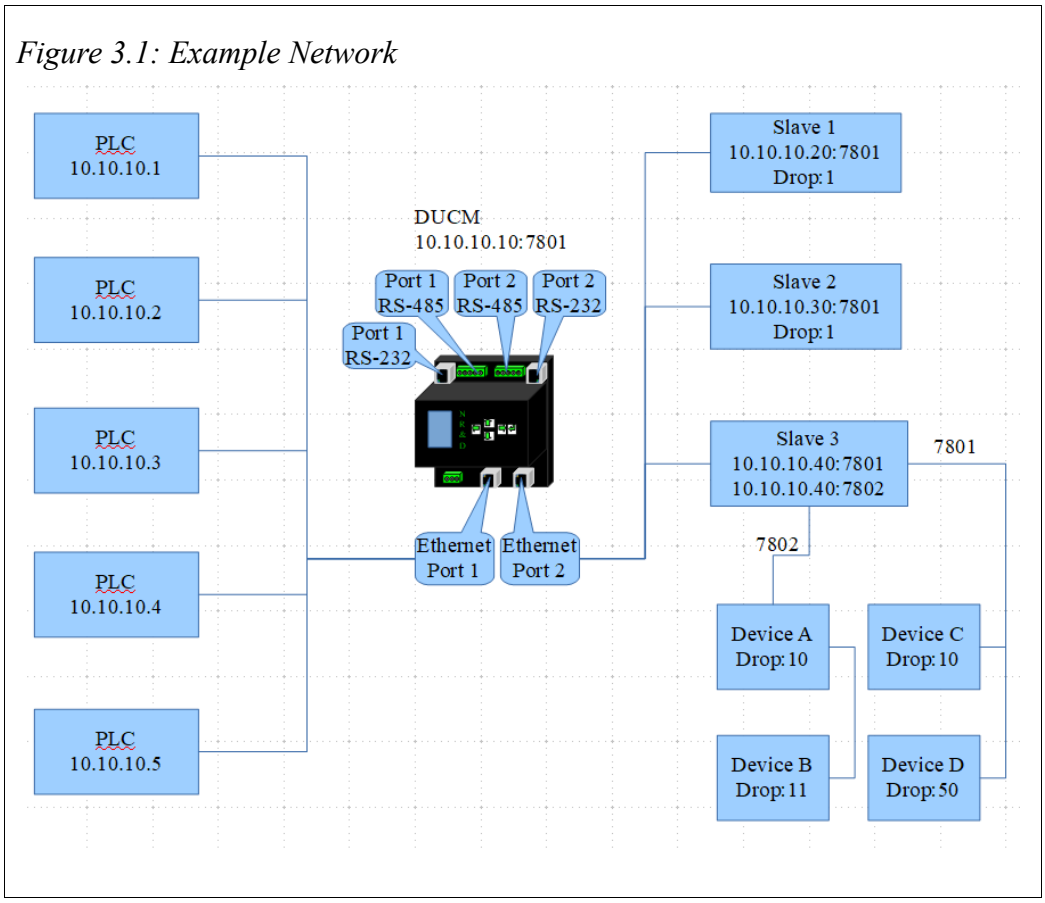
Figure 2.2: Serial Port Configuration Menus



3 Examples

Figure 3.1 shows an example network where the DUCM TCP MUX application would be used,

Figure 3.1: Example Network



Example Network Information

Figure 3.1 is an example of a network consisting of:

- 5 PLC Masters
- 3 Slaves
  - 2 Slaves with 1 drop
  - 1 Slave with 4 drops with 2 off each port

Each device is connected to the same Ethenet network as the DUCM and communication will start from the PLCs and be routed to the Slaves by the DUCM using the routing table in the DUCM which can be uploaded using the webpage of the DUCM.

Routing Table Configuration

The routing table in the DUCM is configured through uploading a .csv file to the DUCM through the webpage. Figure 3.2 shows an example .csv file for the network in Figure 3.1 opened in a spreadsheet as well as the .csv version. The following are the rules that need to be followed in order for the .csv file to be considered valid and saved into the DUCM memory.

- Only lines with at least 3 commas will be used to get routing information.
- The routing information must be in the beginning of the line in the following order.
  1. Index: The value the masters will use to communicate to a specific device.
  2. IP Address: The IP address of the Slave to route the messages to.
  3. Port: The port to the Slave to route the messages to.
  4. Drop: The drop of the Slave device to route the messages to.
- Everything after the forth comma in a line will be ignored.
- Every line with less than 3 commas will be ignored.
- Duplicate Indexes will not be accepted and will throw an error to the webpage. The error will need to be fixed to successfully configure the routing table.
- Order on the Indexes do not matter. (Index 1 can be after Index 20.) The routing table will be reordered by the application.
- Continuity of the Indexes do not matter. (Indexes of 1,2,5,6 are valid.)

Figure 3.2: Example Routing Table Spreadsheet and CSV

	A	B	C	D	E	F
1	{A= Index; B= Downstream IP Address; C= Downstream Port; D= Downstream Drop}					
2						
3						
4	10	10.10.10.20	7801	1	Slave 1	
5	20	10.10.10.30	7801	1	Slave 2	
6	30	10.10.10.40	7801	10	Slave 3	Device A
7	31	10.10.10.40	7801	11	Slave 3	Device B
8	32	10.10.10.40	7802	10	Slave 3	Device C
9	33	10.10.10.40	7802	50	Slave 3	Device D
10						

```
1  {A= Index; B= Downstream IP Address; C= Downstream Port; D= Downstream Drop}
2
3
4  10,10.10.10.20,7801,1, Slave 1
5  20,10.10.10.30,7801,1, Slave 2
6  30,10.10.10.40,7801,10, Slave 3, Device A
7  31,10.10.10.40,7801,11, Slave 3, Device B
8  32,10.10.10.40,7802,10, Slave 3, Device C
9  33,10.10.10.40,7802,50, Slave 3, Device D
10
```

In the Figure 3.2 above lines 1, 2, 3, and 10 will be ignored. The text regarding slave number and device letter in lines 4 through 9 will be ignored. The first route accepted will be:

- Index:10; IP Address: 10.10.10.20; Port:7801; Drop:1

This will route all messages sent to the DUCM with a drop of 10 (for Modbus protocol) to the Slave 1 from Figure 3.1.

For routing ION messages put the Index of 10 into the destination bytes of the ION message.

Directing Messages to the DUCM Application

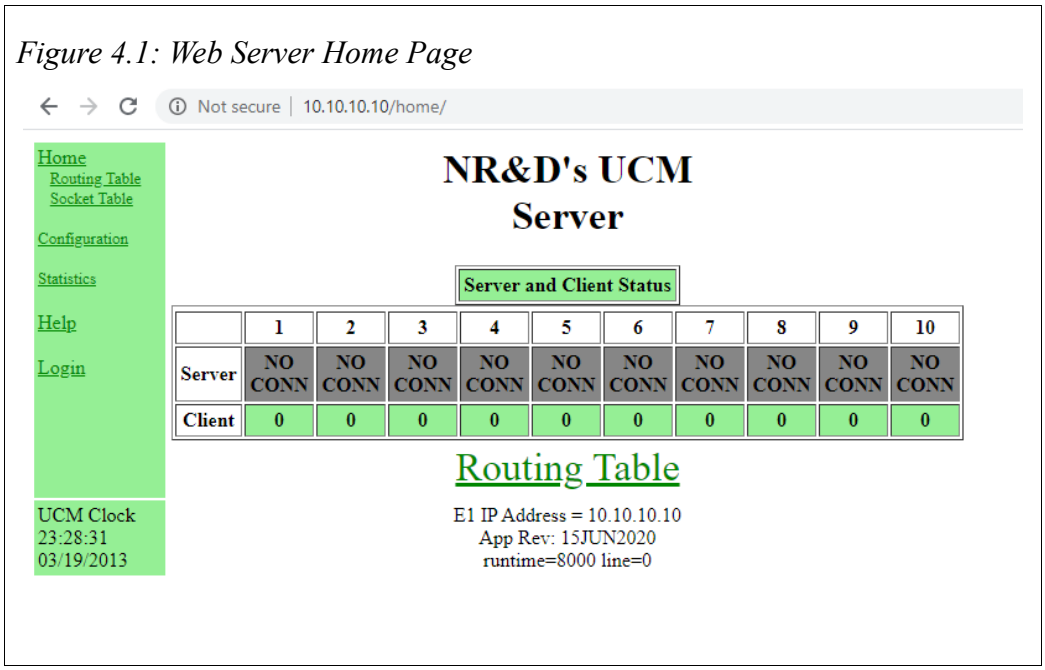
To send the message to the DUCM TCP MUX, send a TCP message to the IP address of the DUCM. Further information for specific protocals are listed below.

- ION
  - Direct TCP messages to port 7801
  - Enter the Index of the Slave device into the destination bytes of the ION message.
  - ex. IP:10.10.10.10; Port:7801; Drop:10 to speak to Slave 1.
- Modbus
  - Direct TCP messages to port 502
  - Enter the Index of the Slave device into the drop of the Modbus message,
  - ex. IP:10.10.10.10; Port:502; Drop:10 to speak to Slave 1.

4 Web Server

The DUCM contains a built in web server that can be accessed over an ethernet network using a web browser. By entering the IP Address of the device into the browser the home page of the server can be accessed as seen in Figure 4.1. The home page shows the servers and clients that are running on the DUCM and basic information on their current state.

Figure 4.1: Web Server Home Page

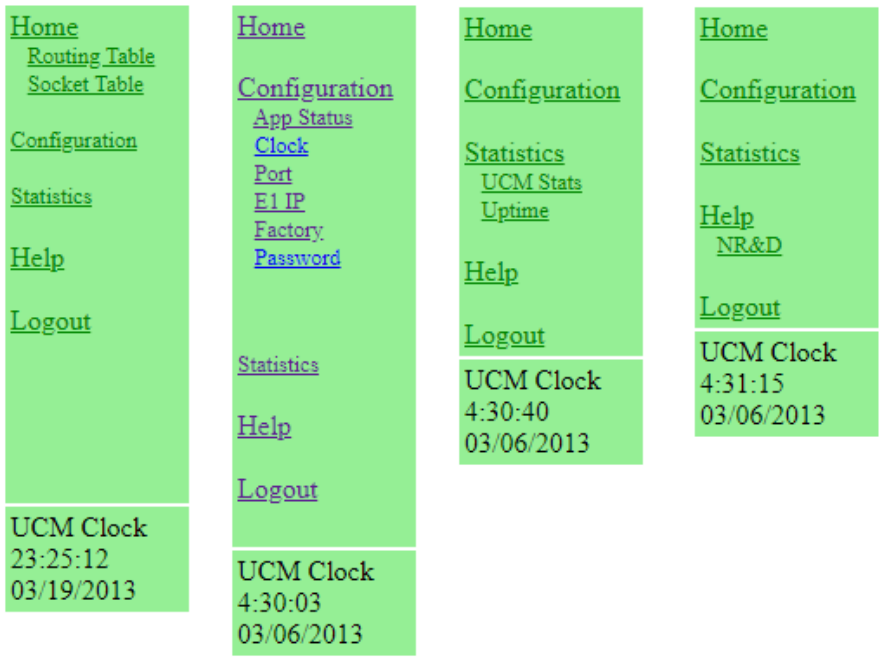


As seen in Figure 4.1 there are 10 server client pairs available in the TCP MUX application. The PLC masters from the example in Figure 3.1 will connect to a server on the DUCM. Once the message is received the paired client on the DUCM will check the routing table for the necessary information and then connect to the Slave and pass the message on. The client will then receive the response from the Slave and hand it over to the server which will send it to the PLC master.

Home Table

The home table is on the left side of every page and is green. It always contains links to the home page, configuration page, statistics page, and help page. Depending on the current page more links will be available.

Figure 4.2: Home Table States



- Home
  - Routing Table, Socket Table
- Configuration
  - App Status, Clock, Port, E1 IP (Ethernet 1 port), and E2 IP
- Statistics
  - UCM Stats, App Stats, Uptime
- Help
  - NR&D (contact information page)

Routing Table Page

The home page contains links to the routing page which will display the current routing table as well as containing the form for submitting a new routing table. To submit the new routing table, click the “Choose File” button, select the .csv file containing the new routing table, then click submit. This will bring you to a page similar the Figure 4.3.

Figure 4.3: Routing Table Page

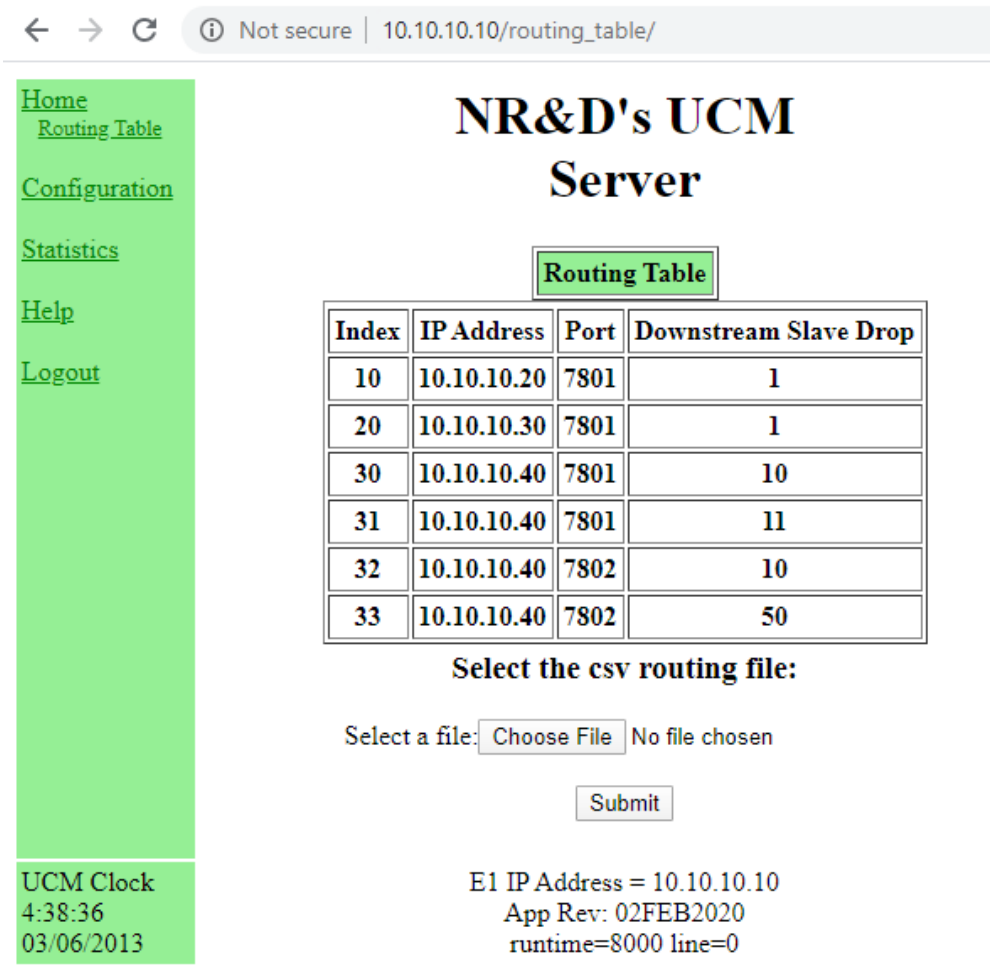
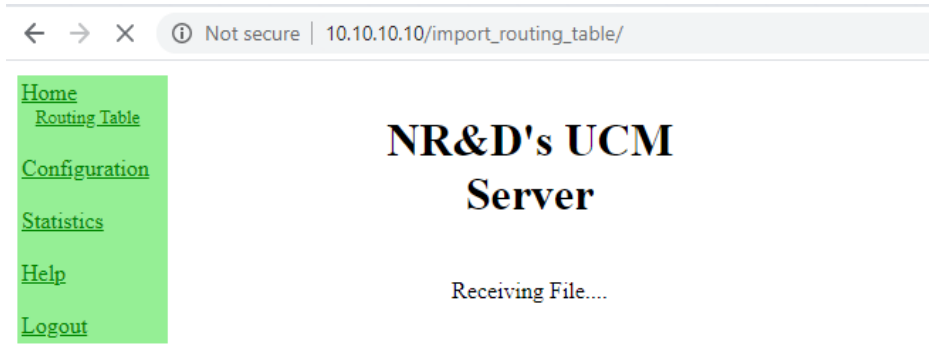
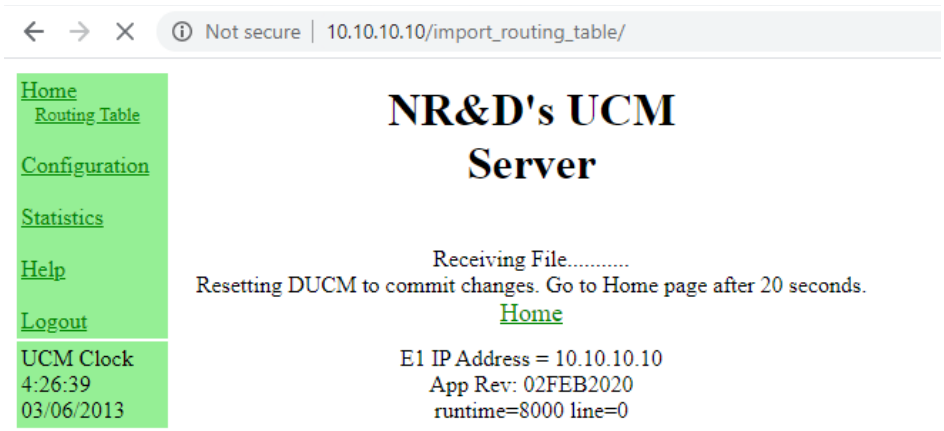


Figure 4.4: Routing Table Importing Page



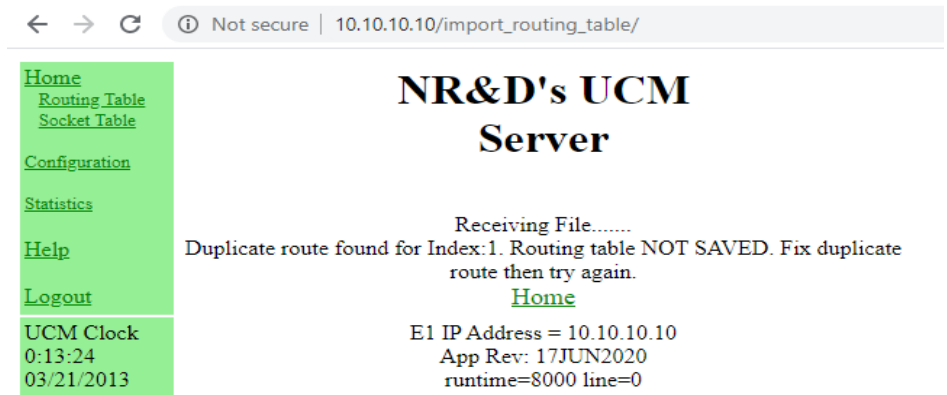
After you have reached this page the download and parsing of the .csv file has begun. While the DUCM is parsing the file periods(.) will be added after the "Receiving File..." on the webpage. Once the download and parsing has finished the webpage will look like Figure 4.5.

Figure 4.5: Routing Table Imported



Once this page has been displayed the DUCM will save the routing table and then reboot to ensure all changes have been saved and the servers and clients running on the DUCM are using the updated table.

Figure 4.6: Routing Table Duplicate Index

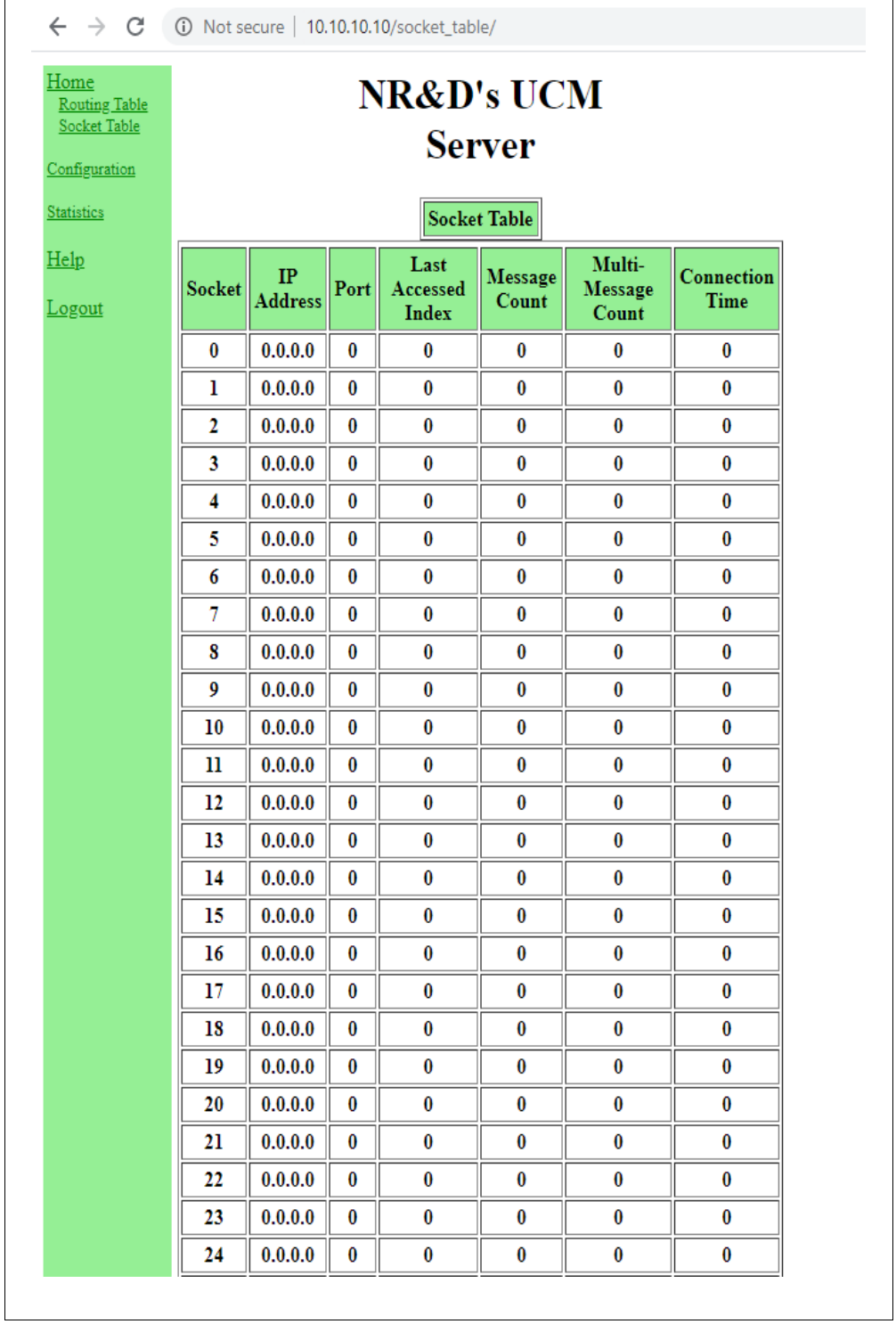


If there is a duplicate Index in the routing table the webpage will show the Index as well inform the user the table was not saved and to try uploading again after fixing the duplicate Index in the routing table.

Figure 4.7 below shows the Socket Table of the application which contains a list of the possible sockets available to connect to the Slave devices along with information regarding those sockets. (Sockets with zeroed information are not in use.)

- IP Address: Slave device IP Address
- Port: Slave device Port
- Last Accessed Index: Last Index used when sending a message to the Slave at the listed IP and Port
- Message Count: Number of messages sent to the Slave
- Multi-Message Count: (Specific to ION) Messages needing multiple replies increment this counter
- Connection Time: Time in seconds this socket has been connected to the Slave device.

Figure 4.7: Socket Table



Socket	IP Address	Port	Last Accessed Index	Message Count	Multi-Message Count	Connection Time
0	0.0.0.0	0	0	0	0	0
1	0.0.0.0	0	0	0	0	0
2	0.0.0.0	0	0	0	0	0
3	0.0.0.0	0	0	0	0	0
4	0.0.0.0	0	0	0	0	0
5	0.0.0.0	0	0	0	0	0
6	0.0.0.0	0	0	0	0	0
7	0.0.0.0	0	0	0	0	0
8	0.0.0.0	0	0	0	0	0
9	0.0.0.0	0	0	0	0	0
10	0.0.0.0	0	0	0	0	0
11	0.0.0.0	0	0	0	0	0
12	0.0.0.0	0	0	0	0	0
13	0.0.0.0	0	0	0	0	0
14	0.0.0.0	0	0	0	0	0
15	0.0.0.0	0	0	0	0	0
16	0.0.0.0	0	0	0	0	0
17	0.0.0.0	0	0	0	0	0
18	0.0.0.0	0	0	0	0	0
19	0.0.0.0	0	0	0	0	0
20	0.0.0.0	0	0	0	0	0
21	0.0.0.0	0	0	0	0	0
22	0.0.0.0	0	0	0	0	0
23	0.0.0.0	0	0	0	0	0
24	0.0.0.0	0	0	0	0	0

Configuration Page

The Configuration page contains links to the:

- *Application Status* page where the mode for the application can be viewed and changed if required as shown in Figure 4.8
- *Set Clock* page where the devices internal clock can be changed as shown in Figure 4.9
- *Change Serial Port Settings* page where the device serial port's settings can be viewed and changed as shown in Figure 4.10
- *Change UCM E1 TCP/IP Address* page where the ethernet settings can be viewed and changed as shown in Figure 4.11

The *Application Status* page shows the current mode which defaults to ION. Options are ION and Modbus.

When accessing the webpage it is necessary to enter a password in order to change settings in the configuration pages and to enter the Routing Table page. The default password for this application is “master”, all lower case.

Figure 4.8: Application Status Page

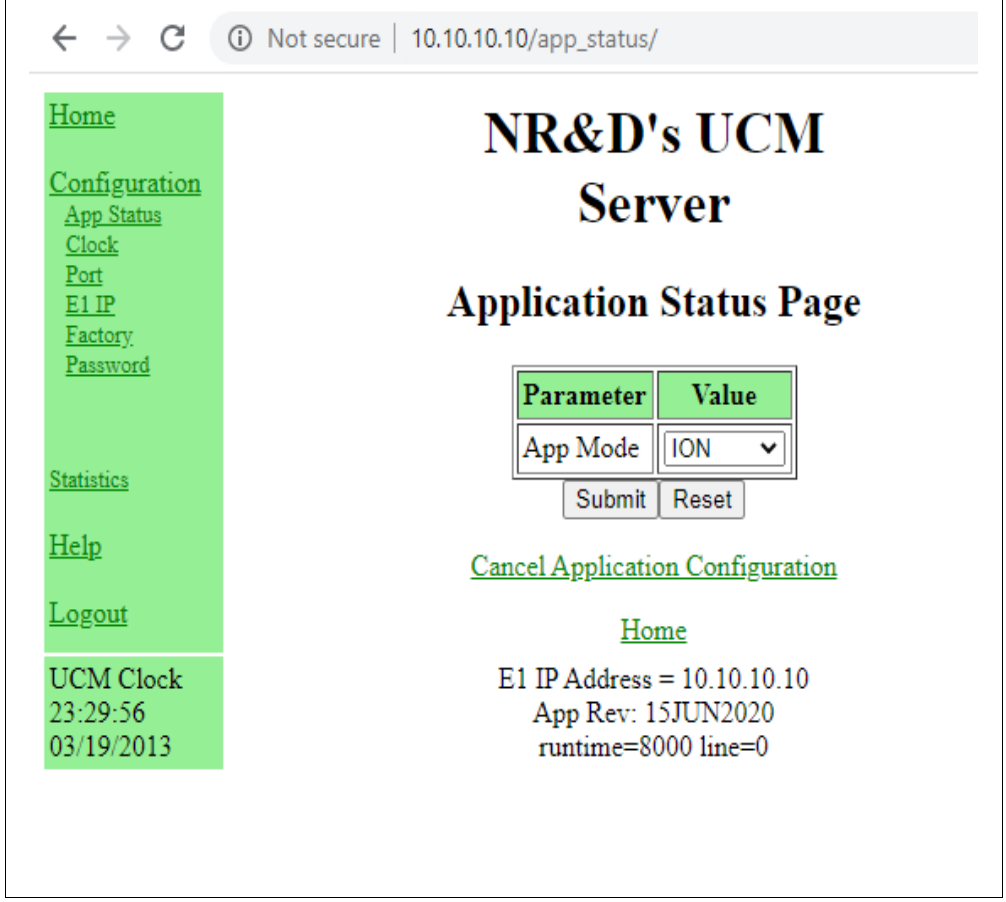


Figure 4.9: Set Clock Page

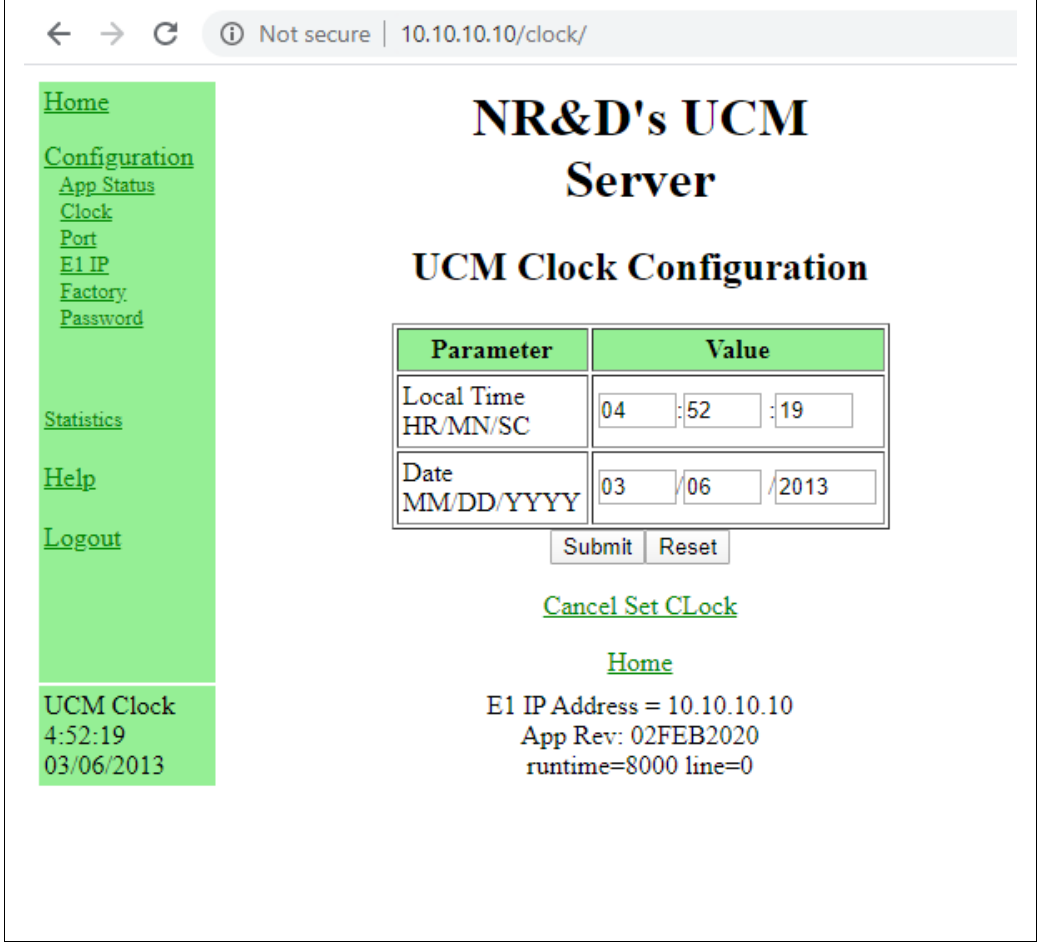


Figure 4.10: Change Serial Port Settings Page

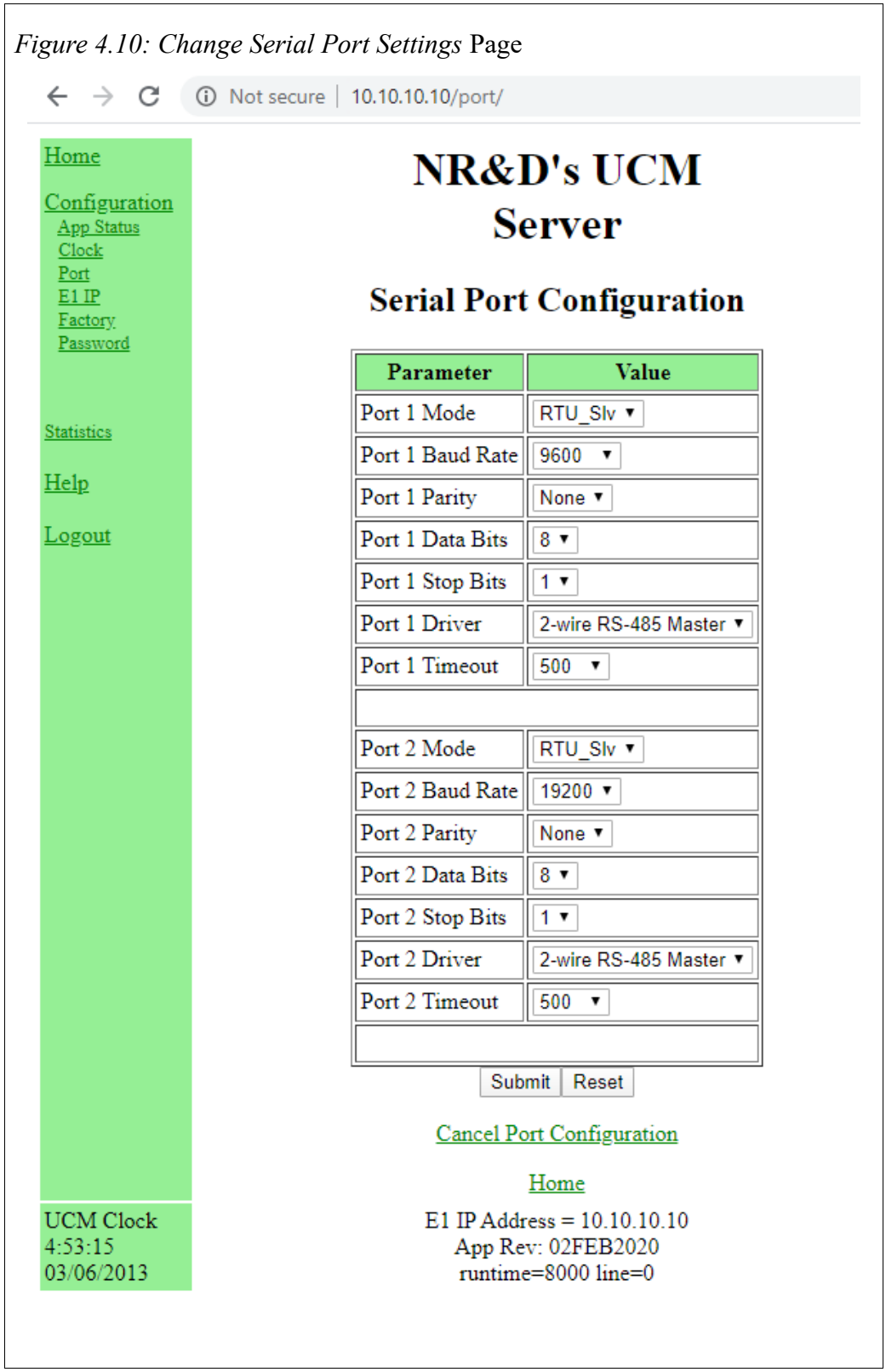
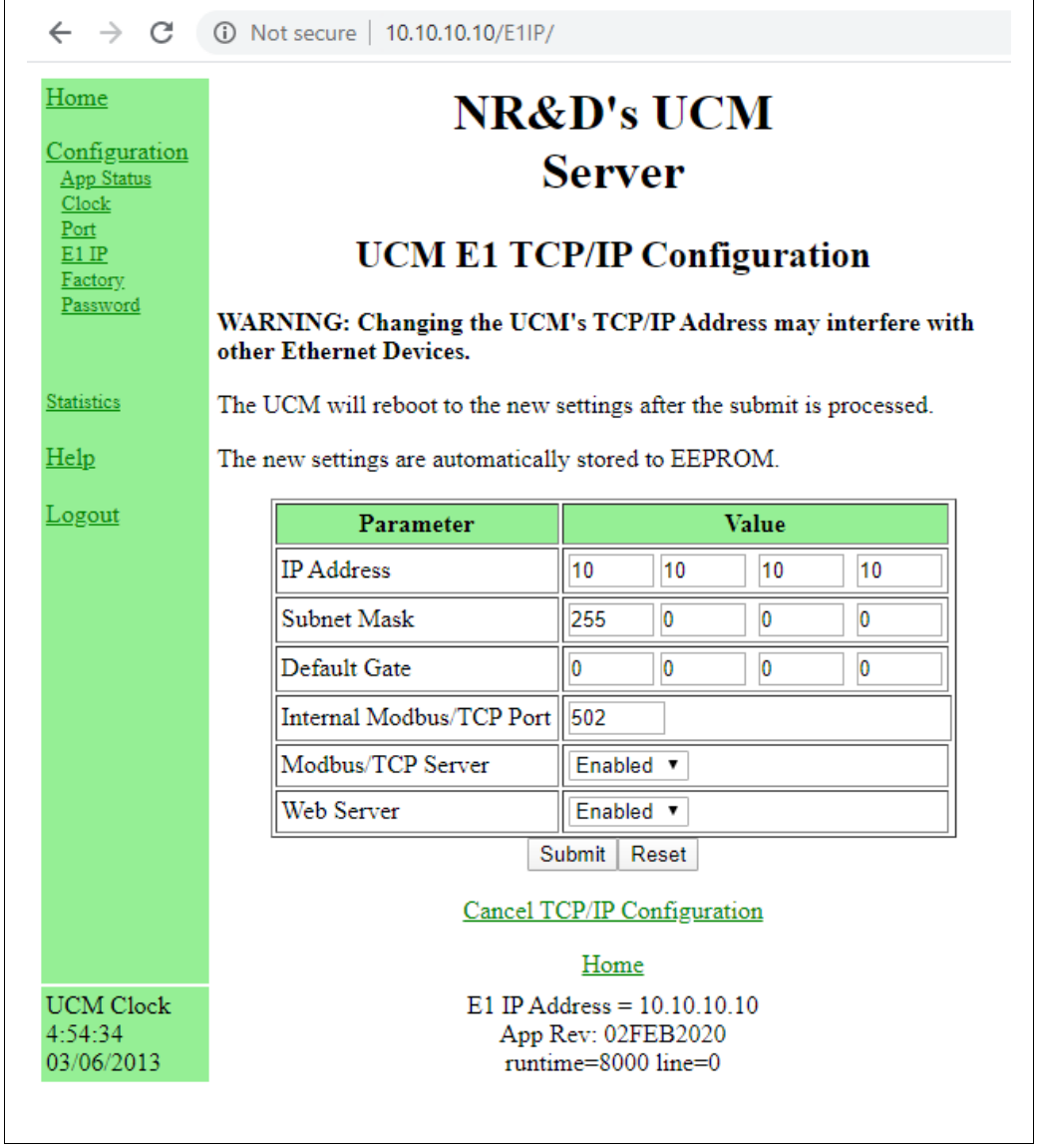


Figure 4.11: Change UCM E1 TCP/IP Address Page



Statistics Page

The Statistics page contains links to the:

- *UCM Stats* page where information regarding the UCM device is given as shown in Figure 4.12
- *Uptime* page where the device serial port's settings can be viewed and changed as shown in Figure 4.13

Figure 4.12: UCM Stats Page

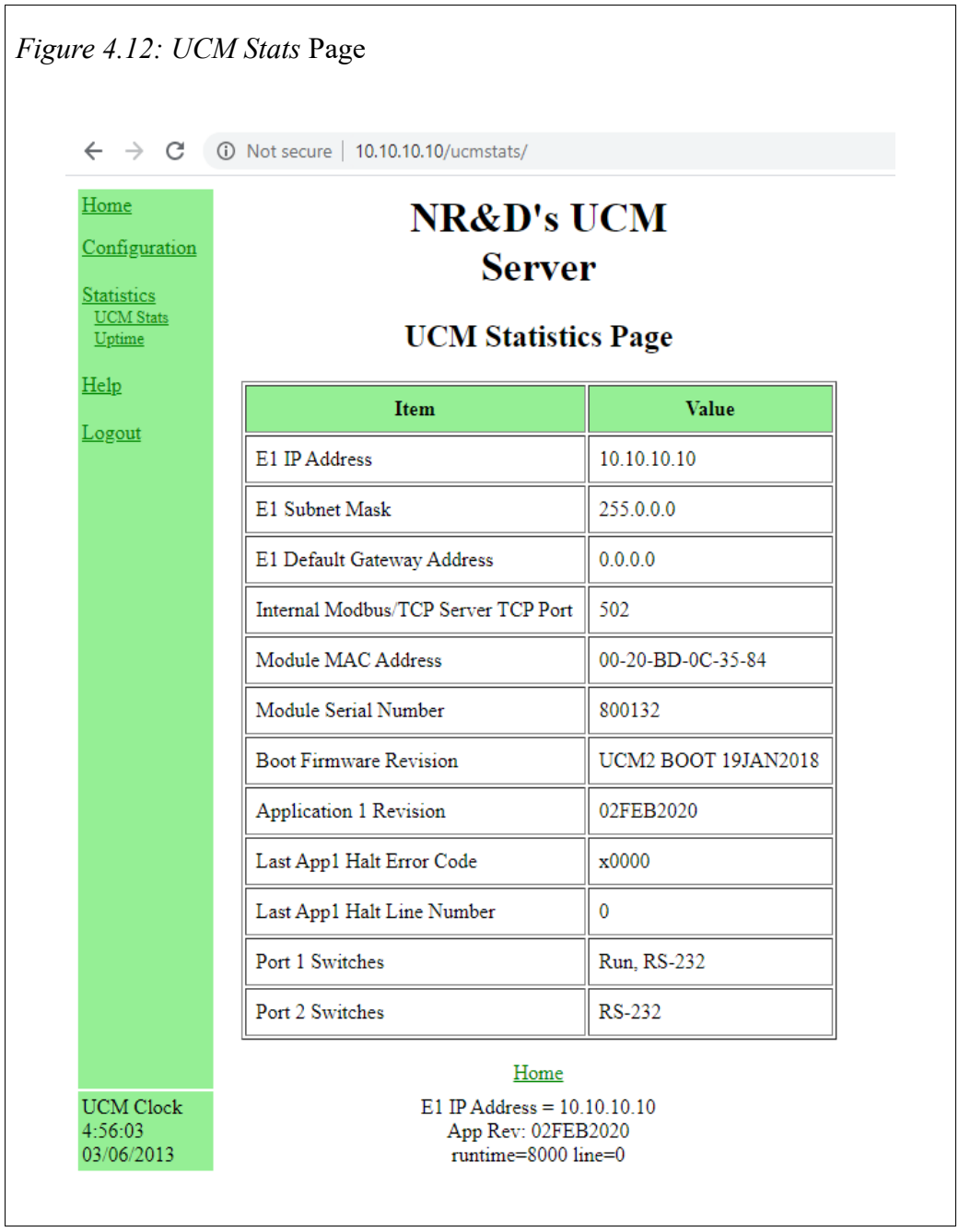
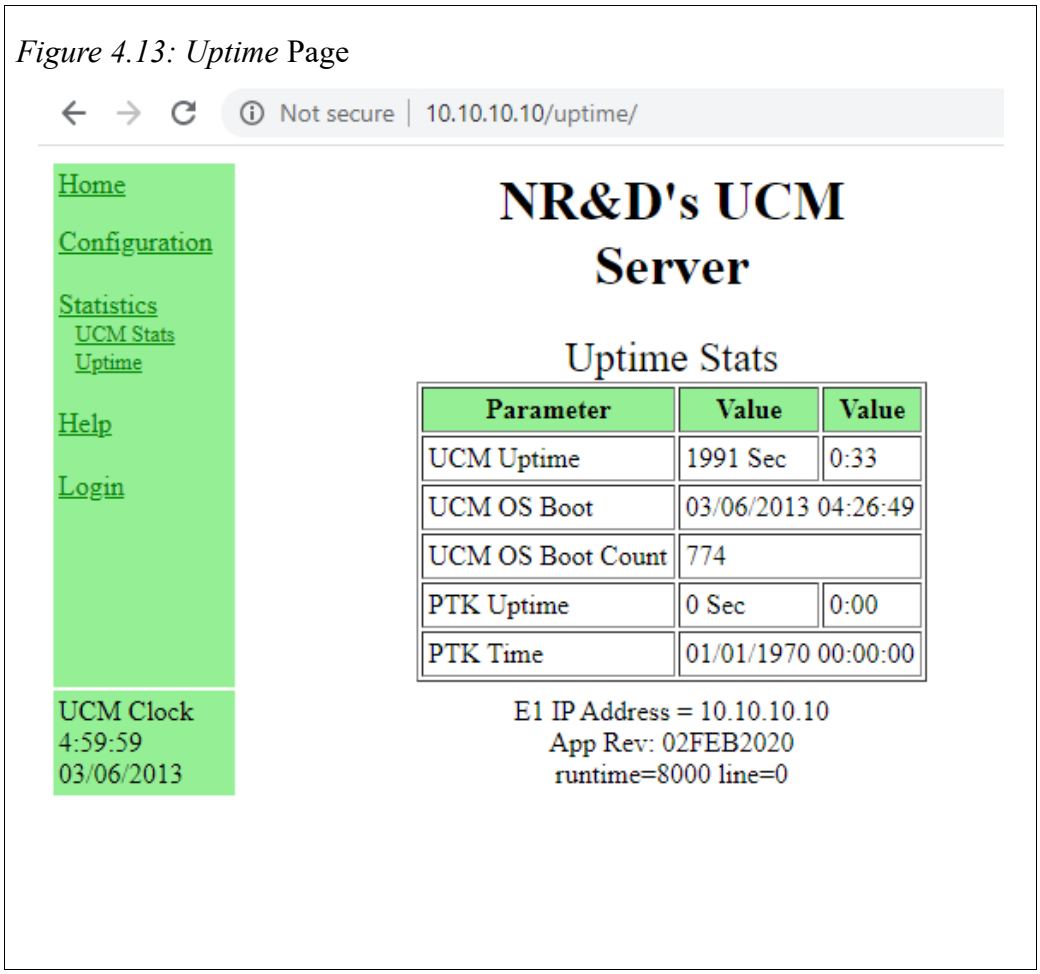


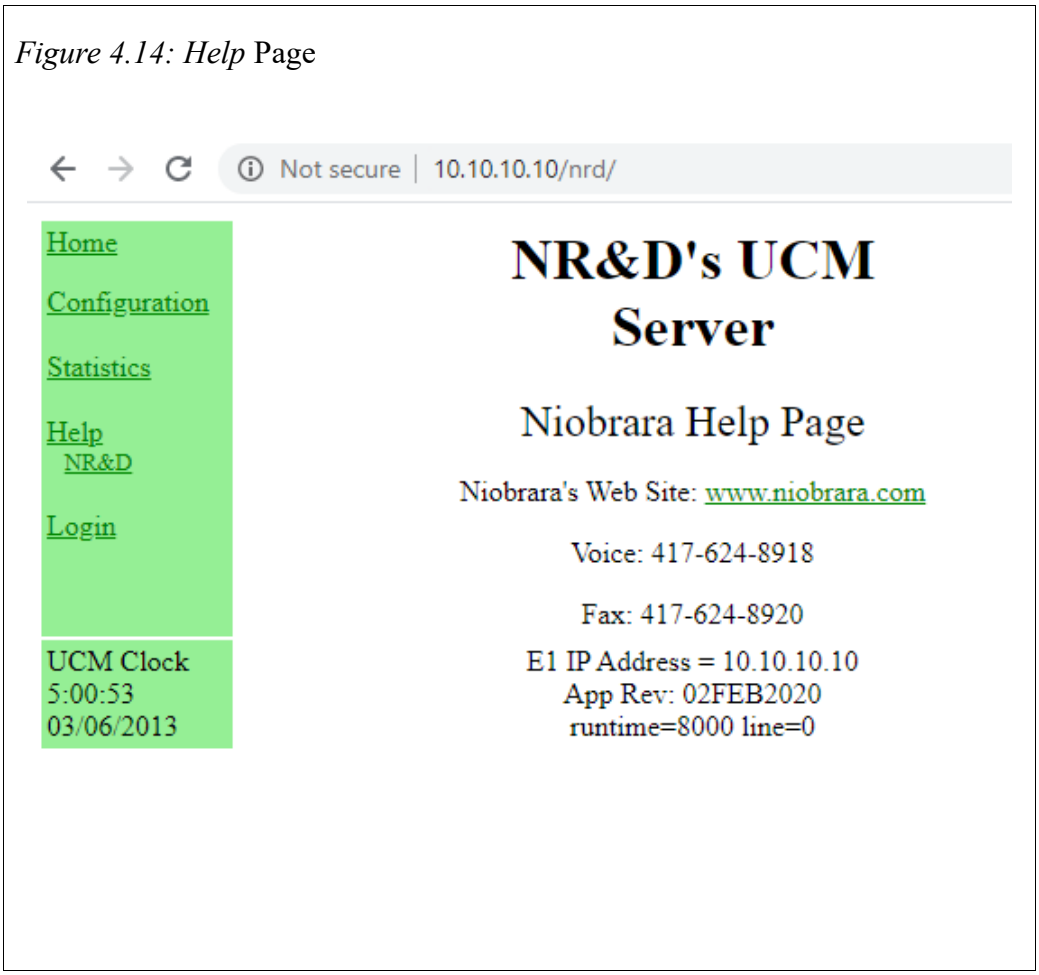
Figure 4.13: Uptime Page



Help Page

The *Help* page contains a link to Niobrara's website as well as other contact information as shown in Figure 4.14

Figure 4.14: Help Page



5 Testing and Troubleshooting

DUCM Lights

The DUCM has several lights to give indication of activity of the application and serial ports.

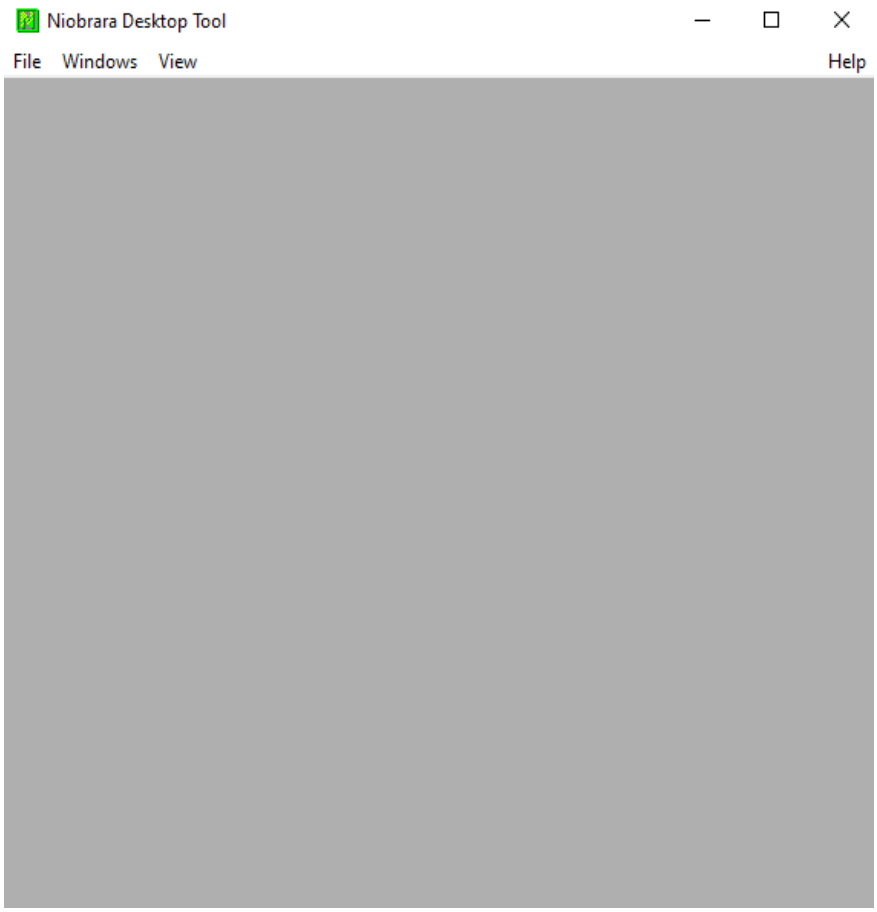
- The **Pwr** light is green and indicates that the DUCM is powered.
- The yellow **Tx1** light indicates that the DUCM RS-232 port is transmitting data. This light should normally be quickly flashing when the port is in use.
- The yellow **Rx1** light indicates that the DUCM RS-232 port is receiving data. This light should normally be quickly flashing when the port is in use.
- The yellow **Tx2** light indicates that the DUCM RS-485 port is transmitting data. This light should normally be occasionally flashing as the DUCM polls the Master-Hub.
- The yellow **Rx2** light indicates that the DUCM RS-485 port is receiving data. This light should normally be occasionally flashing as the DUCM polls the Master-Hub.
- The yellow **Ethernet** light indicates that the DUCM ethernet port is operating as a 100Mbps connection. When this light is off and the green light is on the port is operating as a 10Mbps connection.
- The green **Ethernet** light indicates that the DUCM ethernet port is connected to a network. This light should normally be occasionally flashing as the DUCM communicates over the network.
- **Light 1** is a red light placed behind the LCD screen and is controlled by the application. If light 1 is on a warning or error message will appear on the LCD.
- **Light 2** is a red light placed behind the LCD screen and is controlled by the application. If light 1 is on a warning or error message will appear on the LCD.

Testing the Modbus Connection

The program NRDTOOL.EXE may be used to quickly test the Modbus settings on the DUCM. NRDTOOL.EXE is a register editor contained in DUCM_SETUP.EXE.

1. Download and install DUCM_SETUP.EXE from www.niobrara.com. On the Web site go to Products, Din Rail Products, DUCM, Software. This will download the DUCM_SETUP.EXE.
2. Connect the DUCM ethernet port to the computer, or the network connected to the computer through an ethernet cable.
3. Start NRDTOOL.EXE. On most Windows systems do a Start, All Programs, Niobrara, NrdTool. See Figure 5.1.

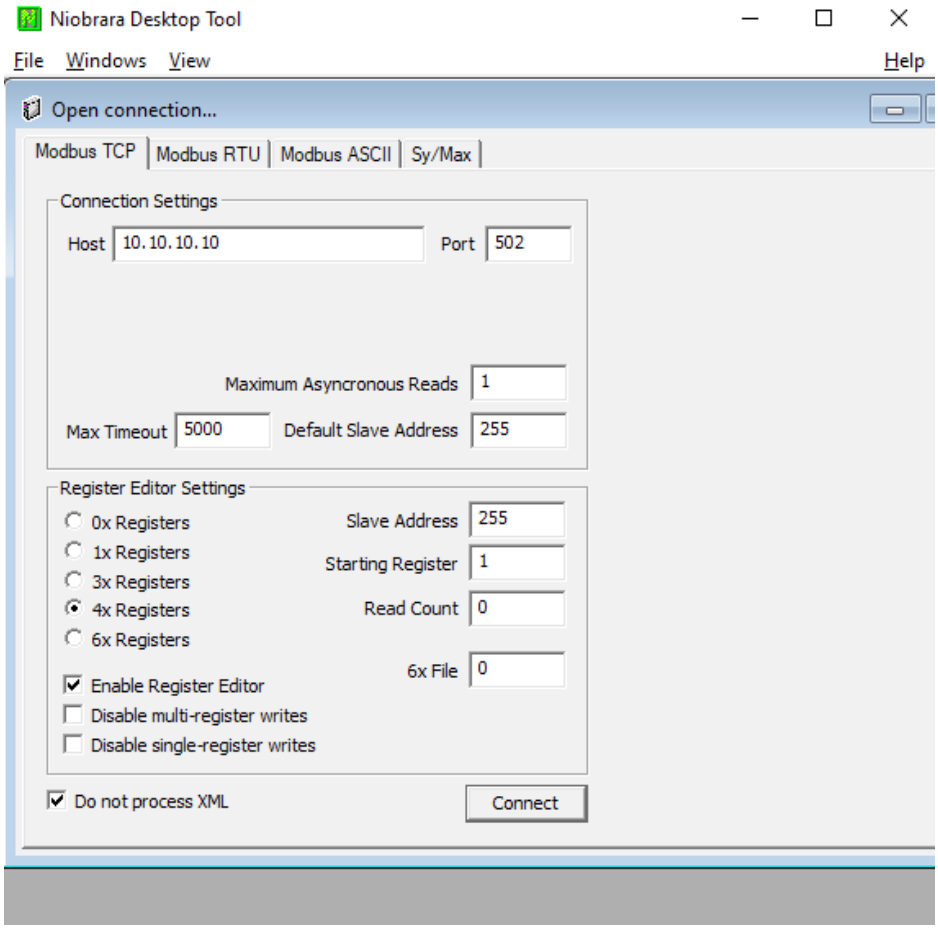
Figure 5.1: NRDTOOL.EXE



4. File, Open Connection
5. Select the Modbus TCP tab

6. Check that the Connection settings match the DUCM ethernet port 1 or 2 settings. The Default Slave Address leave at 255, and set the port to 502. See Figure 5.2
7. Under Register Editor Settings check that 4x registers is selected, set slave address to 255 for the DUCM, Starting Register to 1, Read Count to 0, Enable Register Editor is checked, and Do Not Process XML is check. See Figure 5.2

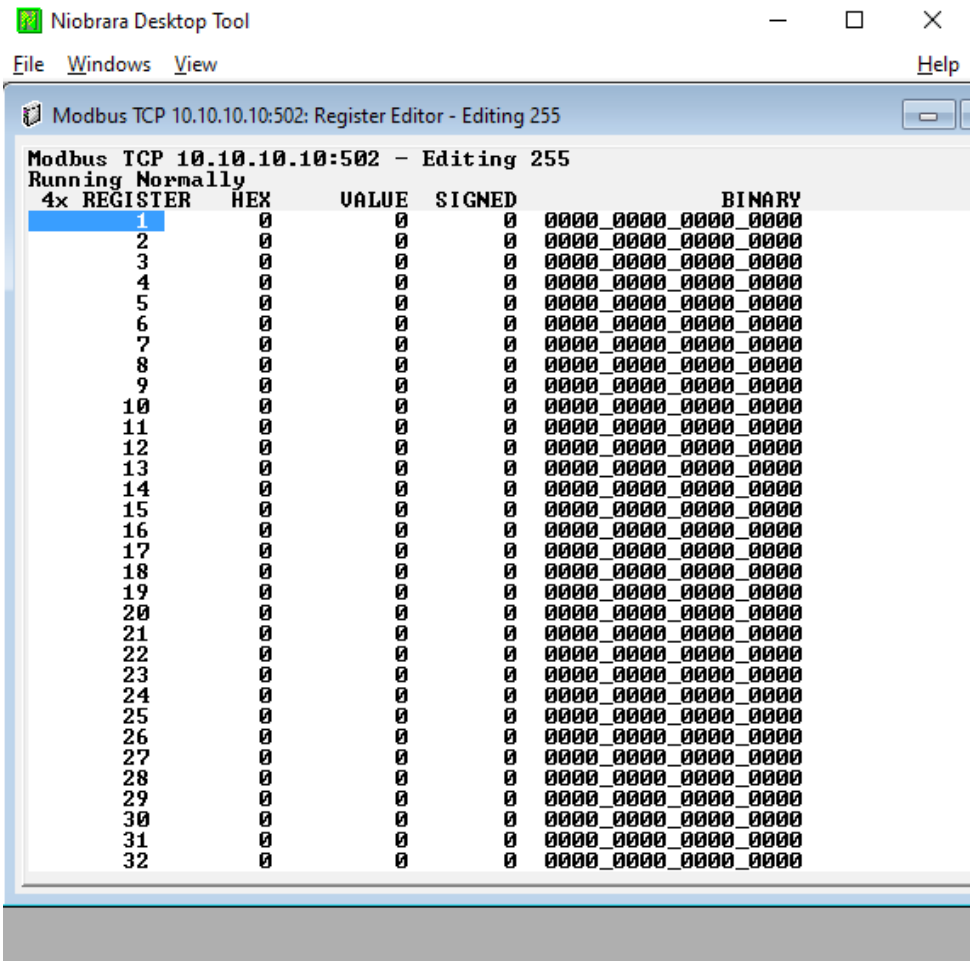
Figure 5.2: Open Connection



8. Click Connect.

   A screen like Figure 5.3 should appear. The left column is the Holding Register number, the data is shown in the HEX, UNSIGNED, SIGNED, and BINARY columns. The arrow keys and Page UP/Down may be used to move around. Values may be entered directly and the change occurs when the Enter key is pressed.

Figure 5.3: Connected to Slave Address 255



When finished verifying that the communication is good, Close NRDTOOL.EXE.

6 Front Panel Operation

Keypad Buttons

The front panel includes five push buttons.

- ⇨ The RIGHT arrow advances to the next screen or field. In many cases, it has the same behavior as the ↵ ENTER key.
- ⇦ The LEFT arrow escapes to the previous screen or field. Changes are saved when the left arrow is pressed.
- ⇧ The UP arrow moves up in a list or increments a selection.
- ⇩ The DOWN arrow moves down in a list or decrements a selection.
- ↵ The ENTER key accepts the values on a screen and exits to a previous screen.

LCD Screen

The DUCM includes a high resolution LCD screen main screen to assist the user in configuring and troubleshooting the device. Serial port parameters may be observed and modified. Statistical information is also provided through the front panel interface.

Backlight

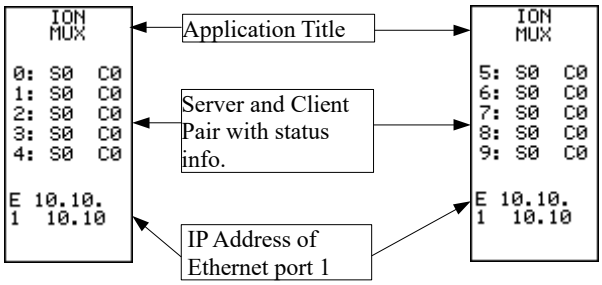
The LCD backlight will illuminate on any button press. The timeout for the backlight is set for 5 minutes.

Operating Screens

Splash Screen

The main page shows the application name, and application status information concerning the servers and clients running on the DUCM.

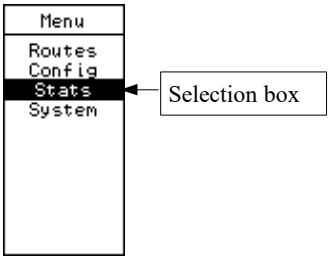
Figure 6.1: Splash screen



Main Menu Screen

Pressing a key while the splash screen is displayed will move to the Main menu page. A selection box indicates the sub-menu to be chosen. Pressing the UP or DOWN arrows will move the selection box to the next choice. Pressing the RIGHT arrow or ENTER buttons will select the sub-menu. Pressing the LEFT arrow will return to the splash screen page.

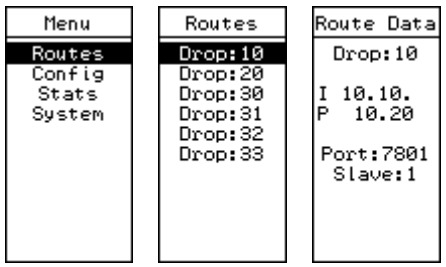
Figure 6.2: Main Menu screen



Routes

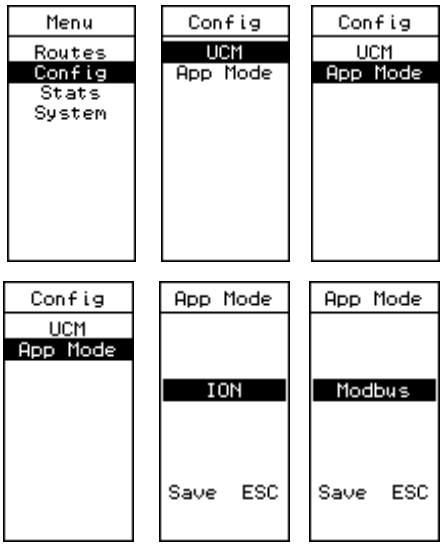
The Routes screen shows a list of all the routes in the DUCM with the drop number used by the PLC masters listed on this page. Scroll down to the drop in question and hit the RIGHT or ENTER button and the route for that drop will be displayed as in Figure 6.3

Figure 6.3: Route Information



The mode of the application can be changed by entering the App Mode option under Config, selecting the desired mode and then saving as seen in Figure 6.4. Currently supported modes are ION, and Modbus over TCP/IP.

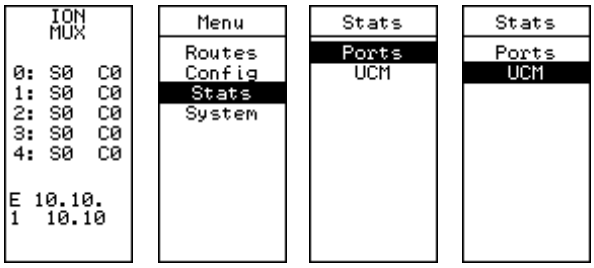
Figure 6.4: Application Mode



Stats Menu

The Stats Menu shows communication statistics for the ports on the DUCM, information on the DUCM device itself. Pressing the Enter key will reset the counts displayed in these screens.

Figure 6.5: Stats Screen



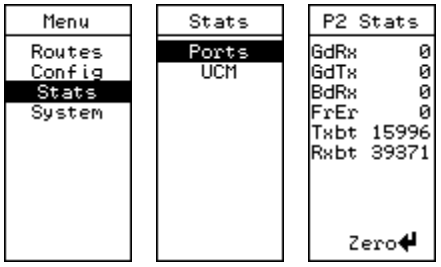
Port Statistics Screen

The names for the statistics displayed on this screen are abbreviated. A less abbreviated name is displayed at the bottom of the screen for the selected statistic.

The statistics displayed on this screen are:

- GdRx – Good read
- GdTx – Good write
- BdRx – Bad read
- FrEr – Framing Error
- Txbt – Transmitted bytes
- Rxbt – Received bytes

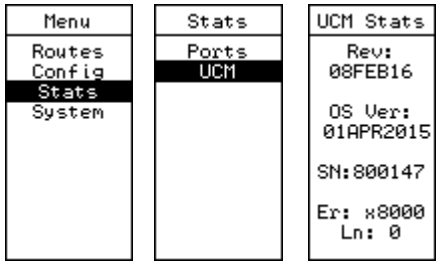
Figure 6.6: Port Stats Screen



DUCM Statistics Screen

The DUCM Stats screen shows hardware revision, OS Version, Module serial number, and application error code and line number.

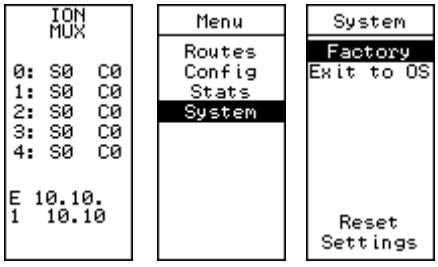
Figure 6.7: DUCM Stats Screen



System Menu

The System Menu provides access to the OS, and reset settings to factory defaults.

Figure 6.8: System Menu Screen



7 Software Installation

Software Installation

NOTICE: If the DUCM was ordered from Niobrara with the part number DCP-549 then the latest TCP MUX application and firmware is already loaded.

The application files for the DUCM are included in the DUCM_TCP_MUX_SETUP.EXE file. The latest version of this file is located at www.niobrara.com. Follow the link for "Application Notes", select "DUCM", and "TCP_MUX".

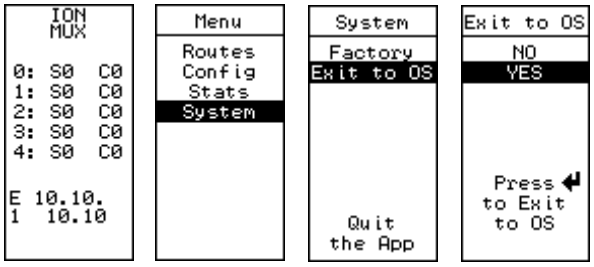
The program DUCM_SETUP.EXE is also required to be run before the TCP MUX program may be loaded into the DUCM. The DUCM_SETUP program installs the QLOAD program and the FWLOAD program.

Updating the Application in the DUCM

The QLOAD program is used to install the TCP MUX program.

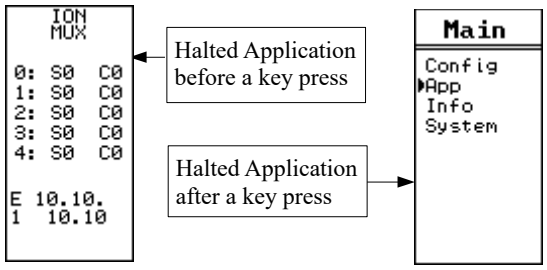
1. The module must be powered.
2. The application must be halted. To accomplish this, use the arrow keys on the module to navigate to the Main menu. Use the Enter or Right arrow button to select the System option. Select the Exit to OS option in the System menu. Use the Enter or Right arrow button to select the YES option. See Figure 7.1

Figure 7.1: Halt the Application



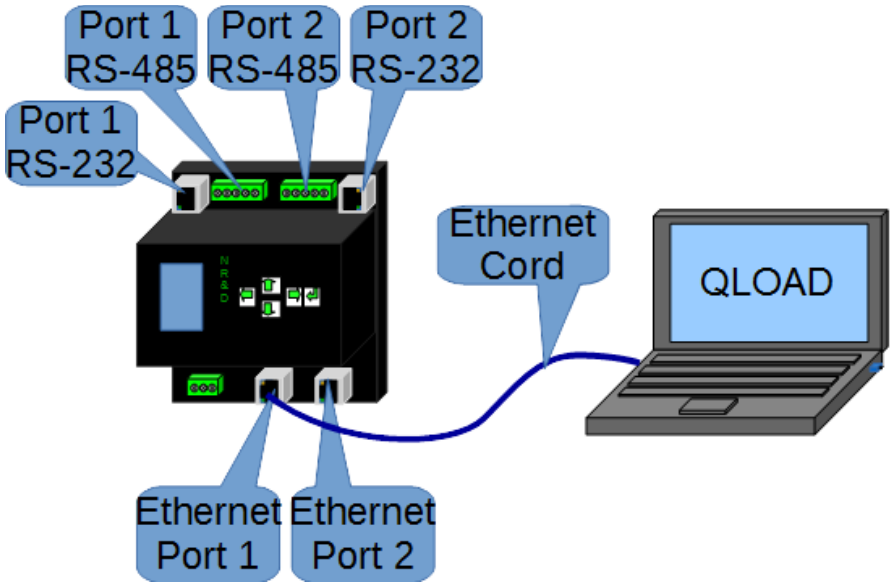
3. When the application halts the operation of the arrow keys and the LCD screen is handled by the DUCM OS. The OS does not continuously paint the LCD screen so the last screen displayed when the application halted will remain on the screen until a key is pressed. Press the Up, Down, or Left arrow keys will bring up the OS Main Menu. See Figure 7.2

Figure 7.2: Halted Application



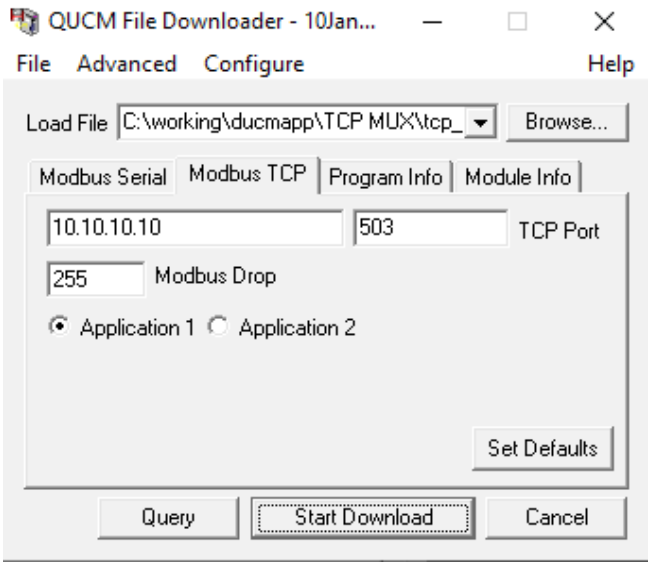
4. Connect the Ethernet cable from the ENET 1 or 2 port to the PC.

Figure 7.3: Connect DUCM Module to PC



5. Start QLOAD.EXE. The Windows Start Menu link is “Start, Programs, Niobrara, DUCM, Apps, TCP MUX, QLOAD_TCP_MUX” See Figure 7.4

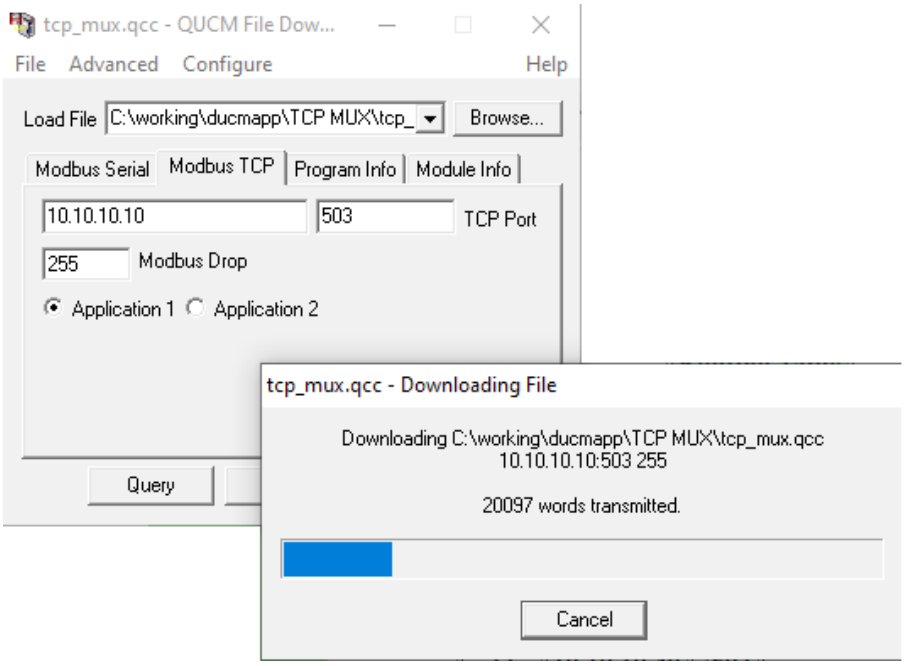
Figure 7.4: QLOAD Application



6. If necessary, Click on the Browse button and select tcp_mux.qcc.
7. Click on the “Modbus TCP” tab and verify the following:
    1. The proper IP Address is selected (10.10.10.10 default).
    2. The TCP Port matches the OS Port of the device(default is 502).
    3. The Modbus Drop is 255.
    4. The Application 1 radio button is selected.

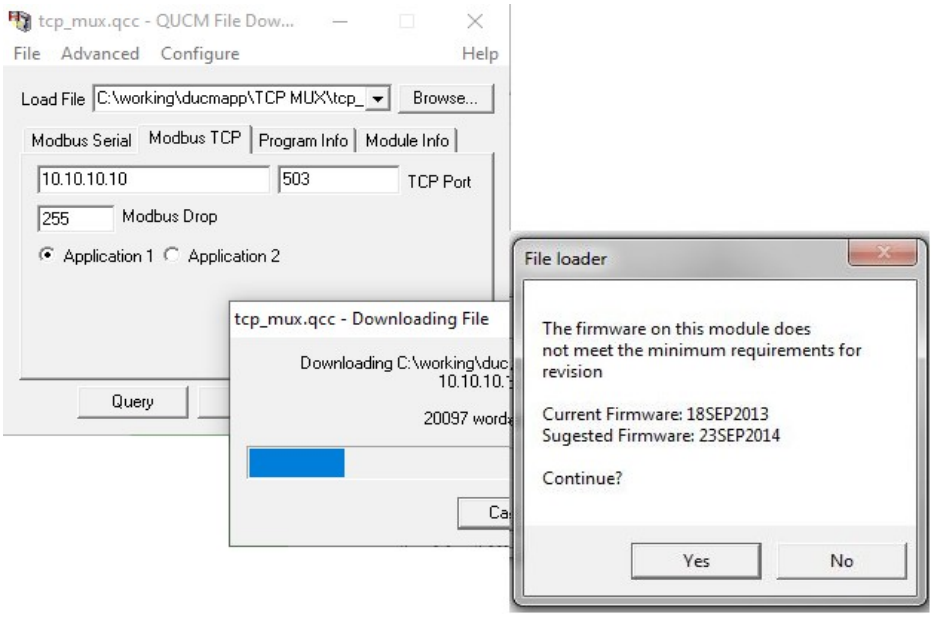
8. Press the “Start Download” button. QLOAD will open a progress bar to show the status of the download see Figure 7.5.

Figure 7.5: QLOAD Progress



If the Firmware Warning dialog appears click “No” and refer to the Updating the DUCM Firmware section of this manual see Figure 7.6.

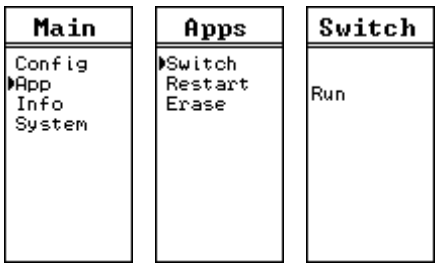
Figure 7.6: QLOAD Firmware Warning Dialog



9. The application Switch must be in Run for the application to be executed:

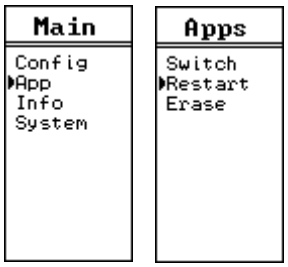
   To accomplish this, use the arrow keys on the module to navigate to the App option in the Main menu. Use the Enter or Right arrow button to select the option. Select the Switch option in the Apps menu. Use the Up or Down arrow to select the Run option. Use the Enter or Left arrow to accept the choice. See Figure 7.7

Figure 7.7: Change Application Switch to Halt



or Restart the application. Use the arrow keys on the module to navigate to the App option in the Main menu. Select the Restart option in the Apps menu. See Figure 7.8

Figure 7.8: Restart the Application



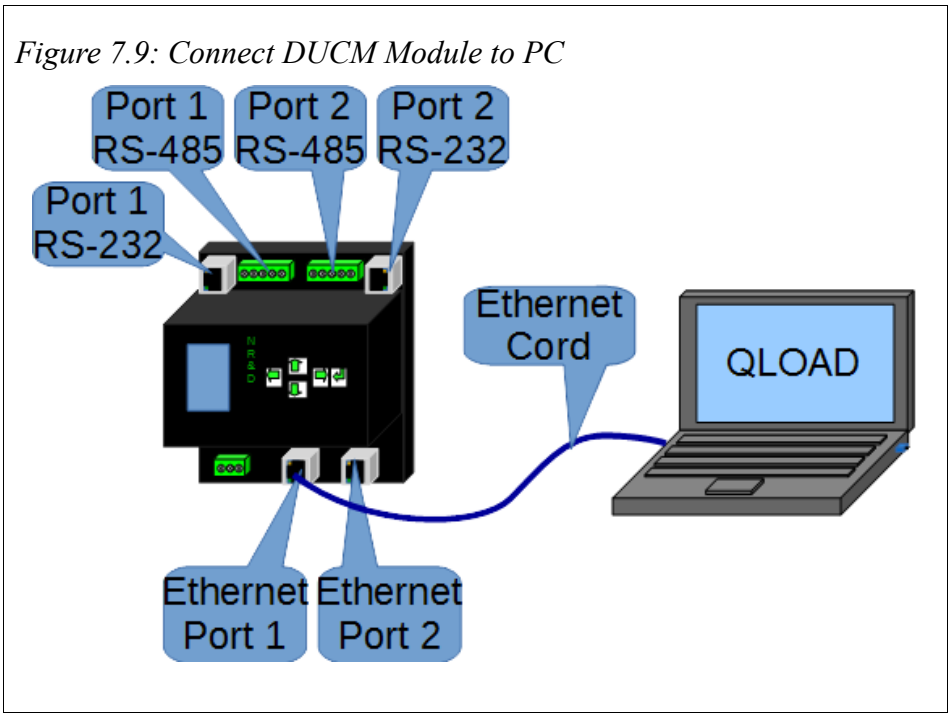
Updating the DUCM Firmware

The QLOAD program may be used to install the module firmware through a Serial port connection using Modbus RTU.

Start QLOAD.EXE from Windows Start Menu:

1. Make sure the DUCM is powered and connected to the PC

Figure 7.9: Connect DUCM Module to PC



2. Start QLOADEXE. The Windows Start Menu Link is "Start, All Programs, Niobrara, DUCM, QLOAD DUCM Firmware"
3. Click on the "Modbus TCP" tab and verify the following:

   See Figure 7.10

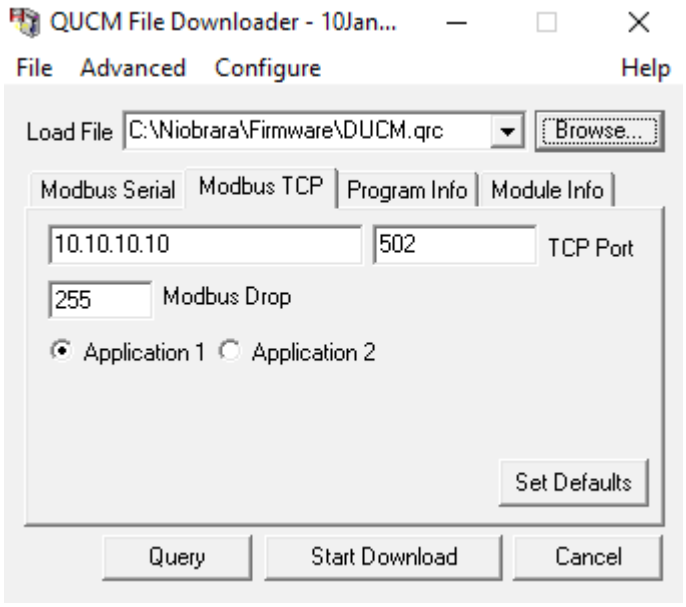
   a) The proper IP Address is selected (10.10.10.10 default).

   b) The TCP Port matches the OS Port of the device(default is 503).

   c) The Modbus Drop is 255.

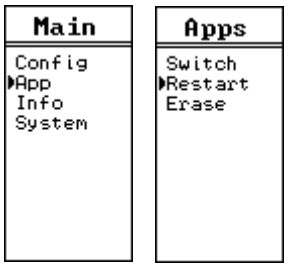
   d) The Application 1 radio button is selected.

Figure 7.10: Using QLOAD to update firmware



4. Press the "Start Download" button. QLOAD will open a progress bar to show the status of the download. When the download is complete the application may have to be restarted. To accomplish this, use the arrow keys on the module to navigate to the App option in the Main menu. Use the Enter or Right arrow button to select the option. Then select the Restart option in the Apps menu. See Figure 7.11

Figure 7.11: Restart the Application



Appendix A Purchasing Options

The part numbering scheme for the TCP MUX kit:

DCP-549-X

X: One digit code for DUCM part number

- No Number - DUCM+102
- 2 – DUCM+202

Example part numbers:

DCP-549- DUCM+102 preloaded with TCP MUX application

DCP-549-2 - DUCM+202 preloaded with TCP MUX application

TR121ST - wall transformer for DUCM