DUCM DF1

Installation and Programming Manual

This manual describes the DUCM application for interfacing DF1 slaves to a Modbus or RNIM serial network.

Effective: February 16, 2017

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

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

Contents

Figures

Tables

1 Introduction

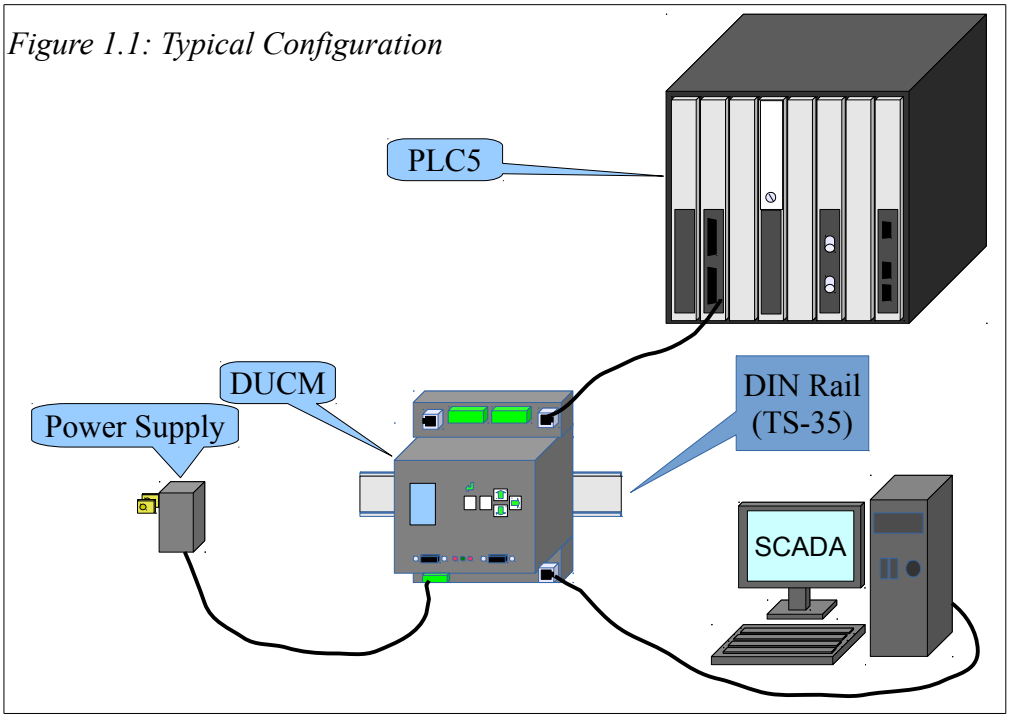
The Niobrara DUCM is a DIN rail mount device capable of running a custom application for performing communication translations between serial and/or Ethernet protocols. This document covers an application that allows a Modbus or RNIM serial master to gather data from one or more DF1 slaves.

Support is currently provided for Allen-Bradley SLC 500, MicroLogix, and PLC5. PLC data is presented as Modbus Holding Registers (4x). The DUCM may be configured as a Modbus RTU (default) or RNIM slave. The Modbus Slave Address (default=1), baud rate (default=19200), data bits (default=8), and parity (default=NONE) may all be configured from the front panel.

Both serial ports of the DUCM may be configured as DF1 master or RNIM or Modbus slave. The Ethernet port will always be a Modbus/TCP slave.

The front panel is used to configure the module. Pressing any key on the keypad will start the menu-driven configuration on the LCD. All ports and DF1 slaves may be configured with this menu.

Figure 1.1: Typical Configuration



2 Installation

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

- DUCM
- Power source for DUCM (use NR&D part TR121ST or available power)
- Cabling between DUCM and Modbus Master may be built or purchased
- Cabling between DUCM and DF1 equipment may be built or purchased.
- DIN rail for mounting

Module Installation

1. Mount the DUCM on a DIN rail.
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.

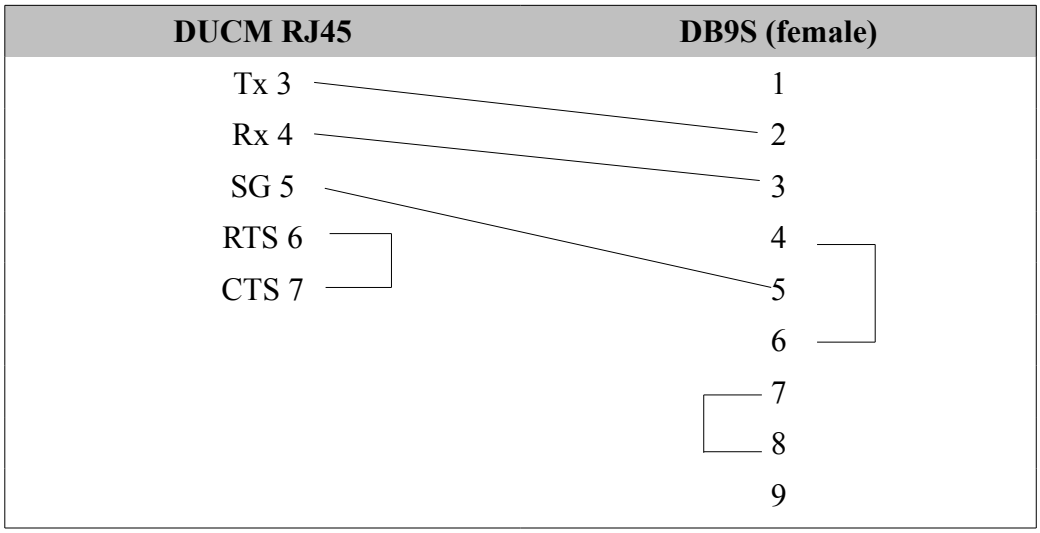
Serial Connections to the DUCM

DUCM RS-232 Serial Port to 9-pin DF1

The RJ45 ports of the DUCM are RS-232 so a simple 3-wire cable is required to connect to the DF1 device. In general, the device's Tx signal will connect to the DUCM's Rx, and the Rx signal will connect to the DUCM's Tx. Signal ground must run from the DF1 device to the DUCM, and each device will have its RTS and CTS handshaking pins shorted together.

The RS-232 port of an SLC-500 uses a standard 9-pin RS-232 serial port and thus the Niobrara MM1 cable may be used. For other standard connections, see the DUCM manual, or contact NR&D's technical support.

Figure 2.1.: DUCM to 9-pin DF1 RS-232 (MM1 Cable)

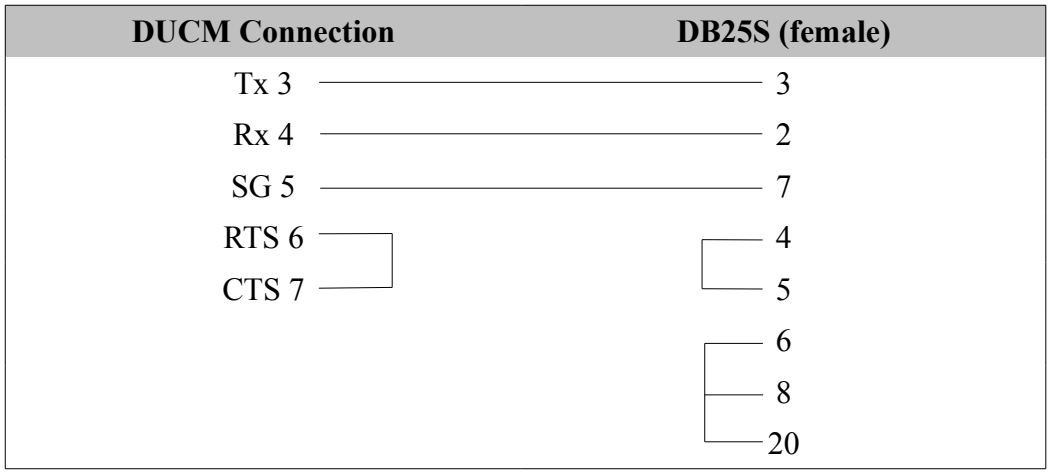


DUCM RS-232 Serial Port to 25-pin DF1

As mentioned above, the PLC's Tx signal will connect to the DUCM's Rx, and the PLC'ss Rx signal will connect to the DUCM's Tx. Signal ground must run from the PLC to the DUCM, and each device will have its RTS and CTS handshaking pins shorted together.

Enhanced PLC5s use a 25-pin RS-232 serial port. Niobrara does not currently have a part number for the appropriate cable, but the pinout is shown below. Contact technical support for a custom cable part number.

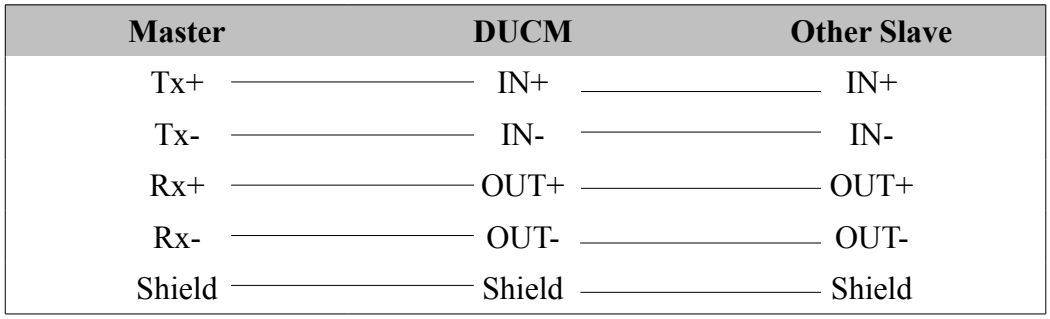
Figure 2.2.: DUCM to 25-pin DF1 RS-232



DUCM RS-485 Serial Port to Modbus Network

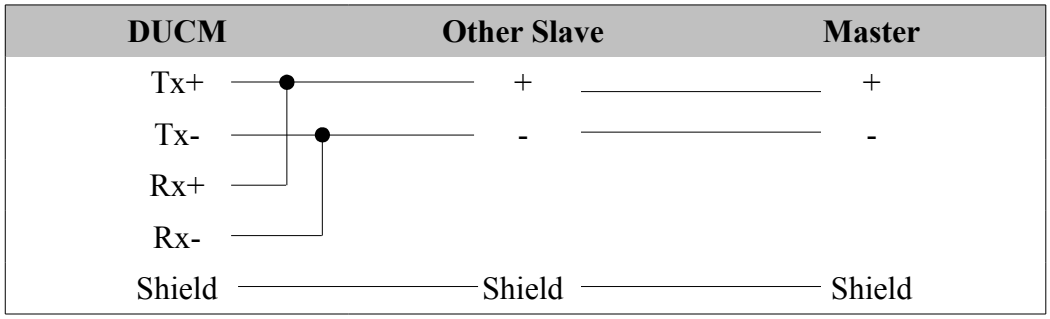
The screw terminal connectors of the DUCM are RS-422/485 so a simple 4-wire cable is required to connect to most Modbus equipment. Twisted pair cable should be used.

Figure 2.3.: DUCM to 4-wire Modbus Slaves



2-Wire RS-485 slaves are supported by the DUCM by jumpering the TX+ and RX+ together to make the (+) connection and the Tx- and Rx- together for the (-) connection.

Figure 2.4.: DUCM to 2-wire Modbus Masters or DF1 Slaves



DUCM Application Configuration

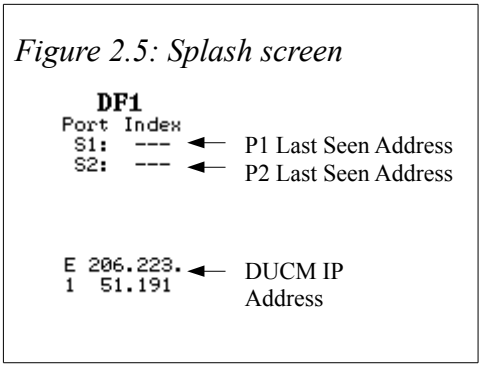
Connect one or more DF1 slaves to a serial port. In this example, connect a PLC-5 to DUCM port 1 and the Modbus Master to DUCM port 2. The default settings for the DUCM are shown in Table 2.1.

Table 2.1: DUCM Default Port Settings

Setting	Port 1	Port 2
Protocol Mode	DF1 Master	Modbus RTU
Baud Rate	19200	19200
Parity	None	None
Data Bits	8	8
Stop Bits	1	1
Data Level	RS-232	RS-485

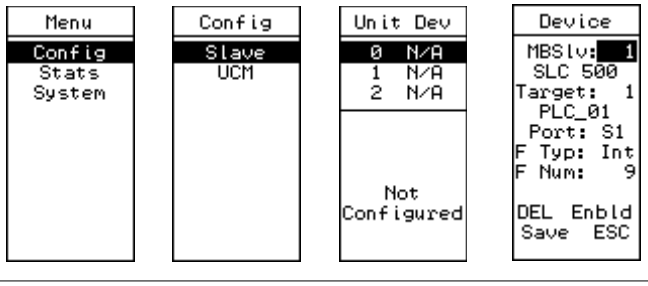
These settings may be modified by using the front panel and LCD screen on the DUCM. When the application starts it is read to translate any incoming messages from the master to the appropriate slave. The DUCM Splash screen will look similar to Figure 2.5. This screen displays information about the DUCM's IP address and about the communication between the DUCM and the master and slaves, as applicable.

Figure 2.5: Splash screen



Pressing the Up, Down or right arrow key will bring up the Main Menu. Use the up, down, right, and enter keys to select Config, Slave to configure the slave(s) connected to the DUCM from the list.

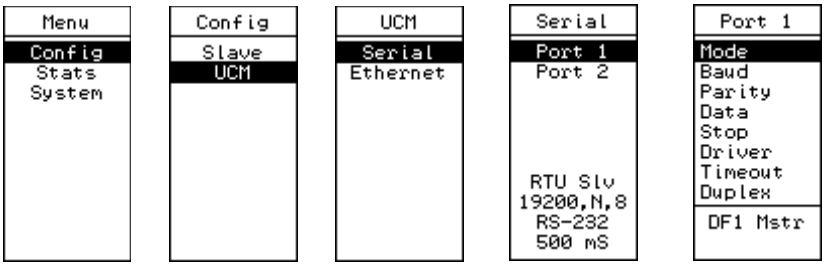
Figure 2.6: Configure Slaves



Use the left and right arrows to move between fields. Use the up and down arrows to change settings. Available settings are: MBSlv (the device address the Modbus/RNIM master will poll), PLC Type, Target (the device address assigned to the PLC), PLC Name, Port (physical DUCM port slave is connected to), F Typ (file type in PLC to be polled), and F Num (file number in PLC to be polled). At the bottom of the screen, the user can delete the current configuration, enable or disable the ability to talk to the selected slave, save the current configuration, or escape without making any changes to the current configuration.

To set up serial port parameters of the DUCM, use the up, down, right, and enter keys to select Menu, Config, Serial, Port 1 (or Port 2) then select the appropriate settings to match the settings of the connected device.

Figure 2.7: Configure Serial Ports



To change a setting, use the up or down arrows to navigate to the setting to be changed, then press the right or enter button. Once inside the setting, use the up or down arrows to change the setting, then left or right and enter to save that setting and return to the settings menu.

Available settings are:

- Mode – Selects the protocol for the serial port. Choices are Modbus RTU Master, Modbus RTU Slave, RNIM Slave, and DF1 Master.
- Baud – Sets the port's baud rate. Choices are 2400, 4800, 9600, and 19200.
- Parity – Sets the port's parity. Choices are Even, Odd, and None.
- Data – Sets the data bits to be used. Choices are 7 or 8. As of the writing of this manual, all available protocols only use 8.
- Stop – Sets the port's stop bits to use. Choices are 1 or 2.
- Data – Sets the port's data level and hardware duplex. Choices are RS-232, 2wire 485, and 4wire 485

- Timeout – When the DUCM's port is a DF1 or RTU master, this sets the timeout before the DUCM gives up on a reply from the slave. Choices are 500 mS, 1S, 2S, 3S, 4S, and 5S.
- Duplex – In DF1 Master mode, this setting determines which version of DF1 is used on the wire. Choices are Half and Full.
- Drop # - Sets the drop number for the port if it is in RNIM Slave mode. Choices are 0-99.
- Force Rte – If set to Yes, RNIM Slave mode will take a message directed through it, and send the DF1 message to address 1, regardless of the actual downstream drop in the RNIM message.
- CTS Delay – In RNIM mode, the port will raise RTS before transmitting the RNIM reply. This setting determines the delay between raising RTS and transmitting. Choices are 0, 50 mS, 100 mS, 200 mS, 500 mS, and 1S.

3 DF1 Operation

The DF1 DUCM application listens on the Modbus/TCP, Modbus RTU, or RNIM slave ports for an appropriate query. When a query comes in, the DUCM checks the slave table for a listing at the device address in the query. If a match is found, the DUCM creates a query to that device, using the file number and type from the slave table, and the register number from the originating query. When the reply comes back from the DF1 slave, the DUCM translates it to the appropriate protocol, and transmits a reply.

The DUCM will always answer Modbus messages directed to slave address 255 using its own registers.

4 Examples

Table 4.1 shows a system with an Allen-Bradley MicroLogix 1100 to be connected to an RNIM master. The PLC is connected to Port 1 of the DUCM with an RS-485 2-wire cable and the A-B 1763-NC01. The two positive pins of Port 1 should be jumpered together, and connected to the “B” terminal of the AB dongle, and the two negative pins of Port 1 should be jumpered, and connected to the “A” terminal. The RNIM Master has an RS-485 port and is configured for 9600 baud, 8 data bits, 1 stop bit and Even parity. The DUCM is configured as shown in Table 4.1. The MicroLogix 1100 is configured as shown in Figure 4.1.

Table 4.1: Example 1 Settings

Parameter	DUCM	
	Port 1	Port 2
Protocol Mode	DF1 Master	RNIM Slave
Baud Rate	19200	19200
Parity	None	NONE
Data Bits	8	8
Stop Bits	1	1
Driver	2-Wire	232
Timeout	500 mS	N/A
Duplex	Half	N/A
Drop Number	N/A	3
Force Route	N/A	Yes
CTS Delay	N/A	50 mS

Figure 4.1: Example 1 MicroLogix Channel 0 Configuration

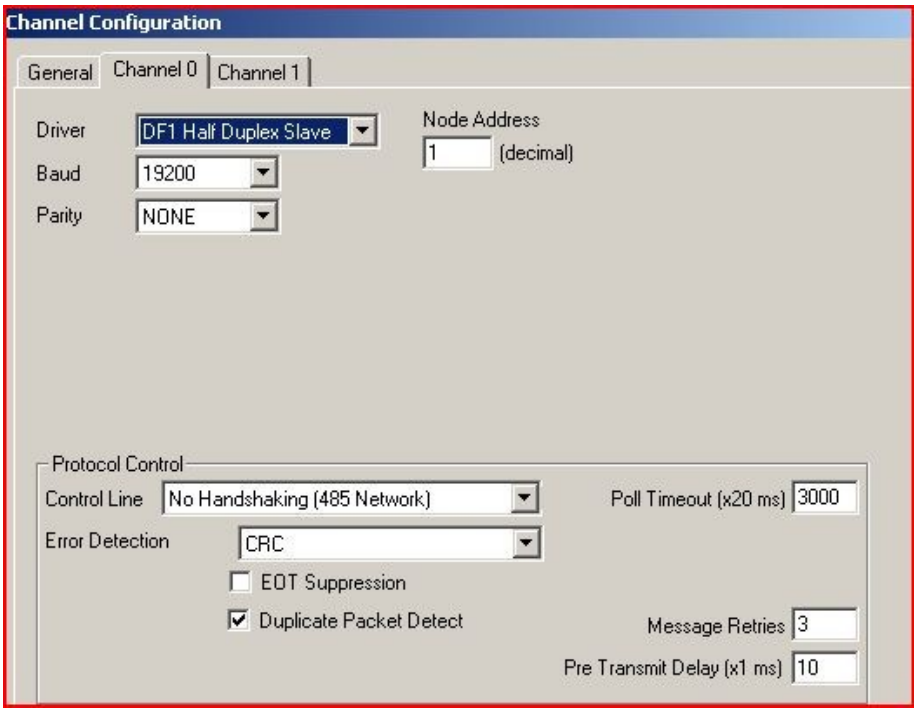
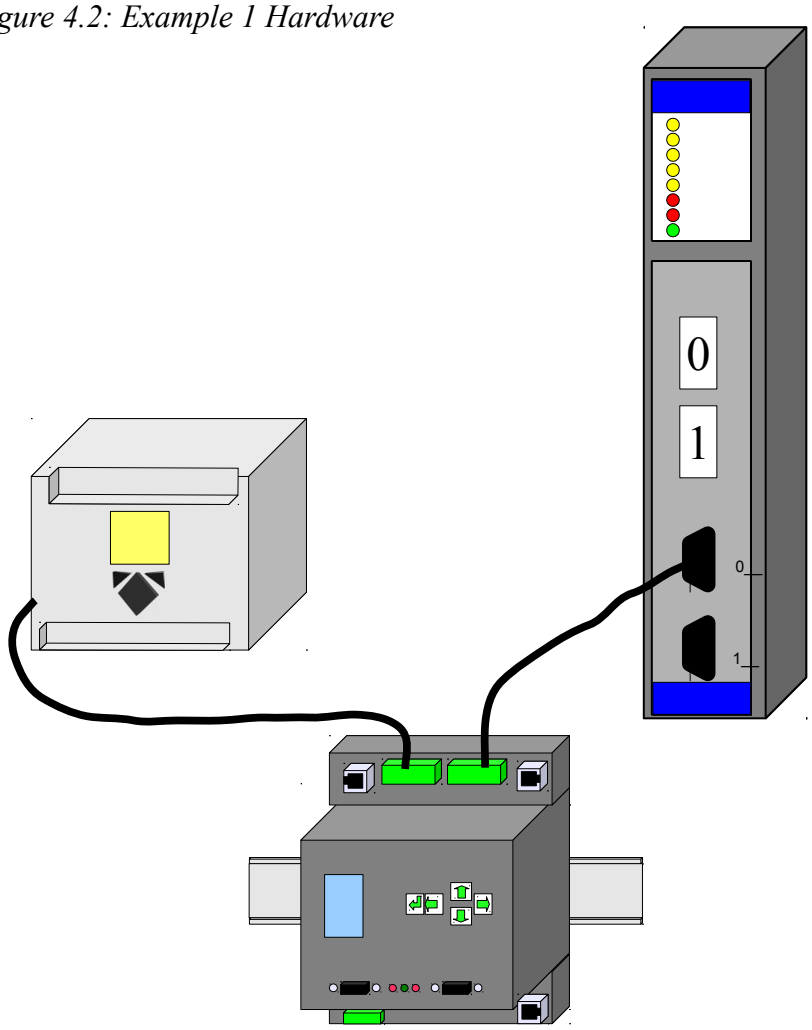
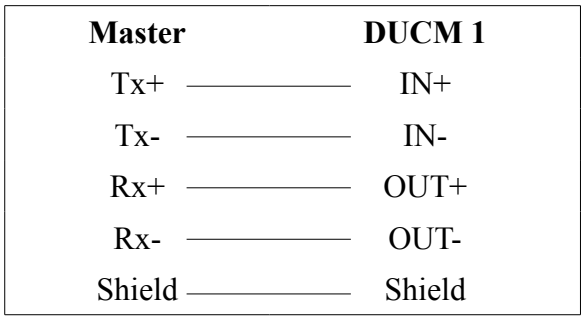


Figure 4.2: Example 1 Hardware



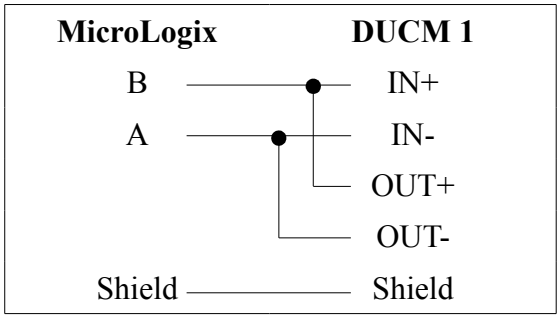
Port 2 of the DUCM will be RS-485 so a simple 4-wire cable is required to connect to most Modbus equipment. A twisted pair cable such as Belden 8723 should be used with one pair on the TX and the other pair on the RX circuit.

Figure 4.3: 4-wire RS-485 Example



The MicroLogix dongle has a 2-wire RS-485 port, so use a single twisted pair cable and jumper the IN+ to OUT+ at the DUCM for the (+) connection as well as jumper the IN- to OUT- for the (-) connection.

Figure 4.4: 2-wire RS-485 Example



5 Testing and Troubleshooting

DUCM Lights

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

- The yellow **Tx** light on each serial port indicates that the DUCM port is transmitting data. This light should quickly flash when the DUCM has a message to transmit to the connected device.
- The green **Rx** light on each serial port indicates that the DUCM port is receiving data. This light should quickly flash when the DUCM receives a message from the connected device.
- The yellow Link/Activity light indicates that the Ethernet port of the DUCM has a link, and is transmitting or receiving packets. This light should blink periodically any time an Ethernet cable is connected.
- The yellow 100 light indicates that the DUCM has a 100 Mbit connection.

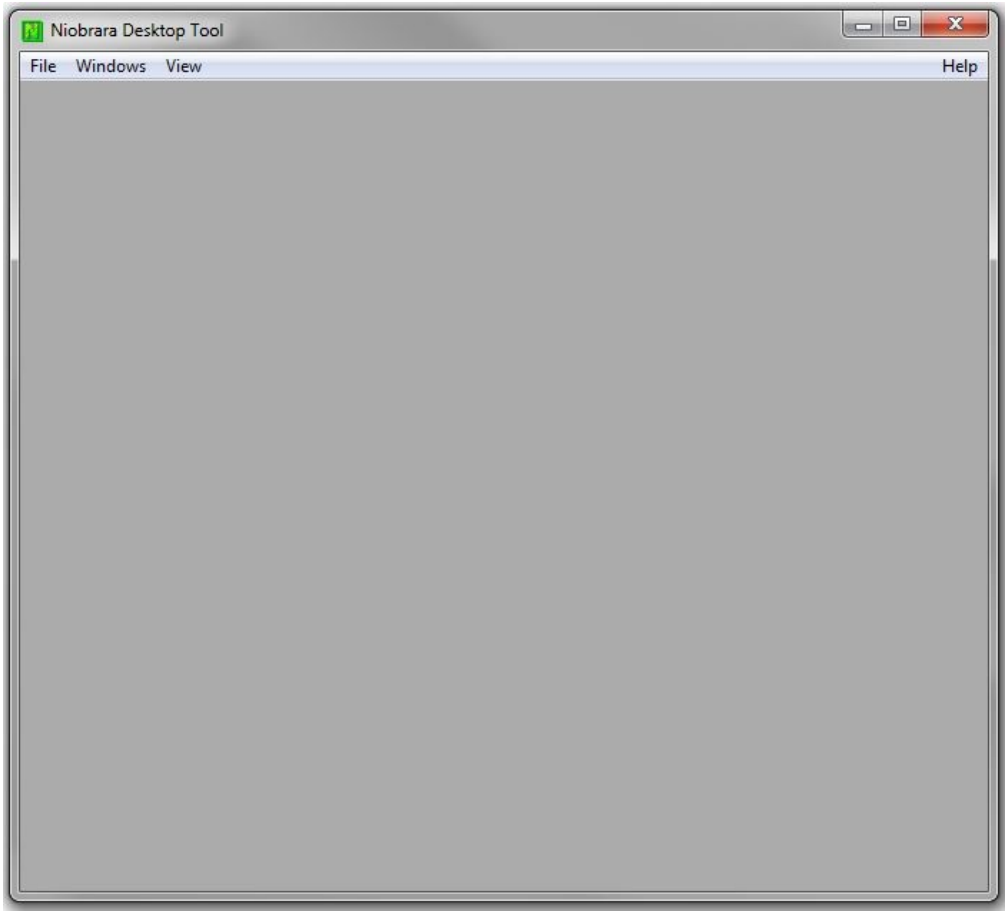
Testing the Modbus Connection

The program NRDTOOL.EXE may be used to quickly test any port of the DUCM that is a Modbus RTU slave. 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 Mount, DUCM, Software. This will download the DUCM_SETUP.EXE.
2. Connect the Niobrara MM1 cable the desired DUCM port and the serial port of the PC.

3. Start NRDTOOL.EXE. On most Windows systems do a Start, All Programs, Niobrara, NrdTool. See Figure 5.1.

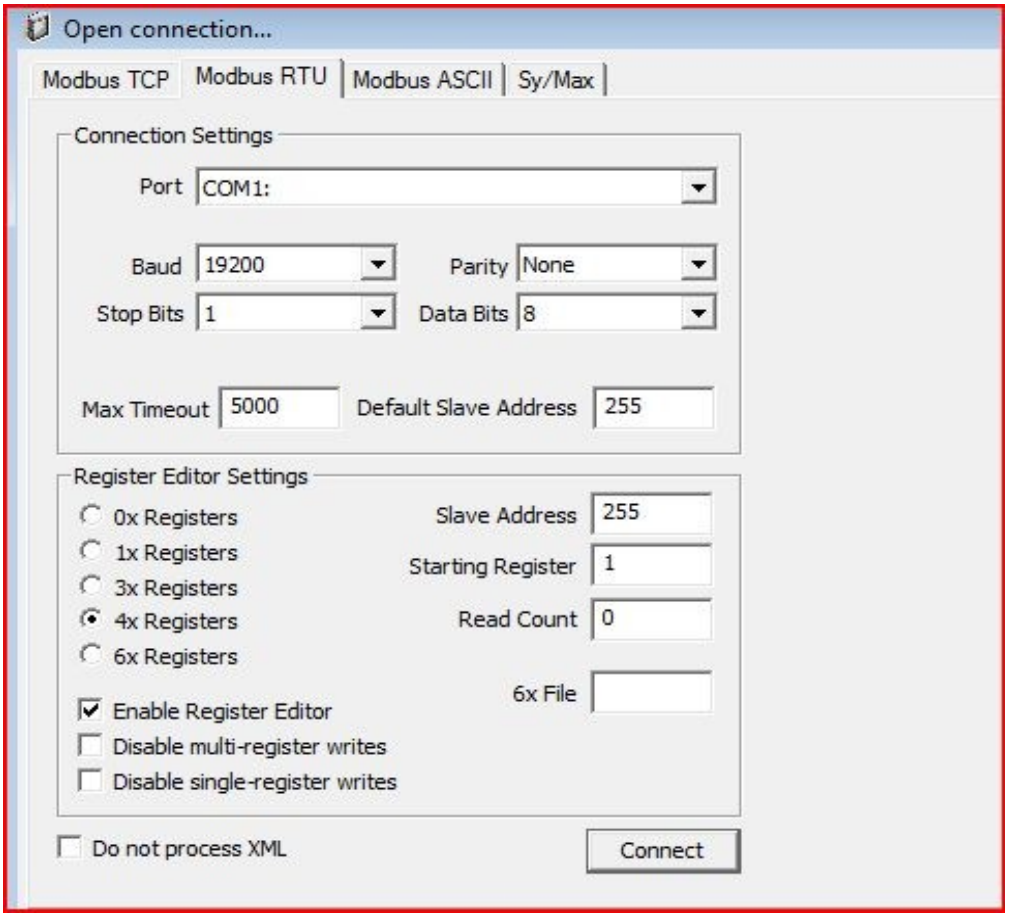
Figure 5.1: NRDTOOL.EXE



4. File, Open Connection
5. Select the Modbus RTU tab
6. Check that the Connection settings match the DUCM port settings. The Default Slave Address leave at 255. See Figure 5.2

7. Under Register Editor Settings check that 4x registers is selected, set slave address to 255, Starting Register to 1, Read Count to 0, Enable Register Editor is checked, and Do Not Process XML is check. See Figure 5.2

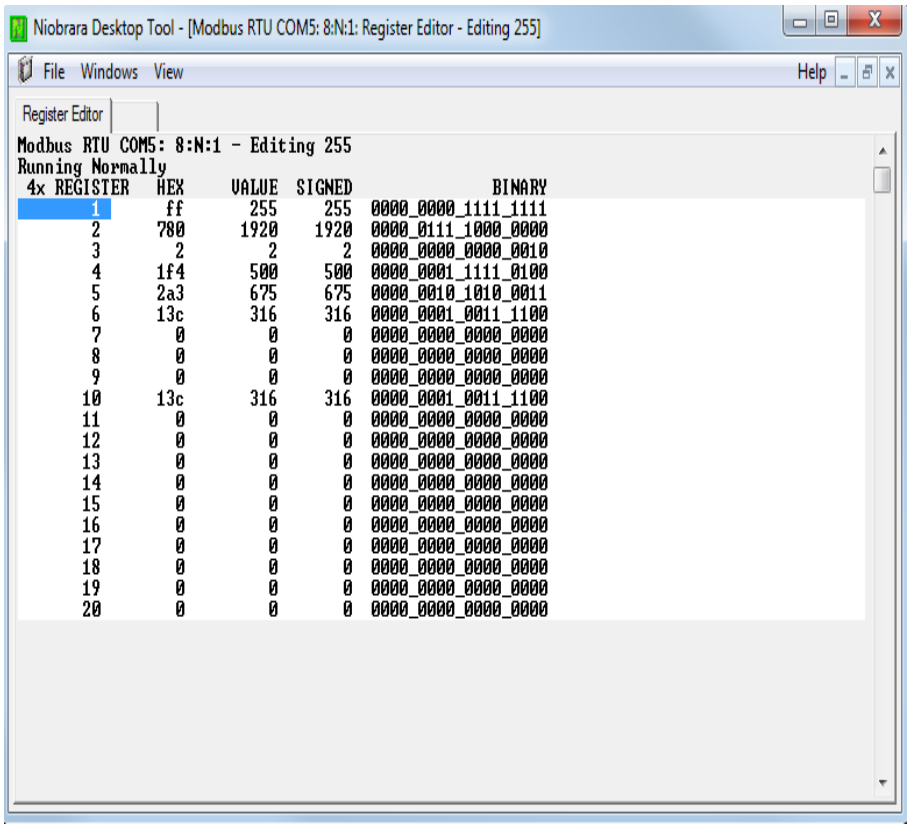
Figure 5.2: Open Connection



8. Click Connect. Slave address 255 is a special drop number that the DUCM will respond to with its own registers.

   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 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

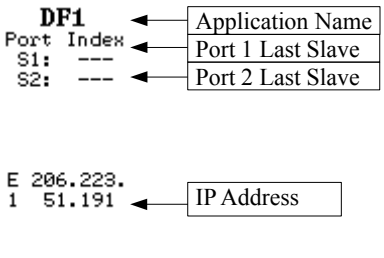
The LCD backlight will illuminate on any button press. The timeout for the backlight is set for 2 minutes.

Operating Screens

Splash Screen

The main page shows the application name, last slave address for each serial port, and optionally, IP address.

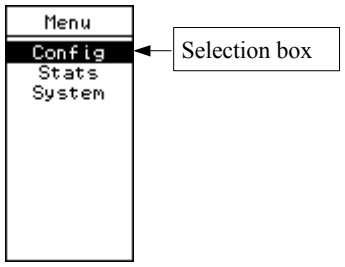
Figure 6.1: Splash screen



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.

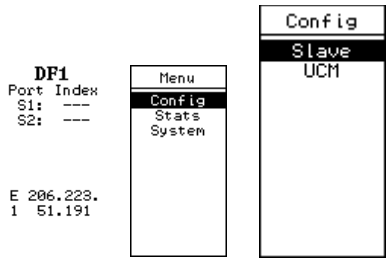
Figure 6.2: Main Menu screen



Config Menu

The Config menu is used to configure the application for the correct slave types, serial port parameters, and optionally the IP address.

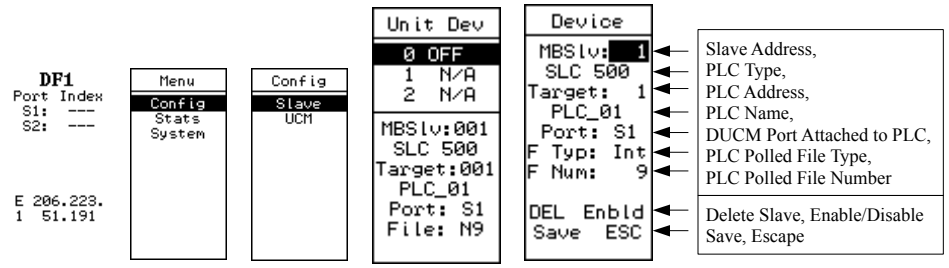
Figure 6.3: UPS Configuration Screen



Slave

Menu used to configure the available slaves. The user can configure the Modbus device address, PLC type, PLC address, PLC name, attached DUCM port, File Type, and File Number desired for the slave. Use the left and right arrows to navigate between fields, up and down arrows to changed the parameters, and the enter key to activate the fields at the bottom of the screen.

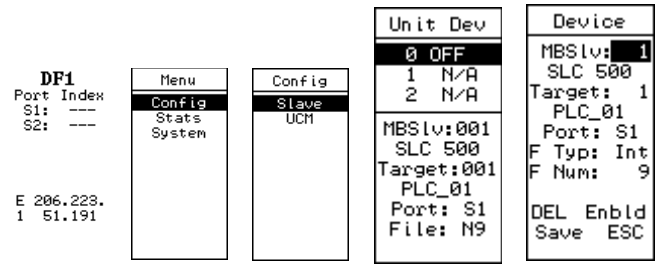
Figure 6.4: Slave Configuration Screen



MBSlv

This setting decides the Modbus/RNIM device address that the DF1 PLC answers at. Valid choices are 1-254.

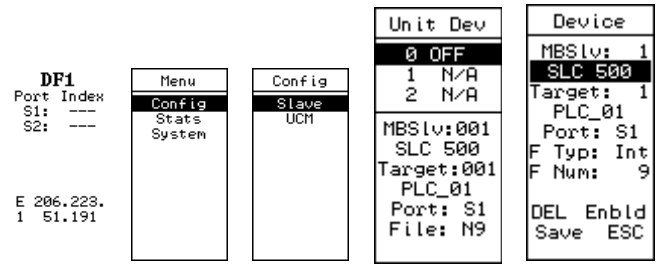
Figure 6.5: Modbus Slave Address Setting



PLC Type

The DUCM needs to know what type of PLC is being polled, as different PLCs use different DF1 commands to obtain the same data. Valid choices are SLC 500, PLC 5, MicroLogix, and RTU Pass(passes Modbus RTU through instead of translating to DF1).

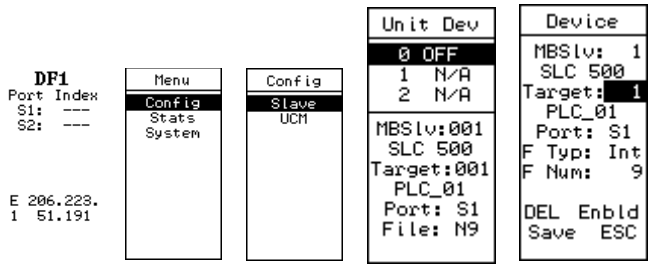
Figure 6.6: PLC Type Setting



Target

This setting tells the DUCM the DF1 device address of the slave PLC. In most cases, this number will match the MBSlv setting, but the ability to have them be different may be desired by the user.

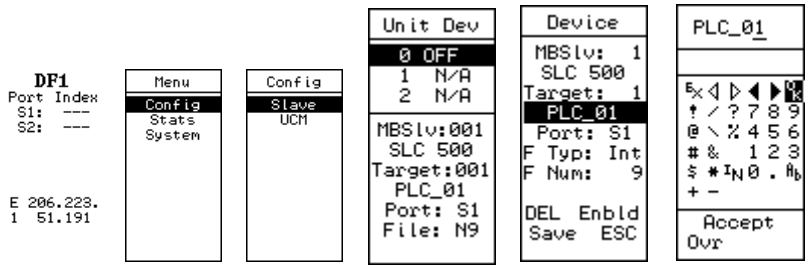
Figure 6.7: DF1 Slave Address Setting



PLC Name

The user may want to assign a unique name to each slave, for identifying purposes later. The application allows up to 10 characters of the user's choosing. The up and down arrows will increment the last character in the name. Pressing the enter key will bring up an editing window as shown in the last screen below.

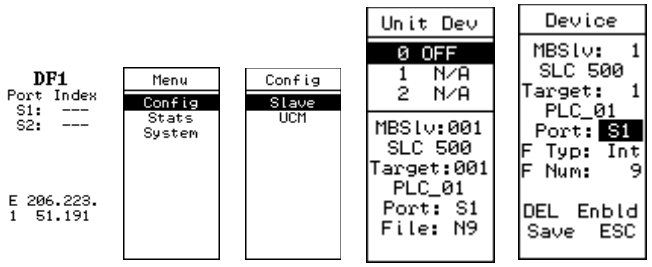
Figure 6.8: PLC Name Setting



Port

Either DUCM serial port may be configured as a DF1 master. The user must tell the DUCM which port the PLC is connected to.

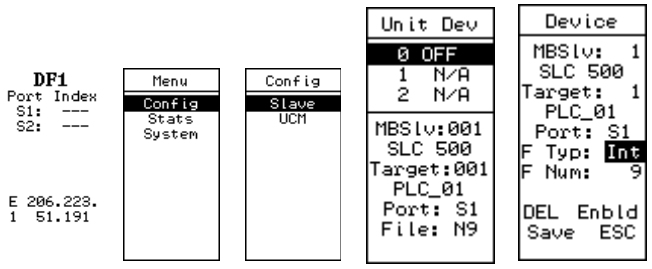
Figure 6.9: DUCM connected port Setting



F Typ

Allen-Bradley PLCs use a variety of different types of files. The DUCM is capable of reading most file types, and converting them into Modbus holding registers or just registers in the case of RNIM. Choices for this setting are Int (Integer), Flo (Floating Point), Str (String), ASC (ASCII), Sta (Status), Bit (Bit Field), Tim (Timer), Cou (Counter), or Con (Control). The most common file type used for this application is Integer.

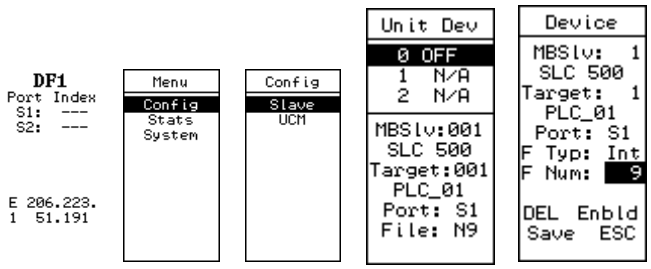
Figure 6.10: DF1 File Type Setting



F Num

Allen-Bradley PLCs often use a number of files for operation. Each file has a unique number, and is made up of a number of elements. The maximum number of elements in each file differs between different PLCs. Valid file numbers are 0-254. Users often use file 9.

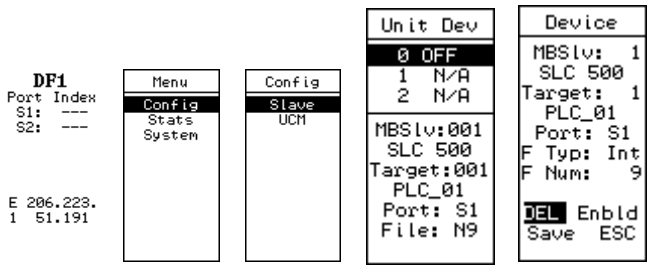
Figure 6.11: DF1 File Number Setting



Del

This setting is used to delete a slave that has already been configured. To remove a DF1 slave, enter the settings for that slave, use the right or left arrows to highlight the “DEL,” then press enter.

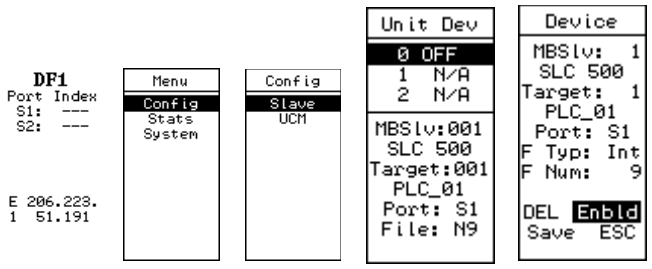
Figure 6.12: DF1 Slave Delete Setting



Enbld/Dsbld

This setting might be used to temporarily disable a slave that is out of service. To disable or enable a DF1 slave, enter the settings for that slave, use the right or left arrows to highlight the “Enbld” or “Dsbld,” then press enter to toggle.

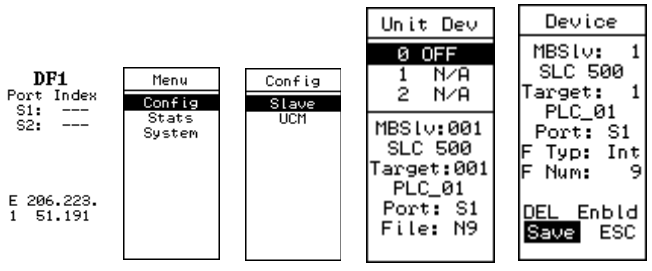
Figure 6.13: DF1 Slave Enable/Disable Setting



Save

This setting is used to save all displayed settings to EEPROM in the DUCM when a slave is created or edited.

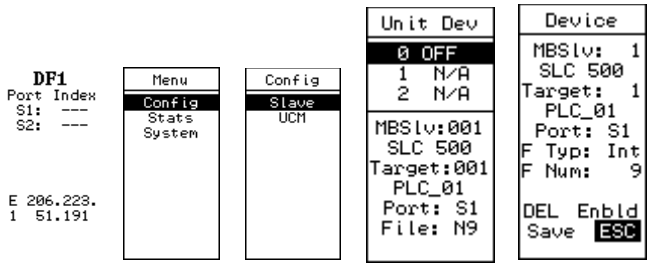
Figure 6.14: DF1 Slave Save Setting



ESC

This setting is used to exit the configuration of a slave without saving settings to EEPROM in the DUCM.

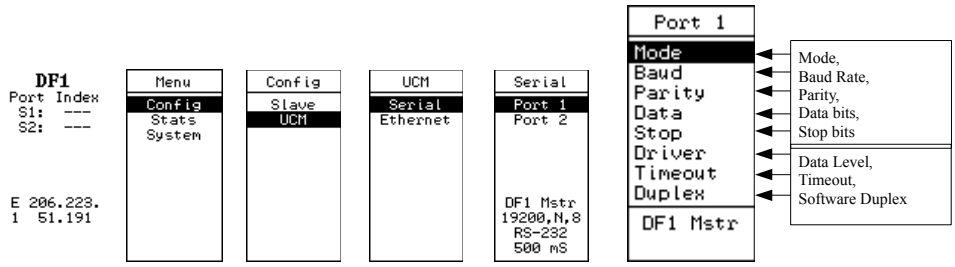
Figure 6.15: DF1 Slave ESC Setting



Serial Config Menu

The serial configuration menu is used to set the operating parameters of both serial ports. Select the Mode, Slave address, Baud rate, Parity, Data bits, Stop bits, Driver mode, Timeout, and if applicable, the Software Duplex in this menu.

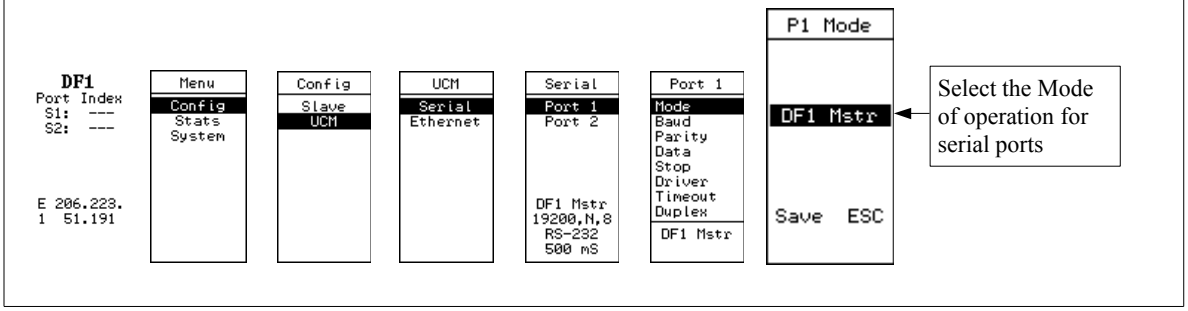
Figure 6.16: Configure Serial Port Screen



Mode Menu

The Mode Menu is used to set the mode of operation for the configured port. DF1 Mstr, RTU Master, RTU Slv, and RNIM Slv are the choices. The Mode should be chosen to match the operation of the device connected to that port. Press the up and down arrows to change the setting, then the left or right arrows to choose to save the current setting or escape without saving changes. Press the enter key once Save or ESC is highlighted.

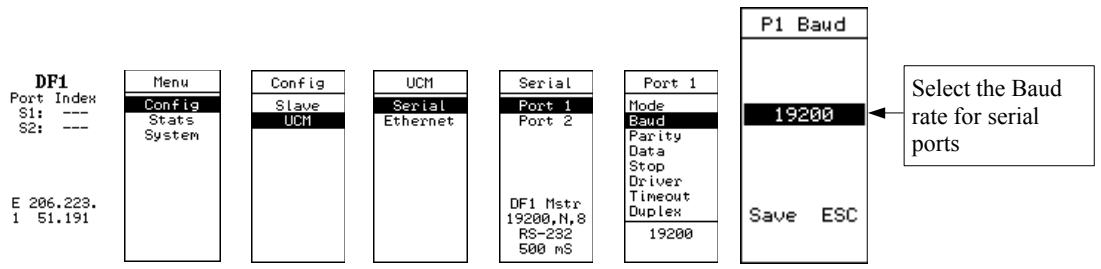
Figure 6.17: Mode Screen



Baud Rate Menu

The Baud Rate is selectable for both ports. Valid choices include 2400, 4800, 9600, and 19200.

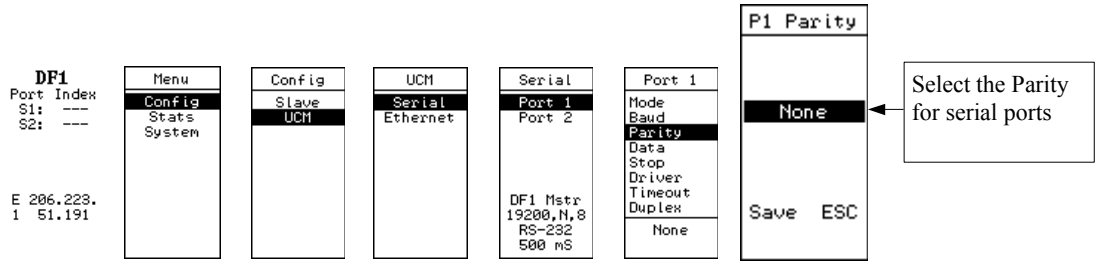
Figure 6.18: Baud Rate Screen



Data Parity Menu

Select the Data Parity for both ports. Valid choices are None, Odd, and Even.

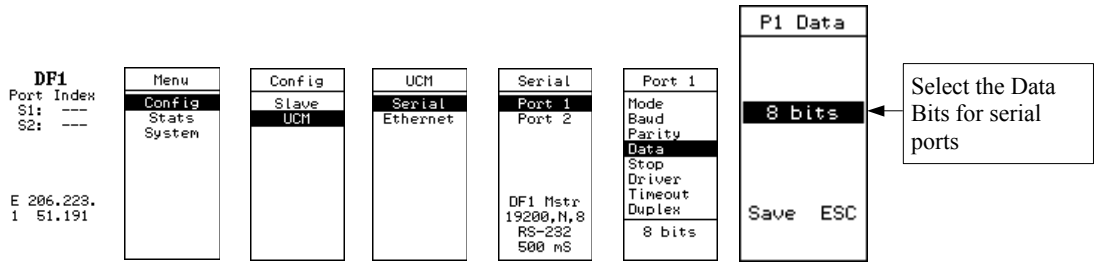
Figure 6.19: Parity Screen



Data Bits Menu

Select the Data Bits for both ports. Valid choices are 7, and 8. Although this option is available, all involved protocols (Modbus RTU, RNIM, and DF1) must use 8 Data Bits.

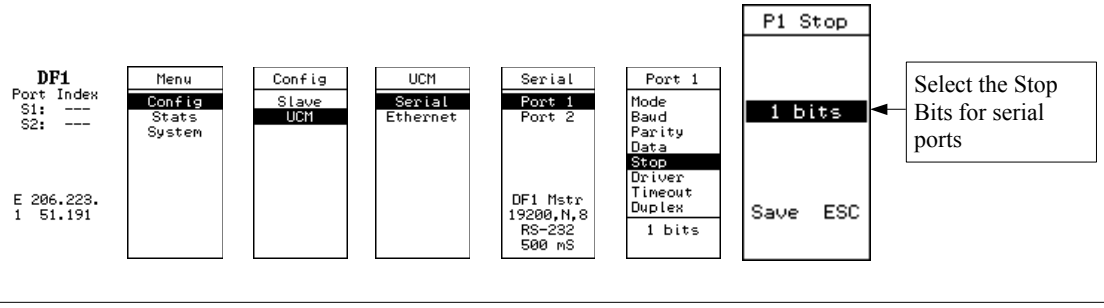
Figure 6.20: Data Bits Screen



Stop Bits Menu

Select the Stop Bits for both ports. Valid choices are 1, and 2.

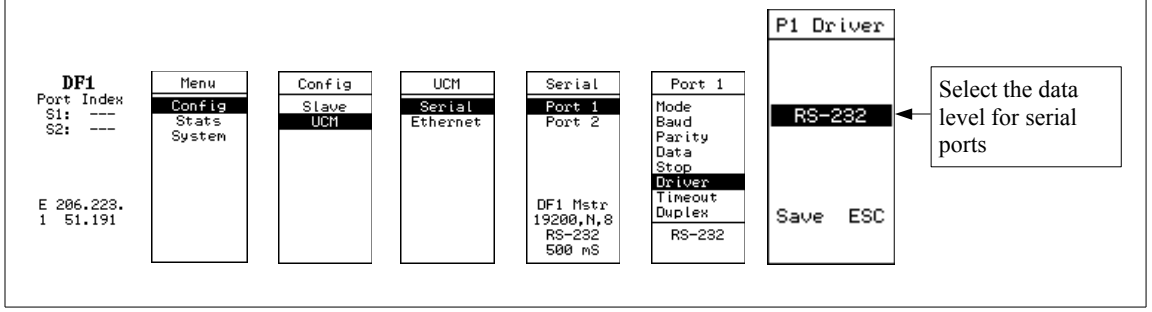
Figure 6.21: Stop Bits Screen



Data Driver Menu

Select the data level for both ports. Valid choices are RS-232, 2wire 485, and 4wire 485.

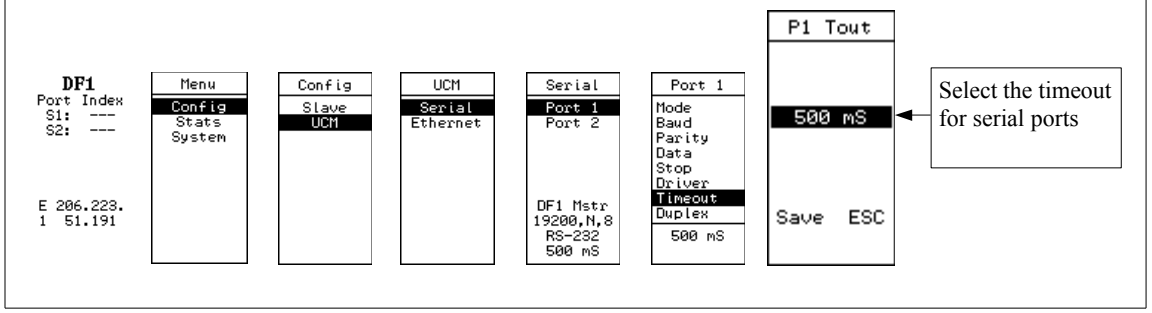
Figure 6.22: Data Driver Screen



Timeout Menu

Select the timeout for both ports. Valid choices are 500 mS, 1 second, 2 seconds, 3 seconds, 4 seconds, and 5 seconds. This menu item is only valid for Modbus and DF1 master modes.

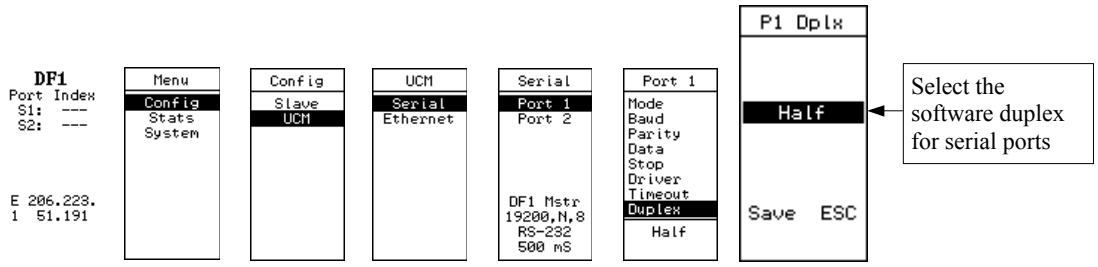
Figure 6.23: Timeout Screen



Software Duplex Menu

Select the software duplex for any DF1 ports. Valid choices are half and full. This menu item is only valid for DF1 master mode and only affects the software duplex, not hardware duplex.

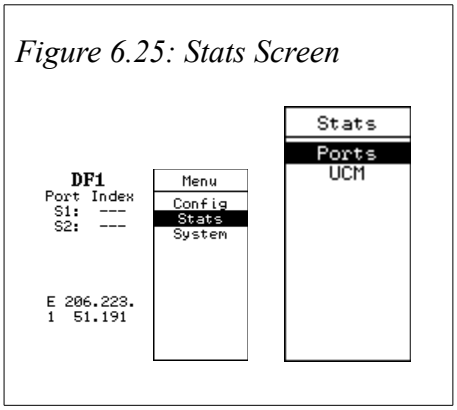
Figure 6.24: Duplex Screen



Stats Menu

The Stats Menu shows communication statistics for the serial ports. Pressing the Enter key will reset the counts displayed in these screens. The user can also see stats about the DUCM and the DF1 application.

Figure 6.25: Stats Screen



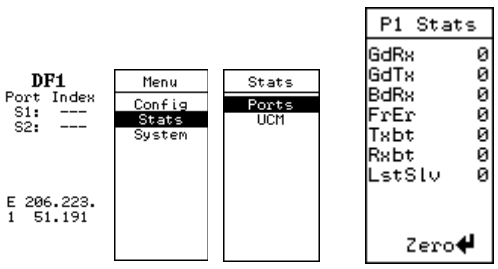
Port Statistics Screen

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 – Valid messages received on this port
- GdTx – Messages transmitted by this port
- BdRx – Indicates timeouts on a DF1 port
- FEr – Framing error on a Modbus port
- Txbt – Transmitted bytes
- Rxbt – Received bytes
- LstSlv – Last Slave polled by the master

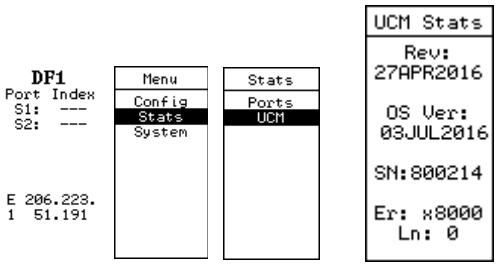
Figure 6.26: Serial Stats Screen



DUCM Statistics Screen

The DUCM Stats screen shows DF1 application revision, OS Version, Module serial number, and application error code and line number.

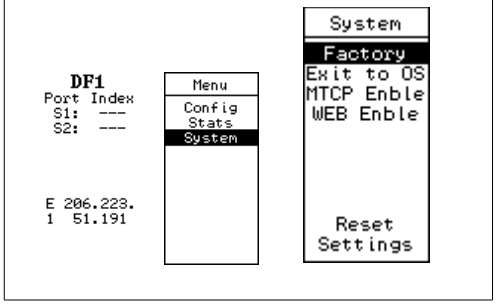
Figure 6.27: DUCM Stats Screen



System Menu

The System Menu provides access to the OS, reset settings to factory defaults, and the ability to prevent access to Modbus/TCP and web configuration.

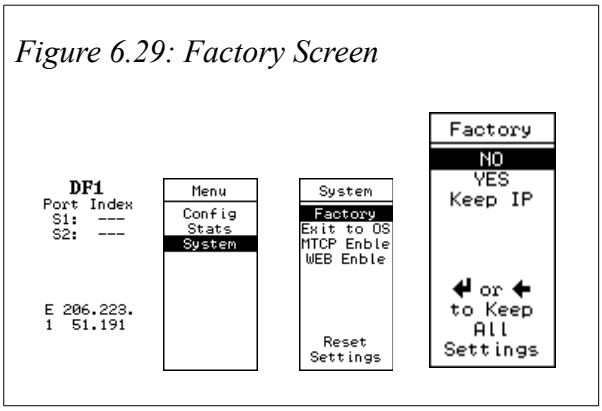
Figure 6.28: System Menu Screen



Factory Settings

Factory gives the user the option to set all the settings back to factory default. In all cases, the serial ports revert back to original protocol and baud rate, and all configured slaves are deleted. If "Keep IP" is selected, the DUCM will retain its IP address. Otherwise, it will revert to 10.10.10.10.

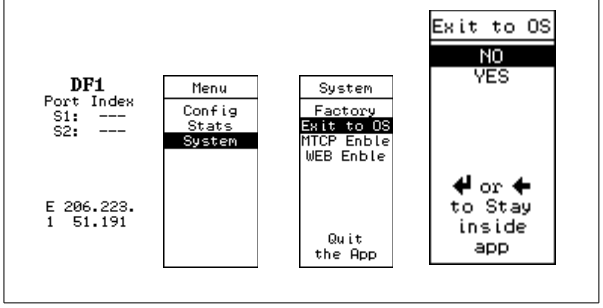
Figure 6.29: Factory Screen



Exit to OS

The user may wish to exit the application, and return to the operating system. This can be especially useful when loading a new version of the application into the DUCM.

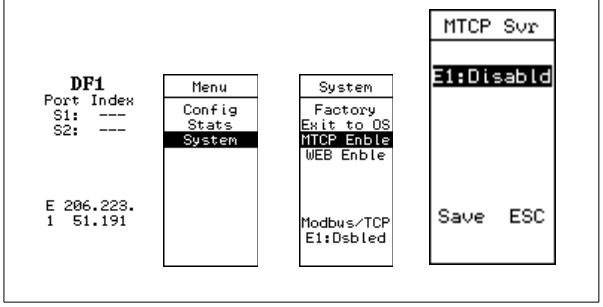
Figure 6.30: Exit to OS Screen



MTCP Enble/WEB Enble

For security purposes, the user may wish to prevent access to Modbus/TCP, or to web-based configuration. Use these menu items to disable those features.

Figure 6.31: Enable Screen



7 Software Installation

Software Installation

The application files for the DUCM are included in the DUCM_DF1_SETUP.EXE file. The latest version of this file is located at www.niobrara.com. Follow the link for "Application Notes", select "DUCM", and "DF1".

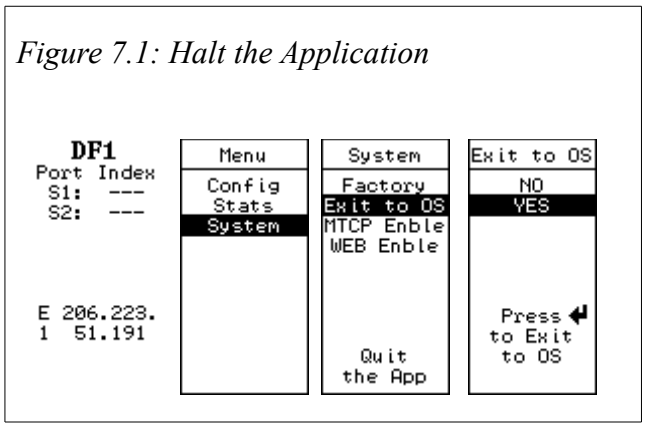
The program DUCM_SETUP.EXE is also required to be run before the DF1 program may be loaded into the DUCM. The DUCM_SETUP program installs the QLOAD program and the FWLOAD program.

Updating the Application in the DUCM via Serial Port

The QLOAD program is used to install the DF1 program.

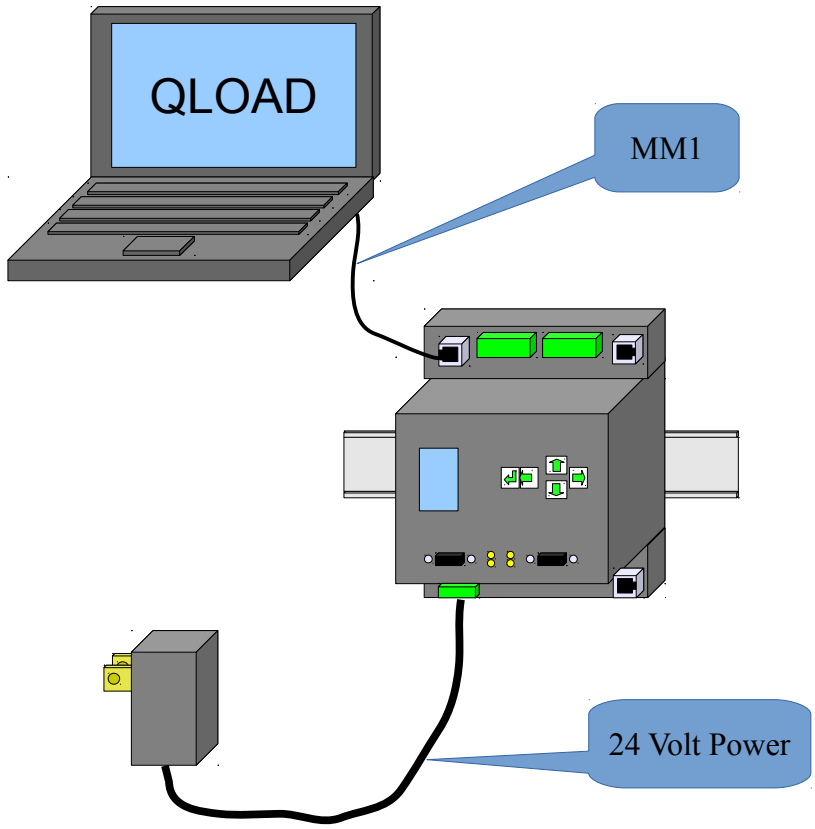
1. The module must be powered.
2. The application must be halted. To accomplish this, use the arrow keys on the module to navigate to the Main menu. Use the Enter or Right arrow button to select the System option. Select the Exit to OS option in the System menu. Use the Enter or Right arrow button to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

Figure 7.1: Halt the Application



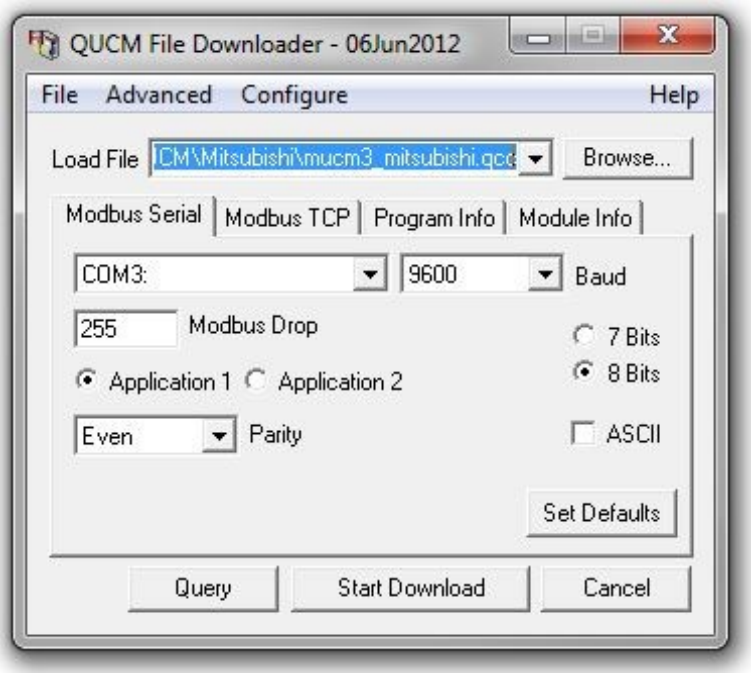
3. Connect the MM1 cable from the module port 1 to the PC.

Figure 7.2: Connect DUCM Module to PC



4. Start QLOAD.EXE. The Windows Start Menu link is “Start, Programs, Niobrara, DUCM, Apps, DF1, QLOAD_DF1” See Figure 7.3

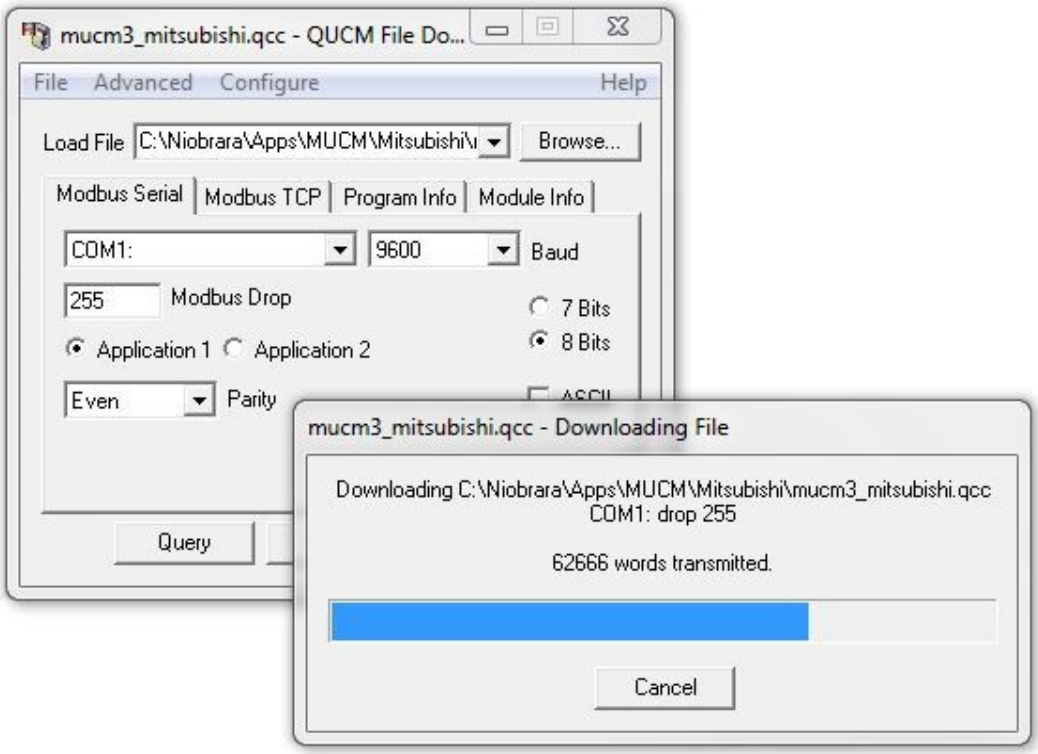
Figure 7.3: QLOAD Application



5. If necessary, Click on the Browse button and select mucm3_mitsubishi.qcc.
6. Click on the "Modbus Serial" tab and verify the following:
    1. The proper PC serial port is selected (COM1, COM2,..).
    2. The baud rate matches the baud rate of the module (default is 9600).
    3. The Modbus Drop is 255.
    4. The Application 1 radio button is selected.
    5. The Parity matches the parity of the module (default is Even).
    6. The number of data bits match that of the module (default is 8 bits).
    7. ASCII is NOT checked.

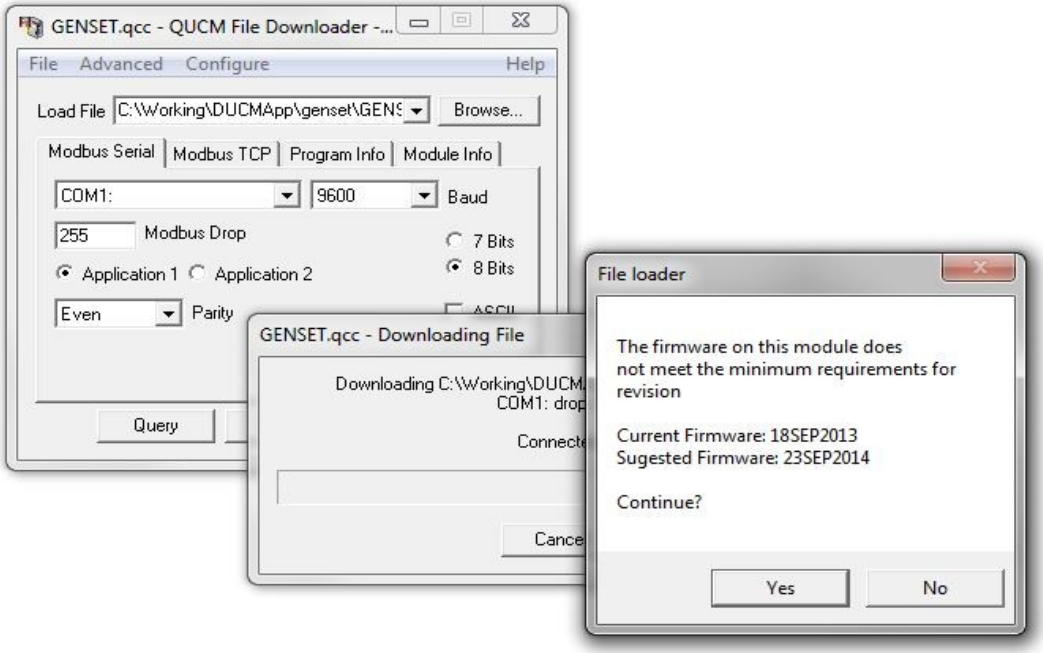
7. Press the “Start Download” button. QLOAD will open a progress bar to show the status of the download see Figure 7.4.

Figure 7.4: QLOAD Progress



If the Firmware Warning dialog appears click “No” and refer to the Updating the DUCM Firmware section of this manual see Figure 7.5.

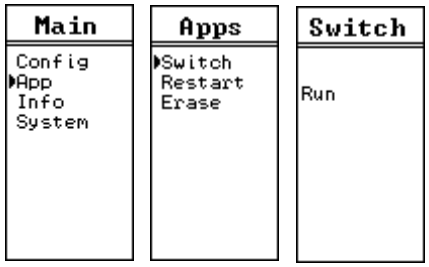
Figure 7.5: QLOAD Firmware Warning Dialog



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

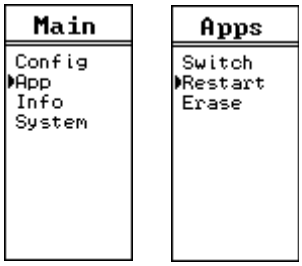
   To accomplish this, use the arrow keys on the module to navigate to the App option in the Main menu. Use the Enter or Right arrow button to select the option. Select the Switch option in the Apps menu. Use the Up or Down arrow to select the Run option. Use the Enter or Left arrow to accept the choice. See Figure 7.6

Figure 7.6: 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 7.7

Figure 7.7: Restart the Application



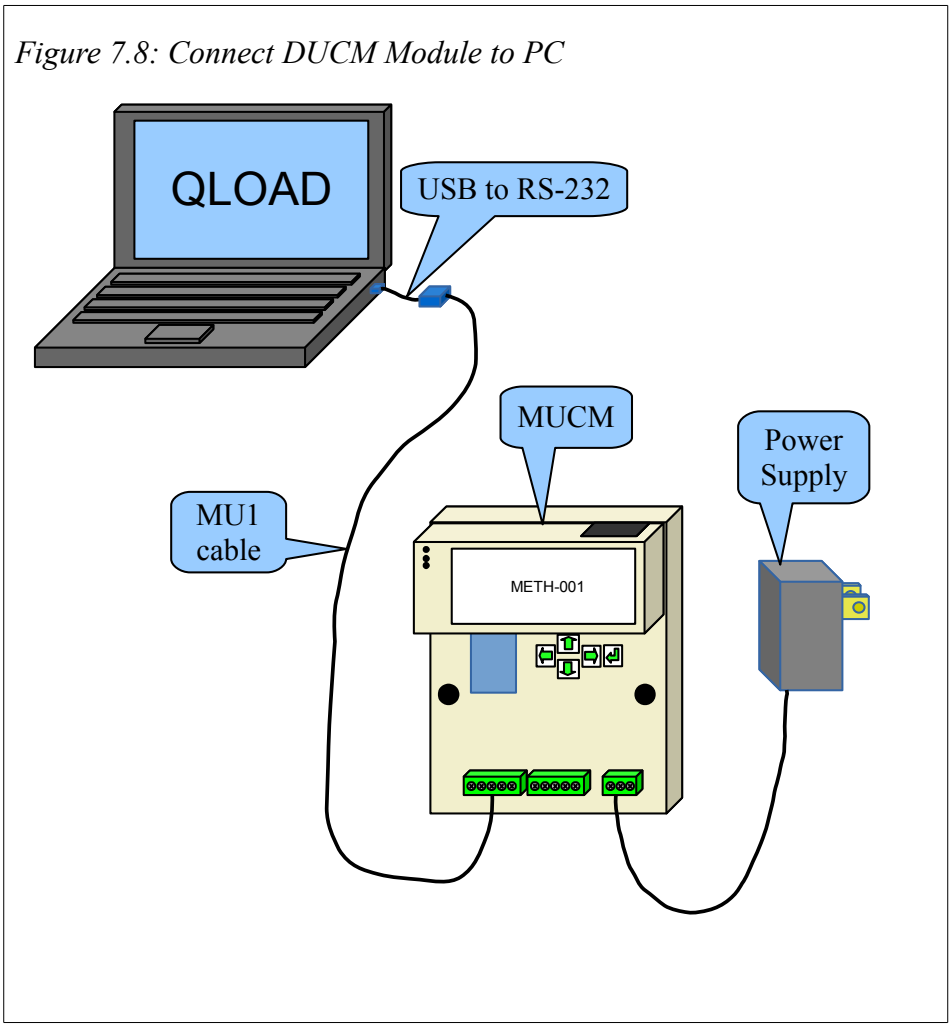
Updating the DUCM Firmware

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 7.8: 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 Serial" tab and verify the following:

   See Figure 7.9

   a) The proper PC serial port is selected (COM1).

   b) The Baud rate matches baud rate of the module.

   c) The Modbus Drop is 255.

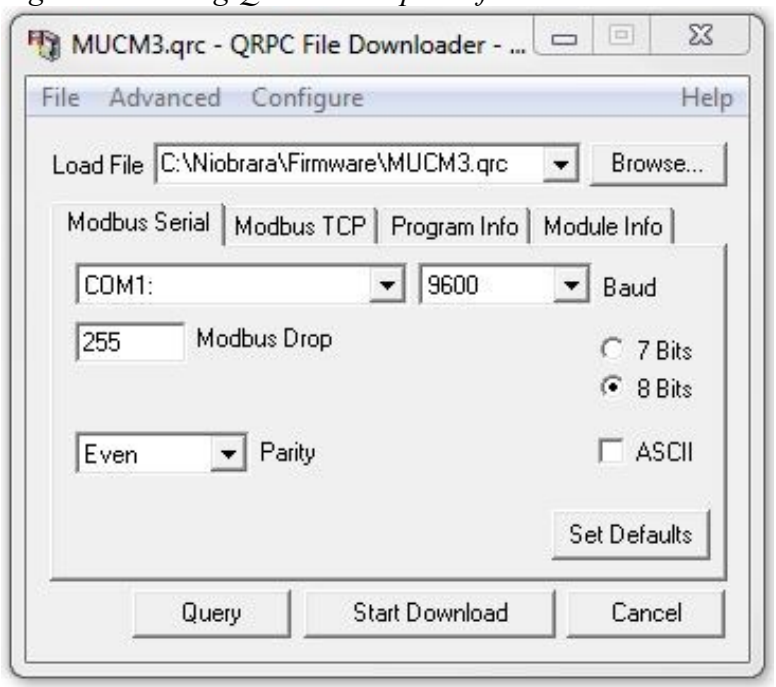
d) Application 1 is selected.

e) The Parity matches the parity of the module.

f) Number of data bits match that of the module.

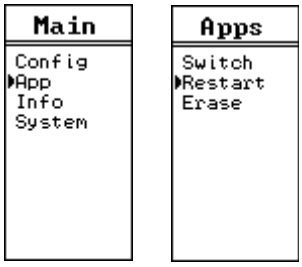
g) ASCII is NOT checked.

Figure 7.9: 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 7.10

Figure 7.10: Restart the Application



Appendix A Purchasing Options

The part numbering scheme for the Mitsubishi kit:

MCP-104-XXX-YZZ

XXX: Three digit code for custom MLWF program preloaded

- 013 - MLWF-013 for 2033A and 9700 UPS
- 014 - MLWF-014 for 2033C UPS
- 015 - MLWF-015 for 2033D, 7011, and 9800AD UPS

Y: Single digit code for transformer

- 0 - for no transformer
- 1 - for TR121ST transformer

ZZ: Two digit code for MU Cable(s) included in the kit

- 01 - MU1 cable included 9-pin serial cable used with 2033C, 2033D, 7011, and 9800AD
- 17 - MU17 cable included 25-pin serial cable used with 2033A, 9700

Example part numbers:

MCP-104-101 - DUCM+302 preloaded with Mitsubishi application, METH-001, wall transformer for DUCM (no connector), MU1 cable

MCP-104-013 - DUCM+302 preloaded with Mitsubishi application, MLWF-013 preloaded with 2033A and 9700 App., no cables or transformer

MCP-104-014-017 - DUCM+302 preloaded with Mitsubishi application, MLWF-014 preloaded with 2033C App., MU1, MU17, no transformer

MCP-104-014-117 - DUCM+302 preloaded with Mitsubishi application, MLWF-014 preloaded with 2033C App., MU1, MU17, wall transformer