

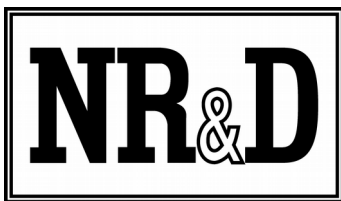
# DUCM Hardware

## Installation Manual

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This manual covers the DUCM hardware features and installation procedures.

Effective: May 29, 2015



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## Contents

1	Introduction.....	5
2	Installation.....	7
	Device Mounting/Removal.....	7
	Power Supply.....	8
3	Removal of the DEB Application.....	9
	Halting the DEB Application.....	9
	Erasing the DEB Application.....	9
	Setting the App switch back to RUN.....	10
4	Ethernet Configuration.....	11
	Setting the E1 IP Address.....	11
	Setting the Subnet Mask.....	12
	Setting the Default Gateway.....	12
	Setting the OS Server Port Number.....	13
	Ethernet Connection to PC.....	13
5	Application Loading.....	15
	Loading the Application into the DUCM.....	15
6	Loading New OS Firmware over Ethernet.....	17
	Updating the DUCM Firmware.....	17
7	Front Panel Operation of OS.....	21
	Main Menu.....	23
8	Front Panel Operation of BOOT Loader.....	25
	Enter the BOOT Loader.....	25
	App, Switch.....	26
	Loading OS Firmware using FWLOAD.....	26
	Exiting the BOOT Loader.....	28
9	Serial Ports.....	29
	Serial Ports.....	29
	RS-232 Ports.....	29
	RS-485 Ports.....	30
	Serial Port Native Operation.....	32

## Figures

Figure 2.1 DIN Rail Mounting and Removal.....	7
Figure 2.2 Power Supply Diagram.....	8
Figure 3.1: Halting the DEB Application.....	9
Figure 3.2: Erasing the DEB Application.....	10
Figure 3.3: Move Switch to RUN.....	10
Figure 4.1: IP Address Source Screen.....	11
Figure 4.2: Subnet Mask Screens.....	12
Figure 4.3: Default Gate Screen.....	12
Figure 4.4: Changing the OS TCP port from 502 to 503.....	13
Figure 4.5 Ethernet Port.....	14
Figure 5.1: QLOAD hello.qcc.....	16
Figure 5.2: DUCM Screens before, during, and after QLOAD of hello.qcc.....	16
Figure 6.1: QLOAD OS Firmware.....	18
Figure 6.2: QLOAD OS Firmware Warning.....	18
Figure 6.3: DUCM Screens during QLOAD of DUCM.qrc.....	19
Figure 7.1: DUCM OS Splash Screen with Single E1 Port (or E2 not in Dual IP mode). 21	
Figure 7.2: DUCM OS Splash Screen with E2 in Dual IP Mode.....	23
Figure 7.3: DUCM OS Main Menu.....	23
Figure 8.1: DUCM BOOT LOADER.....	25
Figure 8.2: APP > Switch > Run to Halt.....	26
Figure 8.3: FWLOAD OS Firmware Cable Connection.....	26
Figure 8.4: FWLOAD OS Firmware.....	27
Figure 8.5: FWLOAD OS Firmware Commit.....	27
Figure 8.6: FWLOAD OS Firmware Completion.....	28
Figure 9.1 RS-232 Port 2.....	29
Figure 9.2 RS-232 Port 1.....	29
Figure 9.3 RS-485 Port.....	31
Figure 9.4 Jumper for 2-wire RS-485.....	31
Figure 9.5: Serial Port Menu.....	32

## Tables

Table 7.1: Runtime Halt Codes.....	22	
The RJ-45 connectors are used for RS-232 operation. The pin configuration is shown in .		
The Niobrara MM1 cable is used to connect an one of these ports to the a standard 9-pin serial port on a PC. Table 9.1: RJ45 RS-232 Pinout.....		29
Table 9.2: 5-position RS-485 pinout.....	30	

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# 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 provides an overview of the hardware features and installation guide.

The DUCM consists of at least two isolated RS-232/RS-485 serial ports, at least one 100BaseTX Ethernet port, and a front panel LCD/Keypad.

An optional second 100BaseTX Ethernet port may be included. The two Ethernet ports may be used in a “Switch” mode for daisy-chaining a single Ethernet network, or part of a RSTP copper ring network. The second Ethernet port may optionally be configured to be independent of the other Ethernet port and have its own IP Address, Subnet Mask, and Default Gateway. The second Ethernet port may optionally be configured to be a “mirror” port to allow Ethernet monitoring of the traffic on the primary Ethernet port during troubleshooting operations.

Optional cards may be included in the DUCM to provide two additional isolated RS-232 (9-pin male) or two additional isolated RS-485 (9-pin female) serial ports. An isolated CAN card is also available.

The DUCM is mounted on a standard TS-35 DIN rail and is powered by 12/24 VDC (6W) power. The Niobrara TR121ST may be used in US style 110VAC outlets.

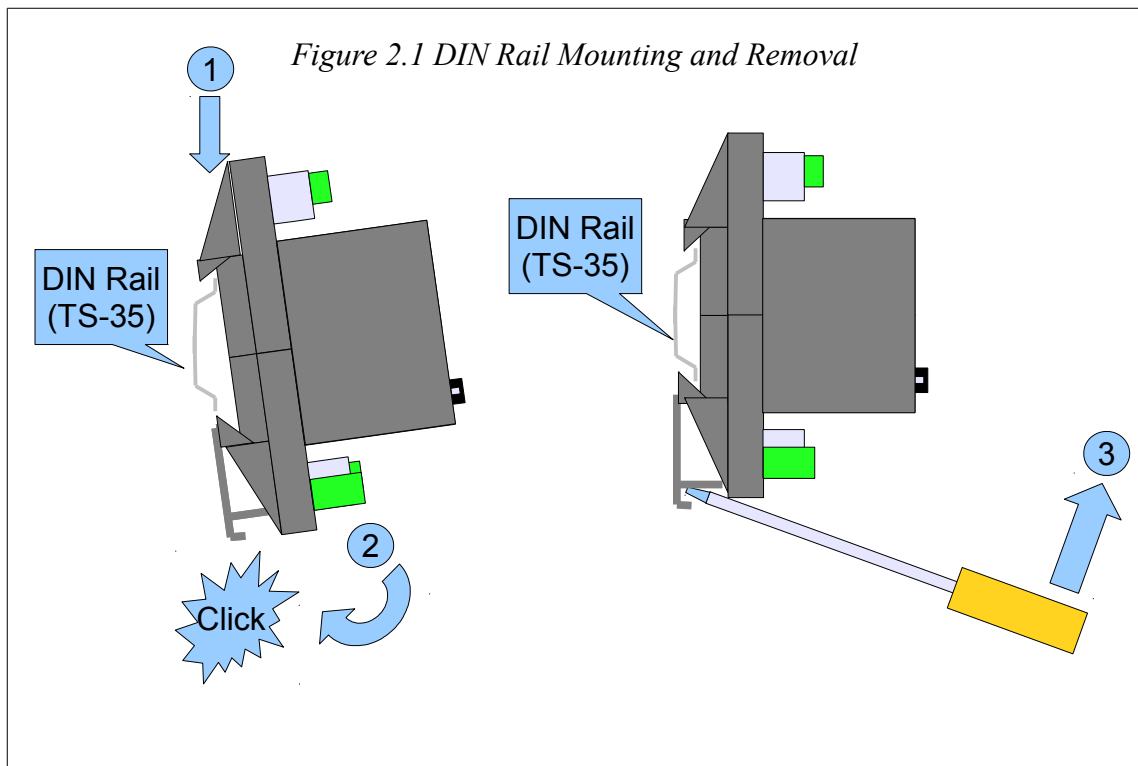


## 2 Installation

**WARNING:** Do not connect the DUCM to any Ethernet or serial network before configuring the appropriate network addresses. Duplicate network address may lead to improper network communication, equipment damage, injury, or death.

### ***Device Mounting/Removal***

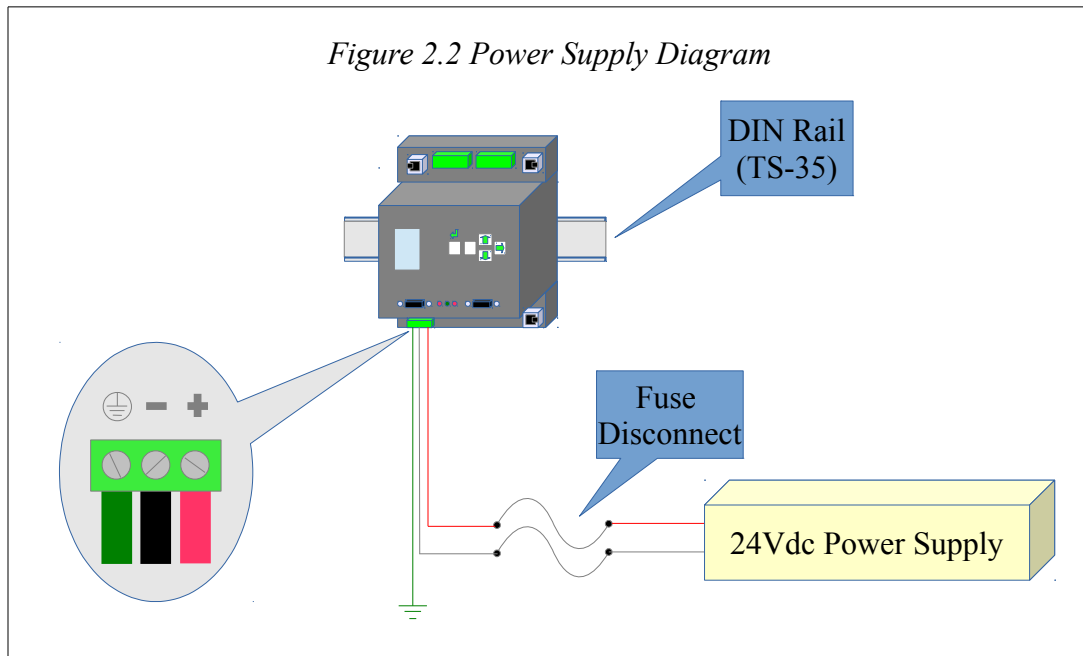
- (1) Hook the top notch on the upper lip of the DIN rail.
- (2) Rotate the DUCM until the lower latches click tight.
- (3) Use a screw driver to unclip the lower latches to remove the DUCM from the DIN rail.(See Figure 2.1 DIN Rail Mounting and Removal)



## Power Supply

Connect a suitable 24VDC power to the three position removable connector. The DUCM requires a 5W minimum supply and will operate on 9-30Vdc but 24Vdc is recommended. (See Figure 2.2 Power Supply Diagram) An external fuse is recommended. Typical power supply wire colors are:

- Red = 24Vdc (+)
- Black = 24Vdc (-)
- Green = Earth Ground





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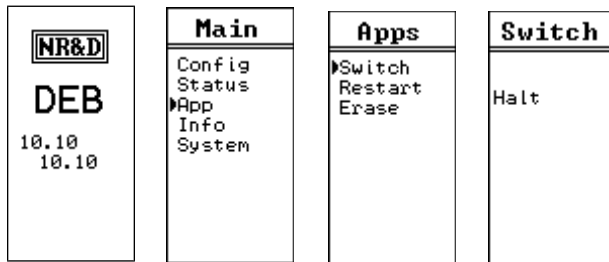
## 3 Removal of the DEB Application

The DUCM may ship from the factory with the DEB application installed. If the front display shows “DEB” and not “DUCM” after booting, then the DEB application needs to be turned off and erased before proceeding to the installation of any custom application.

If the DEB application is not running, proceed to Chapter 4, Ethernet Configuration.

### ***Halting the DEB Application***

From the front panel, press the right arrow to reach the main menu. Move the cursor down to the “App” entry and press the right arrow. Now move the cursor to the “Switch” entry and press the right arrow. Move the cursor to the “Halt” position and press enter. The DUCM will now reboot and the screen should now show “DUCM”.



*Figure 3.1: Halting the DEB Application*

### ***Erasing the DEB Application***

It is a good idea to erase the DEB application at this point.

Press the right arrow to enter the Main menu. Move the cursor to “App” and press the right arrow. Move the cursor to “Erase” and press enter.

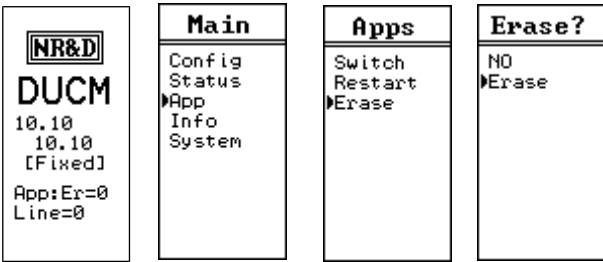


Figure 3.2: Erasing the DEB Application

### Setting the App switch back to RUN

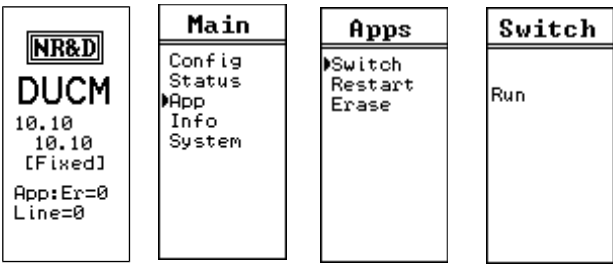


Figure 3.3: Move Switch to RUN

Now move the cursor to “Switch” and press the right arrow. Move the cursor to the “RUN” item and press enter.


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## 4 Ethernet Configuration

The easiest method for loading a custom application into the DUCM from a PC is through Modbus/TCP Ethernet.

NOTE: If the DUCM includes two Ethernet ports, the custom application should provide a method for configuring the second port (E2). Typically, it is only necessary to configure the E1 port before loading the custom application.






### Setting the E1 IP Address

The DUCM E1 port defaults to a fixed IP Address of 10.10.10.10. This is easy to change through the use of the front panel keypad. The most custom applications require a fixed IP Address. Press the  key six times to step through the “> Main > Config > Comms > Ethernet > Enet 1 > Address ” pages.




For this example, E1 will be configured for the IP Address of 192.168.1.17.

E 10.10 1 10.10 F  E 10.10 2 10.11 F  App:Er=8 Line=0	<b>Main</b> ►Config Status App Info System	<b>Config</b> ►Comms Display Clock	<b>Comms</b> ►Ethernet Serial	<b>Enet</b> ►Enet 1 Enet 2	<b>Enet 1</b> ►Address Mask Gate IP Source MTCP Port	<b>IP Add</b>  192.168.  1. <u>17</u>
--	---	---	-------------------------------------	----------------------------------	---	---

Figure 4.1: IP Address Source Screen

If a fixed address is required, make sure that the IP Source is set to Fixed, then select the Address page. The  and  arrows are used to adjust the values while the  and  arrows move between fields. The  key is used to accept the new value.

## Setting the Subnet Mask

The Subnet Mask edit page is designed to quickly step through the valid bit-mapped options. Pressing the  and  arrows adjusts the mask value. The  key is used to accept the new value.

For this example, the E1 Subnet Mask will be set to 255.255.255.0.

<pre>E 192.168 F 1 1.17  E 10.10 F 2 10.11  App:Er=8 Line=0</pre>	<p><b>Main</b></p> <pre>►Config Status App Info System</pre>	<p><b>Config</b></p> <pre>►Comms Display Clock</pre>	<p><b>Comms</b></p> <pre>►Ethernet Serial</pre>	<p><b>Enet</b></p> <pre>►Enet 1 Enet 2</pre>	<p><b>Enet</b></p> <pre>Address ►Mask Gate IP Source MTCP Port</pre>	<p><b>IP Mask</b></p> <pre>255.255. 255. 0 ( /24 )</pre>
---	--	--	---	--	--	--

Figure 4.2: Subnet Mask Screens

## Setting the Default Gateway

The Default Gate edit page functions just like the IP Address edit page.

<pre>E 192.168 F 1 1.17  E 10.10 F 2 10.11  App:Er=8 Line=0</pre>	<p><b>Main</b></p> <pre>►Config Status App Info System</pre>	<p><b>Config</b></p> <pre>►Comms Display Clock</pre>	<p><b>Comms</b></p> <pre>►Ethernet Serial</pre>	<p><b>Enet</b></p> <pre>►Enet 1 Enet 2</pre>	<p><b>Enet</b></p> <pre>Address Mask ►Gate IP Source MTCP Port</pre>	<p><b>IP Gate</b></p> <pre>192.168. 1. <u>1</u></pre>
---	--	--	---	--	--	---

Figure 4.3: Default Gate Screen

In this example the Default Gateway is configured for 192.168.1.1.

## Setting the OS Server Port Number

The most custom applications include their own Modbus/TCP server so it is required to change the DUCM OS server from port 502 to 503. This will allow loading the application remotely without needing to halt the application from the front panel.

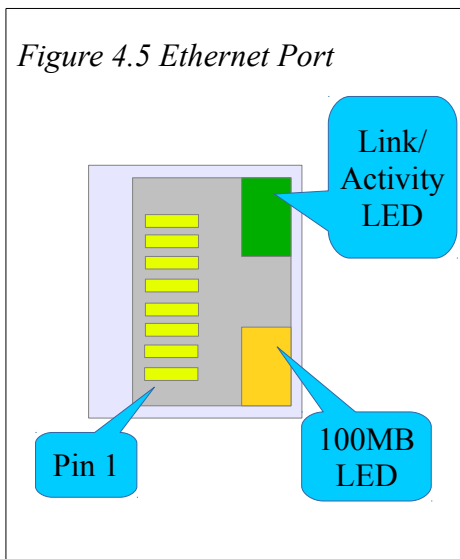
For this example, the OS Modbus/TCP server port is set to 503.

E 192.168 F 1 1.17  E 10.10 F 2 10.11  App:Er=8 Line=0	<b>Main</b> ►Config Status App Info System	<b>Config</b> ►Comms Display Clock	<b>Comms</b> ►Ethernet Serial	<b>Enet</b> ►Enet 1 Enet 2	<b>Enet</b> Address Mask Gate IP Source ►MTCP Port	<b>MTCP Port</b> Modbus/TCP TCP Port <b>503</b>  (502 is default)
---	---	---	-------------------------------------	----------------------------------	---	--

Figure 4.4: Changing the OS TCP port from 502 to 503

## Ethernet Connection to PC

After the IP Address is configured for the DUCM, it is safe to connect the Ethernet port E1 to the network. The DUCM includes a standard RJ-45 Ethernet connector with indicators for Link/Activity (green LED) and 100Mb (amber LED). (See Figure 4.5 Ethernet Port) The green Link/Activity light illuminates when the DUCM has a valid link to the attached network port and blinks off while experiencing network traffic. The 100Mb amber LED is illuminated when the Ethernet port has negotiated 100Mb operation and off while configured for 10Mb operation.



The DUCM's Ethernet port supports 10/100BaseTX auto-crossover operation. Standard CAT5 cables may be used to connect the DUCM to Ethernet switches and hubs.

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## 5 Application Loading

### ***Loading the Application into the DUCM***

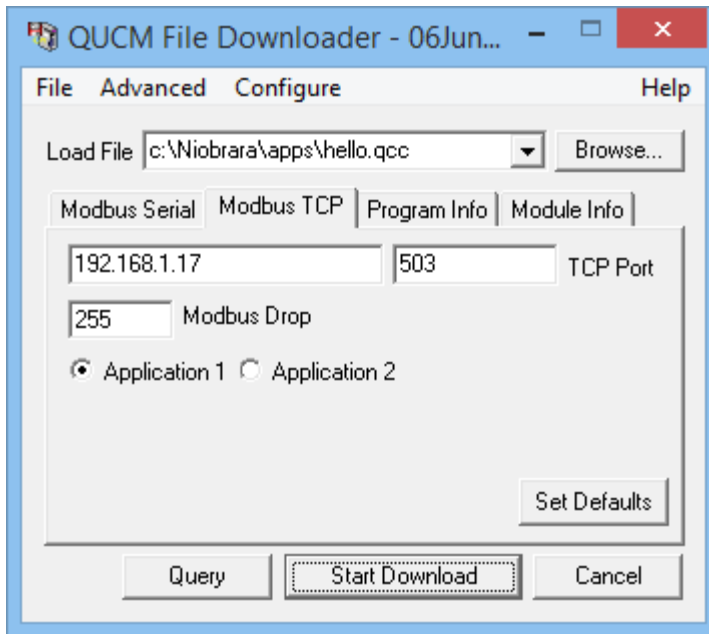
**NOTE:** For this example, the custom application will be hello.qcc. This file should be installed into the c:\Niobrara\apps\ folder on the computer.

The QLOAD program is used to install the compiled hello.qcc program. This is done through Modbus/TCP Ethernet.

**NOTE:** The custom application may be running during the QLOAD operation. It is not necessary to stop the custom program before doing the QLOAD.

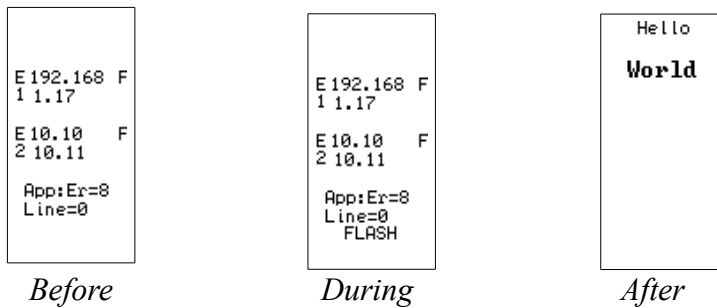
1. The DUCM must be powered and connected to the same Ethernet network as the PC.
2. Start QLOAD.EXE. The Windows Start Menu link is “Start, Programs, Niobrara, QUCM, QLOAD”.
3. Click on the Browse button and select the hello.qcc file to be loaded.
4. Click on the “Modbus/TCP” tab and verify the following:
  1. The proper IP Address of the DUCM (192.168.1.17).
  2. The TCP Port number is 503.
  3. The Modbus Drop is 255.
  4. The Application 1 radio button is selected.
5. Press the “Start Download” button. QLOAD will open a progress bar to show the status of the download.

Figure 5.1: QLOAD hello.qcc



After the qload is finished, the DUCM will complete the storage of the application to FLASH memory. When finished, the application should start and the screen should change to show “Hello World”.

Figure 5.2: DUCM Screens before, during, and after QLOAD of hello.qcc





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## 6 Loading New OS Firmware over Ethernet

### ***Updating the DUCM Firmware***

It may become necessary to update the DUCM OS firmware. This may be done over the Ethernet using QLOAD.

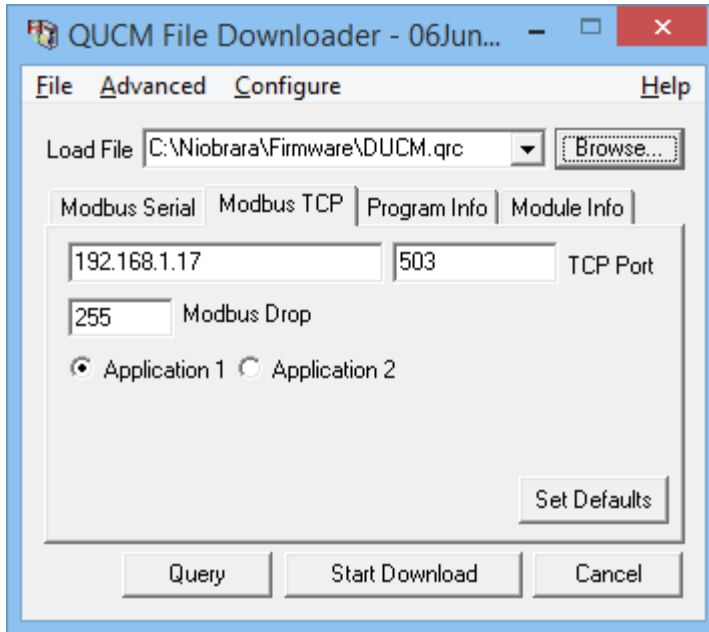
**NOTE:** The QLOAD operation may be done while the custom program is running. It is not necessary to halt the custom program to perform the OS firmware upgrade.

**NOTE:** The DUCM will be offline while the OS firmware operation is underway. The Firmware upgrade takes about 30 seconds after the QLOAD operation is finished. The DUCM will reboot after completing the upgrade.

**NOTE:** The previous version of the custom program will remain and automatically restart after the OS version upgrade is completed.

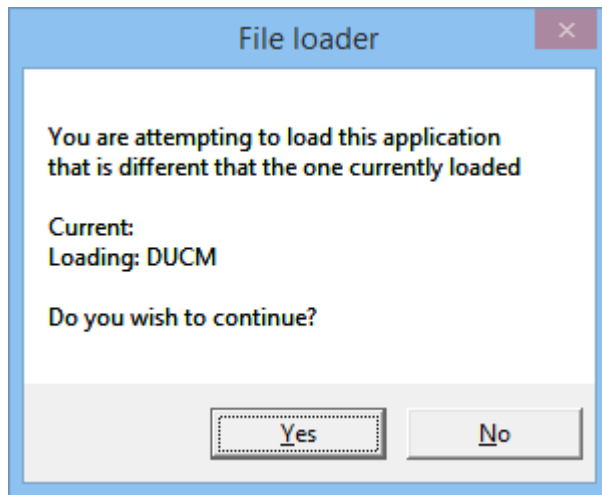
1. The DUCM must be powered and connected to the same Ethernet network as the PC.
2. Start QLOAD.EXE. The Windows Start Menu link is “Start, Programs, Niobrara, QUCM, QLOAD”.
3. Click on the Browse button and select DUCM.qrc.
4. Click on the “Modbus/TCP” tab and verify the following:
  1. The proper IP Address of the DUCM (192.168.1.17).
  2. The TCP Port number is 503.
  3. The Modbus Drop is 255.
  4. The Application 1 radio button is selected.
6. Press the “Start Download” button. QLOAD will open a progress bar to show the status of the download.

Figure 6.1: QLOAD OS Firmware



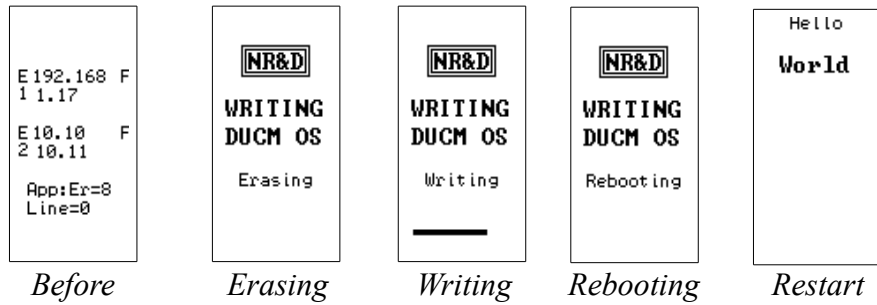
A warning screen may appear indicating that the DUCM firmware is being loaded into a module with another custom application loaded. Simply select “Yes” to proceed.

Figure 6.2: QLOAD OS Firmware Warning



After the completion of the download, the DUCM will apply the new OS. All communication to the DUCM will cease while the OS is being updated. This operation will take about 20 seconds to complete.

Figure 6.3: DUCM Screens during QLOAD of DUCM.qrc



After the OS upgrade is finished, the DUCM will reboot and the original application will start running.

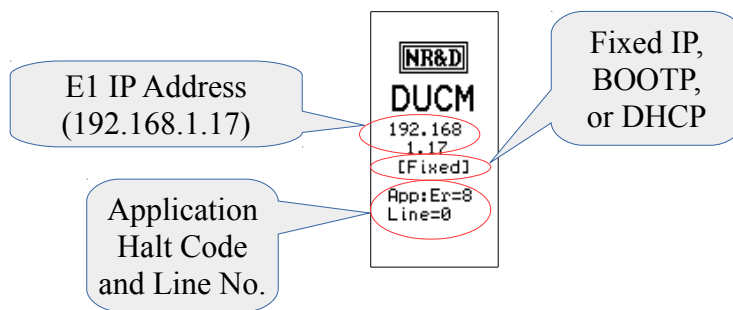


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## 7 Front Panel Operation of OS

Once a custom DUCM application writes to the LCD, it claims control of the LCD and keypad. Before this time, or when the application is halted, the DUCM OS controls the LCD and keypad.

*Figure 7.1: DUCM OS Splash Screen with Single E1 Port (or E2 not in Dual IP mode)*



DUCMs with only a single Ethernet port (or if E2 is not in Dual IP mode) show a splash screen with the following data:

- IP Address of the DUCM (192.168.1.17)
- Source of the IP Address
  - Fixed – Set by the front panel or internal registers and stored to EEPROM
  - BOOTP – Set by an external BOOTP Server, reset on every boot
  - DHCP – Set by an external DHCP Server, reset on every boot
- Application Runtime Error – See Table 7.1: Runtime Halt Codes

Table 7.1: Runtime Halt Codes

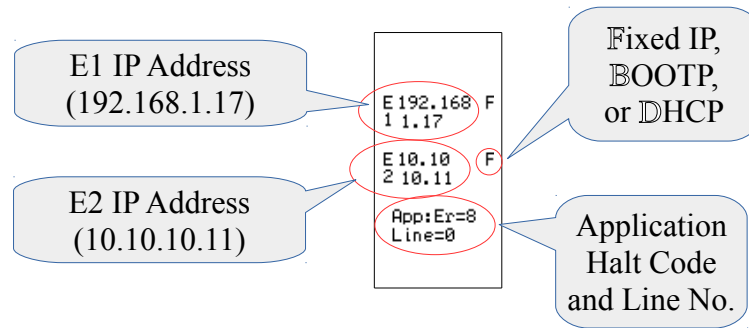
Code	Meaning
x80xx	Application Running, if xx nonzero, xx=last halting error (in hex)
x4000	Application Halted while loading a new version
0	Terminated by clearing all thread run bits
1	STOP statement executed
2	Illegal instruction exception
3	Division by Zero
4	Out of heap space for ON CHANGE
5	Out of heap space for ON RECEIVE
6	Unsupported run-time call, likely compiler/firmware mismatch
7	Parameter or array index out of range
8	Downloaded code corrupt, CRC Error
9	CPU Address exception
10	Stack Underflow
11	TCP Error -1, likely compiler/firmware mismatch
12	TCP Error -2, contact Niobrara
13	TCP Error -3, not enough sockets or buffers, See register 66. Also IP address or gateway not initialized
14	Hardware not authorized to run user code

- Halted Line Number – Source code line number causing the runtime error. E2 in Dual IP Mode

The E2 port may be configured to operate independently from E1. Both ports have their own IP Address, Subnet Mask, and Default Gateway. When E2 is in independent mode, the front splash screen is changed to show both port's IP Addresses as well as an abbreviation letter to indicate the source of the IP Address.

- “F” is for Fixed IP Addresses
- “B” is for BOOTP
- “D” is for DHCP

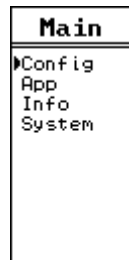
Figure 7.2: DUCM OS Splash Screen with E2 in Dual IP Mode



## Main Menu

Use the Arrow keys to maneuver around the menu system.

Figure 7.3: DUCM OS Main Menu



- Config – Allows changes to Ethernet, Serial, Display, and Clock
- App – Allows changes to the state of the installed Application: Run, Halt, Mem Protect, Erase, and Restart.
- Info – Reports information about the DUCM such as serial number, MAC address, firmware revision, and installed options.
- System – Allows Reset of DUCM to factory Defaults and software reboot.





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## 8 Front Panel Operation of BOOT Loader

It may become necessary to enter the DUCM's BOOT Loader feature. The following conditions may require entering the BOOT Loader:

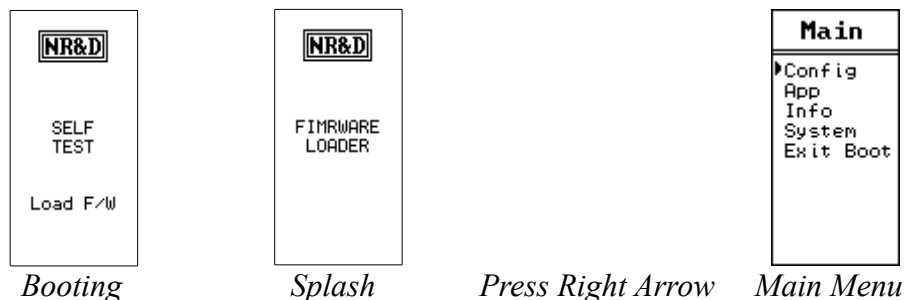
- DUCM OS is corrupted due to a power cycle while a firmware upgrade was underway.
- An error in a custom program is causing the module to continuously reboot.

**NOTE:** It is not recommended to use the CONFIG menus inside the BOOT Loader for editing Ethernet and serial port parameters. The OS CONFIG menus include many features that are not accessible inside the BOOT Loader.

### ***Enter the BOOT Loader***

Press the ENTER keyboard button while the DUCM is booting.

*Figure 8.1: DUCM BOOT LOADER*

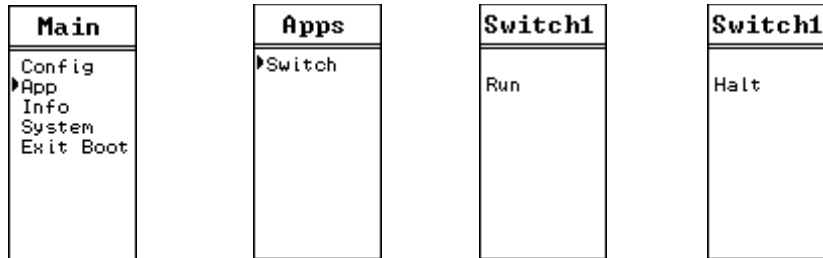


Use the UP, DOWN, LEFT, and RIGHT buttons to move around the menu system.

## App, Switch

In cases where the custom application needs to be halted, the APP>Switch may be changed from RUN to HALT within the BOOT Loader.

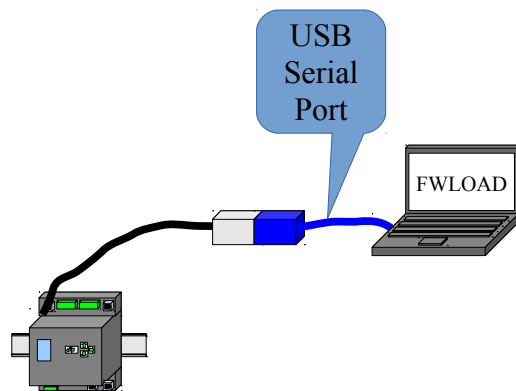
Figure 8.2: APP > Switch > Run to Halt



## Loading OS Firmware using FWLOAD

If the DUCM is in a state where the OS has been corrupted, the method of recovery is to use the FWLOAD program to load firmware through serial port 1. The Niobrara MM1 cable is useful for connecting a standard 9-pin PC RS-232 serial port to DUCM RJ45 port 1.

Figure 8.3: FWLOAD OS Firmware Cable Connection



Start > Programs > Niobrara > FWLOAD DUCM Firmware

Figure 8.4: FWLOAD OS Firmware

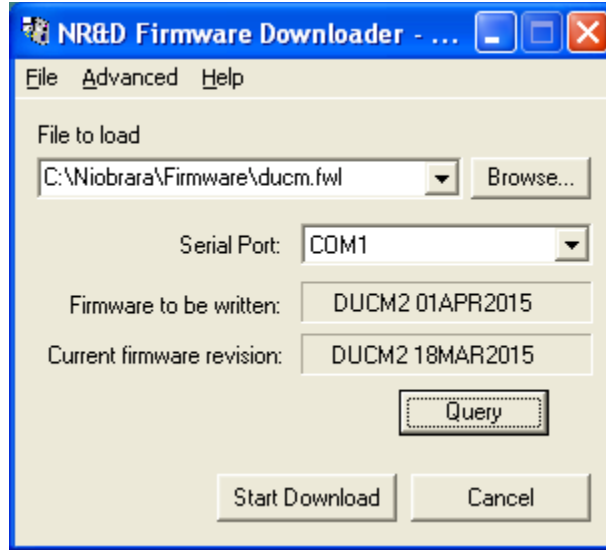
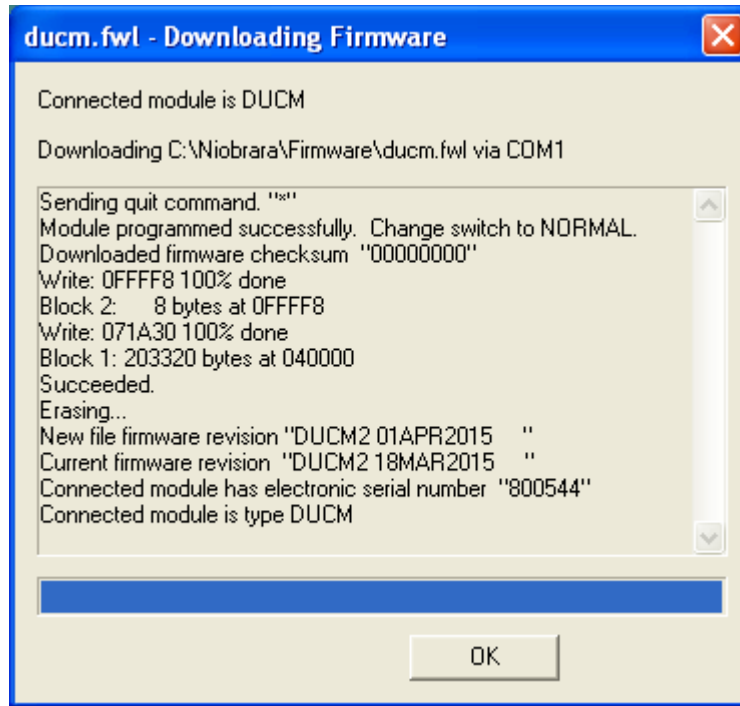


Figure 8.5: FWLOAD OS Firmware Commit



Figure 8.6: FWLOAD OS Firmware Completion



### **Exiting the BOOT Loader**

Simply select "Exit Boot" from the main menu. The DUCM will reboot and return to normal operation.

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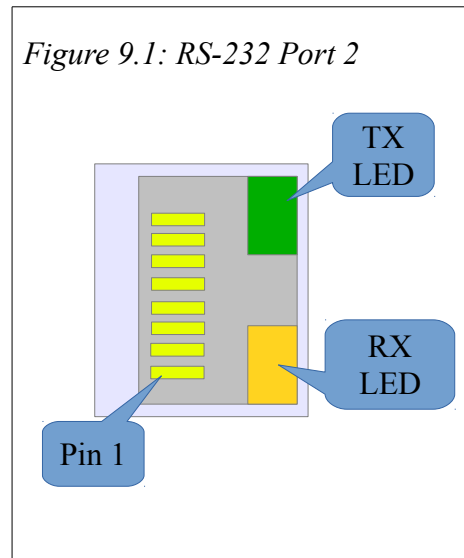
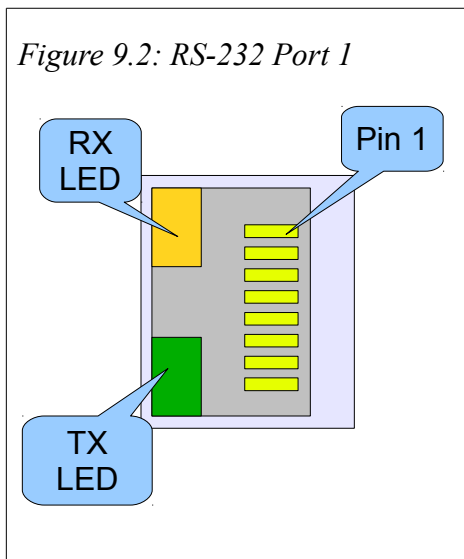
## 9 Serial Ports

### Serial Ports

The DUCM includes two isolated serial ports. Separate connectors are provided for each port with an RJ-45 connector for RS-232 and a removable 5-position screw terminal connector for RS-485/422.

NOTE: Port 1 is electrically isolated from Port 2. The RS-232 connector of a given port is not isolated from the RS-485 connector of the same port.

### RS-232 Ports



The RJ-45 connectors are used for RS-232 operation. The pin configuration is shown in . The Niobrara MM1 cable is used to connect an one of these ports to the a standard 9-pin serial port on a PC. Table 9.1: RJ45 RS-232 Pinout

RS-232 Pinout	
Pin	Function
1	No Connection
2	DSR (pulled high)
3	Data TX
4	Data RX
5	Signal GND
6	RTS
7	CTS
8	Chassis GND

## RS-485 Ports

Port 1 and 2 may be used for RS-485 (4-wire or 2-wire) and RS-422 operation. A 5-pin removable screw terminal connector is provided. The pinout is shown in Figure 9.3: RS-485 Port.

*Table 9.2: 5-position RS-485 pinout*

Pin	Function
Shield	No internal connection
RX-	(-) data into MEBII
RX+	(+) data into MEBII
TX-	(-) data out from MEBII
TX+	(+) data out from MEBII

Figure 9.3: RS-485 Port

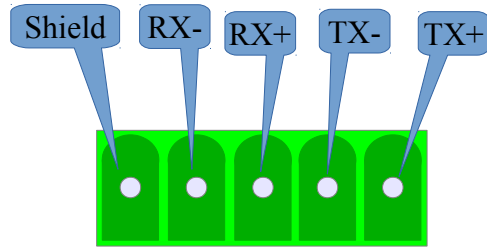
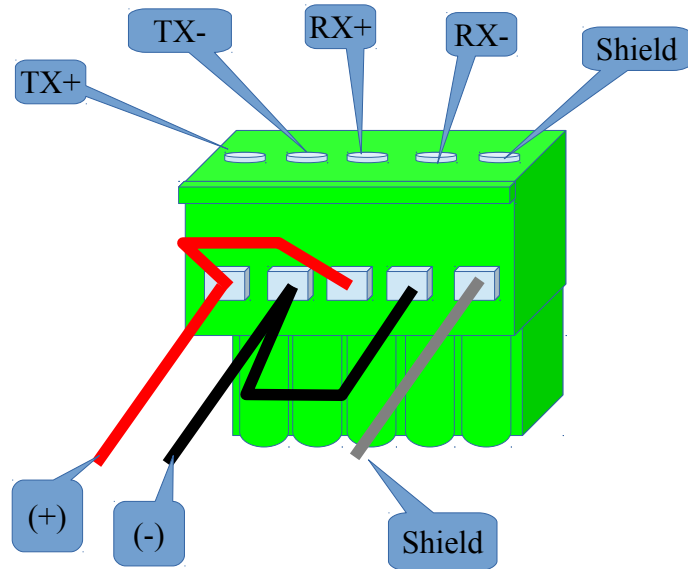


Figure 9.4: Jumper for 2-wire RS-485



For 2-wire RS-485 operation, jumper the TX+ to RX+ to make the (+) connection, then jumper the TX- to RX- to make the (-) connection.

## Serial Port Native Operation

Like the LCD, the two serial ports are “owned” by the DUCM OS while the application is halted, or until the custom application attempts access. Both ports are in Modbus RTU Slave mode and the baud rate, parity, data bits, stop bits, drop number, and driver mode are controlled by the OS settings. These settings may be adjusted from the front panel.

NOTE: If a custom application is running, it may alter the ports settings of the serial ports.

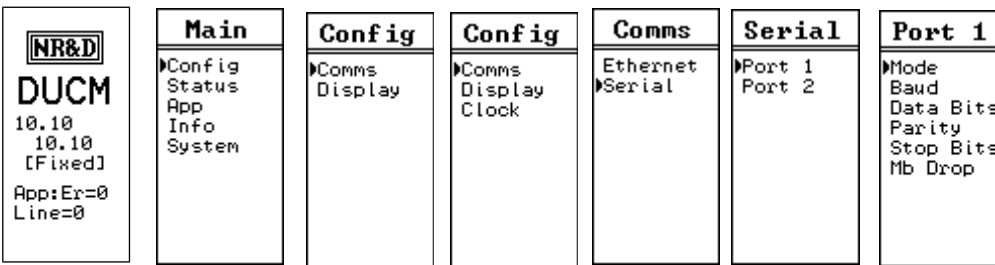


Figure 9.5: Serial Port Menu

- Mode – Sets the physical interface in use
  - RS-232 – Uses the RJ45 connector.
  - RS-422 – Uses the green RS-485 connector for point-to-point 4-wire operation with termination and bias enabled. The RS-485 transmitter is also enabled.
  - 458+Bias – Uses the green RS-485 connector and enables termination and bias.
  - 485-Bias – Uses the green RS-485 connector and disabled termination and bias.
- Baud – Sets the baud rate for the port. Supported values range from 50 to 115200 bps.
- Data Bits – Must be set for 8 bits for Modbus RTU operation.
- Parity – Possible values are NONE, EVEN, and ODD.
- Stop Bits – Possible values are 1 and 2.
- Mb Drop – Sets the Modbus Slave address to access the OS while the application is halted. The DUCM always responds to drop 255 while in this state.