

## DIRECTIONS FOR PROGRAMMING THE MODICON MOMENTUM PLC

The Modicon Momentum PLCs used for RHIC consist of three modules. The Processor Adapter (171 CCC 980 20) is the top module, and houses the CPU and Ethernet port. The Modbus Plus Option Adapter (172 PNN 210 22) is the middle module, and provides the Modbus Plus interface. The bottom module (170 ADI 340 00) is the I/O base, providing power distribution and I/O capabilities. (I/O not used) These PLCs can be programmed via the Modbus Plus adapter or the Ethernet port. It is simpler to use the Modbus Plus adapter because it avoids the complexities of programming the PLC over Ethernet in an IP address domain that is different from the one where it will eventually be used. Both methods are described here.

### MODBUS PLUS PROGRAMMING

To program the Momentum PLC via Modbus Plus your computer must have a Modbus Plus interface card and the ProWORX NxT program, preferably version 2.1. If using a laptop, be sure the Modbus Plus card is installed prior to powering up.

1. Make sure the rotary switches located on top of the Modbus Plus Option Adapter are set as follows: X10 set to 0, X1 set to 2. This configures the PLC with a Modbus Plus address of 2.
2. Power up the PLC. This is accomplished by applying 24Vdc to Connector 1 of the base unit. Pin 18 is the +24 input, and pin 17 is the Return.
3. Connect the Modbus Plus connector on the computer to the Modbus Plus connector on the PLC. (There are two 9-pin connectors on the PLC. The one closest to the I/O base is the Modbus Plus connector. The upper 9-pin connector is not a Modbus Plus connector, and will not work) These connectors both mate with standard 9-pin male DIN connectors. The cable needs only pins 1, 2, and 3 wired, and is pin-to-pin.
4. Start the ProWORX NxT program. (Do not select the ProWORX NxT Online program)
5. From the File menu, open the appropriate “.DCF” file. This is determined by the location where the PLC is to be installed.

There are 5 different PLC programs. They normally reside under the “C:\RHIC Modicon PLC Programs” directory, each in their own subdirectory. The subdirectories and their programs are as follows:

- 1) AC\_Alcoves – Holds the program “Alco\_ac.dcf”, for PLCs located in all A and C alcoves.
- 2) B\_Alcoves - Holds the program “Alcov\_b.dcf”, for PLCs located in all B alcoves.

- 3) Bldg\_10 - Holds the program “B\_10a.dcf”, for PLC located in building 10A.
  - 4) Bldg\_2\_6\_8\_12 - Holds the program “B\_268\_12.dcf”, for PLCs located in buildings 2B, 6B, 8B, and 12A.
  - 5) Bldg\_4 - Holds the program “B\_4.dcf”, for PLC located in building 4B.
6. Check the following program settings before continuing
- A) From the Controller menu, select Communications Setup...  
The Interface should be Modbus Plus, and the Adapter should be 0.
  - B) From the File menu, select Utilities > Database Setup...  
The Controller Address should be 2.
  - C) From the Configuration menu, select Configuration...
    - 1) Under the General tab, the Conf Extension Size should be 00101.
    - 2) Under the Controller Tab, the Current Controller Type should be M1 980-20. (If not, select the “Change Controller Type” button and choose Momentum Controller Group, and the M1 980-20 Controller.)
  - D) From the Configuration menu, select Config Extensions...  
In the white window under the Config Extensions icon you should see TCP/IP. (If not, select the “Add Extension” button and select TCP/IP.)  
Left click once on the TCP/IP icon, which will open the IP address window. Make sure that Extension is selected, and not BOOTP Server. Enter the appropriate Internet Address, Sub-Network Mask, and Gateway Address. (See addresses on last page of this document)
7. To program the PLC
- A) From the Controller menu, select Write to Controller...  
Make sure that Write Type is Regular.
  - B) Select the “Write” button. (If the PLC does not already contain a program, a message will appear that says “Controller in Dim Awareness”. Select the “OK” button)
  - C) A Database/Controller Validation window will appear. The top line should read Controller and Database match. Select the “Write” button. (If the PLC already has a program in it and it is running, a message will appear asking if you want to stop the controller. Select Yes, and then acknowledge the Controller Stopped message.)
  - D) Wait for the program to be written to the PLC. Acknowledge the Write Complete message. (If the PLC had been running before the write procedure, you will be prompted if you want to start the controller. Select No.)

Although the PLC is now programmed and is ready to run, a loss of power would cause the PLC to lose its program. To prevent this, you must now write the program to Flash memory.

8. To write to Flash memory
  - A) From the Controller menu, select EEPROM/Flash...  
The Select Modbus Plus Device window will appear. Make sure that the Device is 2. Select the "OK" button.
  - B) The Transfer to Controller Flash window will appear. Select the "Transfer" button.
  - C) A message will appear asking if you want to Restore PLC run state before power down. Select "NO".
  - D) A message will appear asking if you want to Auto start PLC on load from Flash. Select "YES".
  - E) Wait for the program to be written to the Flash memory.  
Acknowledge the Write to Flash complete message.
9. The programming is now complete. From the File menu, select Exit. This will close the ProWORX NxT program.
10. Power down the PLC.
11. To check if the PLC's program will run properly, reapply power to the PLC. This will cause the program to be read from the Flash memory and auto start the PLC. The time from power on till CPU run is approximately 30 to 60 seconds. Check the CPU RUN lamp on top of the PLC. It should be in a constantly on state.

The PLC can now be installed in its intended location. Once installed, it can be accessed via the Ethernet interface at the appropriate IP address. This can be verified using the ProWORX NxT Online program. However, your computer must have an Ethernet card and be connected to the network.

- A. Start the ProWORX NxT Online program.
- B. From the Controller menu, select Communication Setup...  
Select TCP/IP.
- C. From the Controller menu, choose Select Device...  
Enter the PLC's IP address in the "Device" area, and select "OK".
- D. If the PLC is seen properly, the device's ladder logic will appear in the window.

From this window you can check the ladder logic program, start or stop the PLC (if desired), etc. Be careful not to leave the PLC in a state that will be unusable to the FEC. When done, close the ProWORX NxT Online program. (From the File menu, select Exit.)

## ETHERNET PROGRAMMING

To program the Momentum PLC via Ethernet your computer must have an Ethernet interface card, access to a network, and the ProWORX NxT program, preferably version 2.1. If the PLC you are programming does not have an IP address permanently stored in Flash memory, you will also need the Modicon DOS based executable “Bootplt.exe”. If using a laptop, be sure the Ethernet card is installed before powering up.

1. Power up the PLC. This is accomplished by applying 24Vdc to Connector 1 of the base unit. Pin 18 is the +24 input, and pin 17 is the Return.
2. Connect the Ethernet connector on the computer and on the PLC to an existing network. If you are giving the PLC an IP address for the first time, the connections must be within the same domain.

If the PLC you are programming already has an IP address, jump to step 11. If the PLC has never been programmed or had an IP address saved to Flash memory, proceed with step 3.

3. Open an MS-DOS window on your computer.
4. The computer you are using must have the program “Bootplt.exe”, normally found under the “C:\Bootplt” directory. At the DOS prompt, enter the command to change to the directory containing the Bootplt program. (i.e. CD\bootplt)

If you are not in the domain where the PLC will eventually be located, you must assign the PLC a temporary IP address within the current domain so that you can continue to communicate with it. When you download the program later on, you will give the PLC its permanent IP address. Choose a temporary address that is not currently being used by anyone else.

5. To verify that the temporary IP address is available, at the prompt enter the following command: (Do not include quotation marks)

“Ping xxx.xxx.xxx.xxx” (xxx.xxx.xxx.xxx represents the temporary IP address)

If the request times out 4 times, the address is available. If a device is found at that address, choose another temporary IP address. You may want to talk to your network administrator.

After determining that the temporary IP address is available, you may proceed to program the PLC with the temporary IP address.

6. At the prompt, enter the following command: (Observe the spaces. Do not include quotation marks)

“Bootplt nnnnnnnnnnnn xxx.xxx.xxx.xxx yyy.yyy.yyy.yyy zzz.zzz.zzz”

(Ex: Bootplt 0000541026B4 130.199.105.175 130.199.104.24 255.255.254.0)

nnnnnnnnnnnn represents the MAC address, or the IEEE Global Address, unique to each PLC. This 12-character address is found on a sticker on the side of the PLC. The address may contain alpha characters as well as numerics.

xxx.xxx.xxx.xxx represents the temporary IP address.

yyy.yyy.yyy.yyy represents the current IP router (default router or gateway).

zzz.zzz.zzz.zzz represents the current IP mask (subnet mask).

\*\* Read step 7 and step 8 before actually performing step 7. You must be ready to perform step 8 immediately following step 7. \*\*

7. When you enter the command in step 6, you will be asked if you pinged the IP address. Enter “Y”.
8. You will now be prompted to cycle power to the PLC. Do this immediately! The Bootplt program is sending out ten messages, 3 seconds apart, responding the PLC’s request for an IP address.
9. To prove that the PLC has taken the temporary IP address, repeat step 5. You should receive 4 replies from the PLC.
10. Type “exit” at the prompt to close the DOS window. The PLC can now be recognized over the network, and is ready to be programmed with the appropriate ladder logic program. DO NOT turn off power to the PLC or it will lose the temporary IP address!
11. Start the ProWORX NxT program. (Do not select the ProWORX NxT Online program)

12. From the File menu, open the appropriate “.DCF” file. This is determined by the location where the PLC is to be installed.

There are 5 different PLC programs. They normally reside under the “C:\RHIC Modicon PLC Programs” directory, each in their own subdirectory. The subdirectories and their programs are as follows:

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- 3) Bldg\_10 - Holds the program “B\_10a.dcf”, for PLC located in building 10A.
- 4) Bldg\_2\_6\_8\_12 - Holds the program “B\_268\_12.dcf”, for PLCs located in buildings 2B, 6B, 8B, and 12A.
- 5) Bldg\_4 - Holds the program “B\_4.dcf”, for PLC located in building 4B.

13. Check the following program settings before continuing

- A) From the Controller menu, select Communications Setup...  
The Interface should be TCP/IP, and the Timeout should be 2.
- B) From the File menu, select Utilities > Database Setup...  
The Controller Address should be the same IP address currently in the PLC.
- C) From the Configuration menu, select Configuration...
  - 1) Under the General tab, check that the Conf Extension Size is 00101.
  - 2) Under the Controller Tab, check that the Current Controller Type is M1 980-20. (If not, select the “Change Controller Type” button and choose the Momentum Controller Group and the M1 980-20 Controller.)
- D) From the Configuration menu, select Config Extensions...  
In the white window under the Config Extensions icon you should see TCP/IP. (If not, select the “Add Extension” button and select TCP/IP.)  
Left click once on the TCP/IP icon, which will open the IP address window. Make sure that Extension is selected, and not BOOTP Server. Enter the appropriate Internet Address, Sub-Network Mask, and Gateway Address. These addresses should be the ones that will be used at the intended location, NOT the temporary addresses!  
(See addresses on last page of this document)

14. To program the PLC

- A) From the Controller menu, select Write to Controller...  
Make sure that Write Type is Regular.
- B) Select the "Write" button. (If the PLC does not already contain a program, a message will appear that says "Controller in Dim Awareness". Select the "OK" button)
- C) A Database/Controller Validation window will appear. The top line should read Controller and Database match. Select the "Write" button. If the PLC already has a program in it and it is running, a message will appear asking if you want to stop the controller. Select Yes, and then acknowledge the Controller Stopped message.
- D) Wait for the program to be written to the PLC. If the PLC had been running before the write procedure, you will be prompted if you want to start the controller. Select No. Acknowledge the Write Complete message when it appears.

Although the PLC is now programmed and is ready to run, a loss of power would cause the PLC to lose its program. To prevent this, you must now write the program to Flash memory.

15. To write to Flash memory

- A) From the Controller menu, select EEPROM/Flash...  
The Select TCP/IP Device window will appear. Make sure that the Device is the current (temporary) IP address of the PLC, if different from the one in used in the Configuration Extension referred to in step 13D. Select the "OK" button.
- B) The Transfer to Controller Flash window will appear. Select the "Transfer" button.
- C) A message will appear asking if you want to Restore PLC run state before power down. Select "NO".
- D) A message will appear asking if you want to Auto start PLC on load from Flash. Select "YES".
- E) Wait for the program to be written to the Flash memory.  
Acknowledge the Write to Flash complete message.

16. The programming is now complete. From the File menu, select Exit. This will close the ProWORX NxT program.

17. Power down the PLC. When the PLC is repowered, the temporary IP address will be replaced by the IP address used in the Configuration Extension.

18. To check if the PLC's program will run properly, reapply power to the PLC. This will cause the program to be read from the Flash memory and auto start the PLC. The time from power on till CPU run is approximately 30 to 60 seconds. Check the CPU RUN lamp on top of the PLC. It should be in a constantly on state.

The PLC can now be installed in its intended location. (Prior to installation in the field, make sure the rotary switches located on top of the Modbus Plus Option Adapter are set as follows: X10 set to 0, X1 set to 2.) Once installed, it can be accessed via the Ethernet interface at the appropriate IP address. This can be verified using the ProWORX NxT Online program.

- A. Start the ProWORX NxT Online program.
- B. From the Controller menu, select Communication Setup...  
Select TCP/IP.
- C. From the Controller menu, choose Select Device...  
Enter the PLC's IP address in the "Device" area, and select "OK".
- D. If the PLC is seen properly, the device's ladder logic will appear in the window.

From this window you can check the ladder logic program, start or stop the PLC (if desired), etc. Be careful not to leave the PLC in a state that will be unusable to the FEC. When done, close the ProWORX NxT Online program. (From the File menu, select Exit.)

## PLC IP ADDRESSES

At the time of this writing the addresses were dedicated as follows:

Sub-Network Mask	255.255.252.0	All
Gateway Address	130.199.108.24	All
Internet Addresses	130.199.110.33	Alcove 1A
	130.199.110.34	Alcove 1B
	130.199.110.35	Alcove 1C
	130.199.110.36	Building 2B
	130.199.110.37	Alcove 3A
	130.199.110.38	Alcove 3B
	130.199.110.39	Alcove 3C
	130.199.110.40	Building 4B
	130.199.110.41	Alcove 5A
	130.199.110.42	Alcove 5B
	130.199.110.43	Alcove 5C
	130.199.110.44	Building 6B
	130.199.110.45	Alcove 7A
	130.199.110.46	Alcove 7B
	130.199.110.47	Alcove 7C
	130.199.110.48	Building 8B
	130.199.110.49	Alcove 9A
	130.199.110.50	Alcove 9B
	130.199.110.51	Alcove 9C
	130.199.110.52	Building 10A
	130.199.110.53	Alcove 11A
	130.199.110.54	Alcove 11B
	130.199.110.55	Alcove 11C
	130.199.110.56	Building 12A

This document supercedes all others prior to 6/15/01.