

Introduction:

A separate communication network will be setup for each of the individual lab benches that contain the entire physical setup required for this experiment. This exercise introduces the communication networks that will be utilized by the motor control system and the configuration of the networkable devices that are contained within the motor control systems. Additionally, the concept of network addresses will be presented along with setup instructions that can be utilized to properly assign the required addresses to the various networkable devices.

Internet Protocol (IP) Addresses

In order to communicate across the control system network, every device on the network must be assigned a logical **IP address**. Each address is composed of a **set of four numbers** that range from **0 to 255**. Similar in nature to phone numbers; when one device needs to contact another device on the network, it passes the IP address of the remote device to its network interface, and the network hardware takes care of setting up the connection between the two devices.

Most devices can be assigned either a **static IP address** which they memorize and maintain until that are assigned a new address, or a **dynamic IP address** that they must renew after a preset amount of time (or possibly whenever they are energized or try to reconnect to the network).

When connected to the “campus network”, the **laboratory computers** are configured to request and receive unique, dynamic IP addresses from a campus server. On the other hand, all of the motor control systems will be identically configured such that, when connected to the motor control system’s communication network, each computer must be assigned the same static IP address. Thus, when changing between the campus and the control system networks, the computer’s IP settings will need to be changed.

Although the desktop computer will be assigned a static IP address that should not change once it is connected to the control system network, care should be taken when logging into the computer to be sure that the address is still set to the required value and that it hasn’t been changed by another user.

The **PLC** and the **VFD** are preconfigured such that, every time they are “powered-down”, they will discard their IP addresses. In-turn, whenever they are restarted, the PLC and the VFD will need to request and be reassigned an IP Address. Thus, once they finish their boot-up process after being re-energized, they will begin to broadcast (ARP) requests onto the communication network indicating that they are in need of an IP Address, and special (DHCP Server) software on the desktop computer will be configured to assign those addresses whenever it receives a request.

ARP ≡ *Address Resolution Protocol*

DHCP ≡ *Dynamic Host Control Protocol*

Although addressing theory will not be discussed any further at this point, the required procedural steps are provided for assigning the following set of required **IP Addresses** to each of the system devices, allowing them to communicate with each other across the communication network:

Computer – 192.169.3.1 PLC – 192.169.3.20 VFD – 192.169.3.22

Procedure:

Desktop Computer Network Connection

Verify that the desktop computer's **Ethernet Port** is properly **connected** to the control system's Ethernet Switch via a **blue** cable.

If the desktop computer is still connected to the campus network via a **black** cable, **unplug** that cable from the back of the desktop computer and reconnect the computer to the control system's Ethernet Switch via a **blue** cable.

*The computer **must be disconnected from the campus network** because the control system requires the use of the program *BootP*, which functions as a DHCP Server that can assign IP addresses to computers attached to the network. IT Policy does not allow individual users to operate DHCP Server software while connected to the campus network.*

Log-In to the Desktop Computer

Log-in to the desktop computer using the following credentials:

User Name: .\student

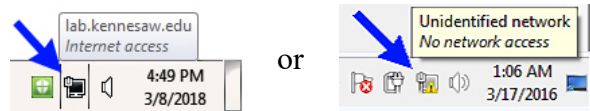
Password: student

CONFIGURATION OF THE NETWORK SETTINGS FOR THE CONTROL SYSTEM DEVICES

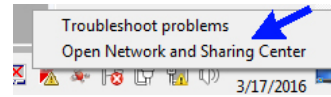
Assigning an IP Address to the Desktop Computer

1. Check the **IP** configuration of the **desktop computer** by performing the following steps:

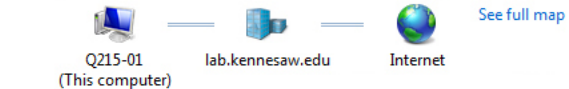
a) **Right-click** on the **Network icon** on the taskbar in the bottom-right corner of the desktop.



b) In the pop-up that appears, **click** **Open Network and Sharing Center**.



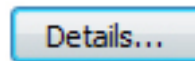
View your basic network information and set up connections



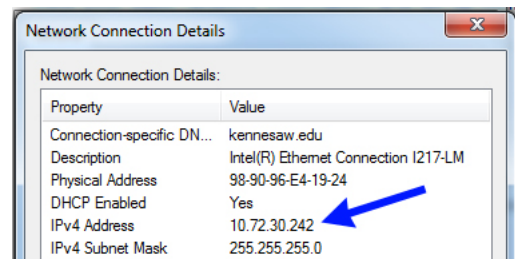
c) In the **Network and Sharing Center** pop-up window, **click** **Local Area Connection**. This will allow you to view and/or modify the computer's network settings.

Note that some of the values in your window may differ from those shown to the right.

d) In the **Local Area Connection Status** pop-up window that appears, **click** the **Details** button.



e) In the **Network Connection Details** window that appears, check the **IPv4 Address** of the computer.



If the IPv4 address is 192.169.3.1 then the computer is already properly configured.

Close all of the network windows, **skip step 2**, and proceed to the next section:

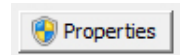
Assigning IP Addresses to the PLC & VFD.

If the IP address is **NOT** correct, complete step 2.

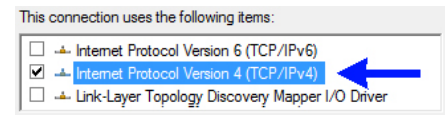
2. Set the IP Address of the desktop computer to 192.169.3.1 by performing the following steps:

a) Close the *Network Connect Details* window. 

b) In the *Local Area Connection Status* pop-up window that should still be open, click the **Properties** button.

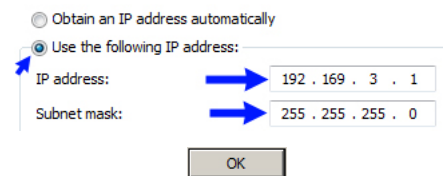


c) In the *Local Area Connection Status* pop-up window, locate and **double-click** on **Internet Protocol Version 4 (TCP/IPv4)** in the list of items.



d) In the *Internet Protocol Version 4 (TCP/IPv4) Properties* pop-up window that appears, click the radio button **Use the following IP address**.

Enter **192.169.3.1** into the **IP Address** field and then click on the **Subnet Mask** field. The subnet mask field will automatically populate with the value **255.255.255.0**. Click **OK** to save the changes.



An **IP Address** has two parts, a **Network Number** and a **Host Number**.

**INFORMATIONAL
NOTE**

The **Network Number** identifies the network to which a device is directly connected and the **Host Number** identifies the specific device connected to the network. The **Subnet Mask** is used to determine which parts of the IP Address relate to the **Network Number** and the **Host Number**.

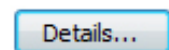
Both the IP Address and the Subnet Mask are composed of a set of four numbers, expressed in the form **A.B.C.D**. Whenever a **255** exists in a specific position in the Subnet Mask, then that respective value in the IP Address relates to the **Network Number**. Whenever a **0** exists in a specific position in the Subnet Mask, then that respective value in the IP Address relates to the **Host Number**.

Given the computer's IP address **192.169.3.1** and its subnet mask **255.255.255.0**, the first three values in the IP address are the **Network Number** and the last value is the **Host Number**.

Thus, the computer is **host 1** on **network 192.169.3.0**.

← Note that the network number is expressed with 0's placed in the host number's position(s).

e) Verify that the IP Address has been changed by **clicking** the **Details** button the *Local Area Connection Status* window and checking the IPv4 Address in the *Network Connection Details* window that appears.



f) Once the IP address is properly set, **close** all of the network windows and continue on to the next section of the procedure.

Assigning IP Addresses to the PLC and the VFD

Whenever the PLC and the VFD are powered-up, they have previously been configured to begin broadcasting requests for an IP Address on the Ethernet network. A **DHCP Server** is required to answer these requests and assign IP Addresses to these devices. The "**BOOTP-DCHP Server**" software on the desktop computer will be utilized to perform this task.

Complete the following steps to configure the BOOTP software to assign the following addresses:

PLC – 192.169.3.20 VFD – 192.169.3.22

3. **Re-energize** both the PLC and the VFD to ensure that they have discarded any previously-assigned IP addresses and begin requesting new addresses:

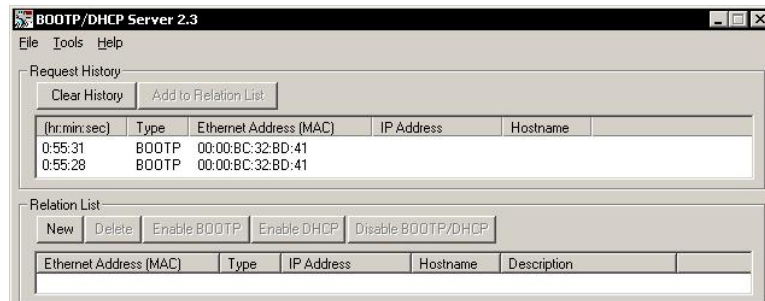
REMINDER: TURN-OFF the main power supply immediately if any unexpected operation occurs while the supply is energized (ON).

- a) Pull the power cord out of the **Power** socket on the *A-B CompactLogix PLC* module’s front panel, wait 5 seconds, and then plug the power cord back in the socket to reset the PLC.
- b) Slowly cycle the main **LabVolt power supply** ON⇒OFF⇒ON to reset the VFD.

4. Start the **BOOTP** software on the desktop computer by clicking “**Start**” and choosing:
All Programs→Rockwell Software→BOOTP-DHCP Server→BOOTP-DHCP Server.

5. The **BOOTP** program window has two main fields; *Request History* and *Relation List*.

The *Request History* field displays the MAC Address of devices requesting an IP Address and the *Relation List* field displays the devices to which **BOOTP** is configured to assign an address.



6. Locate the **Ethernet (MAC) Addresses** of the PLC and the VFD that are present on your workbench. The MAC address of the PLC is written on the front of the PLC’s LabVolt frame and the MAC address of the VFD is written on the VFD’s terminal cover.

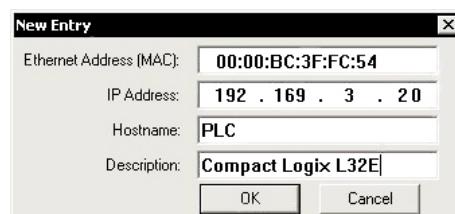
MAC (Media Access Control) Addresses are hardware level addresses that are assigned by the manufacturers of the devices and are specific to the type of network that is being utilized, in this case an Ethernet network. Ethernet MAC addresses are composed of a set of six, two-digit, hexadecimal numbers that are expressed in the form **AA:BB:CC:DD:EE:FF**.

7. Whenever a device on the network broadcasts a request for an IP Address, the request will appear in the *Request History* field of the **BOOTP** window. Locate the **MAC address** of the **PLC** within the *Request History* field and **double-click** that entry. A “**New Entry**” window will appear.



Note – the MAC address shown in the above figure may differ from that of your PLC.

8. Enter the **IP Address**, **Hostname**, and **Description** values shown below and **click OK** when done. Note that the MAC address displayed in the figure may differ from that of your PLC.



9. Once the new entry is complete, the entry will appear in the **Relation List** field of the **BOOTP** window.

Relation List				
New	Delete	Enable BOOTP	Enable DHCP	Disable BOOTP/DHCP
Ethernet Address (MAC)	Type	IP Address	Hostname	Description
00:00:BC:3F:FC:54	BOOTP	192.169.3.20	PLC	Compact Logix L32E

The **Relation List** shows all of the user-defined **MAC** ⇔ **IP** address relations. The next time a device with a listed MAC address requests an IP address, **BOOTP** will assign the appropriate address to the device, after which that device will stop sending out any more address requests.

10. In the same manner, **double-click** on **MAC address** of the **VFD** within the **Request History** field of the **BOOTP** window, enter the following “**New Entry**” values and **click OK**.

IP Address:	192 . 169 . 3 . 22
Hostname:	VFD
Description:	PowerFlex 40

The information for the VFD should now appear in **BOOTP**’s **Relation List** field.

11. When **BOOTP** assigns an address to a device, the assigned value will also appear in the **Request History** field of the **BOOTP** window next to the corresponding request. Note that you may need to scroll up or down in the **Request History** field to verify that an IP address has been assigned to a specific device.

Request History				
Clear History	Add to Relation List			
(hr:min:sec)	Type	Ethernet Address (MAC)	IP Address	Hostname
0:57:11	BOOTP	00:00:BC:3F:FC:54	192.168.2.22	PLC
0:56:35	BOOTP	00:00:BC:3F:FC:54	192.168.2.22	VFD
0:56:01	BOOTP	00:00:BC:32:8D:41	192.168.2.23	VFD

Your MAC addresses may differ from those shown

Your IP addresses will be 192.169.3.20 and 192.169.3.22

12. **Minimize** (do NOT close) the **BOOTP** program window. By minimizing it instead of closing the program, **BOOTP** will continue running in the background. That way, if you have to power-down either the PLC or the VFD, **BOOTP** will automatically reassign them an IP address when they are powered-up again.

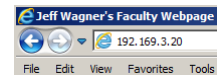
Note that, by choosing **File**→**Save As** in the **BOOTP** window, you can also save a copy of the relation list in a **.bpc** (BootP Config) file to the desktop, after which you can automatically restart **BOOTP** with the previously-entered relations by **double-clicking** on the saved **bpc** file.

Confirming Ethernet Network Connectivity

The PLC, the VFD, and the desktop computer should now be networked together. Confirm this by utilizing **Internet Explorer** to access the web-interfaces provided by both the PLC and the VFD.

13. To access the webpage-based interface of the PLC:

Run **Internet Explorer** and enter the PLC’s IP Address (**192.169.3.20**) into the address bar and hit **Enter**; **Internet Explorer** should display the web-interface.



Take a moment to become familiar with the PLC’s web interface before proceeding to Step 14.

14. To access the webpage-based interface of the VFD:

Enter the VFD’s IP Address (**192.169.3.22**) into **Internet Explorer**’s address bar; **Internet Explorer** should display the VFD’s web-interface.

Take a moment or two to become familiar with the interface before proceeding to Step 15.

15. Close the **Internet Explorer** window.

RSLINX CLASSIC

RSLinx Classic is a program that provides the protocols necessary for Microsoft Windows applications, such as RSLogix 5000, to communicate with any Allen-Bradley networked devices.

Complete the following steps to start and configure the RSLinx software:

16. Run the “**RSLinx Classic**” software from the desktop.

17. In the main **RSLinx** window, choose **Communications**→**Configure Drivers**. A new **Configure Drivers** window will open.

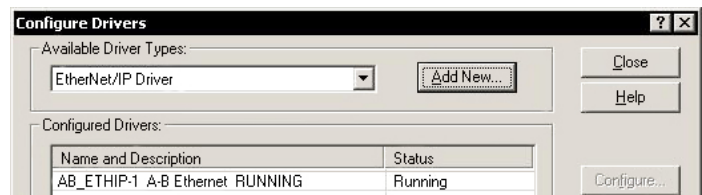
18. If any “**Configured Drivers**” are already present, **Stop** and **Delete** them.

19. In the “**Available Driver Types**” drop-down list, locate and choose “**EtherNet/IP Driver**” and **click** the “**Add New...**” button.

20. **Click OK** to accept the default name “**AB_ETHIP-1**” in the **Add New RSLinx Classic Driver** window that appears.

21. Choose the desktop computer’s Ethernet adapter (IP Address **192.169.3.1**) from the list that appears in the “**Configure Driver:**” window and **click OK**.

22. The “**Configure Drivers**” window should appear as shown to the right.



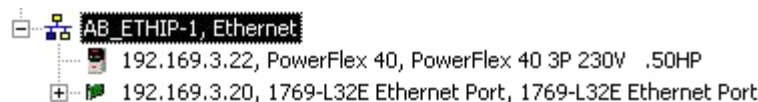
Click Close to save and close the **Configure Drivers** window.

23. In the main **RSLinx** window, choose **Communications**→**RSWho**.

Your **RSLinx** window should look similar to the one shown to the right:

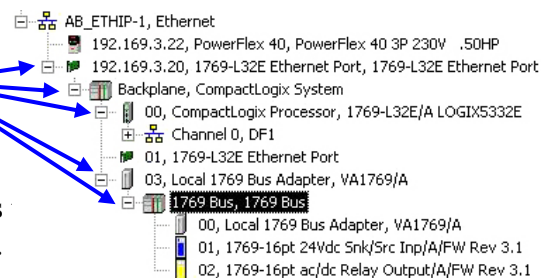


24. **Click** the **+** next to the **AB_ETHIP-1, Ethernet** entry to expand that item. You should see both the **PowerFlex 40** and the **Compact Logix 1769-L32E** devices similarly listed.



25. Fully **expand** all the **1769-L32E** entry to investigate all of its attached components. The complete set of entries should appear as shown to the right.

Note – it may take a few seconds for each of the items appear as you continue to expand down the list.



Also note that the IP addresses shown above for the PLC and VFD may differ from your values.

26. **Minimize** (do NOT close) the **RSLinx** window.

Completion of Part C

Once the physical control system is properly setup as described in **PLC-1A**, the VFD is properly configured as described in **PLC-1B**, and the communications network is properly configured as described in **PLC-1C** (this document), then you are ready to complete the next portion of this experiment: **PLC-1D: RSLogix 5000 Software – Configuration & Programming**

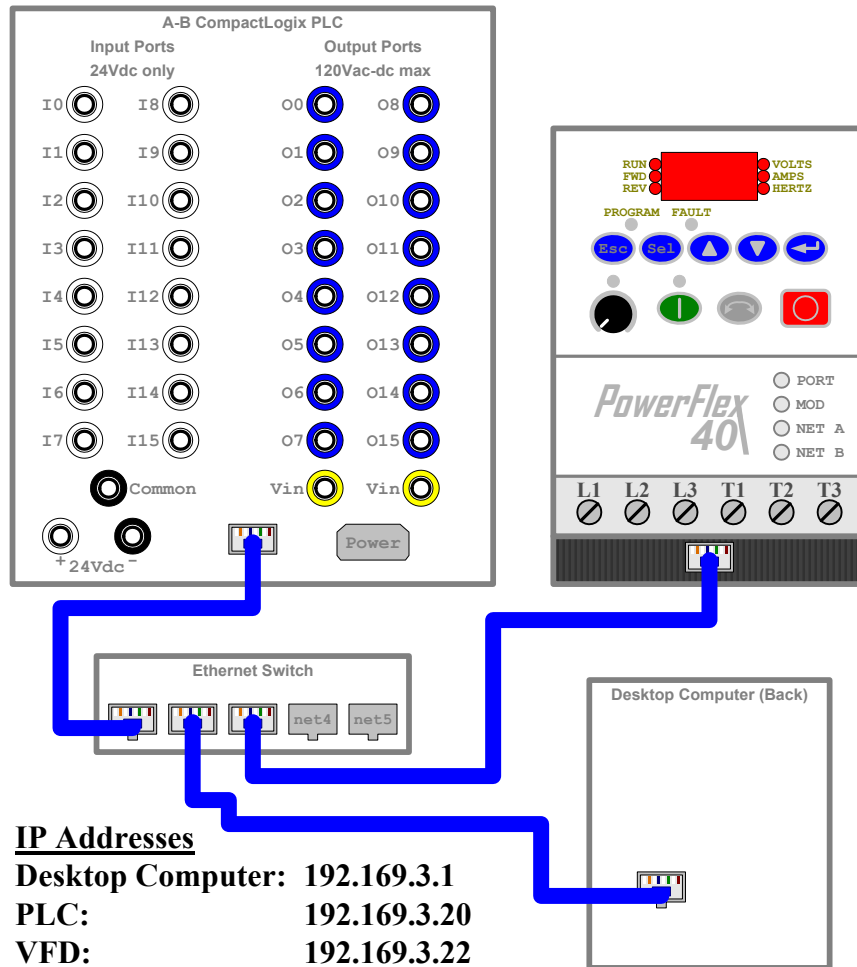


Figure C-1 – Wiring Diagram for Motor Control System Ethernet Network