T E C H N I C A L   N O T E

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Trio Default IP Address

The IP address is (Internet Protocol address) a 32-bit address that has two parts: one part identifies the network (with the *network number*) and the other part identifies the specific machine or host within the network (with the *host number*). An organization can use some of the bits in the machine or host part of the address to identify a specific subnet. Effectively, the IP address then contains three parts: the network number, the subnet number, and the machine number.
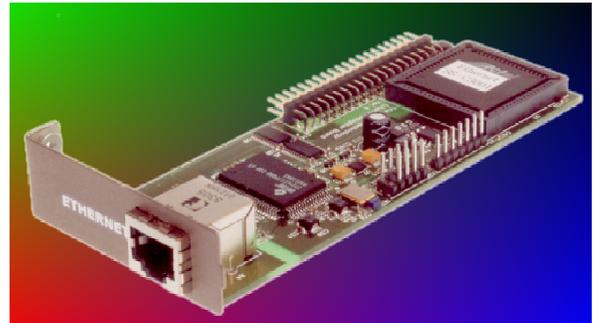
The 32-bit IP Address is often depicted as a dot address (also called *dotted quad notation*) - that is, four groups of decimal digits separated by periods.

For example, the Trio Ethernet daughter board has a default IP of:

        192.168.000.250

Each of the decimal digits represents a string of four binary digits. Thus, the above IP address really is this string of 0s and 1s:

        11000000.10101000.00000000.11111010

As you can see, we inserted periods between each eight-digit sequence just as we did for the decimal version of the IP address. Obviously, the decimal version of the IP address is easier to read and that's the form most commonly used (192.168.000.250).

Part of the IP address represents the network number or address and another part represents the local machine address (also known as the *host number* or *address*). IP addresses can be one of several classes, each determining how many bits represent the network number and how many represent the host number. IP addresses are grouped by classes A,B,C, D and E. The Trio ethernet board is set up for a Class C address.

Using the above example, here's how the IP address is divided:

        <-Network address->.<-Host address->
              192.168   .   000.250

The beginning Network Address portion of 192 begins with the first three bits as 110... and classifies it as a Class C address. This means you can have up to 256 host addresses on this particular network.

If you wanted to add sub-netting to this address, then some portion (in this example, eight bits) of the host address could be used for a subnet address. Thus:

```
<-Network address->.<-Subnet address->.<-Host address->
        192.168    .        000      .        250
```

To simplify this explanation, we've divided the subnet into a neat eight bits but an organization could choose some other scheme using only part of the third quad or even part of the fourth quad.

A subnet (short for "sub-network") is an identifiably separate part of an organization's network. Typically, a subnet may represent all the machines at one geographic location, in one building, or on the same local area network (LAN). Having an organization's network divided into subnets allows it to be connected to the Internet with a single shared network address. Without subnets, an organization could get multiple connections to the Internet, one for each of its physically separate sub-networks, but this would require an unnecessary use of the limited number of network numbers the Internet has to assign. It would also require that Internet routing tables on gateways outside the organization would need to know about and have to manage routing that could and should be handled within an organization.

The Subnet Mask

Once a packet has arrived at an organization's gateway or connection point with its unique network number, it can be routed within the organization's internal gateways using the subnet number as well. The router knows which bits to look at (and which not to look at) by looking at a subnet mask. A mask is simply a screen of numbers that tells you which numbers to look at underneath. In a binary mask, a "1" over a number says "Look at the number underneath"; a "0" says "Don't look." Using a mask saves the router having to handle the entire 32-bit address; it can simply look at the bits selected by the mask.

Using the Trio default IP address, the combined network number and subnet number occupy 24 bits or three of the quads. The default subnet mask carried along with the packet is:

```
255.255.255.000
```

Or a string of all 1's for the first three quads (telling the router to look at these) and 0's for the host number (which the router doesn't need to look at). Subnet masking allows routers to move the packets on more quickly.

Connecting to the Trio Ethernet Daughter Board

The following steps can be followed to establish an ethernet connection from a PC to the MC controller.

1. One-to-One Connection

For a PC to the MC controller direct connection, use a **"null modem"** data cable.
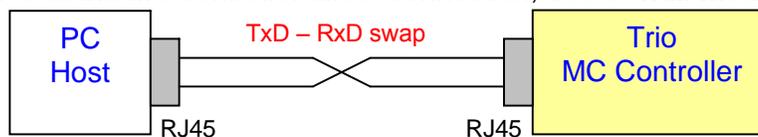
The IP address of the Host PC can be set to the match the default value of the Trio ethernet card.

```
Host PC IP:     192.168.000.251
Subnet:         255.255.255.000

Trio IP:        192.168.000.250
Subnet:         255.255.255.000
```

If leaving the Trio's IP address as default, proceed to step 6 to test communications.

2. Connecting the Trio to Network through an ethernet hub/switch

When connecting the Trio MC controller to an existing ethernet network on a hub, <u>no</u> swap in the data cable is required since the hub or router will handle the data inversion.
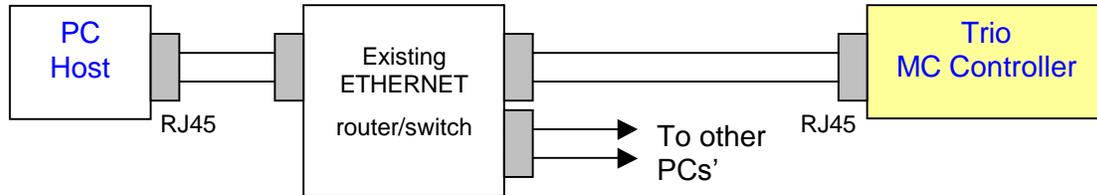
The IP address of the Trio ethernet board can be set to the match the network address. The Trio's default subnet (255.255.255.000) is generic and allows any host PC to communicate with the controller regardless of a specific sub-network mask. Below is a typical example.

```
Host PC IP:      192.200.185.001
Subnet:          255.255.255.224

Trio IP:         192.200.185.a
Subnet:          255.255.255.000
```

Where:
a = Valid IP address for the Trio ethernet board on the given network

3. Select a valid IP address for the Trio

For this network example, the 224 in the subnet indicate the network can have up to (6) sub-networks (224 = 11100000). The (5) remaining bits within the 224 mask will allow up to 30 valid host addresses ranging from 1 to 30.

```
Valid IP Addresses (a) for above example:
      002 = 11100010 to 030 = 11111110

New Trio IP:     192.200.185.002
Trio Subnet:     255.255.255.000
```

4. Checking and Setting The Trio's IP Address

The IP address of the ethernet daughter board can be verified using the RS232 command line interface ">>" of the MC controller. The command line can be accessed via Motion Perfect 2 or a terminal emulator such as Windows HyperTerminal or ProComm. The PORT settings are: 9600 baud, 7 data bits, even parity, 2 stop bits.

At the command line, use the ETHERNET command and type:

```
>>ETHERNET(0,0,0)
```

When connected correctly the controller will respond with the line:

```
>>192.168.000.250
```

The sequence (192.168.000.250) is the IP address of the controller.

5. To change the IP address to a different one

Set a new IP address to match the network:

At the command line, use the ETHERNET command and type:

```
>>ETHERNET(1,0,0,192,200,185,2)
```

Verify the new IP address:

```
>>ETHERNET(0,0,0)
```

The new IP address value prints out:

```
>>192.200.185.002
```

NOTE: Cycle power to the Motion Coordinator for the new IP address to take effect

6. Test the Communications

The easiest way to test the ethernet link is to "ping" the Trio MC controller. This can be done using the ping command at a DOS prompt.

From the START button in Windows, select Accessories and then Command Prompt utility.

At the DOS prompt type the Trio's appropriate IP address:

```
C:\>ping 192.168.0.250
```

Successful reply from controller

```
Pinging 192.168.0.250 with 32 bytes of data:

Reply from 192.168.0.250: bytes=32 time<10ms TTL=64
Reply from 192.168.0.250: bytes=32 time<10ms TTL=64
Reply from 192.168.0.250: bytes=32 time<10ms TTL=64
Reply from 192.168.0.250: bytes=32 time<10ms TTL=64

Ping statistics for 192.168.0.250:
   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
   Minimum = 0ms, Maximum =  0ms, Average =  0ms
```

If the ping command is *unsuccessful* you will see

```
C:\>ping 192.168.0.250

Pinging 192.168.0.250 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

```
       Ping statistics for 192.168.0.250:
           Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
       Approximate round trip times in milli-seconds:
           Minimum = 0ms, Maximum =  0ms, Average =  0ms
```

7. Telnet/Command-line Prompt

If the controller was successfully 'pinged', then the telnet application can be used to open a remote command-line prompt connection the controller. This tests the TCP socket connection.

 Type:

```
    telnet 192.168.0.250
```

using the DOS prompt on the PC. This should open a telnet session, and by typing <return> the characteristic Trio command-line prompt ('>>') should be seen.

It should be noted that it is possible to use other port numbers with the controller, hence if port number 1025 has been configured then a telnet session can still be started by typing:

```
    telnet 192.168.0.250 1025
```

If the serial lead is also connected to the controller then the Ethernet connection will grab and release the port 0 communications as the socket connection (telnet session) is opened and closed.

Web Server Functionality

The Trio ethernet daughter board has simple web page server capability. A 'canned' web page can be viewed over the Internet using a standard browser such as Internet Explorer.

To serve the page, open your Internet browser and enter the controller's IP address 'http://192.168.0.250'. The *Trio Motion Technology Applications* Home Page should appear. The Ethernet daughter board serves the page. Clicking the 'VR Variable Values' and 'Table Data' links on the home page will move you to these respective pages. The first four VR values should be displayed, which can be edited and then updated by clicking the 'submit' button. Press the browser 'back' button (several times if values have been edited) to return to the home page. Additional page functionality will be added at a later date.

It should be noted that the Ethernet daughter board does have a limited amount of RAM, and will encounter problems if web pages are served in quick succession. The problem can be eased to some extent if the socket connection is not open while the web pages are being served.

Note: The Web Server function has been removed to make way for Modbus TCP in Daughter Boards with Software V1.0.3.1 or later.

Additional information

An on-line calculator can be downloaded to help calculate ethernet IP addresses and subnet masks.

http://www.wildpackets.com/products/ipsubnetcalculator.

Ethernet TrioBASIC Keyword parameters :

The format of the ETHERNET command is

ETHERNET(read/write, slot number, function [,data])

Where read = 0, write EEPROM (non volatile) = 1, write RAM (volatile) = 2;
Slot number = comms slot holding the ethernet daughterboard;
The function number is as given in the table below;

The optional data is used when changing a parameter value. (In the case of write to EEPROM, the new value will only be used after power has been cycled to the controller.)

Func. #	Write Type	Description
0	1	IP Address
1	1	Static(1) or dynamic(0) addressing. (Only static addressing is supported.)
2	1	Subnet Mask
3	1	MAC address
4	1	Default Port Number (initialised to 23)
5	1	Token Port Number (initialised to 3240)
6	0	Ethernet daughterboard firmware version number (read only)
7*	2	Modbus TCP mode. Integer (0) or Floating Point (1) (Daughter Board V1.0.3.1 or later)
8	1	Default Gateway. (Daughter Board V1.0.3.2 or later)
9*	2	Modbus target memory. VR (0) or TABLE (1). (Requires System SW V1.62 Dev 31 or later)

Table of function numbers

* Functions written to RAM must be included in a BASIC program that is run on power-up before they become active. Modbus mode and target memory must be set up before the Modbus TCP Socket is opened by the Host.

When you use the ETHERNET command via the serial port, you must connect to the controller using *Motion*Perfect without the 'project connected' – i.e. just a terminal window open. The ethernet comms has been 'tuned' for a telnet session using the controller command line, and this does upset *Motion*Perfect when in its "connected to project" mode.