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Understanding Network Settings

Introduction

If you are connecting your robot to an Ethernet network, you will be required to document your “LAN Interface Settings”. You will need to fill in things like the host setting, domain setting, IP Address, etc. What do these terms mean? Are there “right” and “wrong” answers? How do they affect your use of the robot from other network locations? A basic understanding of network terminology and configuration options is useful when setting up a robot on a network. This becomes critical in environments with multiple robots, networked controls, and situations where you are connecting to an existing network that may be managed by someone else.

The purpose of this document is to provide some explanation of these networking terms to help you make the right choices for your situation. There is a wealth of additional information on the Internet, but some of it starts with the assumption that you already understand the basic terms. You may also need to work with a network expert within or outside of your company to add the robot to an existing network. A basic understanding of the terminology is helpful to be able to explain your needs and understand what they tell you about the network you are connecting to. If you are not interested in all the details and just want to know some “Safe” settings to start out with, those are provided at the end.

These settings are important to make a network function correctly. It is possible to slow down a large portion of the network by getting the settings wrong on one device. If you have someone who is responsible for the network in the site you are working at you will need to talk with them to understand how to setup the robot controller correctly.

If you understand many of the terms but just want to have more information on individual terms, you can use the links below to jump right to the area of interest.

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Accessing the Network Settings

To the right is a screen capture of the LAN Interface Settings screen.

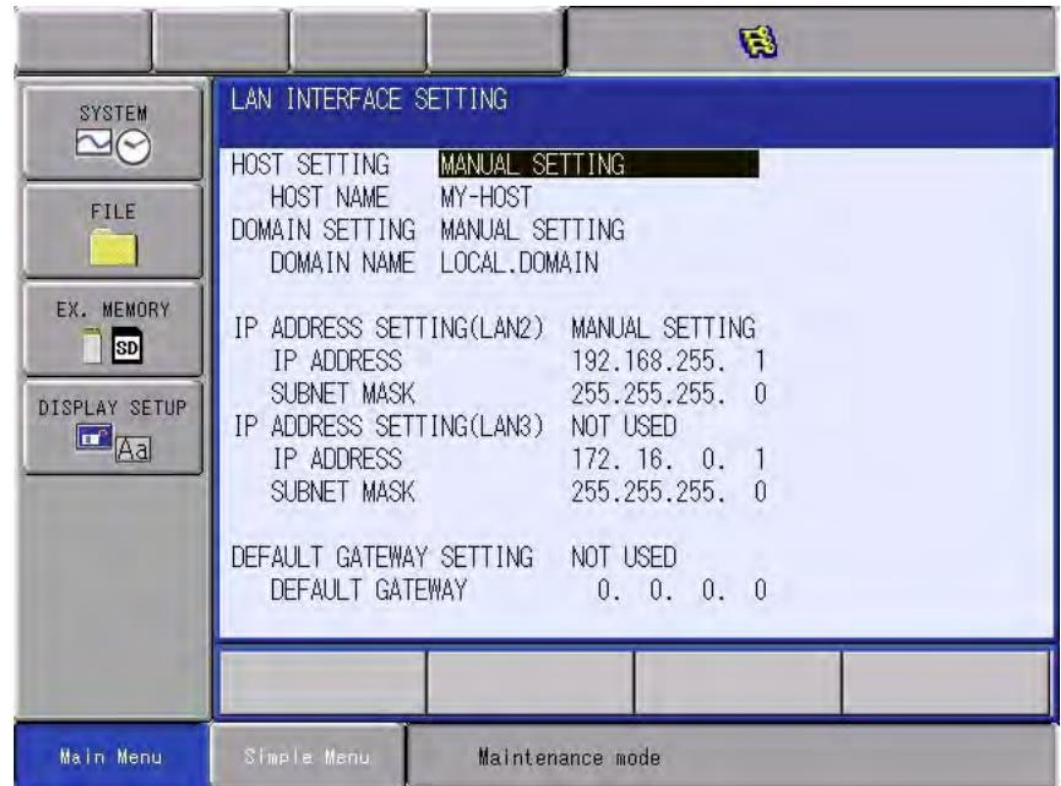
These settings are available when you are in Maintenance Mode (Power off the controller. Hold down the Main Menu key on the pendant while turning power back on. Wait for the beep before releasing the Main Menu key.)

Once in maintenance mode, make sure you are at Management Level Security. (Click on System. Click on Security. Use the Select button to make sure Management Mode is highlighted. Press Enter. The default password is all 9's.)

To navigate down to the Network Settings screen, click on SYSTEM, then SETUP, OPTION FUNCTION and then use the arrow keys to highlight DETAIL next to LAN INTERFACE SETTING. Press the SELECT key to bring up the LAN INTERFACE SETTING screen.

References – LAN Interface Settings

| Controller | Manual Name / Link |
|---------------|--|
| DX100 | Ethernet Function |
| DX200 | Ethernet Function |
| FS100, FS100L | Controller Operator's |
| YRC1000 | General Operator's |
| YRC1000micro | YRC1000micro Operator's Manual |



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Purpose of the Settings

Physically connecting the robot controller to a network provides an electrical path for information to flow but does not tell the robot anything about that network and how to communicate over it. Similarly, other networked equipment needs to know how to communicate with the robot. If there was information to send to the robot, where should it be sent?

Names and addresses are used to identify networked devices so that information can be exchanged with them. These are also referred to as “Host Name” and “IP Address”. A good analogy to think of is a business name and street address. You might have a Main Street Bakery in town. That would be the simple name most people use to refer to that business. However, that may not be enough detail for the Post Office or Fire Department. They would need to know an address (like 112 Main Street) also. Both “Main Street Bakery” and “112 Main Street” refer to the same location. One is easy to remember, and one is more specific. A Host Name identifies a device by name. An IP address identifies a device by a specific number.

Understanding DHCP and DNS

To understand some of the choices in the LAN Interface Setting Screen, you need to know what DNS and DHCP are. These are network services that may be used to simplify network deployment and use. Both services are optional. However, you will need to understand what purposes they serve and whether you will use them to complete your LAN Interface Settings.

Dynamic Host Configuration Protocol (DHCP)

Imagine a big company network with thousands and thousands of network devices. Every single one of them needs to be configured correctly for the network to function. It would not make sense to walk around to every single device and manually type in the required information. Consider the problem if the network configuration changed and you had go back to every single one to make changes! Wouldn't it be nice if there was a way to set up some rules and automatically populate all the network settings on a device every time it was turned on or every few hours?

Dynamic Host Configuration Protocol (DHCP) provides a way to automatically configure network devices. Many PCs and cell phones use this by default. A device on the network (often a router) is designated as the DHCP server. It contains the rules for how to assign addresses and other network settings. It tracks which addresses are being used and which are free to assign. When a new device comes on the network and is configured to use DHCP, it contacts the DHCP server and asks for the configuration data it should use. The server provides that information back to the new device and it proceeds to connect using the settings provided by the server.

This background on DHCP is provided because one of the first network settings to supply is basically asking, “Will you use DHCP for your network settings or be entering them manually?”

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Why wouldn't everyone just use DHCP all the time? While the advantages may be obvious (automatic configuration of your network devices) there are some significant disadvantages to consider.

First, it is possible that the network address assigned to a device will change over time. If the device is off the network for a long period of time and then reconnected it may be issued a different address. That is a big problem if you are looking for that device at a specific address. There are many scenarios where a specific address is needed and the use of DHCP is not possible. One scenario where this applies is network security. It is reasonable to expect there might be firewall rules or security policies that need to be applied to a device at a specific address and it would not be acceptable to randomly assign addresses.

Second, the use of DHCP requires the presence and administration of a DHCP server. This is not a huge obstacle. Many network routers come with a free imbedded DHCP service. However, if you do not have access to the router password to turn on DHCP or do not want the complexity of maintaining DHCP rules, this could be deal killer for use of DHCP.

Domain Name Services (DNS)

In addition to assigning an address to a network device, it is also possible to provide easier-to-use names. It is important to understand the names are optional and used in addition to addresses. Names can automatically be used to lookup an address for communications to occur. How is a directory of names and addresses maintained? Domain Name Services (DNS) provide this function.

The creation of DNS services were critical for the growth of the Internet. Imagine if you wanted to look at the Motoman website and had to know our web server was at 40.70.147.4? Instead, you can type "motoman" in your browser address bar. DNS converts motoman.com to 40.70.147.4 and connects you to our website.

If you wanted to call your robot "robot1", how would it be differentiated from the one called "robot1" on someone else's network? The "domain" concept solves this issue. Network names are defined (and must be unique!) within a domain. Our domain is motoman.com. The fully qualified domain name (FQDN) for a device on our network would be something like robot1.motoman.com. If you worked for acme company, your robot could be found at robot1.acme.com

DNS servers collaborate to resolve names in to addresses. If I were using my home network and wanted to get to robot1.acme.com, my request would be routed to the DNS services for acme.com to respond with an address for robot1. This brings up some potential problems. acme.com may not have DNS services and / or they may not make their internal names available to the public.

Like DHCP, the DNS service sounds like it makes things easier. Why doesn't everyone use it? Like DHCP, someone needs to install and support the service. While there are ways to automatically add names to the DNS registry some organizations prefer to have a person make decisions about changes and perform them manually. DNS lookups are a potential point of failure in a network and an extra step that some view as an unnecessary performance hit. There are also some

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security concerns to be dealt with related to DNS. Some network applications and services will not allow the use of a DNS name and require an address instead. Not everyone wants or needs DNS for their network to run correctly, so it may be viewed as unnecessary overhead.

Now that DHCP and DNS concepts have been covered, let's get to describing the LAN Interface Settings for Yaskawa Motoman robots.

HOST SETTING

Two simple choices here: will you be manually defining a host name, or will it be set by DHCP?

HOST NAME

If you are manually setting a Host Name, enter it here.

DOMAIN SETTING

Again, two choices here: will you be manually defining a Domain Name, or will it be set by DHCP?

DOMAIN NAME

If you are manually entering the Domain Name, enter it here.

IPADDRESS SETTING

Similar two choices here: will you be manually entering an IP Address, or will it be set by DHCP?

IP ADDRESS

If you are manually entering an IP Address, enter it here. Note: the IP address must be unique. Entering an address that is already in use will cause network problems. Typically, the portion that must be unique is the part that comes after the last period. For example, 192.168.1.**31** is typically used by Motoman as the address for our controller. There can be no other device on the same network (192.168.1.(anything) that also ends in 31.

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SUBNET MASK

A subnet mask is used by the network software to determine which part of the address defines a device and which part defines the network it is a part of.

An IP address is represented as 4 numbers ranging from 0 to 255, separated by periods for ease of use. In software, it is treated as a 32-bit address. The 32-bit IP address contains information about the host and its network. It is very necessary to distinguish both. For this, routers use Subnet Mask, which is as long as the size of the network address in the IP address. Subnet Mask is also 32 bits long. If the IP address in binary is ANDed with its Subnet Mask, the result yields the Network address. For example, say the IP Address is 192.168.1.152 and the Subnet Mask is 255.255.255.0 then –

| | | | | | | |
|---------|---------------|----------|----------|----------|----------|---------|
| IP | 192.168.1.152 | 11000000 | 10101000 | 00000001 | 10011000 | } ANDed |
| Mask | 255.255.255.0 | 11111111 | 11111111 | 11111111 | 00000000 | |
| Network | 192.168.1.0 | 11000000 | 10101000 | 00000001 | 00000000 | Result |

This way the Subnet Mask helps extract the Network ID and the Host from an IP Address. It can be identified now that 192.168.1.0 is the Network number and 192.168.1.152 is the host on that network.

DEFAULT GATEWAY SETTING

(Optional) In networking a gateway device is defined as a component that connects networks together. Network devices that need to communicate to other devices outside of the local network need to know how to get to an outside network. Providing an address for the network gateway is the way to document how external networks are accessed. The default gateway address may be provided by DHCP in some cases. It does not need to be defined if the device does not initiate communications with outside networks. In almost all cases, there are no scenarios where the robot will be trying to initiate communications with another network. An exception may be if third-party software is used on the controller.

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Testing the Network Connection

To verify the correct network settings are in place, there is a “ping” function available on most networked systems. (The name comes from submarine active sonar terminology that sends a pulse of sound and listens for the echo to detect objects under water.) A device can send a “ping” network packet targeting other devices on the network and listen to see if there is a response and how long it takes to return.

To issue a ping from your Windows PC, open a command prompt (click on “Start”, type CMD and then press enter.) From the command prompt, enter “ping 192.168.1.31” (or the address of your controller that you entered). A successful response will begin with “Reply from “. Unsuccessful responses are “Request timed out.”

In the example at the right, 10.0.1.70 is a valid network address and the device is responding to pings. 10.0.1.71 is not responding to the ping request.

```
Command Prompt
C:\>ping 10.0.1.70

Pinging 10.0.1.70 with 32 bytes of data:
Reply from 10.0.1.70: bytes=32 time<1ms TTL=64
Reply from 10.0.1.70: bytes=32 time<1ms TTL=64
Reply from 10.0.1.70: bytes=32 time<1ms TTL=64
Reply from 10.0.1.70: bytes=32 time=1ms TTL=64

Ping statistics for 10.0.1.70:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.1.71

Pinging 10.0.1.71 with 32 bytes of data:
Reply from 10.0.1.22: Destination host unreachable.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.1.71:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),

C:\>
```

Figure 1 - Ping from PC

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You can also issue a ping from DX200 or YRC controllers to other devices on the network to check connectivity “outwards” from the controller. The ping command is available under SYSTEM INFO, NETWORK UTILITY if you are at Management Level security. Operation is like on a PC. You provide the target network address and select “EXECUTE” from the bottom of the screen to start the ping. Results will be displayed on the pendant.

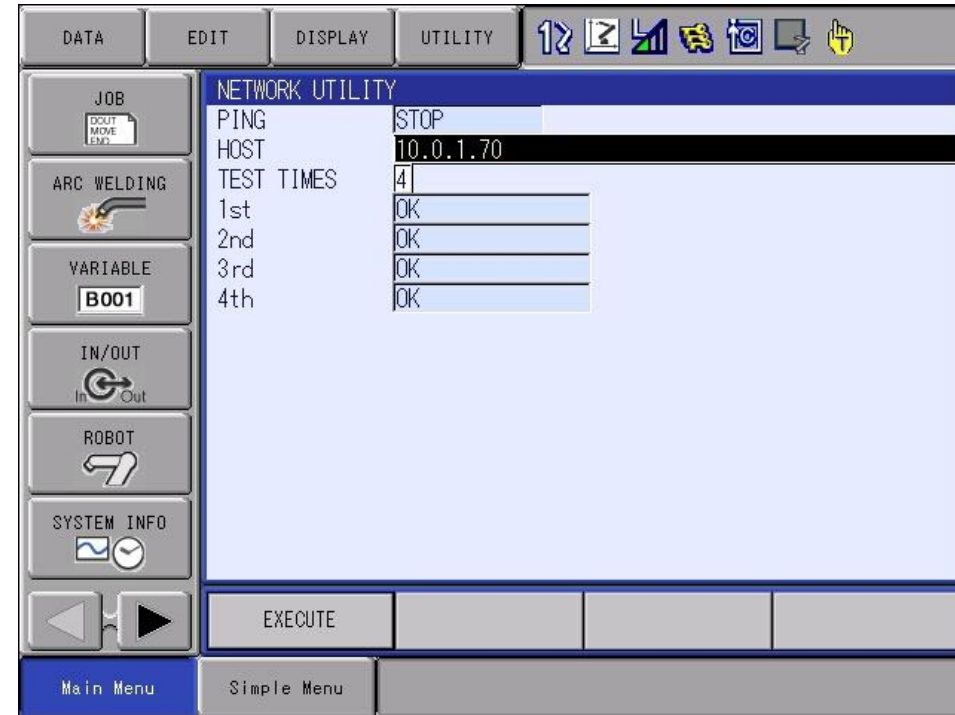


Figure 2 - Ping from Controller

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“Safe” Settings

If all the above was more than you needed or wanted to know, the following settings should be safe to get you started.

| Title | "Safe" Setting | Comment / Explanation |
|---------------------------------|-----------------------|---|
| HOST SETTING | MANUAL SETTING | Enter your settings manually. Do not use DHCP automatic configuration. |
| HOST NAME | MY-HOST | (Default) Leave as is unless you need a specific setting. |
| DOMAIN SETTING | MANUAL SETTING | Enter your settings manually. Do not use DHCP automatic configuration. |
| DOMAIN NAME | LOCAL.DOMAIN | (Default) Leave as is unless you need a specific setting. |
| IP ADDRESS SETTING(LAN2) | MANUAL SETTING | (Default) Leave as is unless you need a specific setting. |
| IP ADDRESS | 192.168.1.31 | Generally, the default we use at the factory. Leave as is, unless you are told a different network address is needed. |
| SUBNET MASK | 255.255.255.0 | This is a common default. |
| IP ADDRESS SETTING(LAN3) | NOT USED | This is generally the default we use at the factory. Leave as is, unless you know you will need a second connection. |
| IP ADDRESS | 172.16.0.1 | Ignored, if LAN3 is "NOT USED" |
| SUBNET MASK | 255.255.255.0 | Ignored, if LAN3 is "NOT USED" |
| DEFAULT GATEWAY SETTING | NOT USED | (Default) Leave as is unless you need a specific setting. |
| DEFAULT GATEWAY | 0.0.0.0 | Ignored, if gateway setting is "NOT USED" |