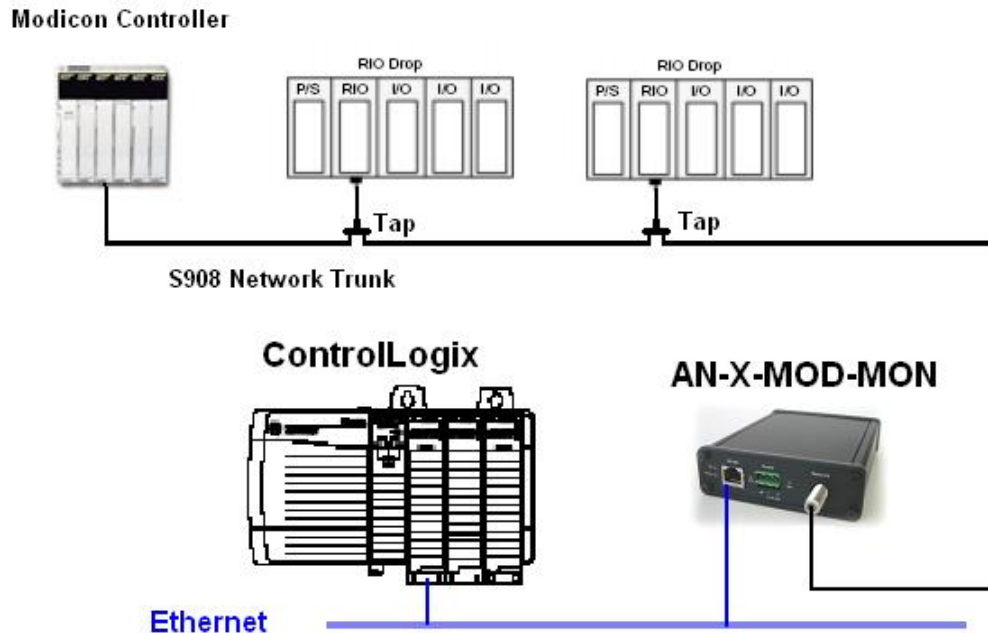


AN-X Application Note

Using AN-X-MOD-MON



This application note describes an approach to upgrading control systems that results in minimal risk and downtime.

To accomplish a control system upgrade:

- Convert existing ladder logic to Logix
- Capture the old controller's I/O configuration
- Have Logix ghost the old controller by sending it live inputs and comparing its outputs to the existing controller's outputs
- Swap in the new controller, test and be able to swap back to the old controller if required

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Once the new control system's functionality has been verified, the old I/O can be replaced a little at a time with modern Rockwell I/O as time and funding permit.

As an example, this application note describes in detail how to replace a Modicon controller with a ControlLogix processor and AN-X-MOD-MAS.

It describes a simple network consisting of two drops. Drop 1 is an 800 series drop; drop 2 is a Quantum drop.

It assumes that you will use the same AN-X hardware for both monitor and master, changing one to the other by downloading firmware.

Before you begin...

Select IP addresses and Ethernet host names for the module as master and as monitor. The IP addresses must be different since RSLogix 5000 will not allow two modules in the same I/O configuration to have the same IP address.

If you're adding the module to an existing network, consult the network administrator first to obtain IP addresses and other network parameters.

All the details for setting the IP address are in the AN-X-MOD-MON manual.

In this example, we'll use 192.168.0.21 for the monitor and 192.168.0.22 for the master.

We'll use names ANXModMon and ANXModMas.

WARNING!

Do not connect or disconnect the AN-X module while the Modicon control system is running!

Connecting the AN-X-MOD-MAS and AN-X-MOD-MON to the S908 Network

The hardware for the AN-X-MOD-MAS and AN-X-MOD-MON contains built-in termination.

When you connect the AN-X-MOD-MAS to the network, it usually replaces a Modicon master and no wiring changes are necessary.

When you connect the AN-X-MOD-MON to the network, you can't connect it just like any other node. There's a loss of about 14 dB through a tap to each drop, so if the AN-X were connected as a drop, there would be a loss of at least 28 dB in the signal from other drops to the AN-X-MOD-MAS, as well as any attenuation along the cables.

The AN-X-MOD-MON should be located at the end of the network trunk. Remove the terminator previously at the end of the network trunk.

If you remove an AN-X-MON-MON from the S908 network, make sure the network is properly terminated after you remove it.

Step 1: Replace the Modicon controller with the AN-X-MOD-MAS

Before we can use the AN-X module to monitor the running Modicon system, we must briefly set it up as master on the network to obtain the tags we will need to program the new control system.

Before you can use the AN-X-MOD-MAS, you must set its IP address, using the Windows utility AnxInit. In this example, we will set the IP address to 192.168.0.22

Give the AN-X a meaningful name. This name will also be used when we configure the module in RSLogix 5000. In this example, we'll name the module ANXModMas.

Use *Utilities/Restart AN-X* to restart the AN-X in production mode after you change the IP address and host name.

Use AnxInit to confirm that the module has the master firmware loaded. If it does not, use AnxInit to download the firmware from the AN-X distribution CD.

If you changed the IP address, use *Utilities/Select An AN-X* to change the selected AN-X.

Step 2: Attach the AN-X-MOD-MAS to the S908 network

Make sure the Modicon controller is stopped. Disconnect it from the S908 network and replace it with the AN-X-MOD-MAS.

Step 3: Autoconfigure the master

Use the web interface to autoconfigure the master. Use your web browser and, in this example, enter 192.168.0.22 as the address.

From the web interface, select *Automation Network/S908 I/O Network configuration*.

Check *Auto-configure S908 network and ControlLogix configuration* and then click *Autoconfigure Network*.

The AN-X-MOD-MAS sends messages to all possible drops and builds a remote I/O configuration from what the responses.

It also builds a default ControlLogix configuration that maps the Modicon I/O data to scheduled connections in the ControlLogix.

Use the web interface to view and save the remote I/O and ControlLogix configuration and tag files to your computer. You'll need the tags to program the ControlLogix.

To view the remote I/O configuration, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MAS S908 Network Configuration File*.

To view the ControlLogix configuration, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MAS ControlLogix Configuration File*.

To view the tags, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MAS ControlLogix Exclusive Owner Data Tags*.

To save these files, right click on the link and select *Save Target As...* from the menu.

Make sure that all the I/O modules appear in the configuration and that there are no error messages.

Step 4: Set up the AN-X-MOD module as monitor

Set the IP address of the module to the address you've chosen for monitor operation. In this example, the monitor IP address is 192.168.0.21

Give the AN-X a meaningful name. This name will also be used when we configure the module in RSLogix 5000. In this example, we'll name the module ANXModMon.

Use *Utilities/Restart AN-X* to restart the AN-X in production mode after you change the IP address and host name.

Download the monitor firmware. (Remember to change the IP address of the selected AN-X using *Utilities/Select An AN-X* in AnxInit after you change the IP address and host name.)

Step 5: Reconnect the Modicon master

Reconnect the Modicon master to the S908 network.

The Modicon master will be connected to one end of the network and the AN-X monitor will be at the other end.

Confirm that the network is correctly terminated. The Modicon controller and the AN-X module are at the ends of the S908 network trunk and have internal termination. There should be no other terminators on the network trunk.

Confirm that the Modicon master and control system are working correctly before proceeding.

Step 6: Autoconfigure the AN-X-MOD-MON

Autoconfigure the AN-X-MOD-MON from traffic on the S908 network.

Whenever the Modicon master starts up, it sends configuration (traffic cop) information based on its current I/O configuration.

At startup, the Modicon master also sends parameter data to Quantum drops. Typical parameter data includes timeout data, channel configurations for analog modules, and so on. The AN-X-MOD-MON captures this parameter data and adds it to the remote I/O configuration where it can later be used by the AN-X-MOD-MAS.

First clear out any previous configuration stored in the AN-X-MOD-MON.

From the web interface, select *Automation Network/S908 I/O Network configuration*. Click the *Clear Heard Configuration* button. When AN-X is done, click the *configuration page* link to return to the main configuration page.

Now stop and start the Modicon master. The AN-X-MOD-MON captures the configuration traffic on the network.

Check *Auto-configure S908 network and ControlLogix configuration* and then click *Autoconfigure network*. The AN-X-MOD-MON builds a configuration from what it previously captured.

It also builds a default ControlLogix configuration that maps the Modicon I/O data to scheduled connections in the ControlLogix.

Use the web interface to view and store the remote I/O and ControlLogix configurations it generated, as well as the tags.

To view the remote I/O configuration, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MON S908 Network Configuration File*.

To view the ControlLogix configuration, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MON ControlLogix Configuration File*.

To view the tags, select *Automation Network/View Configuration Files*, then click *AN-X-MOD-MON Ethernet/IP ControlLogix Data Tags*.

To save these files, right click on the link and select *Save Target As...* from the menu.

Here's an example of a remote I/O configuration:

```
AN-X-MOD-MON Network AutoConfig
.....Scan Successful
AN-X-MOD-MON I/O Network Config File /home/axctrl/ModRioCfg.csv
 6: d01s4 B804
 7: d01s5 B805
 8: d01s6 B863
 9: Drop 1 [O: 2] [I: 10] [MS: 0]
12: d02s1 CPS_114_xx
13: d02s2 CRA_93x_00
14: d02s3 DDI_353_00
15: d02s4 DDO_353_00
17: d02s5 ACI_030_00
19: d02s6 ACO_020_00
21: Drop 2 [O: 12] [I: 22] [MS: 6]
.....Parse Successful
```

Figure 1 Remote I/O Configuration

Things to note

The remote I/O configuration lists the modules the AN-X-MOD-MON saw in the configuration that was sent on the network, by drop, rack and slot.

For example, the line

6: d01s4 B804

indicates that drop 1 slot 4 contains a B804 module.

The line

14: d02s3 DDI_353_00

indicates that drop 2 slot 3 contains a DDI 353 00 module.

AN-X appends a list of supported 800 series and Quantum modules to the end of the I/O configuration file.

Here's an example of a ControlLogix configuration:

```
AN-X-MOD-MON ControlLogix Config File /home/axctrl/ModMonEnetIpSvr.csv
5: ClxExp: ANXModMon
6: ClxPrefix: MOD_
7: ClxPrefixOut: MOD_MONOUT_
12: ClxSlot 0
14: DataInput
15: 0 2 DropErr
17: 2 1 d01s5 MOD_d01s5_Inp B805
18: 3 4 d01s6 MOD_d01s6_Inp B863
19: 7 2 d02s3 MOD_d02s3_Inp DDI_353_00
20: 9 9 d02s5 MOD_d02s5_Inp ACI_030_00
25: 18 1 d01s4 MOD_d01s4_Out B804
26: 19 2 d02s4 MOD_d02s4_Out DDO_353_00
27: 21 4 d02s6 MOD_d02s6_Out ACO_020_00
32: ClxSlot 15
34: DataInput
35: 0 15 DiagCtrs
36: 15 5 D1ModHlth
37: 20 5 D2ModHlth
40: 25 10 D2ModSts
43: 35 10 ConnStats0
.....Parse Successful
```

Figure 2 ControlLogix Configuration

The ControlLogix configuration shows where the I/O data is mapped in the ControlLogix.

Things to note

Data is mapped to generic modules in slots 0 to 15. Data for each slot starts with a line with ClxSlot and the slot number.

AN-X-MOD-MON packs all the inputs together, then all the outputs.

AN-X-MOD-MON maps diagnostic data to slot 15. It comprises the diagnostic counters, module health bits, module status data for Quantum drops, and statistics for the ControlLogix connections.

Step 7: Configure the AN-X-MOD-MON in the ControlLogix

To the ControlLogix processor the AN-X-MOD-MON looks like a 17 slot rack with an ENBT/A module in slot 16 and generic modules in slots 0 to 15.

When you autoconfigure the AN-X-MOD-MON, it maps the Modicon I/O data into the input data for the generic modules in the ControlLogix. You add scheduled connections to those generic modules to read the S908 data from the AN-X.

By default, the AN-X-MOD-MON maps I/O data into the generic modules in slots 0 to 14. It maps diagnostic counters and other status information to the generic module in slot 15.

In the example in Figure 2, the “ClxSlot” lines indicate where the data for each generic module starts. Since this is a small I/O configuration, all the I/O data fits into the input data for slot 0. The diagnostic data is mapped to the input data for slot 15.

To configure the AN-X-MOD-MON, add an ENBT/A module to the I/O configuration at the AN-X-MOD-MON IP address (192.168.0.21)

Add generic modules for each slot we want to create a connection to, in this case slots 0 and 15.

Refer to the appendix for detailed instructions.

Step 8: Configure the AN-X-MOD-MAS in the ControlLogix

To the ControlLogix processor the AN-X-MOD-MAS looks like a 17 slot rack with an ENBT/A module in slot 16 and generic modules in slots 0 to 15.

When you autoconfigure the AN-X-MOD-MAS, it maps the Modicon I/O data into the input and output data for the generic modules in the ControlLogix. You add scheduled connections to those generic modules to read and write the S908 data.

By default, the AN-X-MOD-MAS maps I/O data into the generic modules in slots 0 to 14. It maps diagnostic counters and other status information to the input data for the generic module in slot 15.

To configure the AN-X-MOD-MAS, first add an ENBT/A module to the I/O configuration at the AN-X-MOD-MAS IP address (192.168.0.22)

Add generic modules for each slot we want to create a connection to, in this case slots 0 and 15.

Refer to the AN-X-MOD-MAS user manual for detailed instructions.

Step 9: Check that you can see the I/O data

With the Modicon controller in run mode, check that you can see the input and output data.

In the ControlLogix configuration file, the line

```
17: 2 1 d01s5 MOD_d01s5_Inp B805
```

indicates that the input data for the module in drop 1 slot 5 (a B805) starts at offset 2 and has length 1 word.

The line

```
26: 19 2 d02s4 MOD_d02s4_Out DDO_353_00
```

indicates that the output data for the module in drop 2 slot 4 (a DDO 353 00) starts at offset 19 and has length 2 words.

Use the ControlLogix configuration to verify that you can see input and output data for all the modules on your network.

Step 10: Import tags into RSLogix 5000

Use the tag import facility in RSLogix 5000 to import the files you exported. RSLogix 5000 must be offline when you import tags.

First import the master tags.

Next, import the monitor tags.

When you import the monitor tags, tags for the input data will generate errors since they duplicate some of the master tags. We imported the monitored tags after the master tags so that the control program uses the monitored inputs. When we switch the AN-X over to master mode, we will re-import the master tags so that the control program uses the master inputs.

There will be separate tags for the monitored outputs and the master's outputs.

Download the program and verify that you can use the tags to access the input, output and diagnostic data.

Step 11: Monitor the existing control system in the ControlLogix

Monitor the running process and confirm that you can observe all the I/O data.

Step 12: Create the new control program

Create the ladder logic to read the inputs and control the outputs and write the output values to the AN-X-MOD-MAS.

The control program should be written in terms of the imported tags.

Step 13: Compare the new system with the old

Both the old and new systems receive the same inputs.

Compare the outputs from the new system with the outputs from the old.

There will be slight variations in timing due to differences in processor scan time, I/O scan time, rounding and truncation in analog values, and so on, which you will have to account for in the comparison.

For discrete I/O, you can use timers or counters to measure the time that the outputs from the old and new systems differ and confirm that the differences remain small.

For analog I/O, confirm that the difference between the new and old values remains below whatever limit you choose to be acceptable.

Step 14: Change the AN-X from monitor to master

If you are using the same AN-X hardware for the master as you used to monitor the old system,

- change the IP address
- download the master firmware
- autoconfigure the master. Create both remote I/O and ControlLogix configurations.
- manually download the remote I/O configuration from the monitor. This step ensures that any parameter data the Modicon controller was sending to remote drops is duplicated by the AN-X-MOD-MAS
- import the master tags into RSLogix 5000 so that the master obtains its inputs from the master inputs, not from the monitored inputs

Step 15: Switch over

When you're convinced that the new system duplicates the functionality and timing of the existing system, you can switch over.

If you've missed something and run into problems, you can easily change back to the old system, since the I/O and field wiring are unchanged.

Over time, you can replace the Modicon I/O a bit at a time.

The advantages of this approach...

- the new system is tested before you install it
- results in minimum downtime and lost production. Install the new system during scheduled shutdowns.
- I/O and field wiring are unchanged so you can easily back out of the change until the new control program is working correctly

Some troubleshooting tips...

Use the diagnostic counters to monitor network communication.

Monitor the Modicon diagnostics (drop errors, module status, module health bits) to check for problems with I/O modules and drops.

If you run into problems with I/O or ControlLogix connections, check the AN-X logs for detailed information on the likely cause.

References

- AN-X-MOD-MON User's Guide
- AN-X-MOD-MAS User's Guide

Both are available from the QTS website.

Appendix: AN-X-MOD-MON ControlLogix configuration

To configure the AN-X-MOD-MON in RSLogix 5000:

Add the adapter

Add an ENBT/A to the Ethernet adapter in the ControlLogix rack. This will represent the AN-X. Give it the IP address you chosen for the monitor (in this example 192.168.0.21).

Module Properties - ENBT (1756-ENBT/A 1.1)

Type: 1756-ENBT/A 1756 10/100 Mbps Ethernet Bridge, Twisted-Pair Media
Vendor: Allen-Bradley
Parent: ENBT
Name: ANXModMon
Description:
Comm Format: None
Slot: 16 Chassis Size: 17
Revision: 1 1 Electronic Keying: Disable Keying

Address / Host Name
☒ IP Address: 192 . 168 . 0 . 21
☐ Host Name:

Cancel < Back Next > Finish >> Help

Set the name to match the name in the IP configuration, in this example, ANXModMon.

Set the *Comm format* to *None*.

Set the *Chassis Size* to 17 and the slot to 16.

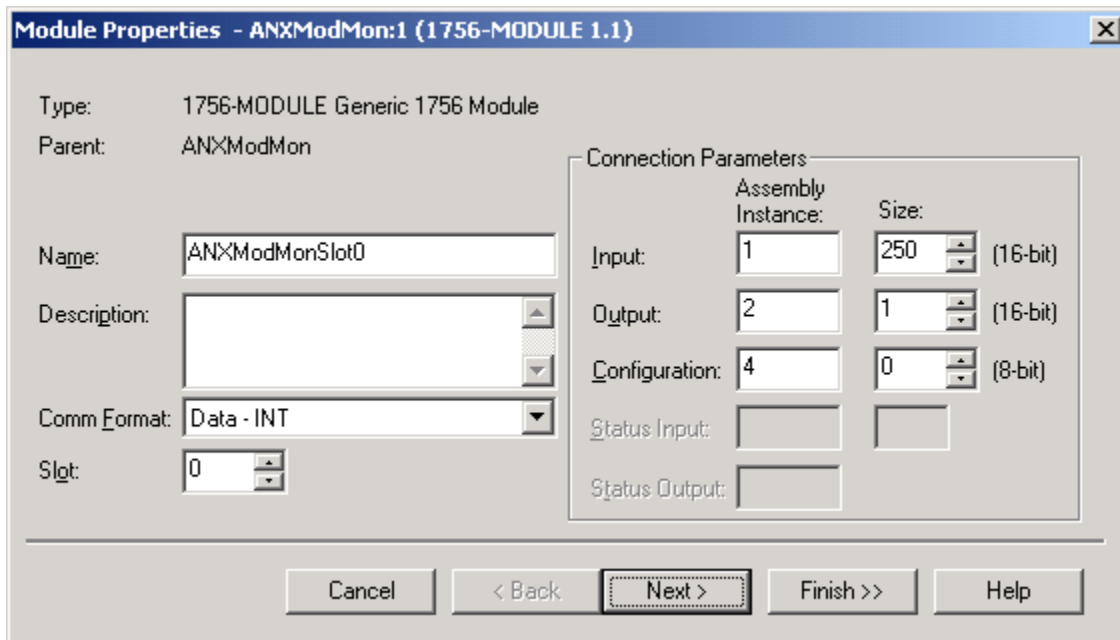
Set the *Electronic Keying* to *Disable Keying*.

Click *Finish*>>

Add generic modules to represent slots

Right click on the ENBT you just added and add as many generic modules as required by the remote I/O configuration. In this example, we'll add a generic module in slot 0 for the I/O data and a generic module in slot 15 for the diagnostics.

Right click on the ENBT you just added and select *Add Module*. From the list, select a module of type *1756-MODULE, Generic 1756 Module*.



The dialog box is titled "Module Properties - ANXModMon:1 (1756-MODULE 1.1)". It contains the following fields and controls:

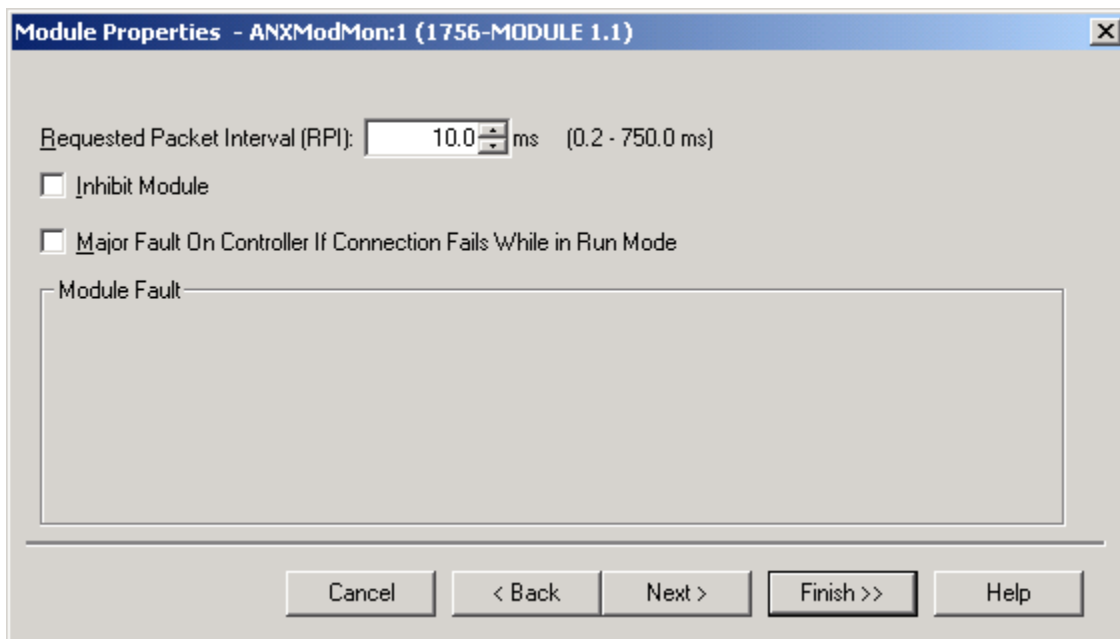
- Type: 1756-MODULE Generic 1756 Module
- Parent: ANXModMon
- Name: ANXModMonSlot0
- Description: (empty text box)
- Comm Format: Data - INT
- Slot: 0
- Connection Parameters (grouped box):
 - Input: 1, Size: 250 (16-bit)
 - Output: 2, Size: 1 (16-bit)
 - Configuration: 4, Size: 0 (8-bit)
 - Status Input: (empty)
 - Status Output: (empty)

Buttons at the bottom: Cancel, < Back, Next > (highlighted), Finish >>, Help.

Set the parameters as shown. Even though there's no output data, we have to set the Output Size to 1 since RSLogix 5000 won't accept a size of 0.

Click *Next >*

Set the RPI for the connection and click *Finish >>*



The dialog box is titled "Module Properties - ANXModMon:1 (1756-MODULE 1.1)". It contains the following fields and controls:

- Requested Packet Interval (RPI): 10.0 ms (0.2 - 750.0 ms)
- ☐ Inhibit Module
- ☐ Major Fault On Controller If Connection Fails While in Run Mode
- Module Fault: (empty text box)

Buttons at the bottom: Cancel, < Back, Next >, Finish >> (highlighted), Help.

Repeat these steps for slot 15. The only differences will be that the slot number will be 15 instead of 0 and the RPI can be much longer (for example, 500 ms) for the diagnostic connection.

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