

AN-X Technical Note

I/O Scanner Redundancy with the AN-X-MOD-MAS



This technical note describes how to implement I/O scanner redundancy with the AN-X-MOD-MAS. This is “soft” redundancy since it depends on logic in the ControlLogix processor to switch between scanners.

Introduction

Version 2.2.1 and above of the firmware for the AN-X-MOD-MAS includes features to make it easy to switch between two AN-X I/O scanners.

One AN-X is designated the primary and acts as the scanner; the other is designated the secondary and acts as a backup.

The ControlLogix processor maintains scheduled connections to both AN-X modules and can easily switch from the primary to the secondary if it decides that there is a problem with the primary. The switchover typically takes 10 ms.

The backup AN-X constantly monitors the S908 network. When it becomes the primary, it has the current state of inputs, drop status, etc. The ControlLogix processor has access to I/O data, diagnostics, etc. on both primary and backup AN-X modules.

The backup AN-X listens to the S908 network when it is told to go online as a scanner. It waits for 10 ms of silence on the network before it takes over. It does not start scanning if it hears another master already online.

There have been changes and additions to the ControlLogix configuration file to support redundancy. No changes are required to the S908 I/O Configuration file.

Since the ControlLogix can use the primary or backup AN-X module to scan the network, the control program should be written in terms of internal arrays. On each logic scan, copy the inputs from the currently active AN-X to the internal input array and copy the internal output array to the outputs of the currently active AN-X, or to the outputs for both AN-X modules.

The aliases the AN-X generates have been modified to support redundancy.

The firmware is backwards compatible. Existing applications do not need to be modified.

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Requirements

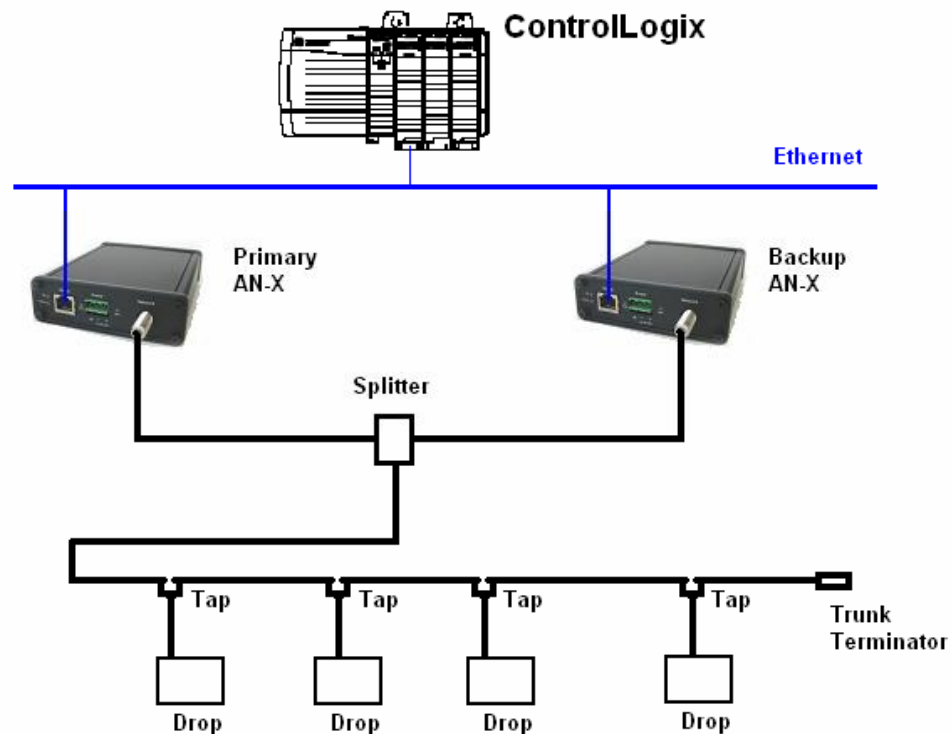
- 2 AN-X-MOD-MAS modules
- firmware version 2.2.1 or above

Cabling**Using the Modicon Redundancy Terminator Kit**

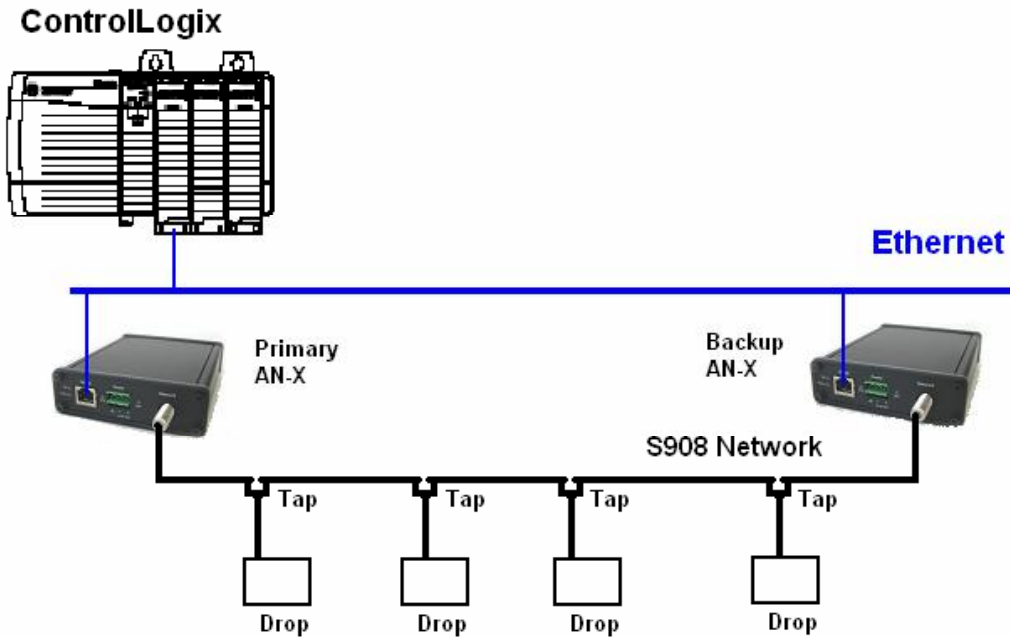
You can use the Modicon Redundancy Terminator Kit to connect to the S908 network.

The AN-X module has built-in termination. Do not use the inline terminators in the cable from the AN-X module to the splitter from the kit.

Do not disconnect either AN-X module from the splitter since that also removes the termination.

**Without the Redundancy Terminator Kit**

The AN-X modules should be located at the physical ends of the network trunk. The AN-X modules have built-in termination so no additional termination is required on the network trunk.



ControlLogix Ethernet Configuration File

There have been changes and additions to the ControlLogix configuration file to support redundancy.

Parameter	Description
RedundEna, RedundPrefix	New parameter RedundEna Must be included at the beginning of the ControlLogix configuration file RedundPrefix is used to create aliases for certain data
RedundCtl	New parameter, must be mapped to the output data for the connection to slot 0
ScanSts	New parameter, can be mapped to the input data for any connection
DataOutput, arrayname DataInput, arrayname	Modified parameter The array names should match the names of the internal ControlLogix arrays used for the data for the connection

Parameter	Description
LongInput	New parameter Forces 800 series drops to send inputs on every scan

RedundEna

Include a line with the RedundEna parameter, followed by a comma and a unique name for the AN-X at the start of the ControlLogix configuration file.

The AN-X uses the RedundPrefix when it generates aliases for elements that are unique to each AN-X module, such as diagnostics.

RedundCtl

Map RedundCtl to the output data for the connection to slot 0 in the AN-X.

RedundCtl consists of a single 16-bit word. Only bit 0 is used. To set an AN-X to act as the scanner, set bit 0 to 1. To set an AN-X to act as a backup, set bit 0 to 0.

If the configuration file contains RedundEna, you must map RedundCtl.

ScanSts

ScanSts is an array of 5 INTs that contain information about the current operation. Only the first 3 are used.

Offset	Description
0	Scan state, 0=idle, 1=monitor, 2=scanning, 3=scan halted
1	Scan counter, increments at the start of each scan
2	Init counter, increments whenever a drop is reinitialized
3	not used
4	not used

Map ScanSts to input data for any connection.

By default, when you perform an autoconfiguration, AN-X maps ScanSts to the connection to slot 15, but comments out the mapping.

DataOutput and DataInput

In redundant applications, DataInput and DataOutput take an additional argument, the name of the internal array the ControlLogix uses for the connection data.

The names should be the same in the ControlLogix configuration files for both AN-X modules.

Omit the names in non-redundant applications.

LongInput

Most 800 series drops send inputs only when the inputs change. You can force 800 series drops to send inputs on every scan by including the LongInput parameter in the ControlLogix configuration file. That way, when you switch between AN-X modules, you can be sure that the backup has the latest inputs.

ClxName

The ClxName is used in the address part of the aliases for elements that are unique for each AN-X, such as diagnostics. It is usually set equal to the Ethernet host name.

ClxPrefix

The ClxPrefix is used in the alias name for I/O data. It should be the same for both AN-X modules in a redundant application.

Aliases

The AN-X-MOD-MAS creates aliases that can be imported into RSLogix 5000.

Item	Alias Name prefix	Base tag prefix
Unique elements, such as diagnostics	RedundPrefix	ClxName
I/O inputs	ClxPrefix	DataInput name
I/O outputs	ClxPrefix	DataOutput name

Criteria for Switching between AN-X Modules

The ControlLogix processor maintains connections to both AN-X modules. It can monitor data on both AN-X modules and can switch between them based on:

- diagnostic counters
- drop error table
- module health bits

Procedure

Configuration

1. Connect both AN-X modules to the S908 network.
2. Autoconfigure the primary AN-X module. Create both remote I/O and ControlLogix configuration files.
3. Upload the ControlLogix configuration to the computer and edit it.
4. Uncomment the RedundEna line and add a prefix that uniquely identifies the AN-X.
 - Map RedundCtl to connection 0. The autoconfiguration maps it to outputs to the connection to slot 0 but comments it out.
 - Map RedundSts to the inputs for any connection. The autoconfiguration maps it to outputs to the connection to slot 15 but comments it out.
 - Set the ClxPrefix.
 - For each connection, add names to the DataInput and DataOutput parameters. These names should match the names of the internal ControlLogix arrays that will hold the data.
 - Include the LongInput option.
5. Save the modified file and upload it to the primary AN-X.
6. Autoconfigure the secondary (backup) AN-X module. Create both remote I/O and ControlLogix configuration files.
7. Upload the ControlLogix configuration to the computer and edit it.
 - Uncomment the RedundEna line and add a prefix that uniquely identifies the AN-X.
 - Map RedundCtl to connection 0. The autoconfiguration maps it to outputs to the connection to slot 0 but comments it out.
 - Map RedundSts to the inputs for any connection. The autoconfiguration maps it to outputs to the connection to slot 15 but comments it out.

- Set the ClxPrefix. It should match the ClxPrefix for the primary AN-X.
 - For each connection, add names to the DataInput and DataOutput parameters. These names should match the names of the internal ControlLogix arrays that will hold the data and should match the names in the primary AN-X
 - Include the LongInput option.
8. Save the modified file and upload it to the secondary (backup) AN-X.
 9. Upload the alias files from each AN-X and save them. Import them into RSLogix 5000. There will be some errors from duplicates.

Create the ControlLogix application

1. Add connections to both AN-X modules.
2. Add logic to select the active AN-X and to switch between modules if necessary.
3. On each scan, copy the inputs from the active AN-X to an internal array.
4. On each scan, copy an output array to the outputs on the active AN-X.
5. Write the control program in terms of the internal arrays

Switchover

To switch between AN-X modules:

1. Set RedundCtl on the backup AN-X to 1. The backup AN-X will not go online while it sees the primary AN-X as master on the network.
2. Set RedundCtl on the primary AN-X to 0. The backup AN-X will now become master on the S908 network.

When you turn on the RedundCtl bit for an AN-X-MOD-MAS module, it waits for 10 ms of silence on the network before it starts scanning as master.

If the RedundCtl bits on both AN-X modules are on, only one will act as master. However, if the bits are set on both AN-X modules and the current master is disconnected from the S908 network, even for a very short period, the backup will take over. When the module that was disconnected comes online, both modules will be master on the S908 network. **YOUR APPLICATION MUST ENSURE THAT THE RedundCtl BITS ARE BOTH ON ONLY DURING SWITCHOVER!**

Other factors to consider...

Do not use the ScanModProg parameter if you are using redundancy.

Do not set the RedundCtl bits on both primary and backup AN-X modules at the same time, except during switchover.

When you modify the ControlLogix configuration file and add elements, the mapped data may become larger than the maximum for a connection, especially for large I/O networks or for networks with many analog modules. It may be necessary to change some of the mappings. Also, when you add elements, the offsets in the comments generated by the autoconfiguration will no longer be correct.

Make sure the mappings in the ControlLogix configurations in both AN-X modules are the same. Each AN-X module cannot check the configuration in the other AN-X module.

LEDs

When the AN-X-MOD-MAS is used in redundant mode, the network LED is green when scanning, orange when monitoring and red when there has been an error or during switchover.

Sample Application

In this example, the S908 network consists of two drops: drop 4 is a Quantum drop; drop 5 is an 800 series drop.

Remote I/O Configuration files

The S908 remote I/O configuration files must be the same for both AN-X modules

```
Drop=4,
,Rack=1,
,,Slot=1,Type=CPS_114_xx,;Addr=d4s1,Inp=00,Out=00,AC PS 115/230V 10A
,,Slot=2,Type=CRA_93x_00,;Addr=d4s2,Inp=00,Out=00,RIO DROP S908
,,Slot=3,Type=DDI_353_00,;Addr=d4s3,Inp=04,Out=00,DC IN 24V 4x8
,,Slot=4,Type=DDO_353_00,;Addr=d4s4,Inp=00,Out=04,DC OUT 24V 4x8
,,,,CfgLen=2,0x0000,0x0000
,,Slot=5,Type=ACO_020_00,;Addr=d4s5,Inp=00,Out=08,AN OUT 4CH CURR
,,,,CfgLen=6,0x8001,0x5555,0x0000,0x0000,0x0000,0x0000
,,Slot=6,Type=ACI_030_00,;Addr=d4s6,Inp=18,Out=00,AN IN 8CH UNIPOLAR
,,,,CfgLen=1,0x0001
EndDrop
```

```
Drop=5,
,Rack=1,
,,Slot=2,Type=B810,;Addr=d5s2,Inp=00,Out=01,8-OUT ISO B810
,,Slot=3,Type=B863,;Addr=d5s3,Inp=08,Out=00,REG 4 CH IN B863
,,Slot=4,Type=B804,;Addr=d5s4,Inp=00,Out=02,16-OUT B804
EndDrop
```

ControlLogix Configuration Files

The mappings in the files must be the same. The RedundEna and ClxName names must be unique.

Primary AN-X

```
RedundEna,MODA ; Enable Redundant configuration and specify Redund Prefix
LongInput ; Force drops to send all inputs on every scan
ClxName,ANXA
ClxPrefix,MOD
ClxSlot,0
```

```
DataOutput, outputarray0 ; ,<ClxBaseTag> Outputs from ControlLogix
,RedundCtl ; Redundancy Control
,d4s4,d04s4_Out;; DDO_353_00 DC OUT 24V 4x8
,d4s6,d04s6_Out;; ACO_020_00 AN OUT 4CH CURR
,d5s2,d05s2_Out;; B810 8-OUT ISO B810
,d5s3,d05s3_Out;; B804 16-OUT B804
```

```
DataInput, inputarray0 ; ,<ClxBaseTag> Inputs to ControlLogix
,DropErr
,d4s3,d04s3_Inp;; DDI_353_00 DC IN 24V 4x8
,d4s5,d04s5_Inp;; ACI_030_00 AN IN 8CH UNIPOLAR
,d5s4,d05s4_Inp;; B863 REG 4 CH IN B863
;The following lines map Diagnostics into ClxSlot 15
ClxSlot,15
```

```
DataInput , inputarray15 ; ,<ClxBaseTag> Inputs to ControlLogix
,DiagCtrs, ;
,ScanSts ; S908 Scan Status
,d4ModHlth;;
,d5ModHlth;;
;Module Status Byte for Quantum Only
,d4ModSts, ;
;ControlLogix Connection Statistics
,ConnStats0, ;
```

Secondary (Backup) AN-X

```
RedundEna,MODB ; Enable Redundant configuration and specify Redund Prefix
LongInput ; Force drops to send all inputs on every scan
ClxName,ANXB
ClxPrefix,MOD
ClxSlot,0
DataOutput ,OutputArray0; Outputs from ControlLogix
,RedundCtl ; Redundancy Control
,d4s4,d04s4_Out;; DDO_353_00 DC OUT 24V 4x8
,d4s6,d04s6_Out;; ACO_020_00 AN OUT 4CH CURR
,d5s2,d05s2_Out;; B810 8-OUT ISO B810
,d5s3,d05s3_Out;; B804 16-OUT B804
```

```
DataInput ,InputArray0; Inputs to ControlLogix
,DropErr
,d4s3,d04s3_Inp;; DDI_353_00 DC IN 24V 4x8
,d4s5,d04s5_Inp;; ACI_030_00 AN IN 8CH UNIPOLAR
```

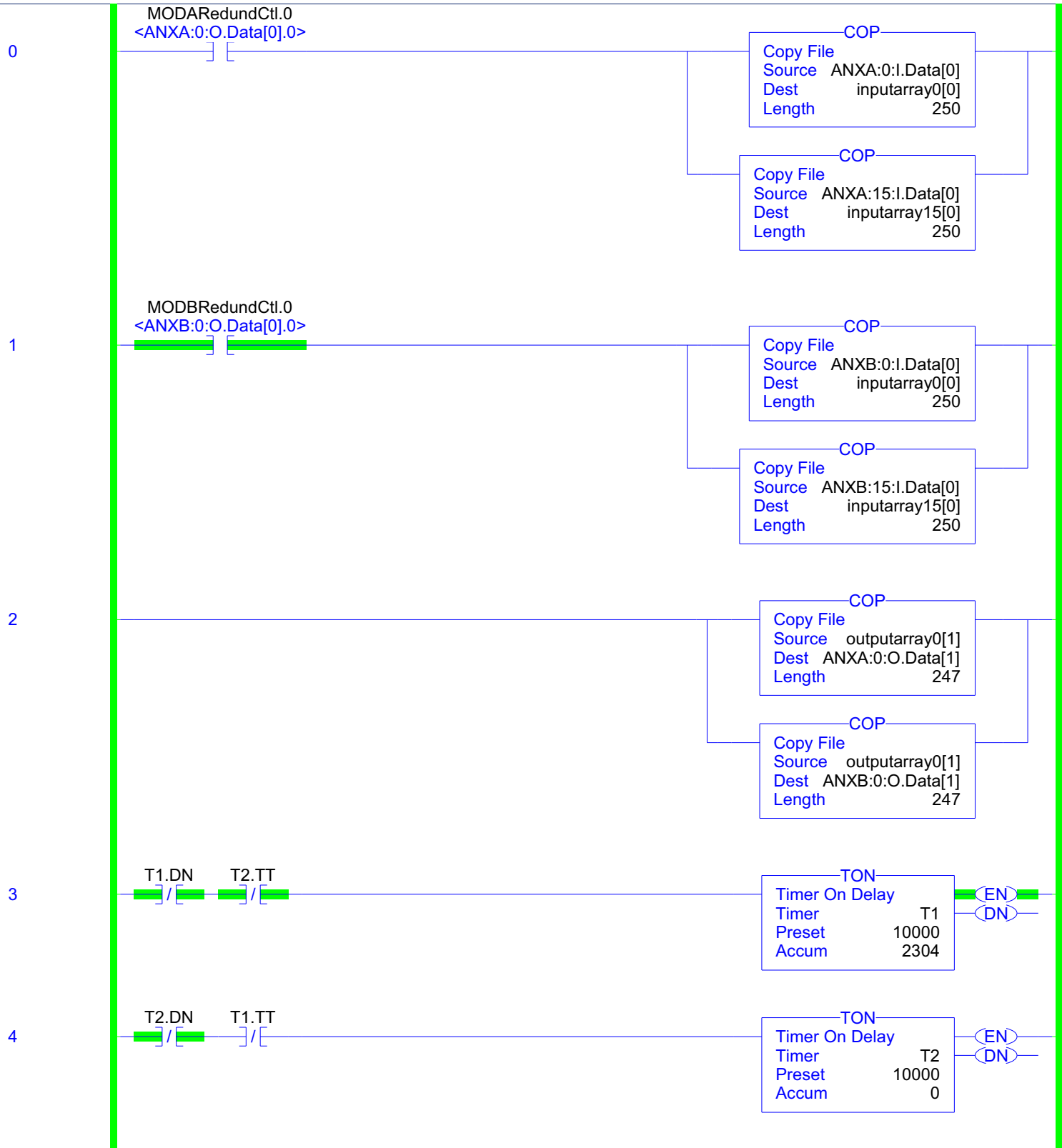
```
,d5s4,d05s4_Inp,; B863 REG 4 CH IN B863
;The following lines map Diagnostics into ClxSlot 15
ClxSlot,15
DataInput ,InputArray15; <ClxBaseTag> Inputs to ControlLogix
,DiagCtrs, ;
,ScanSts ; S908 Scan Status
,d4ModHlth,;
,d5ModHlth,;
;Module Status Byte for Quantum Only
,d4ModSts, ;
;ControlLogix Connection Statistics
,ConnStats0, ;
```

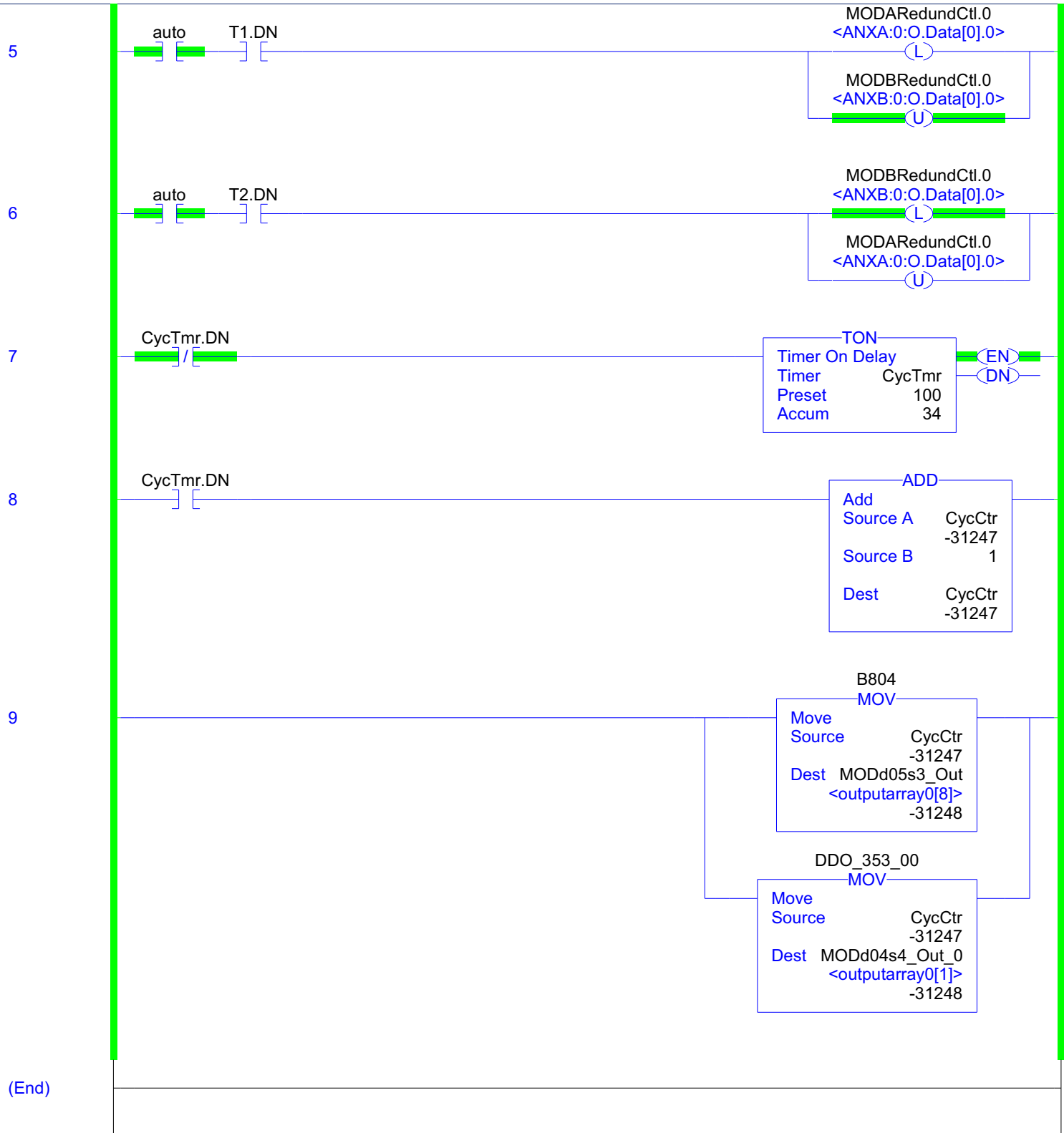
Ladder Logic

The sample ladder logic (appended) switches between AN-X modules every 10 seconds.

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MODR - Controller Tag Listing

MODR (Controller)

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Filter:Show All Sort by:Tag Name

C:\ModRedundant\AnxModRedundTest.ACD

Tag Name	Type	Description
[-]ANXA:0:C	AB:1756_MODULE:C:0	
[-]ANXA:0:I	AB:1756_MODULE_INT_ 500Bytes:I:0	
[-]ANXA:0:O	AB:1756_MODULE_INT_ 496Bytes:O:0	
[-]ANXA:15:C	AB:1756_MODULE:C:0	
[-]ANXA:15:I	AB:1756_MODULE_INT_ 500Bytes:I:0	
[-]ANXA:15:O	AB:1756_MODULE_INT_ 496Bytes:O:0	
[-]ANXB:0:C	AB:1756_MODULE:C:0	
[-]ANXB:0:I	AB:1756_MODULE_INT_ 500Bytes:I:0	
[-]ANXB:0:O	AB:1756_MODULE_INT_ 496Bytes:O:0	
[-]ANXB:15:C	AB:1756_MODULE:C:0	
[-]ANXB:15:I	AB:1756_MODULE_INT_ 500Bytes:I:0	
[-]ANXB:15:O	AB:1756_MODULE_INT_ 496Bytes:O:0	
auto	BOOL	
[-]CycCtr	INT	
[-]CycTmr	TIMER	
[-]inputarray0	INT[250]	
[-]outputarray0	INT[248]	
[-]inputarray15	INT[250]	
[-]T1	TIMER	
[-]T2	TIMER	
[-]timermask	INT	
[-]MODARedundCtl	INT	
[-]MODd04s4_Out_0	INT	DDO_353_00
[-]MODd04s4_Out_1	INT	DDO_353_00
[-]MODd04s6_Out_0	INT	ACO_020_00
[-]MODd04s6_Out_1	INT	ACO_020_00
[-]MODd04s6_Out_2	INT	ACO_020_00
[-]MODd04s6_Out_3	INT	ACO_020_00
[-]MODd05s2_Out	INT	B810
[-]MODd05s3_Out	INT	B804
MODAd04_CommError	BOOL	
MODAd05_CommError	BOOL	
[-]MODd04s3_Inp_0	INT	DDI_353_00
[-]MODd04s3_Inp_1	INT	DDI_353_00
[-]MODd04s5_Inp_0	INT	ACI_030_00
[-]MODd04s5_Inp_1	INT	ACI_030_00
[-]MODd04s5_Inp_2	INT	ACI_030_00
[-]MODd04s5_Inp_3	INT	ACI_030_00
[-]MODd04s5_Inp_4	INT	ACI_030_00
[-]MODd04s5_Inp_5	INT	ACI_030_00
[-]MODd04s5_Inp_6	INT	ACI_030_00
[-]MODd04s5_Inp_7	INT	ACI_030_00

MODR - Controller Tag Listing

MODR (Controller)

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Filter:Show All Sort by:Tag Name

C:\ModRedundant\AnxModRedundTest.ACD

Tag Name	Type	Description
[-]MODd04s5_Inp_8	INT	ACI_030_00
[-]MODd05s4_Inp_0	INT	B863
[-]MODd05s4_Inp_1	INT	B863
[-]MODd05s4_Inp_2	INT	B863
[-]MODd05s4_Inp_3	INT	B863
[-]MODAScanSts	INT	
[-]MODAScanCtr	INT	
[-]MODAInitCtr	INT	
MODd04s1_Health	BOOL	CPS_114_xx
MODd04s2_Health	BOOL	CRA_93x_00
MODd04s3_Health	BOOL	DDI_353_00
MODd04s4_Health	BOOL	DDO_353_00
MODd04s5_Health	BOOL	ACI_030_00
MODd04s6_Health	BOOL	ACO_020_00
MODd05s2_Health	BOOL	B810
MODd05s3_Health	BOOL	B804
MODd05s4_Health	BOOL	B863
[-]MODd04s2_1_StsBytes	INT	CRA_93x_00 / CPS_114_xx
[-]MODd04s4_3_StsBytes	INT	DDO_353_00 / DDI_353_00
[-]MODd04s6_5_StsBytes	INT	ACO_020_00 / ACI_030_00
[-]MODBRedundCtl	INT	
MODBd04_CommError	BOOL	
MODBd05_CommError	BOOL	
[-]MODBScanSts	INT	
[-]MODBScanCtr	INT	
[-]MODBInitCtr	INT	