
Module Overview

This AMCI Nexus module is a single incremental encoder input programmable limit switch module that communicates on a network. The available networks, along with the corresponding AMCI part numbers, are shown in the following table.

Network	Part Number
ControlNet	NX3M1C
DeviceNet	NX3M1D
Ethernet	NX3M1E
Profibus	NX3M1P

Each module accepts an incremental encoder transducer for position feedback and generates up to 16 limit switch outputs based on the transducers' position and velocity. The NX3M1X module has several modes of operation that allow you to enable or disable the outputs based on discrete inputs and the speed of the machine.

The NX3M1X module has two *modes* of operation, *Independent Mode* and *Group Mode*. While in Independent Mode, each output is independent of the others and has a corresponding input that is ANDed with the output. When in Group Mode, the outputs are combined into groups. The NX3M1X module has a maximum of six groups. Each group is assigned an *Operating Mode* that controls how the outputs fire. At this time, there are eight Operating Modes. These Operating Modes are useful on high speed packaging and assembly machines.

This unit has sixteen I/O points. Eight of the outputs and all sixteen inputs are located on the Nexus module itself, and the remaining eight outputs can be located on an external RB-8 relay board.

The inputs can be programmed to be used either high true or low true, and provide ANDing functions and group control. The inputs are divided into two groups of eight, and can be used as either sinking or sourcing inputs. The status of the 16 inputs is also reported over the Network.

Each of the outputs has 8 On/Off setpoints, and can be programmed to operate in normal, timed, or pulse mode. The outputs can be ANDed with an input or with a motion detector, and can be forced ON or OFF from the PLC. The outputs will turn off when there is a transducer fault condition, even if it is a clearable transducer fault. The status of the 16 outputs is reported to the PLC over the Network. **Outputs setpoints should not be programmed on the fly.**

The NX3M1X has the ability to detect an Encoder Fault. If this feature is enabled, then the encoder signals are checked in the following way. If the A+ signal is not opposite from the A- signal, and the B+ signal is not opposite from the B- signal, then the module will set the encoder fault status bit and disable the outputs.

The NX3M1X can operate as a Slave. In this mode, a Master NX3M1X uses a serial link to send the encoder data to a Slave NX3M1X. This increases the number of outputs that can be controlled from one encoder.

The module contains a non-volatile memory so all of the setup data and On/Off setpoints will be saved on power down. Because the non-volatile memory is a battery backed RAM, all of the parameters can be changed often without damaging the module.

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General Information

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein. Throughout this manual, the following two notices are used to highlight important points.

WARNINGS tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.

CAUTIONS tell you when equipment may be damaged if the procedure is not followed properly. No patent liability is assumed by AMCI, with respect to use of information, circuits, equipment, or software described in this manual. The information contained within this manual is subject to change without notice. UNDER NO CIRCUMSTANCES WILL ADVANCED MICRO CONTROLS, INC. BE RESPONSIBLE OR LIABLE FOR ANY DAMAGES OR LOSSES, INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM THE USE OF ANY INFORMATION CONTAINED WITHIN THIS MANUAL, OR THE USE OF ANY PRODUCTS OR SERVICES REFERENCED HEREIN.

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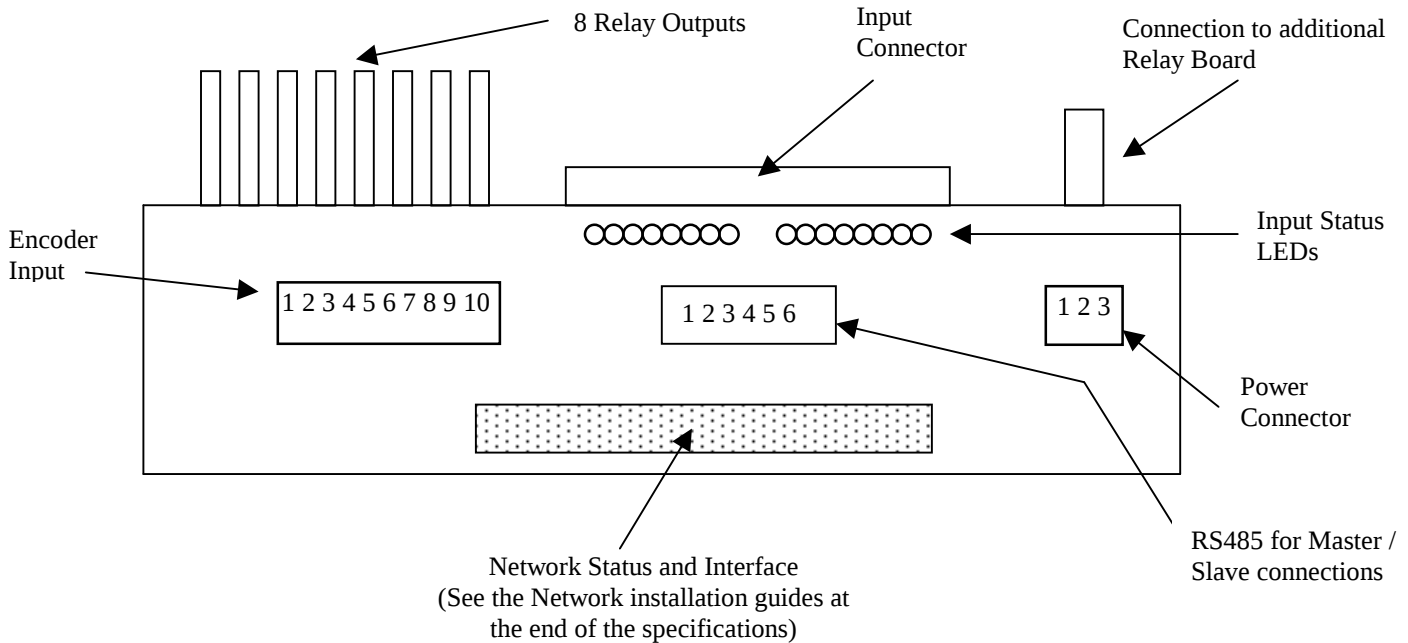
Returns Policy

All equipment being returned to AMCI for repair or replacement, regardless of warranty status, must have a Return Merchandise Authorization number issued by AMCI. Call (860) 585-1254 with the model and serial numbers along with a description of the problem. A "RMA" number will be issued. Equipment must be shipped to AMCI with transportation charges prepaid. Title and risk of loss or damage remains with the customer until shipment is received by AMCI.

24 Hour Technical Support Number

Technical Support, in the form of documents, FAQs, and sample programs, is available from our website, www.amci.com. 24 Hour technical support is also available on this product. For technical support, call (860) 585-1254. Your call will be answered at the factory during regular business hours, Monday through Friday, 8AM - 5PM EST. During non-business hours, an automated system will ask you to leave a detailed message and the telephone number where you can be reached. The system will page an engineer on call. Please have your product model number and a description of the problem ready before you call.

Chapter 1: Hardware Overview



1. The ribbon cable from the NX3M1X must be plugged into the CN2 connector of the additional RB-8 relay board.
2. The additional relay board does not require any external power connections
3. The inputs on the relay board do not have any function.

Dimensions

Length = 10 inches
 Width = 4 inches (not including Network Connectors)
 Height = 4.75 inches (including relays)

Power Requirements

Power Connector

Pin	Function
1	10 to 30Vdc
2	DC Common
3	Chassis Ground

Note: The Chassis Ground Pin is connected to the NX3M1X's body and MUST be connected to your earth ground bus for proper module operation.

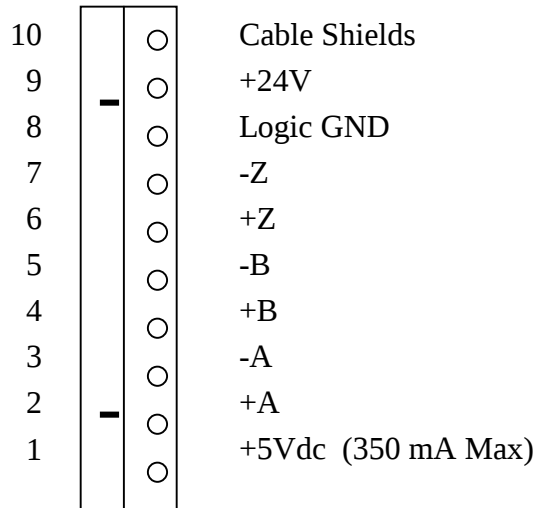
At power up, it will take about 7 seconds for the Network status LEDs to activate.

The Nexus Module requires 500mA @24Vdc to operate.

Even though the unit will operate within a voltage range of 10 to 30Vdc, it is recommended that the unit be powered with a supply that is within the operating range of the relays. The Opto 22 ODC24 relays have an operating range of 18 to 30Vdc.

Encoder Wiring

The following diagram shows the wiring of the 10 pin Encoder Input connector. Pin 1 is towards the left when the connector is plugged into the NX3M1X unit. This 10 pin connector is included with the NX3M1X unit.

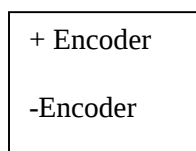


- The 24Vdc pin (pin 9) receives its power directly from the NX3M1X's 24V supply power. If you are powering your encoder from this pin, add the current draw of your encoder to the NX3M1X's requirements when sizing your power supply.
- If your encoder operates from a 5Vdc supply, and draws less than 350 mA, then it can be powered directly from pin 1 of the NX3M1X's connector.
- It is possible to reverse the increasing count direction either by setting a bit in the programmable setup data or by swapping the +A signal with the +B signal and the -A signal with the -B signal.
- The Logic Ground pin is connected to the DC common pin of the 3 pin power supply connector.

The NX3M1X module is designed to work with +5Vdc differential encoders. Use the following table and diagrams to attach single ended encoders to the NX3M1X module. Current limiting resistors, R_{lim}, must be installed for encoders that do not operate at 5Vdc.

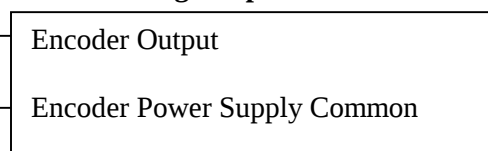
Encoder Signal Level	Resistor Value
5V	none
12V	1KΩ
15V	1.3KΩ
24V	2.2KΩ

NX3M1X Encoder Inputs

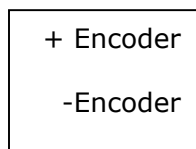


R_{lim}

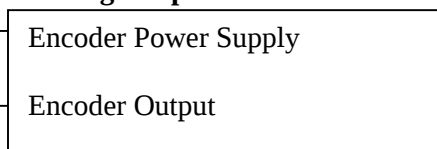
Sourcing Output Encoder



NX3M1X Encoder Inputs



Sinking Output Encoder



R_{lim}

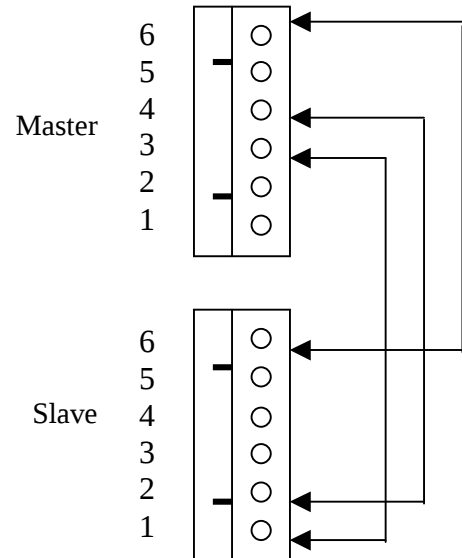
Slave Mode Wiring

The NX3M1X can operate either as a Master or as a Slave. In this mode, the Master NX3M1X uses a serial link to send the encoder data to a Slave NX3M1X. This increases the number of outputs that can be controlled from one encoder. The following tables and diagram show how to connect the Master and Slave units together.

Connector for Serial Interface RS485

Pin Number	Function
1	+ RxD
2	- RxD
3	+ TxD
4	- TxD
5	Isolated Ground
6	Shields

RS485 Master to Slave Wiring



General Wiring Notes

- Encoder signals are generally low voltage, low power signals. If you are using A-B guidelines for cabling installation, treat the transducer cable as a Category 2 cable. It can be installed in conduit along with other low power cabling such as communication cables and low power ac/dc I/O lines. It cannot be installed in conduit with ac power lines or high power ac/dc I/O lines.
- Like all signal and communication cable, the encoder cable should be shielded. These shields must be grounded only at one end of the cable. Because the rack cabinet is typically better grounded than the machine, AMCI recommends that the cable shields be terminated at the NX3M1X module.
- If a junction must be made in the signal cable, treat the shield as a signal-carrying conductor. Do not connect the shield to ground at any junction box or the transducer. If your transducer cable has individually shielded pairs, then ideally the shields in the cable are also kept isolated from each other in the junction box as well.
- If the signal cable must cross power feed lines, it should do so at right angles.
- Route the cable at least five feet from high voltage enclosures, or sources of “rf” radiation.

Input Status LEDs

The Nexus unit has 16 inputs that are divided into two groups, each with its own common. Depending on what is connected to the common, the inputs can be either sinking or sourcing.

Common Connection	Input Type	LED color when input active
Ground	Sinking	Red
+DC voltage	Sourcing	Green

Input Function

The inputs to the NX3M1X have a debounce time of 0ms, and are scanned every 1ms. If the NX3M1X is operating in Group Modes 1 or 2, the inputs are scanned every 100 μ s.

In Independent Mode, each input is ANDed with each output. That is, input 1 is ANDed with output 1, input 2 is ANDed with output 2 ... input 16 is ANDed with output 16.

In group mode, the inputs have the following functions.

Input	Function
1	Group 1 Control
2	Group 2 Control
3	Group 3 Control
4	Group 4 Control
5	Group 5 Control
6	Group 6 Control
7	Limit Switch Enable Input
8	First Cycle Input
9 to 16	Not used in Group Mode

Throughput Time

The NX3M1X has a minimum throughput time of 100 μ s from input to output. The maximum throughput time from position reset input (mode 1 & 2) to output is 220 μ s. The typical throughput time is 170 μ s. The inputs in the other modes are scanned at rate of 1mS. The outputs must be programmed to be on for a minimum of 200 μ s and Off for a minimum of 200 μ s.

Relay Board Connections

An additional RB-8 relay board can be connected to the NX3M1X if more than the eight built in outputs are required.

Interconnections between the NX3M1X and relay board is made with a *CRP-(x)* cables, where (x) is the length in feet. Presently, two, six, and twelve foot cables are available from AMCI. CRP cables are shielded, fine pitch ribbon cables with drain lugs at both ends. Due to their complexity, AMCI strongly recommends that you purchase pre-assembled and tested CRP cables instead of making them yourself. Connections are made by inserting the blue IDC connector into the proper socket and connecting the drain wire to the screw terminal. Note that the IDC connector is keyed and can only be inserted in one way. The retaining clips on the IDC socket snap over the top of the connector to secure it in place. The drain wire on the CRP cable must be connected to the screw terminals next to the IDC sockets. The screw terminal on the NX3M1X module is connected to Earth Ground. The two screw terminals on the RB-8 relay boards are connected together. The CRP cable from the NX3M1X must be connected to the socket labeled “CN2” of the RB-8 relay board.

The additional RB-8 relay board does not require any external power connections

Chassis Ground

When a relay board is DIN rail mounted the case is isolated from the panel by the plastic DIN rail adapters. You *MUST* run a heavy gauge wire from the Chassis GND terminal of the TB2 terminal block to your ground bus to ground the metal relay board case. When a relay board is panel mounted the case is usually connected to chassis ground through the mounting hardware. If you believe that the ground is insufficient, then run a heavy gauge wire from the Chassis GND terminal to your ground bus.

RB-8 Sink / Source Inputs

The inputs on the additional RB-8 relay board do not have any function.

Compatible Relays

Every output, requires a solid state relay. These relays are fused protected and have a retaining screw and indicator LED. These relays are available from AMCI under the following part numbers.

	Output Voltage	Rated Current
KD-6	3 to 60Vdc	3Adc
KA-3	120Vac	3Aac

Chapter 2: Programmable Parameters

The NX3M1X module is programmed from the Output Registers assigned to the network. The module is setup by setting its *Programmable Parameters*. The programmable parameters are broken down as follows:

- **Module Operation Parameters** – These functions allow the PLC to directly control the functions of the Groups and the Limit Switch Outputs.
- **Module Setup Parameters** – Parameters that set the modules' mode of operation, such as the active state of the physical inputs, parameters that scale the tachometer data, and parameters that program the range of the two motion detectors.
- **Transducer Setup Parameters** – Parameters that affect the encoder position data.
- **Limit Switch Parameters** – Parameters that program the type of limit switch, any ANDing functions that are to be used, the On/Off setpoints, and the advance parameters.
- **Group Setup Parameters** – If you configure the module to operate in Group Mode then you also have to program the Group Setup Parameters. These parameters assign the number of limit switch outputs in the group, the Operating Mode of the group, the setpoints of the Group Channel, the Group Offset / Preset value, and the inputs that are used to enable the group outputs.

Module Operation Parameters

Output State without Network Connection

This setup parameter allows you to choose if the outputs will be disabled or remain enabled when the Network Connection is lost. By default, the outputs will be disabled when there is no network connection. Please note that forced outputs will always be disabled when the network connection is removed.

Increment/Decrement

This feature allows the PLC to either increase or decrease the On or Off setpoint of a Limit Switch output by one count at a time. It is possible to change just the On setpoint, just the Off setpoint, or both at the same time.

Please note that the Increment/Decrement function only changes the On/Off setpoints in the NX3M1X module's memory. The On/Off setpoints that are stored in the PLC's memory are not changed by the Increment/Decrement function.

Output Forces

You can force any output on or off by setting the appropriate bit in the output registers. A Force OFF bit takes precedence over the corresponding Force ON bit. That is, if both the Force Off and Force On bits are set at the same time, then the output will be Off, not On.

Input Forces

You can force any Physical Input on or off by setting the appropriate bit in the output registers. A Force OFF bit take precedence over the corresponding Force ON bit. That is, if both the Force Off and Force On bits are set at the same time, then the input will be Off, not On.

Module Setup Parameters

Module Type

A bit value that sets whether the NX3M1X will be used in *Independent Mode* or in *Group Mode*. While in Independent Mode, each output is independent of the others and has a corresponding input that is ANDed with the output. When in Group Mode, the outputs are combined into groups. The NX3M1X module has a maximum of six groups. Each group is assigned an *Operating Mode* and an Input that controls how the outputs fire.

Encoder Fault Detection

A bit value that sets whether or not the NX3M1X will detect an Encoder Fault. If this feature is enabled, then the encoder signals are checked in the following way. If the A+ is not opposite from the A-, and the B+ is not opposite from the B-, then the module will set the encoder fault bit.

Master/Slave Mode

A bit value that determines if the NX3M1X is operating as a Master or as a Slave. The incremental encoder is attached to the Master module. A RS485 serial link is used to send the encoder data to the Slave NX3M1X. This increases the number of outputs that can be controlled from one encoder. The status of the Z pulse input is not transferred; therefore, the slave module cannot be used in group mode 6.

Tachometer Response

A bit value that sets how often the NX3M1X module updates the tachometer data to the processor. The two choices are 120 mSec and 504 mSec. The default value is 504 mSec. The NX3M1X module has two motion detectors that can be used to disable outputs when the machine speed is outside of the motion detectors programmed range. These motion detectors are also updated at the programmed Tachometer Response time. The update time applies to the tachometer data reported over the network and the ON/OFF status of the motion detectors.

Tachometer Scalars

The NX3M1X module allows you to scale the tachometer value reported to the processor. Therefore, you can have the NX3M1X report a tachometer value scaled to boxes per minute, inches per minute, or any other meaningful value instead of the default counts per second. The tachometer is scaled with three values, *Tach Multiplier*, *Tach Divisor*, and *Tach Decimal Point*. The tachometer reports the rounded off integer value of the equation: $((\text{Speed}[\text{Counts/Second}] * \text{Tach Multiplier}) / \text{Tach Divisor}) / \text{Tach Decimal Point}$. The Tach Multiplier can be any integer between 0 and 1,100. The Tach Divisor can be any integer between 1 and 63. The Tach Decimal Point can be 1, 10, 100, or 1000. As an example, assume a speed of 100 COUNTS/SEC, a multiplier of 2, a divisor of 3. The table below shows the different Tachometer values based on the Tach Decimal Point value.

	Decimal Point Value			
	1	10	100	1000
Calculated Tach	66.67	6.67	0.67	0.067
Reported Tach	67	7	1	0

When programming the Tach Decimal Point, you enter 0, 1, 2, or 3 into your programming data. This corresponds to a Tach Decimal Point Value of 1, 10, 100 or 1000.

Physical Input Active State

These sixteen bit values program the active state of the Physical Inputs. When an Active State bit is set to its default value of zero, the corresponding input works like a normally closed relay. The input must have current flowing through it to be deactivated. When an Active State bit is set to one, the corresponding input works like a normally open contact. The input must have current flowing through it to be activated.

Reset these bits to zero if you are not using the Physical Inputs in your application.

Motion Detector ON/OFF setpoints

The NX3M1X has two motion detectors, *MD1* and *MD2*, which function as speed based limit switches. You program a low speed setpoint and a high speed setpoint for each motion detector. If the low speed setpoint is less than the high speed setpoint then the output will be on when the velocity is between the two setpoints and off at all other speeds. If the low speed setpoint is greater than the high speed setpoint then the output will be off when the velocity is between the two setpoints and on at all other speeds. You can logically AND any limit switch output with the state of either motion detector, but not both at the same time. This disables the limit switch output unless the machine is running within the programmed range. The motion detector setpoints are always programmed in COUNTS/SEC, regardless of the values of the Tachometer Scalars. The setpoints have a range of zero to 32,767.

How often the ON/OFF state of the motion detectors are updated is based on the Tachometer Response parameter. Like the tachometer, they will update either every 120 mSec or 504 mSec.

Note: If you are using the motion detectors to disable limit switch outputs and your machine accelerates to its final speed quickly, you may have to change the Tachometer Response from its default of 504 mSec to 120 mSec. This insures that the limit switches will be enabled as quickly as possible once the machine is running at operating speed.

Transducer Setup Parameters

Count Direction

A bit value that sets the direction the transducer shaft must rotate to increment the position count. It can be set to clockwise or counter-clockwise with a default of clockwise. Please note that it is also possible to reverse the count direction by swapping the +A signal with the +B signal, and the -A signal with the -B signal.

Transducer Fault Latch

A bit value that determines if a detected transducer fault is self clearing or latched. Transducer faults can be caused by improper wiring, electrical noise, or a damaged transducer. When the module detects a transducer fault, it sets an error bit in the data it transmits over the network. By default, the NX3M1X latches the fault until it sees a clear error command. It is also possible to program the NX3M1X to clear the fault message as soon as a working transducer has been attached. The Limit Switch Outputs are always disabled when there is a transducer fault.

Scale Factor

This word level parameter defines the NX3M1X's maximum count value. The position data will count from 0 to the (Scale Factor - 1), roll over to 0, and start counting again. This parameter has a range of 2 to 16384 and a default value of 8192.

Encoder Decoding

This two bit parameter determines if the NX3M1X position value with X1, X2, or X4 decoding. X1 decoding counts only one transition on the A pulses and will give you a count equal the number of pulses of the encoder. X2 decoding counts both the positive and negative transition of the A pulses and will give you a count that is twice the number of pulses of the encoder. X4 decoding counts all four transitions of both the A and B pulses and will give you a count that is four times the number of pulses of the encoder.

Encoder Scaling

The NX3M1X can scale the encoder's actual count per turn to any count value that is less than or equal to the encoder's actual count. Two word parameters are used to accomplish this, the *Actual Encoder Counts* and the *Desired Encoder Counts*. The following formula shows the limitation of this setup function.

$$((\text{Actual Encoder Counts} / \text{Desired Encoder Counts}) * \text{Scale Factor}) \leq 16384$$

Preset Value

This parameter sets the value that the *Machine Position* will be set to when the Apply Preset command bit is set in the setup data. Its default is zero and it is programmable to any value between zero and (Scale Factor - 1). The *Machine Position* is the position that the NX3M1X module reports to the processor. As you will see later, when operating the NX3M1X in Group Mode, you can offset the position that the *group* uses when determining the on/off state of its outputs. When this happens, the manual will use the term *Group Position* to distinguish this position count from the *Machine Position*.

Limit Switch Parameters

Limit Switch Type Parameter

Programs the type of limit switch the output channel will be. The three choices are *Normal*, *Pulse*, and *Timed*. Normal outputs turn on and off based only on encoder's position. Pulse outputs generate a pulse train between two position values. Timed outputs are position on, time off or position off, whichever occurs first, outputs.

Motion ANDing Parameter

You can disable a limit switch output by ANDing it with one of the two motion detectors. This prevents the output from firing until the machine is running at a speed within the programmed motion detector range. This parameter gives you the choice of no Motion ANDing or ANDing it with either MD1 or MD2.

Enable ANDing Parameter

When in Group Mode you can disable a limit switch output by ANDing it with an input. Use this bit value to attach the *LS Enable Input* to the limit switch output. This parameter is not used when in Independent Mode because each output has a corresponding, dedicated input that can be used to disable the output.

Limit Switch ON / OFF Setpoints

Limit Switch Setpoints are a pair of position values at which the outputs turn on and off. The limit switch is on when the position value is between the two setpoints. Setpoints can be programmed to any value between 0 and (Scale Factor -1).

Normal Limit Switch: Eight pairs of ON / OFF setpoints that give you the ability to turn the output on and off eight times per cycle.

Pulse Limit Switch: One ON / OFF setpoint pair that sets the leading edge of the pulse train and the trailing edge of the pulse train. Two additional parameters, *Total Number of Pulses* and *Pulse Duration*, must also be programmed. The *Total Number of Pulses* is the number of pulses in the train. The *Pulse Duration* is the number of counts that each pulse is On. The difference between the ON and OFF setpoints must be greater than or equal to: $((\text{Total Number of Pulses} * \text{Pulse Duration}) + (\text{Total Number of Pulses} - 1))$.

Timed Limit Switch: One ON / OFF setpoint pair that sets the ON position and OFF position of the limit. A third parameter sets the amount of time the output is on. Usually, the output will turn on at the ON setpoint and remain on for the specified length of time. However, if the OFF setpoint is reached before the timer times out, the output turns off immediately. The Time Value is programmed in milliseconds and has a maximum value of 9999ms. All 16 outputs of the NX3M1X can be programmed as a timed output.

Limit Switch ON / OFF Advances

Two parameters that allow the limit switch channel to compensate for fixed delays in the system. The maximum compensation is ± 99.9 mSec. Setting the Advance to a positive value will cause the output to turn on earlier in the cycle. Setting the Advance to a negative value will cause the output to turn on later in the cycle.

The speed compensation advances parameter programmed into the AMCI PLS modules are programmed as a fixed time value, but when used it is proportional to the speed of the encoder. These advances compensate for fixed delays in the system by turning the outputs on or off in advance of their programmed setpoints as a function of shaft speed. Separate time values can be programmed for both the on and off output setpoints.

For example, let say that you have your Scale Factor parameter set to 360 counts/rev and that the device you are connecting the relay output to requires 10ms to turn both on and off. Let us also say that your output is programmed to turn on at 50 counts and off at 100 counts.

At very low speeds, the advance parameter will have almost no affect and your output will turn on at position 50 and off at position 100.

However, if you are running your machine at 200 rpm,

$$(200 \text{ rev/min}) * (1 \text{ min} / 60,000\text{ms}) * (360 \text{ counts} / \text{rev}) = 1.2 \text{ counts/ms},$$

At this speed, to ensure that the output is still on at position 50 and off at position 100, the AMCI PLS module will turn the output on and off 12 counts $(1.2 \text{ counts/ms} * 10\text{ms})$ early, or from position 38 to 88.

Group Setup Parameters

If you are using the NX3M1X module in Group Mode the Group Setup Parameters are also available. There are a maximum of six groups available.

Output Quantity

This parameter sets the number of limit switch outputs in the group. Outputs are assigned to a group in consecutive order. As an example, assume that Group 1 is assigned six outputs and Group 2 assigned eight outputs. Then limit switch outputs 1 to 6 are assigned to Group 1 and limit switch outputs 7 to 14 are assigned to Group 2. This leaves two outputs for another group. If you try to assign more than two outputs to another group, the NX3M1X will respond with an error message.

Group Operating Mode

This parameter specifies the groups' Operating Mode. Seven different modes are presently available.

Mode 0: Outputs operating in Mode 0 function as a simple limit switch and are not affected by the input terminal or group channel.

Mode 1: Outputs operating in Mode 1 are always enabled to turn on at their programmed setpoints. When the group input is activated, the group's position is preset to the group's preset value. The input is ignored until the group control position is reached. The input must transition from 0 to 1 after the group control position is reached.

Mode 2: Outputs operating in Mode 2 are disabled until the group input is activated, at which time the group's position is preset to the preset value. The outputs will be active until the group control position is reached. The input is ignored until the group control position is reached. The input must transition from 0 to 1 after the group control position is reached.

Mode 3: Outputs operating in Mode 3 can be active only when the group control input is active. The group channel On/Off points are not used in mode 3.

Mode 4: Outputs operating in Mode 4 will be active for one cycle only when the group's input transitions from 0 to 1 between the group channel's On and Off points. The cycle ends when either the group channel On or Off point is reached, at which point the outputs turn off.

Mode 5: Outputs operating in Mode 5 will be active for one cycle only when the group's input is active in the range between the group channel's On and Off points. The outputs will be active only when the encoder's shaft is turning, or if the first cycle input is active. The outputs will turn off after there is no change in position for either 504ms or 120ms, depending on how the tachometer response parameter is set. The cycle ends when either the group channel On or Off setpoint is reached, at which point the outputs turn off.

Mode 6: Outputs operating in Mode 6 are always enabled to turn on at their programmed setpoints. When encoder's Z input transitions from 0 to 1, the group's position is preset to the group's preset value. The marker pulse input is ignored until the group's position data has passed through the group on/off setpoint.

Mode 7: Mode 7 is similar to mode 5 except that the outputs will be disabled when the group's position data passes through zero in either direction of travel.

Group Channel ON / OFF Setpoints

Each Group has an internal limit switch called the Group Channel. Its use is dependent on the groups' Operating Mode. It is typically used either to enable or disable the group's inputs and outputs. The state of the Group Channel is only used internally by the group.

Group Offset / Preset Value

Each group has an offset / preset value to adjust the machine position for the group. In Operating Modes 0, 3, 4, 5, and 6, this value acts as a position offset. In Operating Modes 1 and 2 this value acts as a preset. These values do not affect the Machine Offset that adjusts the position value reported over the backplane. They only affect the position value used by the group when calculating the on/off status of the groups' limit switch outputs.

Chapter 3: INDEPENDENT MODE OPERATIONS

When To Use Independent Mode

You should use Independent Mode when your only requirement is for encoder position based limit switches. Group Mode adds powerful functionality to the NX3M1X that can decrease the operations performed by the PLC by off loading a substantial amount of logic to the NX3M1X. However, if you do not need this functionality, operating the NX3M1X module in Independent Mode eliminates all of the Group Mode programming which simplifies module setup. When in Independent Mode, the Enable ANDing Parameter and all of the Group Setup Parameters are not used.

Independent Mode Features

The following limit switch features are available while in Independent Mode.

Limit Switch Output Type

You can program the type of limit switch the output channel will be, Normal, Pulse, or Timed. Normal outputs turn on and off based on position. Pulse outputs generate a pulse train between two position values. Timed outputs are position on, and either time off or position off, whichever occurs first.

Speed Compensation

Separate ON/OFF advances for each limit switch are still available to compensate for fixed delays in the system. The maximum compensation is $\pm 99.9\text{mSec}$. Setting the Advance to a positive value will force the output to turn on earlier in the cycle. Setting the Advance to a negative value will force the output to turn on later in the cycle. Because most PLCs do not support numbers with decimal points in them, the Speed Compensation value entered will appear to be ten times the desired value. For example, a Speed Compensation value of 5.2ms would be entered as 52.

Motion ANDing

Both motion detectors are available in Independent Mode. You can disable a limit switch output by ANDing it with either of the two motion detectors. This prevents the output from firing until the machine is running within the speed range programmed into the motion detector.

Physical Limit Switch Disable Inputs

A feature not available in Group Mode is the Physical LS Disable Inputs. While in Independent Mode, each output is ANDed with and can be disabled by the corresponding Physical input. Output 1 is attached to Input 1, Output 2 to Input 2, etc. The outputs will not fire unless the corresponding Physical input is active. By default, this feature is automatically disabled. If you leave the Physical Input Active State parameters to their default values of zero, the inputs will act like normally closed relays. If you do not use the input, the outputs will then fire normally. While in Group Mode, a single input per group can be used to disable the outputs assigned to the group.

Chapter 4: GROUP MODE OPERATIONS

When To Use Group Mode

You should use Group Mode when you want to control multiple Limit Switch outputs from a single input. The Group Mode functions allow you to fire the outputs only after a product has been detected, or only if a product has been detected while it is in the correct location.

In addition to all of the features available in Independent Mode (Limit Switch Output Type, Speed Compensation, and Motion ANDing), the following features are also available in Group mode.

Assigning Limit Outputs to Groups

Each Group has an *Output Quantity* parameter. This parameter defines the number of outputs assigned to the group. Outputs are assigned in consecutive order. The maximum number of outputs per group is sixteen. When operating the NX3M1X module in Group Mode you must assign an output to a group before using it. The module will give you an error if you try to program Limit Switch Parameters for a limit switch output that is not assigned to a group.

Group Inputs

Each of the six groups has a dedicated input. The Operating Mode assigned to the group defines the function of the input.

When the NX3M1X module is in Group Mode, there are also two additional inputs available. The first is the *LS Enable Input*. Any output can be tied to the LS Enable Input. The output is tied to the LS Enable Input with an ANDing function. That is to say, every output tied to the corresponding LS Enable Input will only fire if the LS Enable Input is active.

The second of the inputs is the *First Cycle Input*. This input only applies to groups operating in Modes 5 or 7. The purpose of the First Cycle Input is to enable the group outputs to fire on the first machine cycle if other conditions are also met. Its use is fully described below in the Mode 5 section of this chapter.

Note: In group modes 4, 5, and 7, the inputs will be acted on only if the position data is scanned between the programmed group channel's On and Off points. If the encoder position data passes through the group channel in less than 1ms, the input may not be detected.

Each Group has its own dedicated input. That is, Group 1 is always controlled by Input 1, Group 2 by Input 2, etc. The table below lists the input numbers for all of the Groups, LS Enable, and First Cycle Inputs.

	Physical Input
Group 1 Input	1
Group 1 Input	2
Group 1 Input	3
Group 1 Input	4
Group 1 Input	5
Group 1 Input	6
LS Enable Input	7
First Cycle Input	8
Not used in Group Mode	9 to 16

Mode 0

When a group is placed in Mode 0 its outputs will function as normal limit switches. Inputs assigned to the group are not used and the Group Channel need not be programmed. Outputs in the group can still be conditioned by tying them to the LS Enable Input and/or either of the two motion detectors. The outputs assigned to the group will cycle their outputs once per transducer rotation. The group also has a Group Offset parameter that can be used to make the Group Position different from the Machine Position. If the Group Offset equals zero then the Group Position will equal the Machine Position.

Mode 1

When a group is placed in Mode 1 its outputs will function as normal limit switches. Outputs in the group can be conditioned by tying them to the LS Enable Input and/or either of the two motion detectors. The difference between Mode 1 and Mode 0 is that you can use the Group Input to Apply a Preset to the Group Position. Typically the Group Input is tied to a sensor that detects a registration mark on the machine or a product. When the mark is sensed the Group Position is preset to the value programmed in the Group Preset parameter. This synchronizes the outputs in the group to the registration mark or the product. The position can be preset to any value between zero and (Scale Factor -1). Any transitions of the Group Input are ignored until either of the Group Channel's On/Off setpoints are reached.

Mode 2

Mode 2 is very similar in operation to Mode 1. The only difference between the two Operating Modes is that the outputs in Mode 2 are normally disabled. The Group Input is used to preset the Group Position to the value stored in the Group Preset parameter. As in mode 1, the group position can be preset to any value between zero and (Scale Factor -1). When the Group Position is preset, the outputs are enabled, and the Group Input disabled, until the dwell in the Group Channel is reached. Outputs in the group can be further conditioned by tying them to the LS Enable Input and/or either of the two motion detectors. Typically, the Group Input is tied to a sensor that detects the presence of product. When the product is sensed, the group outputs are synchronized to the product and are allowed to fire. If a product is not present on the next transducer rotation, the outputs will not fire again.

Mode 3

When a group is placed in Mode 3 the Group Input is used to enable the outputs in the group. The Group Channel has no affect and need not be programmed. The Group Input is typically tied to a sensor that detects the presence of material. The outputs will then only fire when material is present. Outputs in the group can be further conditioned by tying them to the LS Enable Input and/ or either of the two motion detectors. The outputs assigned to the group will cycle their outputs once per transducer rotation. The group has a Group Offset that can be used to make the Group Position different from the Machine Position. If the Group Offset equals zero then the Group Position will equal the Machine Position.

Mode 4

When a group is placed in Mode 4 the Group Input is used to enable the outputs for one cycle. The positive transition, (inactive state to active), on the Group Input must occur between the programmed Group On and Off Channel Setpoints in order for the outputs to be enabled. The outputs are enabled until the dwell on the Group Channel is again reached. The Group Input is typically tied to a sensor that detects the presence of material. The outputs will then only fire when material is present and correctly positioned. Outputs in the group can be further conditioned by tying them to the LS Enable Input and/or either of the two motion detectors. The outputs assigned to the group will cycle their outputs once per transducer rotation. The group has a Group Offset that can be used to make the Group Position different from the Machine Position. If the Group Offset equals zero then the Group Position will equal the Machine Position.

Mode 5

When a group is placed in Mode 5 the Group Input is used to enable the outputs for one cycle. In Mode 4, a positive transition on the Group Input must occur between the Group Channels' On and Off setpoints in order for the outputs to be enabled. In Mode 5, the outputs are enabled if the Group Input is active at any time between the programmed Group On and Off Channel Setpoints. The outputs are enabled for one cycle. The Group Input is typically tied to a sensor that detects the presence of material. The outputs will then only fire when material is present. Outputs in the group can be further conditioned by tying them to the LS Enable Input and/or either of the two motion detectors.

In Mode 5, the outputs are disabled within the programmed update time of the Tach Response if the machine stops for any reason. In gluing applications this shuts off the glue gun if the machine stops while glue is being applied. The First Cycle Input can be used to re-enable the outputs once the machine has started again. The group has a Group Offset that can be used to make the Group Position different from the Machine Position. If the Group Offset equals zero then the Group Position will equal the Machine Position.

Mode 6

When a group is placed in Mode 6 its outputs will function as normal limit switches. Outputs in the group can be conditioned by tying them to the LS Enable Input and/or either of the two motion detectors. The difference between Mode 1 and Mode 6 is that it uses the Z pulse input to Apply a Preset to the Group Position. When the Z pulse is detected, the Group Position is preset to the value programmed in the Group Preset parameter. This synchronizes the outputs in the group to the encoder value. The position can be preset to any value between zero and (Scale Factor -1). Any transitions of the Z Pulse are ignored until either of the Group Channel's On/Off setpoints are reached.

Mode 7

Mode 7 is similar to mode 5 except that the outputs will be disabled when the group's position data passes through zero in either direction of travel.

Chapter 5: Input Registers

The NX3M1X module reports the encoder position and velocity data, as well as module status and programming errors to the PLC using 17 sixteen bit input registers. These registers have the following function.

Note: A ControlLogix system using ControlNet will require 19 input words. The first two words will always be zero, and the module Status Word will be located in word 2.

Input Word	Function
0	Module Status (see description below)
1	Machine Position Data (reset to zero at power up)
2	Encoder Velocity Data (default units of Counts/Second)
3	Limit Switch Output Status (bit 0 = output 1, bit 1 = output 2 ... bit 15 = output 16)
4	Input Status (bit 0 = input 1, bit 1 = input 2 ... bit 15 = input 16)
5	Setup Programming Errors (see description below)
6	Group Programming Errors (see description below)
7	Group Number with error
8	Group 1 position data (Zero if the group is not used)
9	Group 2 position data (Zero if the group is not used)
10	Group 3 position data (Zero if the group is not used)
11	Group 4 position data (Zero if the group is not used)
12	Group 5 position data (Zero if the group is not used)
13	Group 6 position data (Zero if the group is not used)
14	Output Programming Errors (see description below)
15	Output Number with error
16	Output Setpoint Number with error

Word 0: Module Status

- Bit 0: set when setup data is invalid (see input register 5 for a detailed description of the error)
- Bit 1: set when group data is invalid (see input registers 6 and 7 for a detailed description of the error)
- Bit 2: set when Limit Switch data is invalid (see input registers 14 to 16 for a detailed description of the error)
- Bit 3: set when Increment / Decrement Output Number is invalid (range 1 to 16). Also set if any of the unused bits are set in the control word are set, if neither the increment or decrement setpoint bits are selected, or if you try to increment or decrement an output that has not yet been programmed.
- Bit 4: set when the Increment / Decrement Setpoint Number is invalid (range 1 to 9, 9 programs all of the on/off setpoints), if you try to increment an on setpoint past the off setpoint or vice versa, or if you try to increment or decrement a setpoint that has not been programmed.
- Bit 5: set when Message Ignored Error (generated by trying to program the module when a programming error exists)
- Bit 6: set when Module Fault (generated if the NX3M1X fails its power up test)
- Bit 7: set when Encoder Fault. If the fault is clearable, the position data will be updated, the velocity data will be zero, and the outputs will be disabled.

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- Bit 8: MD1 bit, set when the encoder's velocity in COUNTS/SEC is within the range programmed into Motion Detector 1.
- Bit 9: MD2 bit, set when the encoder's velocity in COUNTS/SEC is within the range programmed into Motion Detector 2.
- Bit 10: Tachometer Overflow, set when the scaled tachometer value in input register 2 exceeds 32,767.
- Bit 11: Set when the output registers are being used to force the outputs and inputs on and off.
- Bit 12: Command Error. Set when more than one of the bits 0 to 4 are set, if reserved bits 5 to 12 are set during a programming cycle, or if you try to program groups when the module is operating in independent mode.
- Bit 13: reserved, always equal to zero
- Bit 14: mode status bit, 0 = independent mode, 1 = group mode
- Bit 15: Acknowledge bit. Set when the NX3M1X module sees that the Transmit bit in output register 0 is set.
- Word 1: Machine Position. The position data is reported if there is a clearable encoder fault, and is reset to zero at power up.
- Word 2: Scaled Encoder Velocity Data. Unscaled velocity data is in units of counts/sec and will be affected by the decoding type. For example, a thousand line encoder rotating at 1 rev/sec will have a velocity value of 1000 if X1 decoding is used and 4000 if X4 decoding is used. The velocity data will be zero if there is a clearable encoder fault.
- Word 3: Limit Switch Output Status (bit 0 = output 1, bit 1 = output 2 ... bit 15 = output 16)
- Word 4: Input Status (bit 0 = input 1, bit 1 = input 2 ... bit 15 = input 16) (If the input is configured to be active high, than these bits will be on when the input is receiving power. If the input is configured to be active low, than these bits will set when the input is not receiving power.)
- Word 5: Setup Programming Errors
- Bit 0: Scale Factor Error. Set if the Scale Factor is outside of the 2 to 16384 or if the result of the scaled encoder count calculation is greater than 16384.
- Bit 1: Preset Value Error. Set if the Preset Value is outside of the range of 0 to (SF-1).
- Bit 2: reserved, will always be zero.
- Bit 3: Motion Detect 1 Error. Set if one or both Motion Detector 1 setpoints are outside the range of 0 to 32,767, or if the setpoints are equal but not zero.
- Bit 4: Motion Detect 2 Error. Set if one or both Motion Detector 2 setpoints are outside the range of 0 to 32,767, or if the setpoints are equal but not zero.
- Bit 5: Tachometer Scalars Errors. Set if the Tachometer Multiplier, Tachometer Divisor, or Tachometer Decimal Point parameters are outside of their programmable ranges.
- Bit 6: Set if the encoder count scaling parameters are invalid. That is, if the desired encoder counts parameter is greater than the actual encoder counts parameter.
- Bits 7 to 14: Reserved, will always set to zero.
- Bit 15: Setup Command Word Error. Set if one or more of the reserved bits in the setup command word are set to "1" during a setup programming cycle. This bit will also be set if both of the encoder decoding bits, 8 and 9, are set during a programming cycle.

Word 6: Group Programming Errors

Bit 0: Group Offset/Preset Error. Set if the Group Offset/Preset value is outside of the range of 0 to (SF-1)

Bit 1: Group Programming Error. Set if the output quantity or operating mode parameter is invalid.

Bit 2: Group Channel Setpoint Error. Set when one or both of the group channel setpoints are outside of the range of 0 to (SF-1) or both setpoints are equal but not zero.

Bits 3 to 14: Reserved, will always be set to zero.

Bit 15: Group Command Word Error. Set when one or more of the reserved bits in the group command word are set to "1" during a group programming cycle.

Word 7: Group Number with error. If bits 0 through 2 or 15 are set in input register 6, then this word will indicate which group, 1 to 6, has the programming error.

Word 8: Group 1 position data

Word 9: Group 2 position data

Word 10: Group 3 position data

Word 11: Group 4 position data

Word 12: Group 5 position data

Word 13: Group 6 position data

Note: The Group Position data is reset to zero at power up.

Word 14: Output Programming Errors

Bit 0: On Setpoint Error. Set when a Limit Switch ON Setpoint is outside of the range of 0 to (SF – 1). Input registers 15 and 16 will report which output and setpoint have the error.

Bit 1: Off Setpoint Error. Set when a Limit Switch OFF Setpoint is outside of the range of 0 to (SF – 1) or if the on and off setpoints are equal but not zero. Input registers 15 and 16 will report which output and setpoint have the error.

Bit 2: Advance Error. Set when an advance value is outside of the range of ± 999 . Input register 16 will report which output has the error.

Bit 3: Timed Output Error. Set when a timed output range is outside of the range of (1 to 9999) or if the on/off setpoints of a timed output are outside of the range of 0 to (SF-1).

Bit 4: Reserved, will always be equal to zero.

Bit 5: Pulsed Output Error. Set if there is an error with one or more of the pulsed output parameter. The difference between the leading and trailing edge setpoints must be less than $((\text{Pulse Quantity} * \text{On count}) + (\text{Pulse Quantity} - 1))$. This bit will also be set if the on/off setpoints of the pulsed outputs are outside of the range of 0 to (SF-1).

Bit 6: Output Quantity Programming Error. This bit will be set under four conditions.

1. If you try to program more than two outputs at a time in Output Programming Block word 1.
2. If no outputs are selected in Output Programming Block word 1.
3. While operating in Group Mode, if you attempt to program the outputs before the groups have been programmed.
4. While operating in Group Mode, if you try to program outputs not assigned to a group.

Bit 7: Reserved, will always be equal to zero.

Bit 8: Limit Switch Disabled. Set to “1” when the outputs are disabled because the outputs have not been programmed, if there is an encoder fault, or if the outputs have been disabled by the disable output command. The outputs will also be disabled, and this bit set when either the Setup or the Group data has been programmed.

Bits 9 to 14: Reserved, will always be equal to zero.

Bit 15: Limit Switch Command Word Error. Set under the following two conditions.

1. Set when one or more of the reserved bits in the output command word are set to “1” during an output programming cycle.
2. Set if you try to use both motion detect ANDing on a single output.

Word 15: Output Number where the output programming error occurred, range of 1 to 16.

Word 16: Setpoint Number where the output programming error occurred, range of 1 to 8

Chapter 6: Output Registers

The NX3M1X module is programmed through 40 sixteen bit output registers. Because of the amount of data that is required to totally program the module, and to limit the number of words transferred over the Network, five different programming blocks are used to program the module. Output register 0 always has the same function, and the function of registers 1 to 39 will vary depending on the data contained in register 0. Because of this programming method, a maximum of 10 programming cycles will be required to completely program the module. The following table outlines the five programming blocks.

Programming Block	Function
Setup	Count Direction, Tachometer Response, Module type, Transducer Fault Latch, Transducer Input Type, Scale Factor, Preset Value, Motion Detect Values, and Input Active State.
Group	Number of outputs assigned to group, group mode, group channel on and off setpoints, group preset/offset value. All six groups are programmed with one cycle.
Output	Limit switch type, ANDing type, on/off advances, 8 on/off setpoints. Two outputs can be programmed with each programming cycle, requiring 8 programming cycles to program all 16 outputs.
Increment / Decrement	Select increment/decrement type, limit switch to be adjusted, and setpoint to be adjusted. Only one output can be changed with each programming cycle.
Force	Force outputs and inputs on or off. Sending this programming block places the module in a "Force Mode" in which any changes to the appropriate output registers will be acted on without a programming cycle.

Word 0: Control Word (This Command word will be used to program all of the programming blocks. Setting more than one of the bits 0 to 4, or setting bits 5 to 12 during a programming cycle will generate a command error, Input register 0, bit 12)

Bit 0: Apply Preset Value to Machine Position

Bit 1: Program Setup

Bit 2: Program Groups

Bit 3: Program Outputs

Bit 4: Program Increment / Decrement Function

Bit 5: Place Output Registers in Force mode

Bits 6 to 12: Reserved, must be equal to zero

Bit 13: Set to disable all outputs, reset to enable all outputs (This parameter is not saved on power down.)

Bit 14: Clear Errors

Bit 15: Transmit bit

Note: If the PLC is powered, and the transmit bit is set when the Nexus unit is powered up, then the Nexus unit will act on any valid data contained in the output registers. However, if the PLC is powered up with the transmit bit on, then the Nexus unit will ignore any valid data in the output registers.

Setup Programming Block, Words 1 to 39



Programming the Setup Data resets the position data to zero and clears both the Group and Limit Switch Programming,

Word	Function
1	Bit Level Setup Parameters (See description below)
2	Scale Factor (2 to 16384, default = 8192)
3	Preset Value (0 to (SF-1))
4	Motion Detect 1 Low COUNTS/SEC (0 to 32,767)
5	Motion Detect 1 High COUNTS/SEC (0 to 32,767)
6	Motion Detect 2 Low COUNTS/SEC (0 to 32,767)
7	Motion Detect 2 High COUNTS/SEC (0 to 32,767)
8	Real Input Active State. Reset if the input is active low, set if the input is active high. (bit 0 = input 1, bit 1 = input 2, ... bit 15 = input 3) (Reset these bits to zero if you are not using the Physical Inputs in your application.)
9	Tachometer Multiplier (0 to 1100)
10	Tachometer Divisor (0 to 63, 0 only if Tachometer Multiplier is 0)
11	Tachometer Decimal Point (0 to 3)
12	Actual Encoder Counts (0 to 65535)
13	Desired Encoder Counts (0 to (Actual Encoder Counts – 1))
14 to 39	Not used. These words should be “don’t cares.”

Note: The following formula shows the limitation using the parameters contained in Setup words 12 and 13.

$$((\text{Actual Encoder Counts} / \text{Desired Encoder Counts}) * \text{Scale Factor}) \leq 16384$$

Word 1: Bit level Setup Functions

- Bit 0: Count Direction (0 = A leading B for increasing counts, 1 = B leading A for increasing counts)
- Bit 1: Tachometer Response (0 = 504ms, 1 = 120ms update time. The update time applies to the tachometer data reported over Network, and the ON/OFF status of the motion detectors.)
- Bit 2: Module Type (0 = Independent Mode, 1 = Group Mode)
- Bit 3: Master Unit Encoder Check. If this bit is set when the NX3M1X is acting as a Master unit, then the encoder input signals are checked. If the A+ is not opposite from the A- and the B+ is not opposite from the B-, then the module will set the encoder fault bit. If this bit is reset, the module will never indicate an encoder fault.
- Bit 4: Transducer Fault Latch. 0 = fault latched, 1 = fault self cleared. Default value is latched. This bit will only affect Master units if bit 3 (the Master Unit Encoder Check) bit is also set. This bit will always affect a unit programmed to operate in slave mode.
- Bit 5: Reserved, must be set to zero

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- Bit 6: Master (if = 0) or Slave (if = 1) Mode Control. The module uses the serial RS485 connection for transferring the encoder counts to the slave unit. The status of the Z pulse input is not transferred; therefore, the slave module cannot be used in mode 6.
- Bit 7: Reset to disable the outputs when there is no network connection. Set to have the outputs remain enabled when there is no network connection. If set, the outputs will turn on and off based on the encoder's position. Please note that forced outputs are always disabled when the network connection is removed, regardless of the state of this bit.
- Bit 8 & 9: Program encoder decoding type:

Bit 9	Bit 8	Decoding
0	0	X1
0	1	X2
1	0	X4
1	1	Fault

Bits 10 to 15: Reserved, must be equal to zero

Group Programming Block, Words 1 to 39



Programming the Group Data clears Limit Switch Output Programming.

Word	Function
1	Group 1 Setup Programming Bits (See description below)
2	Group 1 Channel On Point (0 to Scale Factor – 1)
3	Group 1 Channel Off Point (0 to Scale Factor –1)
4	Group 1 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
5	Group 2 Setup Programming Bits (See description below)
6	Group 2 Channel On Point (0 to Scale Factor – 1)
7	Group 2 Channel Off Point (0 to Scale Factor –1)
8	Group 2 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
9	Group 3 Setup Programming Bits (See description below)
10	Group 3 Channel On Point (0 to Scale Factor – 1)
11	Group 3 Channel Off Point (0 to Scale Factor –1)
12	Group 3 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
13	Group 4 Setup Programming Bits (See description below)
14	Group 4 Channel On Point (0 to Scale Factor – 1)
15	Group 4 Channel Off Point (0 to Scale Factor –1)
16	Group 4 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
17	Group 5 Setup Programming Bits (See description below)
18	Group 5 Channel On Point (0 to Scale Factor – 1)
19	Group 5 Channel Off Point (0 to Scale Factor –1)
20	Group 5 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
21	Group 6 Setup Programming Bits (See description below)
22	Group 6 Channel On Point (0 to Scale Factor – 1)
23	Group 6 Channel Off Point (0 to Scale Factor –1)
24	Group 6 Offset or Preset Value (mode dependent) (0 to Scale Factor –1)
25 to 39	Not used. These words should be “don’t cares.”

The Group Setup Programming bits of all six groups has the following layout:

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 09	Bit 08	Bit 07	Bit 06	Bit 05	Bit 04	Bit 03	Bit 02	Bit 01	Bit 00
Set to enable group	0	0	0	0	The mode used in the group, range of 0 to 7			0	0	The number of limit switch outputs assigned to the group, range of 1 to 16					

Limit Switch Output Programming Block, Words 1 to 39

Word 1: Outputs Programmed

This word controls which two outputs are programmed in output registers 2 to 39. Each bit in this word corresponds to an output, that is bit 0 = output 1, bit 1 = output 2, ... bit 15 = output 16. Any two bits can be set during an output programming cycle. The output assigned to the least significant bit of the two will be programmed in words 2 through 20 and is called the *Lower Output*. The most significant bit of the two will be programmed in words 21 through 39 and is called the *Upper Output*. If only one bit is set, only registers 2 through 20 will be used, and the data in words 21 through 39 will be ignored. Setting more than two bits will generate an Output Quantity Error, which is indicated by input word 14, bit 6. Any errors in the output programming data will cause even valid changes to be ignored.

The function of Output Programming Words 2 through 39 is shown in the following table.

Lower Output Word	Upper Output Word	Normal Output Function	Pulsed Output Function	Timed Output Function
2	21	Output Setup Bits (See description below)		
3	22	On Advance (0 to +99.9) in 0.1ms increments		
4	23	Off Advance (0 to +99.9) in 0.1ms increments		
5	24	On Setpoint 1 (0 to SF-1)	On position, leading edge of 1 st pulse	On Setpoint
6	25	Off Setpoint 1 (0 to SF-1)	Off Position, trailing edge of last pulse	Off Setpoint
7	26	On Setpoint 2 (0 to SF-1)	Total Number of Pulses	Dwell Time
8	27	Off Setpoint 2 (0 to SF-1)	Pulse Duration	0
9	28	On Setpoint 3 (0 to SF-1)	0	0
10	29	Off Setpoint 3 (0 to SF-1)	0	0
11	30	On Setpoint 4 (0 to SF-1)	0	0
12	31	Off Setpoint 4 (0 to SF-1)	0	0
13	32	On Setpoint 5 (0 to SF-1)	0	0
14	33	Off Setpoint 5 (0 to SF-1)	0	0
15	34	On Setpoint 6 (0 to SF-1)	0	0
16	35	Off Setpoint 6 (0 to SF-1)	0	0
17	36	On Setpoint 7 (0 to SF-1)	0	0
18	37	Off Setpoint 7 (0 to SF-1)	0	0
19	38	On Setpoint 8 (0 to SF-1)	0	0
20	39	Off Setpoint 8 (0 to SF-1)	0	0

OUTPUT SETUP WORDS: The first word of each of the two output programming blocks, words 2 and 21, contain the Output Setup Word. These words define the type of output (normal, timed, or pulsed) and if any ANDing will be used. The description of these output words is shown below.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 09	Bit 08	Bit 07	Bit 06	Bit 05	Bit 04	Bit 03	Bit 02	Bit 01	Bit 00
Output Enable ANDing	Motion ANDing control bits		0	0	0	0	0	0	0	0	0	0	0	Output Type	

Bit 1	Bit 0	Function
0	0	Output not used
0	1	Pulse Output
1	0	Timed Output (Starts timing only after the input is active. This does not include the group mode enable bit.)
1	1	Normal Output

Bit 14	Bit 13	Function
0	0	No Motion ANDing
0	1	Motion ANDing 1
1	0	Motion ANDing 2
1	1	Reserved for future use

bit 15: In Group Mode only, this bit is set for Output Enable ANDing (by input) and reset for no ANDing. In group mode, enable ANDed timed outputs start timing regardless of the state of the enable input. This bit is a “don’t care” in independent mode.

Output Programming Notes

- Because most PLCs do not support numbers with decimal points in them, the Speed Compensation value entered will appear to be ten times the desired value. For example, a Speed Compensation value of 5.2ms would be entered as 52.
- When programming a Timed Output, the dwell time has a range of 1 to 9999 (for 1ms to 9999ms) and the On/Off setpoints have a range of 0 to (Scale Factor-1).
- Pulsed outputs have two additional parameters. The *Total Number of Pulses* is the number of pulses in the train. The *Pulse Duration* is the number of counts that each pulse is On.
- When programming a Pulsed Output, the difference between the On and Off setpoints must be greater than or equal to: $((\text{Total Number of Pulses} * \text{Pulse Duration}) + (\text{Total Number of Pulses} - 1))$. Also, the range of the On and Off setpoints is 0 to (Scale Factor -1).

Increment / Decrement Programming Block, Words 1 to 39

Word 1: control bits

Bit 0: set to change on setpoint

Bit 1: set to change off setpoint

Bit 2: reset to increment setpoint, set to decrement setpoint

Bits 3 to 15: reserved, must be reset to zero

Word 2: Increment/Decrement Limit Switch Number (range 1 to 16)

Word 3: Increment/Decrement Setpoint Number (range 1 to 9) (if the value equals 9, than all of the on/off setpoints will be incremented or decremented.)

Words 4 to 39: Not used. These words should be “don’t cares.”

Note: The Increment/Decrement function cannot be used on outputs that have not been programmed.

Force Function Programming Block, Words 1 to 39

The force function works differently than the other programming blocks. Once the output registers are in force mode, any changes to the data will be acted on immediately. That is it will not be necessary to use a programming cycle to change the force values. Input register 0, bit 11 will be set to indicate that the module is in force mode.

Word 1: Force Outputs On

Word 2: Force Outputs Off

Word 3: Force Inputs On

Word 4: Force Inputs Off

Words 5 to 39: Not used, should be considered “don’t cares.”

Note 1: Force Off takes priority over Force On. That is, if both the Force Off and Force On bits are set, than the output will be Off not On.

Note 2: It is not necessary to program the outputs before the force will take affect.

Note 3: Cycling power to the unit takes the module out of force mode.

Note 4: Transmitting any of the other programming blocks to the Nexus will take the unit out of force mode.

Note 5: Outputs that have been forced on will remain on even if the unit is in transducer fault.

Specification Revision History

Revision 1.0 was released on 8/29/01 and was the initial release.

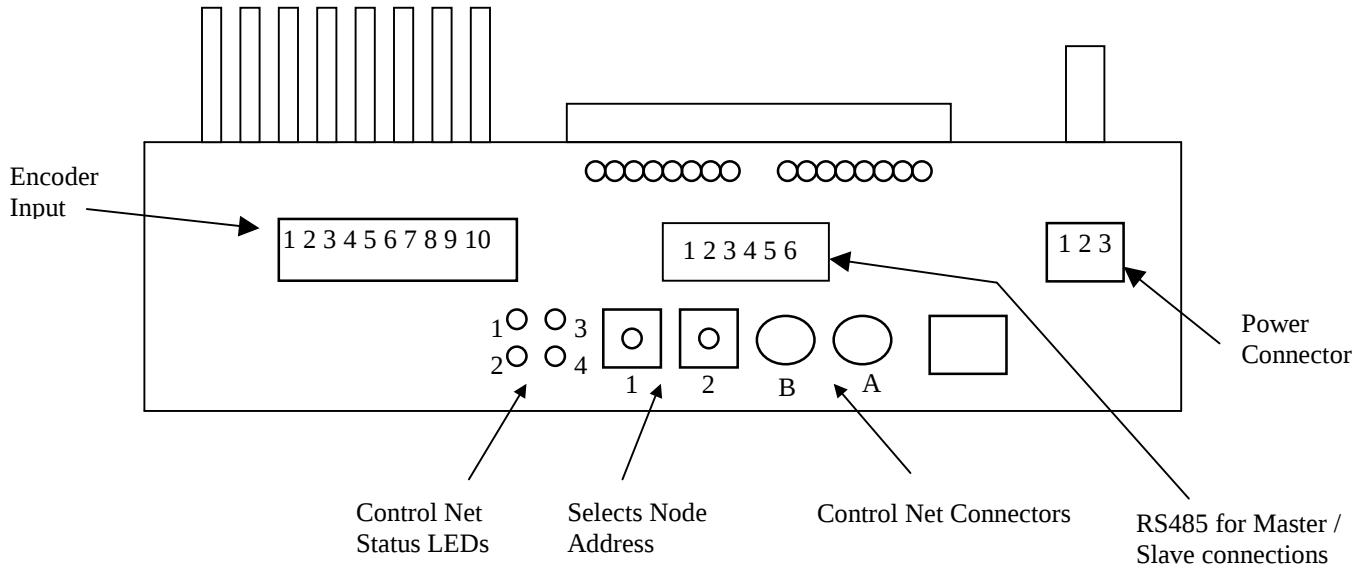
Revision 1.1 was released on 3/18/02. The RSLogix revision numbers were removed from the Quickstart guide.

Revision 1.2 was released on 4/28/05. This version added a note to the functionality of ControlNet LED 3.

Revision 1.3 was released on 5/5/06. This version changed the name of the document to NX3M1X and added all four of the network options into one document. Expanded descriptions of the various programmable parameters were also added.

Chapter 7: Network Connections

ControlNet Hardware Overview



ControlNet Connectors

The Nexus module has two BNC network connections labeled A and B.

Node Address Selection

The Nexus module has two rotary switches used to set the module's address on the network. Any node from 0 to 99 can be selected. Switch 1 sets the one digit and switch 2 sets the 10s digit of the address. For example, if the Nexus is to be installed at node 46, switch 1 would be set to 6, and switch 2 would be set to 4. Note, changing the node address only takes affect at power up. Changing the address while power is applied to the Nexus module will generate a minor fault.

Network Update Time

The NX3M1C has a minimum network update time of 5ms.

Note: A ControlLogix system using ControlNet will require 19 input words. The first two words will always be zero, and the module Status Word will be located in word 2.

ControlNet Status LEDs

The following table describes the function of the four network status LEDs.

LED Number	Name	LED Pattern	Function
1	Channel B status	Solid Green Flashing Red/Off Solid Off	Channel Operating Correctly Channel Disconnected from Network Channel Disabled
2	Channel A status	Solid Green Flashing Red/Off Solid Off	Channel Operating Correctly Channel Disconnected from Network Channel Disabled
3	Module Owned	Solid Green Off Solid Red	Network Card is communicating with Nexus Network Card is not communicating with Nexus Incorrectly Configured Network. Possible causes are incorrect Node #, Number of I/O words, or Comm format.
4	Module Status	Flashing Green Solid Green Flashing Red Solid Red	Network Card is waiting for initialization Module is initialized and operating correctly Minor Fault (For example Node address changed) Major Fault, module must be restarted

Note: If the Nexus module is removed from the Network, than both LEDs 1 and 2 will flash RED.

Quick Start Guide

AMCI Nexus to ControlLogix

1. With the power off, use the rotary switches on the Nexus to select the desired node address.
2. Connect the Nexus to the ControlNet using a ControlNet Tap to coax media. Either the A or B port can be used, depending on how your network is configured.
3. Apply power to the Nexus unit.
4. Start RSLogix 5000.
5. Start RSLinx and establish communications to the ControlLogix system.
6. Configure the ControlLogix hardware system, processor and discrete I/O. If it is not already present, also add the ControlNet adapter 1756-CNB(R) module to the system.
7. Right-click on the 1756-CNB(R) module and Click on **New Module...**
8. Define the NX3M1C as a generic CONTROLNET-MODULE. Click on **OK** and define the properties as follows.

Name: *Your Choice*
Description: *Your Choice*
Comm Format: Data-INT (must be Data_INT)
Node: Set it to the same value as the Node address on the NX3M1C

Assembly Instance – 100, **Input** – 19 for the NX3M1C
Assembly Instance – 150, **Output** – 40 for the NX3M1C
Assembly Instance – 110, **Config** – 0 for the NX3M1C

9. Click on **Next>**
10. Define the RPI. The minimum value is 5.0ms, however the value may be set higher.
11. Click **Finish**.
12. Save and Download the file to the Processor
13. Start RSNetworx for ControlNet and either open an existing project or create a new one.
14. If this is the first time using the NX3M1C, register the appropriate EDS and icon files. These files are available from AMCI's website www.AMCI.com.
15. Go Online. RSNetWorx will scan the ControlNet network and should discover the NX3M1C.
16. Click on the Enable Edits checkbox and then save the project.

At this point, the 1756-CNB(R) should be communicating; steady green LED and the top right LED (ControlNet Status LED #3) for the NEXUS communication should be on.

Go online to the ControlLogix processor. Select the **Logic** menu, followed by **Monitor Tags**. The data associated with the NX3M1X is available under the name you chose when configuring it.

Quick Start Guide

AMCI Nexus to PLC-5

1. With the power off, use the rotary switches on the Nexus to select the desired node address.
2. Connect the Nexus to the ControlNet using a ControlNet Tap to coax media. Either the A or B port can be used, depending on how your network is configured.
3. Apply power to the Nexus unit.
4. Start RSNetworx. If this is the first time using the NX3M1C, register the appropriate EDS and icon files. These files are available from AMCI's website www.AMCI.com.
5. From RSNetworx for ControlNet, go Online. After browsing the network, the NX3M1C will appear as an "Extra Device" at the node selected by the Nexus' rotary switches.
6. Click the **Enable Edits** checkbox and choose "Use online data (upload)". Click **OK**. At this point you can right click on the NX3M1C icon and select **Properties** from the pop-up menu. In the properties window, you can change the name associated with the unit and add a description.
7. Go Offline.
8. Click the **Enable Edits** checkbox.
9. Right Click on the PLC-5 icon and click on **Scanlist Configuration** in the pop-up menu.
10. In the Device Name column, right click on the name of the Nexus unit, and click on **Insert Connection** in the pop-up menu. The Connection Properties window will appear on the screen.
11. If needed, set the Input Size and Input Address of the Data Input File. This file resides in the PLC-5 and is used by all of the ControlNet nodes. Therefore, it must be large enough to hold all of the input data on the network. The number of words that the NX3M1C transfers to the PLC-5 is shown below.

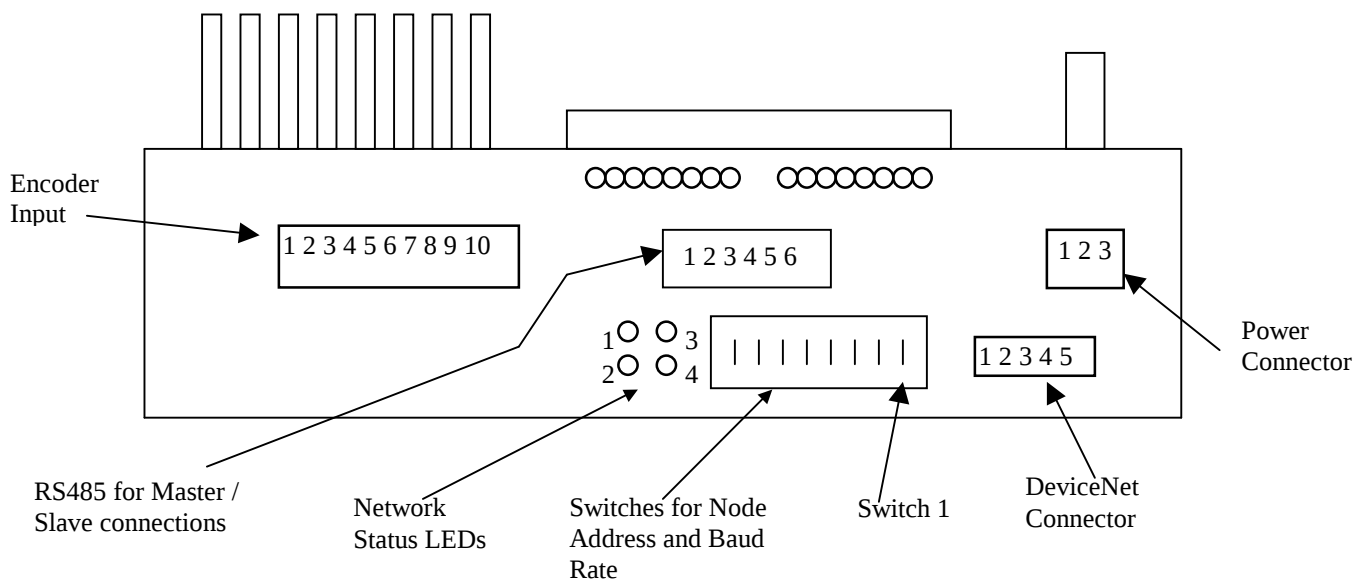
17 Input words for the NX3M1C

12. If needed, set the Output Size and Output Address of the Data Output File. This file resides in the PLC-5 and is used by all of the ControlNet Nodes. Therefore, it must be large enough to hold all of the output data on the network. The number of words that the NX3M1X receives from the PLC-5 is shown below.

40 Output words for the NX3M1X

13. Set the Request Packet Interval time. This has a minimum acceptable value of five milliseconds, but can be set higher.
14. Click OK to close the Connection Properties window. In the Scanlist Configuration window, save the changes and close the window.
15. Go Online.
16. Verify that the PLC is in Program Mode.
17. Click on **Network** in the toolbar select **Download to Network** from the pull down menu that appears. After the download is complete, the Nexus unit should be communicating with the PLC.

NX3M1D Hardware Overview



DeviceNet Connector

The 5 pin DeviceNet Connector has the following wiring.

Pin Number	Function	Standard Wire Color
1	+24Vdc	Red
2	Can High	White
3	Shields	Bare
4	Can Low	Blue
5	Common	Black

Node Address and Baud Rate Selection

The NX3M1D uses eight DIP switches to select the Node Address and the Baud Rate. Switches 1 and 2 set the Baud rate and switches 3 to 8 set the node, with switch 8 being the least significant bit. The following table shows the possible switch setting combinations.

The DIP switch package is mounted so that the numbers are upside down. However, “1” or “ON” is still in the up position and “0” or “OFF” is in the down position.

Baud Rate	Switches 1 & 2	Node Address	Switches 3 to 8
125k	0 0	0	0 0 0 0 0 0
250k	0 1	1	0 0 0 0 0 1
500k	1 0	2	0 0 0 0 1 0
Reserved	1 1	61	1 1 1 1 0 1
		62	1 1 1 1 1 0
		63	1 1 1 1 1 1

Example: For a Baud Rate = 250K and the Node Address = 5, switches 2, 6, and 8 would be ON, up towards the top of the module and switches 2, 3, 4, 5, and 7 would be OFF, down towards the bottom of the module.

Note: The state of the switch settings is only taken into account at power up.

DeviceNet Status LEDs

The following table describes the function of the four network status LEDs.

LED Number	Name	LED Pattern	Description
1	Module Network Status	Steady Off Steady Red Steady Green Flashing Red	No Power Unrecoverable Fault Device Operational Minor Fault
2	Network Status	Steady Off Steady Red Steady Green Flashing Red Flashing Green	Not Powered / Not On Line Critical link failure Link OK, On Line, Connected Connection Time Out On Line not connected
3	Reserved		
4	Reserved		

Network Update Time

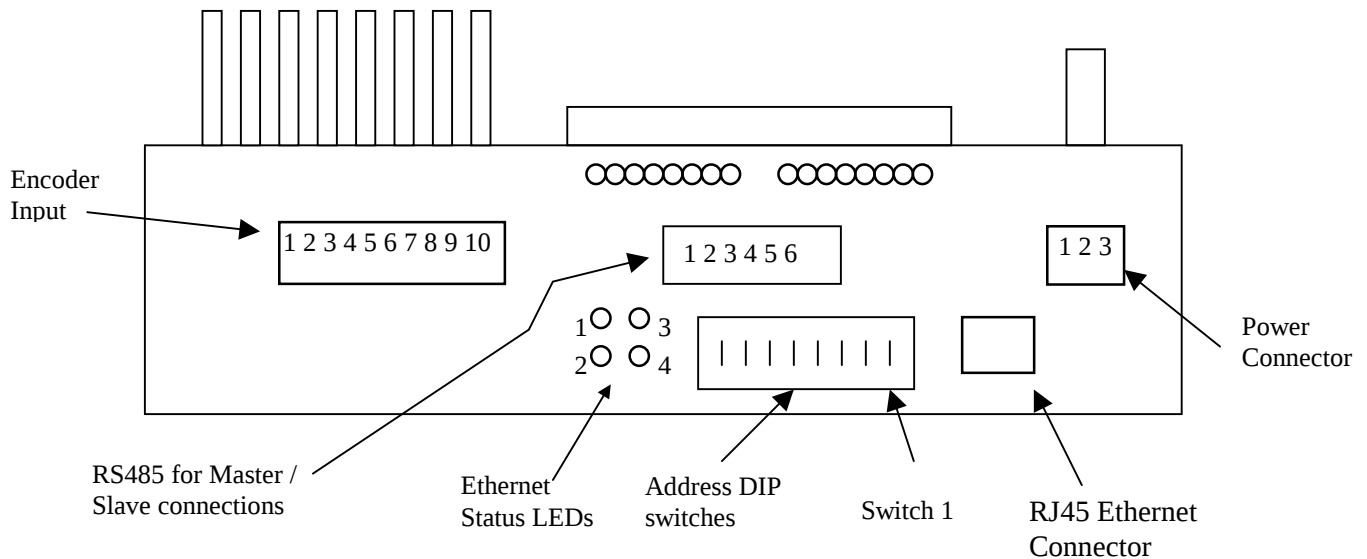
The NX3M1D sends new data to the DeviceNet network every 1ms.

Adding the NX3M1D to your network

Before the NX3M1D can be attached to a network, it must be added to the RSNetWorx for DeviceNet software. The EDS and icon files are available in the *Driver File Download* section of our website, www.amci.com. The following procedure to add the EDS file to RSNetWorx assumes that you have already downloaded these files and un-zipped them.

1. With the power off, use the dip switches on the front of the NX3M1D to set the node address and the baud rate.
2. Start RSNetWorx for DeviceNet.
3. In the RSNetWorx program, click on **Tools** in the menu bar.
4. Click on **EDS Wizard...** from the pull down menu that appears.
5. Click on **Next>** in the window that appears.
6. Select **Register an EDS file(s)** and click on **Next>**.
7. Select **Register and EDS file**.
8. Click on **Choose File...** and navigate to the folder where you placed the un-zipped EDS and icon files.
9. Double click on **NX3M1D_r01.eds** file.
10. Click on **Next>**.
11. Click on **NX3M1D_r01.eds** file so that it is highlighted.
12. Click on **Next>** to assign an icon to the device.
13. Click on the NX3M1D and then click on **Change icon...** to select the icon for the Nexus unit. You can choose one of the built in icons from Rockwell Automation or click on the **Browse...** button and select the **NX3M1D_r01.ico** icon file.
14. Click on **Next>** and then click on **Finish** to complete the installation of the AMCI NX3M1D EDS file to the RSNetWorx system.

Once the EDS file is added to your system, add the NX3M1D to your network as you would any other device, including adding it to the scanlist configuration of the scanner module.

NX3M1E Hardware Overview**Network Update Time**

The NX3M1E has a minimum network update time of 5ms.

Ethernet Address Selection

The NX3M1E uses an IP address of 192.168.000.XXX where “XXX” can be any number between 1 and 254. Eight dip switches on the NX3M1E are used to set the “XXX” portion of the address. Switch 8, the left most switch, is the least significant bit and switch 1, the right most switch, is the most significant bit. The address is programmed using the following procedure.

1. Determine the address of the NX3M1E. It can be any unused address between 1 and 254.
2. Convert the address to a binary number. A value of 50 will be 0011 0010.
3. Enter the address on the dip switches. Continuing the above example, switches 8, 6, 5, 2 and 1 will be off (down) and switches 7, 4, and 3 will be on (up).

Ethernet Status LEDs

LED Number	Name	LED Pattern	Function
1	Network Status	Steady Off Steady Green Flashing Green Flashing Red Steady Red Flashing Green/Red	The module has no power or an IP address has been assigned. The module has at least one established Ethernet/IP connection. There are no Ethernet/IP connections established to the module One or more of the connections in which this module is the target has timed out The module has detected that its IP address is already in use The module is performing a power on self test
2	Module Status	Steady Off Steady Green Flashing Green Flashing Red Steady Red Flashing Green/Red	No Power. The module is operating correctly. The module has not been initialized. A minor recoverable fault has been detected. A major internal error has been detected. The module is performing a power on self test.
3	Activity LED		This LED flashes green each time a packet is received or transmitted
4	Link		This LED indicates that the module is connected to an Ethernet network

Setup Example

AMCI NX3M1E to Rockwell Automation 1756-ENET/B module

1. With power removed, use the dip switches to set the address of the NX2A4E.
2. Open an existing or create a new ControlLogix program.
3. From the project tree, right click on I/O configuration and select New Module.
4. From the Module Type list that appears, select 1756-ENET/B, the 1756 Ethernet Bridge module.
5. Type a name for the Bridge module, which must begin with a letter, in the Name field.
6. Enter the slot number where the 1756-ENET/B module is located in the ControlLogix rack.
7. In the Address/Host Name field, select the IP Address and enter the address 192.168.000.XXX where XXX can be a unique number between 1 and 254.
8. Click the Finish button.
9. From the project tree, right click on the 1756-ENET/B module and select New Module.
10. Select ETHERNET-MODULE Generic Ethernet Module from the list that appears and click on OK.
11. In the module properties that appear, enter the following parameters.

Name: **Your Choice** (must begin with a letter)

Comm Format: **Data-INT** (must be Data-INT)

IP Address: **192.168.000.XXX** where XXX is the number entered on the DIP switches

	Assembly Instance	Size
Input	100	17
Output	150	40
Configuration	110	0

12. Click on Next.
13. Select the RPI time, minimum = 3ms.
14. Click on Finish.
15. Save and download the program to the ControlLogix rack.
16. While online with the PLC, right click on the Ethernet Bridge module and select Properties. Click on the Port Configuration tab and modify the following fields.

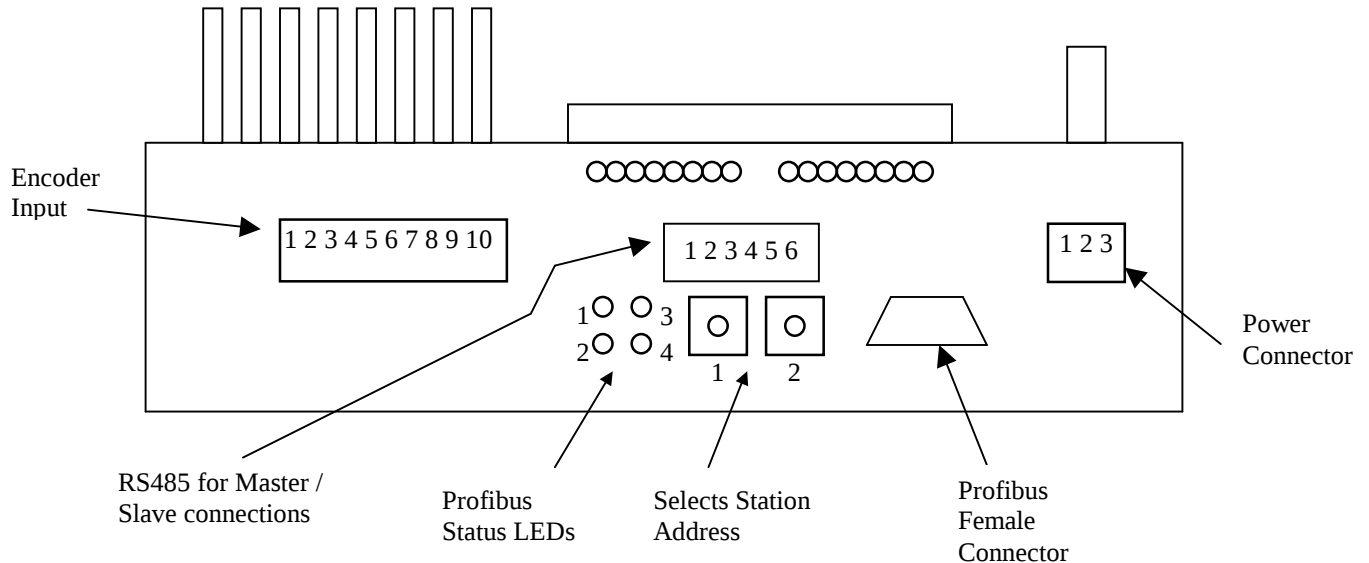
Enable Bootp: **Unselected** (This will allow the data to be manually entered in the IP address and Domain Name fields.)

IP Address: **192.168.000.XXX** (must be the same as step 7 above)

Subnet Mask: **255.255.255.0**

The Gateway Address, Domain Name, Primary DNS Server Address, and Secondary DNS Server Addresses all remain unchanged.

NX3M1P Hardware Overview



Profibus Connector

The Nexus module uses a 9 pin female D-sub connector to communicate with the Profibus network.

Station Address Selection

The Nexus module has two rotary switches used to set the module's address on the network. Any station from 0 to 99 can be selected. Switch 1 sets the one digit and switch 2 sets the 10s digit of the address. For example, if the Nexus is to be installed at station 46, switch 1 would be set to 6, and switch 2 would be set to 4. Note, changing the station address only takes affect at power up. Changing the address while power is applied to the Nexus module will generate a minor fault.

Profibus Status LEDs

LED Number	LED Pattern	Function
1	Red Off	Module is Offline and no data exchange is possible The module is Online
2	Green Off	Module is Online and data exchange is possible The module is Off line
3	Flashing Red 1Hz Flashing Red 2Hz Flashing Red 4Hz Off	Error in configuration: IN and/or OUT length set during initialization of the module is not equal to the length set during the configuration of the network Error in User Parameter data: The length/contents of the user parameter data set during initialization of the module is not equal to the length/contents set during configuration of the network. Error in initialization of the Profibus communication ASIC. No diagnostic present
4	Off	Not Used

Network Baud Rate

The NX3M1P supports the following network baud rates

9.6 kbits/sec, 19.2 kbits/sec, 93.75 kbits/sec, 187.5 kbits/sec, 500 kbits/sec, 1.5 Mbits/sec, 3 Mbits/sec, 6 Mbits/sec, and 12 Mbits/sec

Quick Start Guide**AMCI Nexus to SST-PFB-SLC Profibus interface module**

1. If it is not already present, install the SST-PFB-SLC module in the SLC rack and configure the rack (the ID code is 13635) for the module.
2. Place the PLC in program mode.
3. Connect a serial cable from the computer's COM port to the RS232 port of the SST-PFB-SLC module.
4. With the power off, use the rotary switches on the Nexus unit to select the desired station address. The left switch sets the 1s digit and the right switch sets the 10s digit of the station address.
5. Attach the Nexus unit to the Profibus network.
6. Apply power to the Nexus unit.
7. Start the SST Profibus Configuration software. (Current Version 1.9)
8. Either create a new or open an existing network.
9. If it has not already present, register the Nexus units GSD file.

Click on Library in the toolbar and then select Add GSD file. Choose the directory where the GSD file is located, and then select the AnyBPRfB file.

When registered this module will appear under Slaves as:

HMS Fieldbus Systems AB
ANYBUS-S PDP

10. If SST-PBF-SLC module is not already present, click on Masters. Click and drag the Master (Rev 1.4) into the network. Right click on it and configure it according to your system's requirements.
11. Under slaves, click and drag the ANYBUS-S PDP module into the network. The setup window will appear.
 - Under the **General** tab, set the station number to match the station number set by the rotary switches on the Nexus unit.
 - Click on the **Modules** tab and then click on Add. The NX3M1P must be set for 17 input words and 40 output words. If a different number of words is programmed, Network LED 3 will flash indicating an Error in Configuration. The input words can be located in either the Input Image table or in the M1 file, however, all 17 input words must be located in one file. The 40 output words must be located in the M0 file.
 - Click on Input 32 Byte (16 word) and then on OK.
 - Click on the **SLC Address** tab and then select the Input Type, either I or M1, and the offset value, that is where in the I or M1 table the data begins. It is important not to leave gaps between an existing Profibus module and the data used by the Nexus unit.
 - Again click on the **Modules** tab and click on Add.
 - Click on Input 2 Byte (1 word) and then on OK.
 - Click on the **SLC Address** tab and then select the Input Type to be the same as was selected above. Set the offset value to the value assigned to the value assigned above plus 16.
 - Again click on the **Modules** tab and click on Add.
 - Click on Output 64 Byte (32 word) and then on OK.
 - Click on the **SLC Address** tab and then select the Output Type to be M0 and then select an offset value. As before, it is important not to leave gaps between an existing Profibus module and the data used by the Nexus unit.
 - Again click on the **Modules** tab and click on Add.
 - Click on Output 16 Byte (8 word) and then on OK.
 - Click on the **SLC Address** tab and then select the Output Type to be M0. Set the offset value to the value assigned to the 64 Byte plus 32.
 - Click on OK to accept.
12. Save the network file.
13. Right click on the Master Module and select Connect from the menu that appears.
14. Click on Yes if asked to retain the configuration.
15. Again right click on the Master Module and then select Load Configuration from the menu that appears.
16. Place the PLC in Run mode.

File: NX3M1X_specs.doc
Date: 5/5/06