



**RFL Electronics Inc.**

# INSTRUCTION DATA

## **RFL NCM Network Communications Module**

### **DESCRIPTION**

The Network Communications Module (NCM) is an Asynchronous Data Module designed for use in RFL IMUX 2000 T1 and E1 multiplexers. It provides one DCE Half/Full-Duplex channel between an unlimited number of locations using a single 64 kbps DS0 time slot. The NCM provides a fast and reliable NMS communication path between nodes of a T1 or E1 network, and can also be used for party-line applications such as DNP and Modbus networking.

The NCM is remote-controllable when installed in an RFL remote controllable shelf. The following module parameters can be configured remotely via NMS or locally via DIP switches. A DIP switch setting selects whether the card is in remote or local mode.

- |   |   |  |
|---|---|--|
| o | TX/RX Time Slot                           | 1-31   |
| o | TX Bus Direction                          | TX-A(RX-B) / TX-B(RX-A)                      |
| o | Service enable/disable                    | On/Off                                       |
| o | Equipment Loopback                        | On/Off                                       |
| o | Payload Loopback                          | On/Off                                       |
| o | Block timeslot 16 for CAS in E1 operation | On/Off                                       |
| o | Port 2                                    | On/Off                                       |
| o | Rogue Control                             | On/Off                                       |
| o | CM Address                                | Any, Greater Than, Less Than                 |
| o | Baud Rate                                 | 2400, 4800, 9600, 19.2k, 38.4k               |
| o | Parity                                    | None, Odd, Even, Mark, Space                 |
| o | Word Length                               | 7 or 8 data bits                             |
| o | Application Modes                         | Broadcast, NMS, Master, D&I slave, End slave |
| o | Remote Operation                          | On/Off                                       |

## SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL NCM Module. Because all of RFL products undergo constant improvement and refinement, these specifications are subject to change without notice.

**Live Insertion/Extraction:** The NCM Module is capable of live insertion and extraction into the IMUX 2000 shelf without interruption to the DS1 or any other DS0.

**Asynchronous Data Interface:** Full duplex or half duplex, one channel operation, one or two data ports.

**Data Rate:** 2400, 4800, 9600, 19.2kbps and \*38.4kbps. (\*38.4kbps may require character pacing and/or additional stop-bits)

**Start-Stop Distortion:** Referenced to actual Rx Baud <9%

**Gross Start-Stop Distortion:** Referenced to nominal Baud <50%

**Character Delay:** 16 characters max (delay is dependant on input frequency deviation from nominal data rate)

**Frequency Deviation:** Allowable input Frequency Deviation from nominal data rate is  $\pm 4\%$ . (Stop bit reduction is used to compensate for frequencies greater than local oscillator generated baud).

**NMS Mode ASCII Character Addressing Format:** [0-9][0-9][0-9] [:]  
Example: NMS sends "215:"

**Time Slots:** Occupies one selectable DS0 time slot.

**Jitter:** Excluding Stop bit <1%

**Rogue Detectors:** One minute pick-up, two minute drop-out

**RS-232 DCE Interface:**

Supports: Tx Data, Rx Data, and Signal Ground. Receive Line Signal Detect and Clear to Send are always held active.

**RS-485 DCE Interface:**

Two-wire: Supports half-duplex, transmit data or receive data, and ground.

Four-wire: Supports full-duplex transmit data, receive data, and ground.

**Telnet Interface:** Supports: Tx Data and Rx Data over ethernet.

**Connector:**

For RS-232 the NCM module uses an MA-402I Module Adapter, which provides two DB-9 female connectors.

For RS-485 the NCM module uses an MA-485 Module Adapter, which provides a single, six position terminal block.

For Telnet the NCM module uses a shielded RJ45 connector.

**Power Dissipation:** 0.5 Watt nominal

**MTBF (Calculated):** TBD

**Operating Temperature:** -20°C to +55°C (-4°F to +131°F).

**Humidity:** 0 to 95 %, non-condensing.

## INSTALLATION

Before the RFL NCM module can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Expansion Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal and power wiring to the Module Adapter, checking the settings of all switches, and inserting the module into the front of the shelf.

### NOTES

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing an RFL NCM module into an existing system. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
2. Determine the module slot in the Main Shelf or Expansion Shelf where the module will be installed.

**The RFL NCM module occupies one module slot in the Main Shelf or Expansion Shelf.**

3. Determine which module adapter will be used to make connections to the RFL NCM module.  
**Each module in the IMUX 2000 multiplexer requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface. There are three Module Adapters that are compatible with the RFL NCM:**

<u>Module Adapter</u>	<u>Part Number</u>	<u>Interface Type</u>	<u>Connector</u>	<u>Figure</u>
MA-402I	9547-16921	2-Port RS-232	9-pin D-subminiature	1
MA-485	107470	1-Port RS-485	Removable terminal block	2
MA-490 Telnet I/O	107495	2-Port RS-232 1-ethernet port	9-pin D-subminiature* RJ-45 jack	3

**\*One 9-pin connector is the RS-232 port. The other 9-pin connector is the local port.**

The MA-402I module adapter is shown in Figure 1. This module is a two-port RS-232 I/O which has two 9-pin D-subminiature (DC-9) connectors on its rear panel. Each of these 9-pin connectors is wired in a standard RS-232 configuration as shown in the table at the bottom of the figure. Each connector is labeled to show the corresponding port on the NCM module.

The MA-485 module adapter shown in Figure 2 supports both 2-wire and 4-wire RS-485 applications. The 2-wire mode supports *only* half-duplex, and the 4-wire mode supports *both* half *and* full duplex. The MA-485 is typically used for party-line applications such as DNP and Modbus networking, or simple point-to-point applications. This module has one 6-position removable terminal block on its rear panel, which is wired in accordance with the table in Figure 2.

The MA-490 module adapter shown in Figure 3 is an RS-232/Telnet I/O module adapter used for systems that have an RS-232 port which needs Telnet link capability. This module has two RS-232 ports using DB9 connectors and one Ethernet port using an RJ-45 jack on its rear panel. One of the RS-232 ports is the Craft port and the other is the Data port. The Craft port is used to set up TCP/IP parameters, and the Data port is used for communications. Refer to the tables in Figure 3 for wiring information.

**Make sure the module adapter you are installing is correct for the desired application. Make sure the programmable jumpers on these modules are set to the desired configuration, as applicable.**

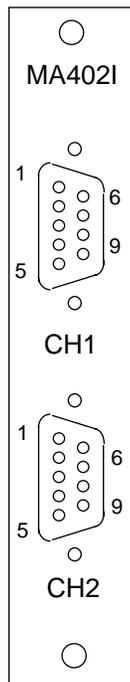
4. Insert the Module Adapter into the rear of the shelf directly behind the module slot where the RFL NCM module will be installed. Secure the module with the screws provided.
5. Connect the Module Adapter to the user equipment using the connector pin assignments detailed in Figures 1, 2, or 3 as applicable.
6. Refer to Figures 4 & 5, and Table 1 for the location of DIP switches on the NCM module.
7. Set the module address using DIP switches SW1-1 through SW1-6 for the desired remote address (SCB address).

**For remote access, each channel module in the IMUX 2000 must have a distinct module address. Valid addresses are the numbers “1” to “36”. In most installations the address will be set to the number of the slot the module is occupying. Table 3 shows the switch settings for the module address. (Consult your multiplexer manual for details on using the remote access and configuration features of the system.)**

8. In E1 systems, set DIP switch SW2-8 to enable or disable CAS (channel associated signaling). In T1 systems, this switch setting is ignored.

**Place SW2-8 in the UP position to disable CAS.**

**Place SW2-8 in the DOWN position to enable CAS.**



Pin No.	Function
1	Receive Line Signal Detect*
2	Receive Data
3	Transmit Data
4	Not used
5	Signal Ground
6	Not used
7	Data Set Ready*
8	Clear To Send*
9	Not used

\* These signals always active

**Figure 1. MA-402I Module adapter, connector pinouts**

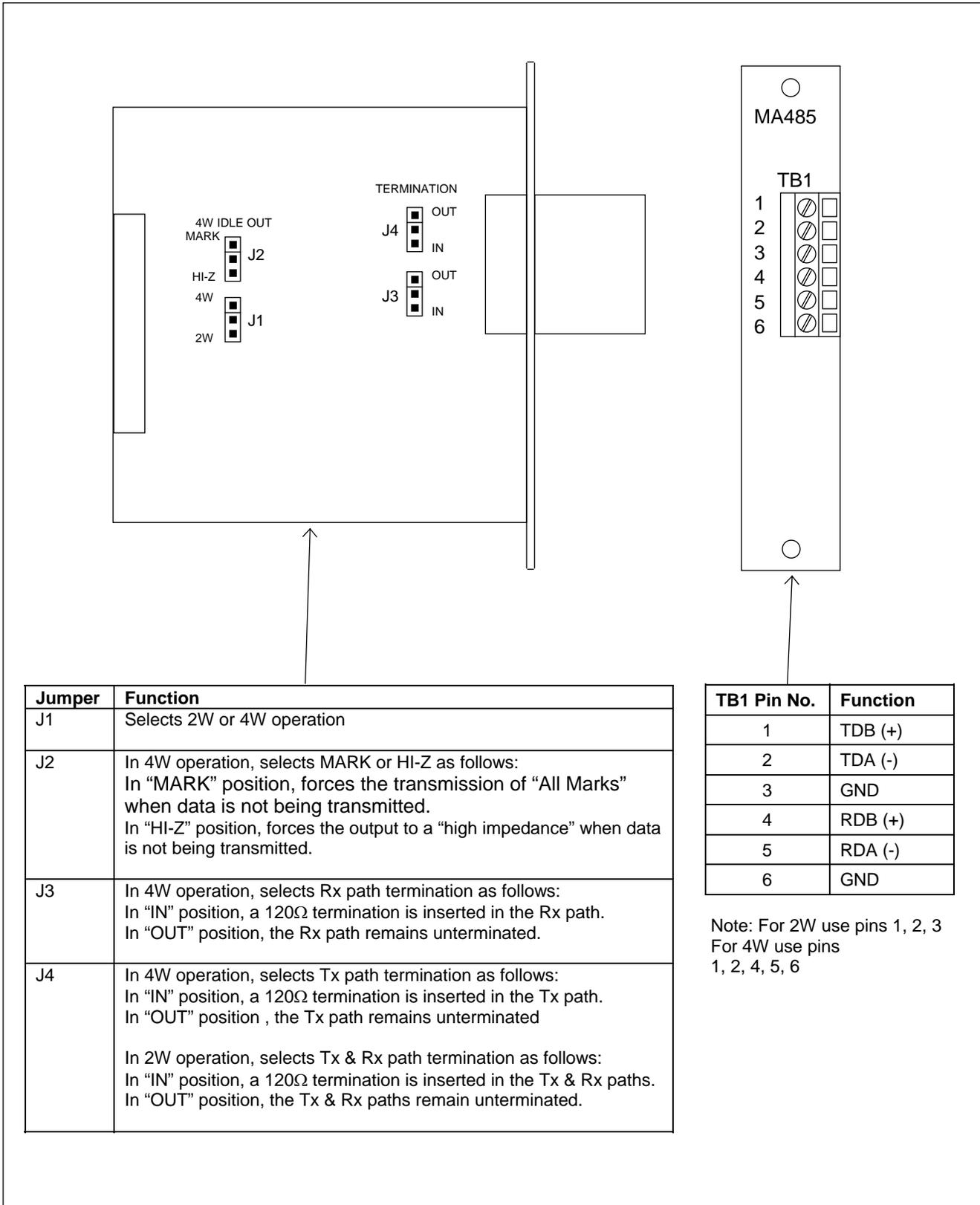
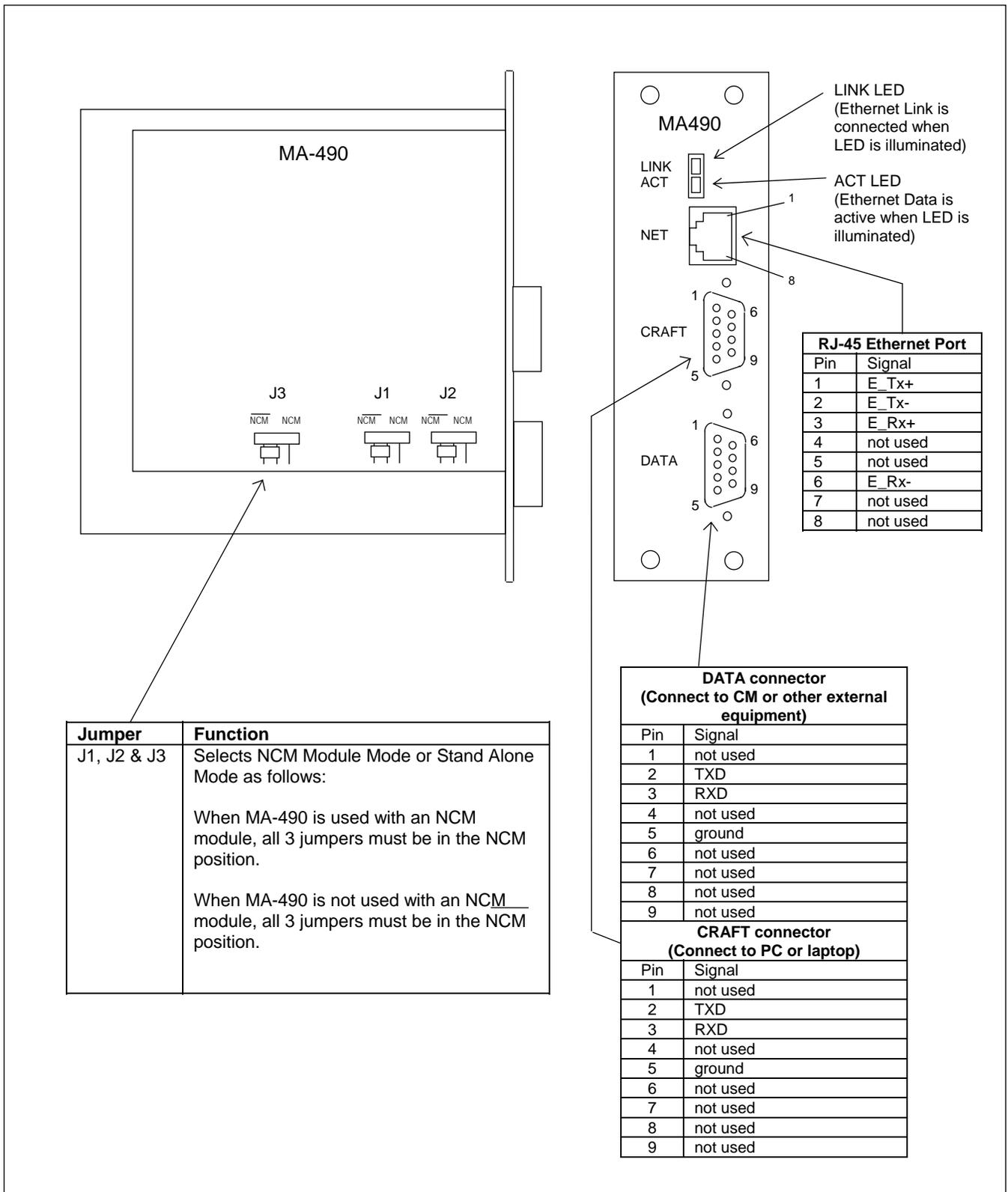


Figure 2. MA-485 Module adapter, jumper functions and TB1 pinouts



**Figure 3. MA-490 Telnet I/O Module adapter, jumper functions, LED functions and connector pinouts**

9. Select an unused time slot for the NCM using DIP switches SW2-1 through SW2-5. The NCM uses one 64 Kbps digital time slot within the multiplexer's aggregate rate. Set the time slot using direct binary coding as shown in Table 4. Refer to the multiplexer manual for guidelines on time slot selection.

Note that selecting an invalid time slot will disable the module. In T1 systems, only time slots 1 through 24 are allowed.

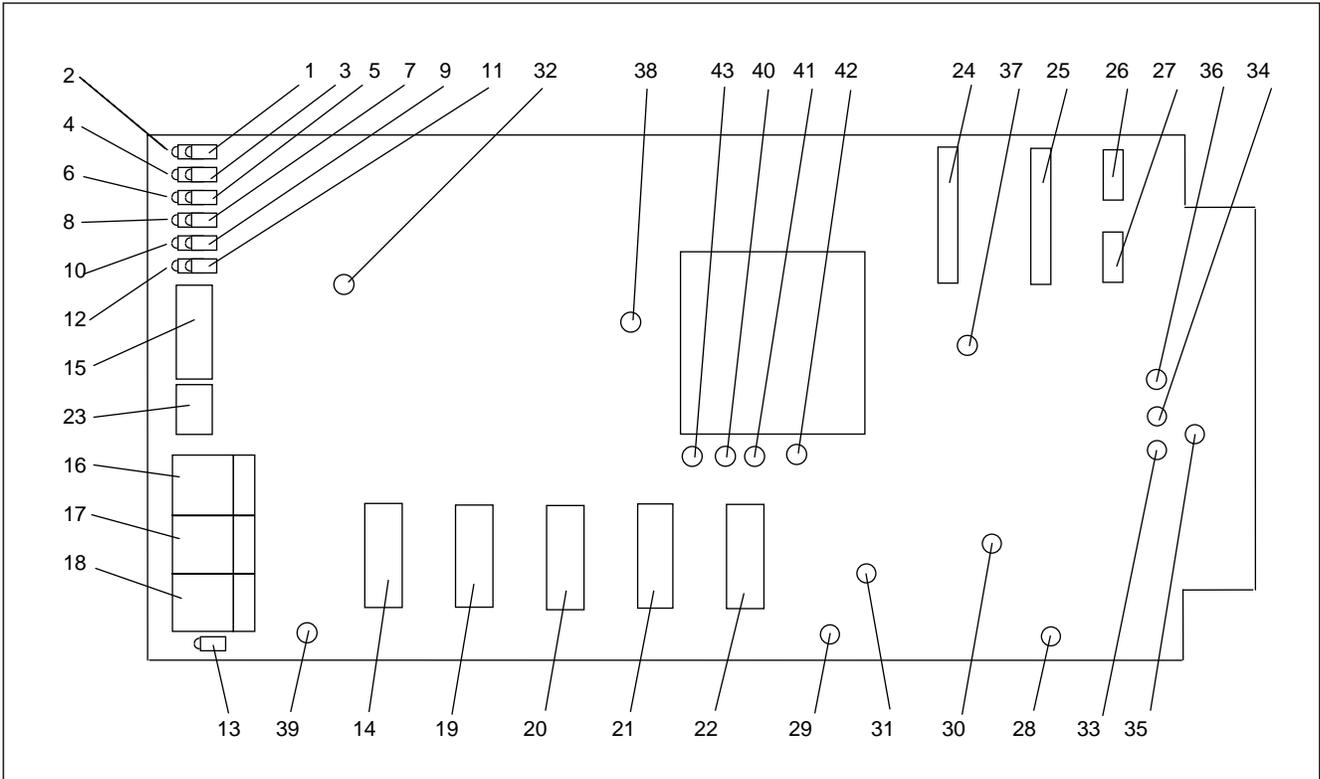
In E1 systems, time slots 1 through 31 are allowed, however, time slot 0 is reserved and cannot be used. Time slot 16 is also reserved and cannot be used if CAS is enabled in E1.

10. Select Bus direction by using DIP switches SW2-6 and SW2-7.

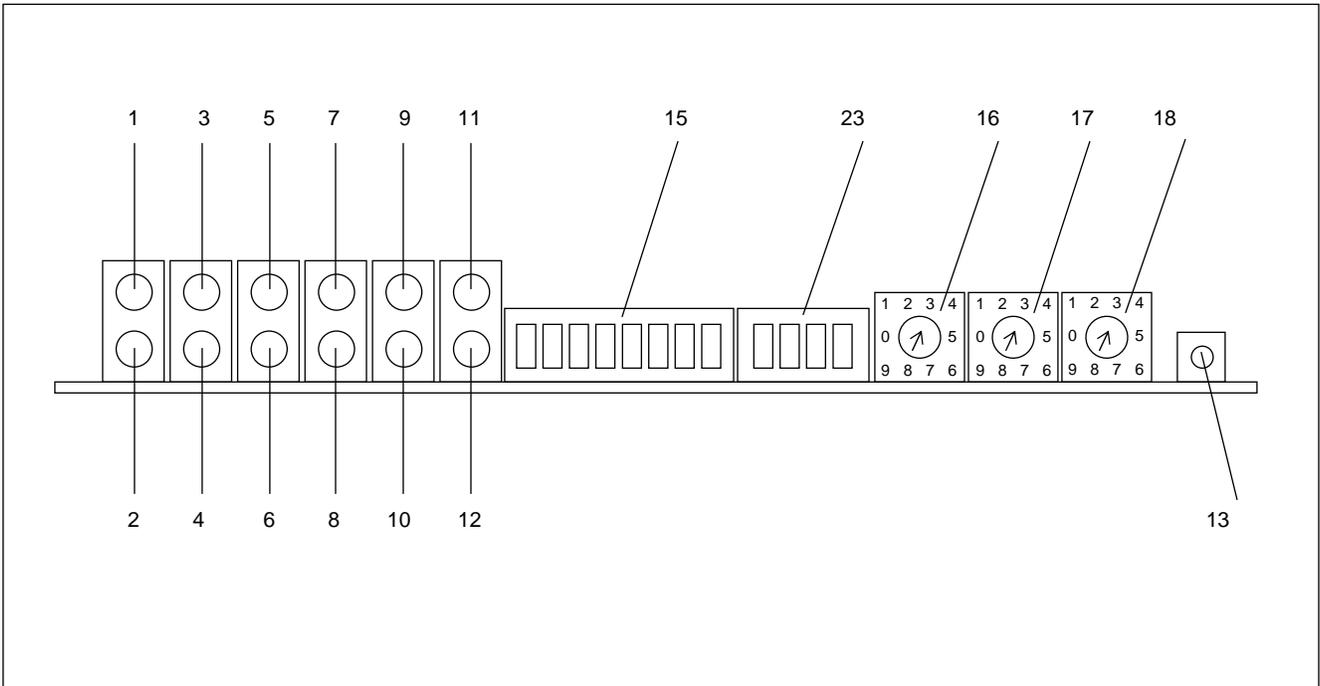
**Place SW2-6 in the DOWN position to transmit in the A direction and receive from the B direction. Place SW2-6 in the UP position to disable transmit in the A direction and receive from the B direction.**

**Place SW2-7 in the DOWN position to transmit in the B direction and receive from the A direction. Place SW2-7 in the UP position to disable transmit in the B direction and receive from the A direction.**

11. Switches SW3, SW4 and SW5 are only used when the NCM module is in the NMS application mode. In all other application modes these switch settings are ignored. Set Rotary Switches SW3, SW4, and SW5 to the local CM address. SW3 sets the hundreds position, SW4 sets the tens position, and SW5 sets the units position. The NCM supports CM addresses from 001 to 999. The "local CM address" must be set to the same address as the local Common Module (CM3B, CM3C, CM3R, CM6B, or CM4).
12. Set DIP switches SW6-1, -2, and -3 to set the baud rate in accordance with Table 1. If the system application mode is NMS, the baud rate must be set to the same baud rate as the local common module. Otherwise, any baud rate can be used.
13. Set DIP switches SW6-4, -5, and -6 to set the parity in accordance with Table 1. If the system application mode is NMS, the parity must be set to the same parity as the local common module. Otherwise, any parity can be used.



**Figure 4. Controls and indicators, RFL NCM, Network Communications Module**



**Figure 5. Front Panel View of RFL NCM, Network Communications Module**

14. Set DIP switches SW6-7 and SW6-8 to set the word length (number of bits per character) in accordance with Table 1. If the system application mode is NMS, the word length must be set to the same word length as the local common module. Otherwise, any word length can be used.

**NOTE**

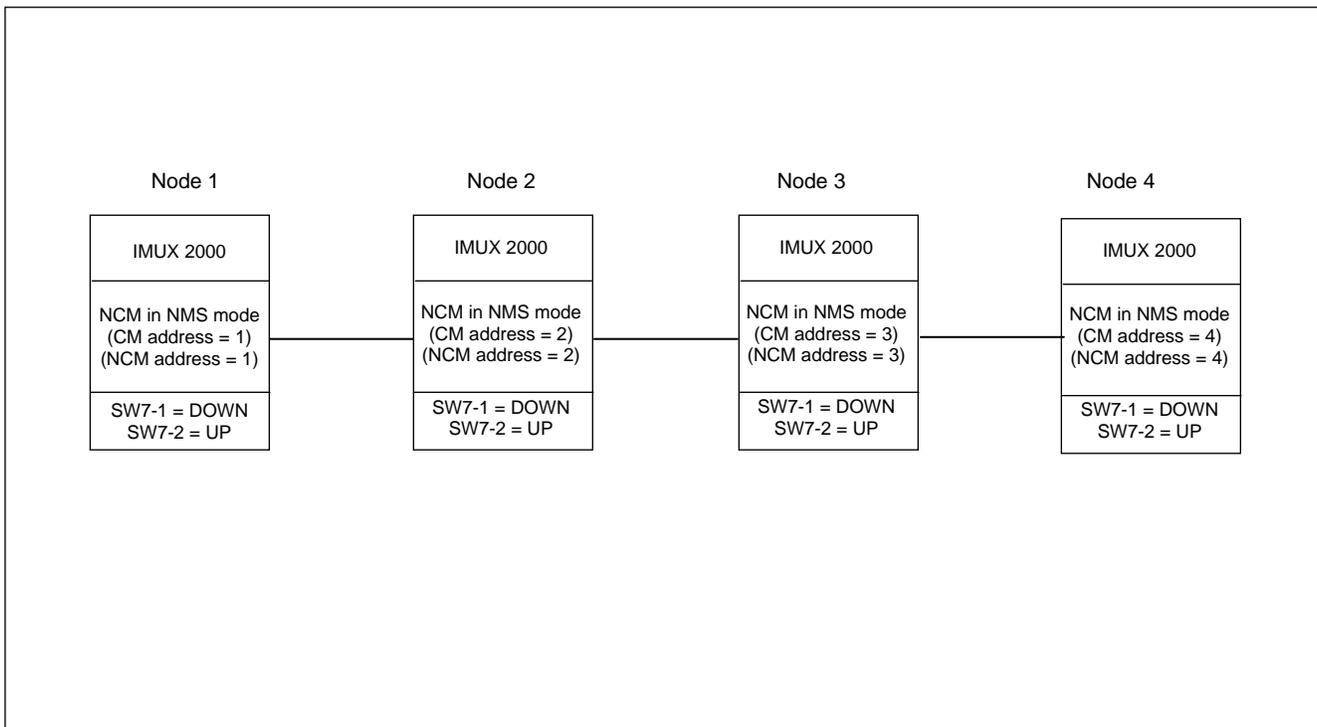
In any Application Mode, the Baud Rate, Parity and Word Length settings of the NCM must match at all nodes in the network. Additionally, In the NMS application mode, the Baud Rate, Parity and Word Length settings of the NCM and CM must match at all nodes in the network.

15. Switches SW7-1 and SW7-2 are only used when the NCM module is in the NMS application mode. In all other application modes these switch settings are ignored. Use DIP switches SW7-1 and SW7-2 to set the CM address Pass Setting in accordance with Table 1. Typically, if all the nodes in a T1/E1 network have an NCM as shown in Figure 6, the address Pass Setting will be set to only pass messages with addresses equal to the local CM address of the NCM. This feature prevents the local node from responding to queries sent to remote nodes.

**Place SW7-1 in the DOWN position**

**Place SW7-2 in the UP position**

In this example, all inter-node communication is done via the NCM path and FDL (Facility Data Link) is not used.



**Figure 6. Typical network example with all nodes having an NCM module**

15. (continued).

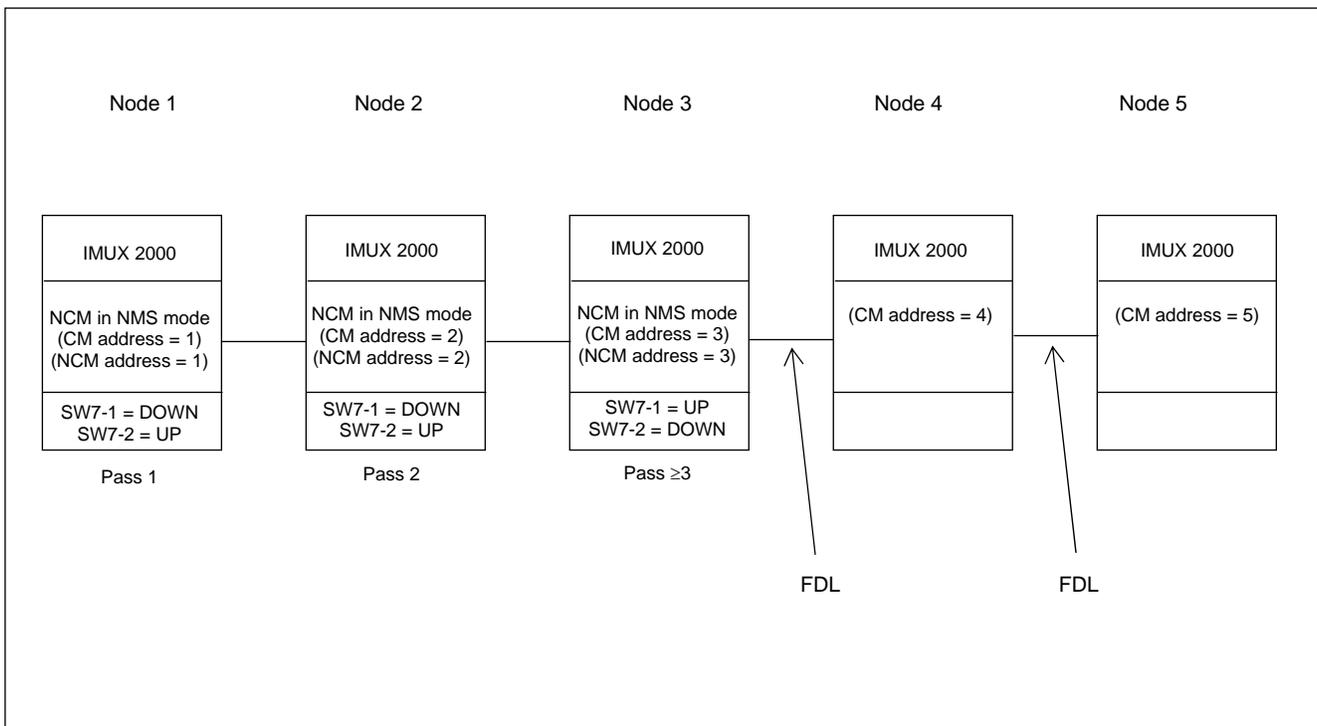
If some of the nodes in a T1/E1 network have an NCM, and others do not as shown in Figure 7, the address Pass Setting will be set differently at some of the nodes. In Figure 7, nodes 1, 2 and 3 have NCM modules, and nodes 4 and 5 do not have NCM modules. This network requires that at nodes 1 and 2, SW7 is set as follows:

**Place SW7-1 in the DOWN position**  
**Place SW7-2 in the UP position**

And at node 3, SW7 is set as follows:

**Place SW7-1 in the UP position**  
**Place SW7-2 in the DOWN position**

Additionally all 5 nodes must have the CM setting UNIV = ON to enable the FDL path. This allows a user to “transparently” communicate to all nodes regardless of which node the PC is connected to. If the PC is connected to node 1, 2 or 3, a user can “talk to” nodes 1, 2 or 3 via the NCM path, and “talk to” nodes 4 and 5 over the FDL path. If the PC is connected to nodes 4 or 5, communication to all nodes is over FDL.



**Figure 7. Network example with nodes 1, 2 and 3 having an NCM module, and nodes 4 and 5 without NCM modules**

**Table 1. Controls and indicators, RFL NCM Module**

Item	Name/Description	Function
1	IN1 LED DS1	Lights (GREEN) when Port 1 Input Data is active and no errors detected
		Lights (RED) when Port 1 Input Data is active and errors are detected
		Lights (flashing RED) when Port 1 Rogue detector is active
		LED is (OFF) when Port 1 Input Data is idle
2	OUT1 LED DS2	Lights (GREEN) when Port 1 Output Data is active and no errors detected
		Lights (RED) when Port 1 Output Data is active and errors are detected
		LED is (OFF) when Port 1 Output Data is idle
3	IN2 LED DS3	Lights (GREEN) when Port 2 Input Data is active and no errors detected
		Lights (RED) when Port 2 Input Data is active and errors are detected
		Lights (flashing RED) when Port 2 Rogue detector is active
		LED is (OFF) when Port 2 Input Data is idle
4	OUT2 LED DS4	Lights (GREEN) when Port 2 Output Data is active and no errors detected
		Lights (RED) when Port 2 Output Data is active and errors are detected
		LED is (OFF) when Port 2 Output Data is idle
5	RXB LED DS5	Lights (GREEN) when T1/E1 Receive Data from BUS B is active and no errors detected
		Lights (RED) when T1/E1 Receive Data from BUS B is active and errors are detected
		Lights (flashing RED) when Receive BUS B Rogue detector is active
		LED is (OFF) when T1/E1 Receive Data from BUS B is idle
6	TXA LED DS6	Lights (GREEN) when T1/E1 Transmit Data to BUS A is active
		LED is (OFF) when T1/E1 Transmit Data to BUS A is idle
7	RXA LED DS7	Lights (GREEN) when T1/E1 Receive Data from BUS A is active and no errors detected
		Lights (RED) when T1/E1 Receive Data from BUS A is active and errors are detected
		Lights (flashing RED) when Receive BUS A Rogue detector is active
		LED is (OFF) when T1/E1 Receive Data from BUS A is idle
8	TXB LED DS8	Lights (GREEN) when T1/E1 Transmit Data to BUS B is active
		LED is (OFF) when T1/E1 Transmit Data to BUS B is idle
9	EQLB LED DS9	Lights (YELLOW) when Equipment Loopback for ports 1 and 2 is active
		LED is OFF when Equipment Loopback for ports 1 and 2 is inactive
10	PALB LED DS10	Lights (YELLOW) when Payload Loopback for ports 1 or 2 is active
		LED is OFF when Payload Loopback for ports 1 and 2 is inactive
11*	ADRA LED DS11	Lights (GREEN) when NCM is receiving any CM address except its own from Bus A. (This will occur during T1/E1 Line and Payload Loopbacks) Lights (YELLOW) when NCM is receiving only its own CM address from Bus A. Lights (RED) when NCM is not receiving any CM address from Bus A.
12*	ADRB LED DS12	Lights (GREEN) when NCM is receiving any CM address except its own from Bus B. (This will occur during T1/E1 Line and Payload Loopbacks) Lights (YELLOW) when NCM is receiving only its own CM address from Bus B. Lights (RED) when NCM is not receiving any CM address from Bus B.
13	Service ON LED DS13	Lights (GREEN) when service is ON
14	DIP Switch, SW1	SW1-1 to SW1-6 Selects SCB Address (See Table 3)
		SW1-7 For RFL use
		SW1-8 For RFL use

\*Used in NMS application mode only.

**Table 1. - continued, Controls and indicators, RFL NCM Module**

Item	Name/Description	Function																																				
15	DIP Switch, SW2	SW2-1 to SW2-5 Selects Time Slot (See Table 4)																																				
		SW2-6 Selects Transmit on A Receive on B DOWN = enables Transmit on A, Receive on B UP = disables Transmit on A, Receive on B																																				
		SW2-7 Selects transmit on B receive on A DOWN = enables Transmit on B, Receive on A UP = disables Transmit on B, Receive on A																																				
		SW2-8 In E1 Systems, Selects CAS ON or OFF In T1 Systems (ignored) DOWN = CAS ON UP = CAS OFF																																				
16	Rotary Switch, SW3 (Hundreds)	SW3-1 to SW3-10 Selects Hundreds position of "Local CM Address" (Used in NMS application mode only. In all other application modes this switch setting is ignored.)																																				
17	Rotary Switch, SW4 (Tens)	SW4-1 to SW4-10 Selects Tens position of "Local CM Address" (Used in NMS application mode only. In all other application modes this switch setting is ignored.)																																				
18	Rotary Switch, SW5 (Units)	SW5-1 to SW5-10 Selects Units position of "Local CM Address" (Used in NMS application mode only. In all other application modes this switch setting is ignored.)																																				
19	DIP Switch, SW6	SW6-1 to SW6-3 Selects Baud Rate in accordance with the table below:  <table border="1"> <thead> <tr> <th>SW6-1 (Baud 2)</th> <th>SW6-2 (Baud 1)</th> <th>SW6-3 (Baud 0)</th> <th>Baud Rate</th> </tr> </thead> <tbody> <tr> <td>Down</td> <td>Down</td> <td>Down</td> <td>2400</td> </tr> <tr> <td>Down</td> <td>Down</td> <td>Up</td> <td>4800</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Down</td> <td>9600</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Up</td> <td>19,200</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Down</td> <td>38,400</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Up</td> <td>Undefined</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Down</td> <td>Undefined</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Up</td> <td>Undefined</td> </tr> </tbody> </table>	SW6-1 (Baud 2)	SW6-2 (Baud 1)	SW6-3 (Baud 0)	Baud Rate	Down	Down	Down	2400	Down	Down	Up	4800	Down	Up	Down	9600	Down	Up	Up	19,200	Up	Down	Down	38,400	Up	Down	Up	Undefined	Up	Up	Down	Undefined	Up	Up	Up	Undefined
		SW6-1 (Baud 2)	SW6-2 (Baud 1)	SW6-3 (Baud 0)	Baud Rate																																	
		Down	Down	Down	2400																																	
		Down	Down	Up	4800																																	
Down	Up	Down	9600																																			
Down	Up	Up	19,200																																			
Up	Down	Down	38,400																																			
Up	Down	Up	Undefined																																			
Up	Up	Down	Undefined																																			
Up	Up	Up	Undefined																																			
SW6-4 to SW6-6 Selects Parity in accordance with the table below:  <table border="1"> <thead> <tr> <th>SW6-4 (PEN)</th> <th>SW6-5 (SP)</th> <th>SW6-6 (EPS)</th> <th>Parity</th> </tr> </thead> <tbody> <tr> <td>Down</td> <td>Down</td> <td>Down</td> <td>No Parity</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Down</td> <td>Odd Parity</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Up</td> <td>Even Parity</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Down</td> <td>Mark Parity</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Up</td> <td>Space Parity</td> </tr> </tbody> </table>	SW6-4 (PEN)	SW6-5 (SP)	SW6-6 (EPS)	Parity	Down	Down	Down	No Parity	Up	Down	Down	Odd Parity	Up	Down	Up	Even Parity	Up	Up	Down	Mark Parity	Up	Up	Up	Space Parity														
SW6-4 (PEN)	SW6-5 (SP)	SW6-6 (EPS)	Parity																																			
Down	Down	Down	No Parity																																			
Up	Down	Down	Odd Parity																																			
Up	Down	Up	Even Parity																																			
Up	Up	Down	Mark Parity																																			
Up	Up	Up	Space Parity																																			
SW6-7 to SW6-8 Selects Word Length (Number of data bits per character) in accordance with the table below:  <table border="1"> <thead> <tr> <th>SW6-7 (WLS1)</th> <th>SW6-8 (WLS0)</th> <th>Word Length</th> </tr> </thead> <tbody> <tr> <td>Down</td> <td>Down</td> <td>7 data bits</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>8 data bits</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>undefined</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>undefined</td> </tr> </tbody> </table>	SW6-7 (WLS1)	SW6-8 (WLS0)	Word Length	Down	Down	7 data bits	Down	Up	8 data bits	Up	Down	undefined	Up	Up	undefined																							
SW6-7 (WLS1)	SW6-8 (WLS0)	Word Length																																				
Down	Down	7 data bits																																				
Down	Up	8 data bits																																				
Up	Down	undefined																																				
Up	Up	undefined																																				

**Table 1. - continued, Controls and indicators, RFL NCM Module**

<b>Item</b>	<b>Name/Description</b>	<b>Function</b>																																		
20	DIP Switch, SW7	SW7-1 to SW7-2      Selects CM address pass setting in NMS application mode only in accordance with the table below. In all other application modes, these switch settings are ignored.																																		
		<table border="0"> <tr> <td>SW7-1 (ADR1)</td> <td>SW7-2 (ADR0)</td> <td><u>Pass Setting</u></td> </tr> <tr> <td>Down</td> <td>Down</td> <td>Will pass any messages regardless of the "Local CM Address" setting of the NCM. Messages without address headers are also passed.</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Will only pass messages with addresses equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 &amp; SW5.</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Will only pass messages with addresses greater than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 &amp; SW5.</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Will only pass messages with addresses less than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 &amp; SW5.</td> </tr> </table>	SW7-1 (ADR1)	SW7-2 (ADR0)	<u>Pass Setting</u>	Down	Down	Will pass any messages regardless of the "Local CM Address" setting of the NCM. Messages without address headers are also passed.	Down	Up	Will only pass messages with addresses equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.	Up	Down	Will only pass messages with addresses greater than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.	Up	Up	Will only pass messages with addresses less than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.																			
		SW7-1 (ADR1)	SW7-2 (ADR0)	<u>Pass Setting</u>																																
		Down	Down	Will pass any messages regardless of the "Local CM Address" setting of the NCM. Messages without address headers are also passed.																																
		Down	Up	Will only pass messages with addresses equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.																																
Up	Down	Will only pass messages with addresses greater than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.																																		
Up	Up	Will only pass messages with addresses less than or equal to the "Local CM Address" setting of the NCM as defined by SW3, SW4 & SW5.																																		
SW7-3	Not Used																																			
SW7-4 to SW7-6	Selects "Application Mode Setting" in accordance with the table below:																																			
<table border="0"> <tr> <td>SW7-4 (Mode 2)</td> <td>SW7-5 (Mode 1)</td> <td>SW7-6 (Mode 0)</td> <td><u>Application Mode Setting</u></td> </tr> <tr> <td>Down</td> <td>Down</td> <td>Down</td> <td>broadcast mode</td> </tr> <tr> <td>Down</td> <td>Down</td> <td>Up</td> <td>NMS mode</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Down</td> <td>master mode</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Up</td> <td>D&amp;I slave mode</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Down</td> <td>End, slave mode</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Up</td> <td>Undefined</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Down</td> <td>Undefined</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Up</td> <td>Undefined</td> </tr> </table>	SW7-4 (Mode 2)	SW7-5 (Mode 1)	SW7-6 (Mode 0)	<u>Application Mode Setting</u>	Down	Down	Down	broadcast mode	Down	Down	Up	NMS mode	Down	Up	Down	master mode	Down	Up	Up	D&I slave mode	Up	Down	Down	End, slave mode	Up	Down	Up	Undefined	Up	Up	Down	Undefined	Up	Up	Up	Undefined
SW7-4 (Mode 2)	SW7-5 (Mode 1)	SW7-6 (Mode 0)	<u>Application Mode Setting</u>																																	
Down	Down	Down	broadcast mode																																	
Down	Down	Up	NMS mode																																	
Down	Up	Down	master mode																																	
Down	Up	Up	D&I slave mode																																	
Up	Down	Down	End, slave mode																																	
Up	Down	Up	Undefined																																	
Up	Up	Down	Undefined																																	
Up	Up	Up	Undefined																																	
Note: Refer to Table 2 for additional switch setting information.																																				
SW7-7	Enables or disables Port 2 UP = Port 2 enabled DOWN = Port 2 disabled																																			
Note: Port 2 not available when MA-485 I/O is used.																																				
SW7-8	Enables or disables Rogue Control UP = Rogue Control enabled DOWN = Rogue Control disabled																																			
21	DIP Switch, SW8	SW8-1 to SW8-8      Not Used																																		
22	DIP Switch, SW9	SW9-1 to SW9-8      Not Used																																		

**Table 1. - continued, Controls and indicators, RFL NCM Module**

<b>Item</b>	<b>Name/Description</b>	<b>Function</b>															
23	DIP Switch, SW10	SW10-1 to SW10-2      Selects Loopback operation in accordance with the table below:  <table border="0"> <tr> <td>SW10-1 (LB1)</td> <td>SW10-2 (LB2)</td> <td><u>Loopback Setting</u></td> </tr> <tr> <td>Down</td> <td>Down</td> <td>Enable port 2 payload loopback</td> </tr> <tr> <td>Down</td> <td>Up</td> <td>Enable ports 1 &amp; 2 equipment loopback</td> </tr> <tr> <td>Up</td> <td>Down</td> <td>Enable port 1 payload loopback</td> </tr> <tr> <td>Up</td> <td>Up</td> <td>Disable loopbacks</td> </tr> </table>	SW10-1 (LB1)	SW10-2 (LB2)	<u>Loopback Setting</u>	Down	Down	Enable port 2 payload loopback	Down	Up	Enable ports 1 & 2 equipment loopback	Up	Down	Enable port 1 payload loopback	Up	Up	Disable loopbacks
		SW10-1 (LB1)	SW10-2 (LB2)	<u>Loopback Setting</u>													
		Down	Down	Enable port 2 payload loopback													
Down	Up	Enable ports 1 & 2 equipment loopback															
Up	Down	Enable port 1 payload loopback															
Up	Up	Disable loopbacks															
SW10-3*      Enables or disables Remote operation UP = Local Operation DOWN = Remote Operation																	
SW10-4      Enables or disables Service On UP = Service On DOWN = Service Off																	
24	J1 Header	For RFL Use (used to program the Lattice Device U6)															
25	J2 Header	For RFL Use (used for JTAG Interface and ACTEL Probe)															
26	J5 Jumper	For RFL Use (selects J1 or J2 Header)															
27	J6 Jumper	For RFL Use (selects J1 or J2 Header)															
28	Test Point TP1	+5Vdc															
29	Test Point TP2	Ground															
30	Test Point TP3	2.5Vdc															
31	Test Point TP4	3.3Vdc															
32	Test Point TP5	Not Used															
33	Test Point TP6	Port 1 Input Data															
34	Test Point TP7	Port 2 Input Data															
35	Test Point TP8	Port 1 Output Data															
36	Test Point TP9	Port 2 Output Data															
37	Test Point TP10	PRA (ACTEL probe A)															
38	Test Point TP11	PRB (ACTEL probe B)															
39	Test Point TP12	Ground															
40	Test Point TP13	For RFL use															
41	Test Point TP14	For RFL use															
42	Test Point TP15	For RFL use															
43	Test Point TP16	For RFL use															

\* If your NCM module is to be used in NMS Application Mode, this switch should be in the Local (UP) position, otherwise you may lose NMS communications if settings are changed.

**Table 2. Application Modes And Bus Settings**

<b>NMS Application Mode (SW7-4, SW7-5 &amp; SW7-6)</b>	<b>Transmit on A Receive on B (SW2-6)</b>	<b>Transmit on B Receive on A (SW2-7)</b>	<b>Application</b>
Broadcast	enabled	disabled	The NCM mode will be Terminal broadcast or DI-A broadcast
	disabled	enabled	The NCM mode will be DI-B broadcast
	enabled	enabled	The NCM mode will be D&I broadcast
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
NMS	enabled	disabled	The NCM mode will be Terminal NMS or DI-A NMS
	disabled	enabled	The NCM mode will be DI-B NMS
	enabled	enabled	The NCM mode will be D&I NMS
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
Master	enabled	disabled	The NCM mode will be Terminal Master or DI-A Master
	disabled	enabled	The NCM mode will be DI-B Master
	enabled	enabled	The NCM mode will be D&I Master
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
D&I Slave	enabled	disabled	The NCM mode will be D&I Slave and the Master NCM node is in the A direction.
	disabled	enabled	The NCM mode will be D&I Slave and the Master NCM node is in the B direction.
	enabled	enabled	(Not a valid setting. The NCM module is disabled)
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
D&I End	enabled	disabled	The NCM mode will be Terminal End Slave or DI-A End Slave
	disabled	enabled	The NCM mode will be DI-B End Slave
	enabled	enabled	(Not a valid setting. The NCM module is disabled)
	disabled	disabled	(Not a valid setting. The NCM module is disabled)

Note: enabled = DOWN, disabled = UP

**Table 3. SCB address settings, RFL NCM module**

<b>Module Address</b>	<b>SW1-1</b>	<b>SW1-2</b>	<b>SW1-3</b>	<b>SW1-4</b>	<b>SW1-5</b>	<b>SW1-6</b>
1	DOWN	DOWN	DOWN	DOWN	DOWN	UP
2	DOWN	DOWN	DOWN	DOWN	UP	DOWN
3	DOWN	DOWN	DOWN	DOWN	UP	UP
4	DOWN	DOWN	DOWN	UP	DOWN	DOWN
5	DOWN	DOWN	DOWN	UP	DOWN	UP
6	DOWN	DOWN	DOWN	UP	UP	DOWN
7	DOWN	DOWN	DOWN	UP	UP	UP
8	DOWN	DOWN	UP	DOWN	DOWN	DOWN
9	DOWN	DOWN	UP	DOWN	DOWN	UP
10	DOWN	DOWN	UP	DOWN	UP	DOWN
11	DOWN	DOWN	UP	DOWN	UP	UP
12	DOWN	DOWN	UP	UP	DOWN	DOWN
13	DOWN	DOWN	UP	UP	DOWN	UP
14	DOWN	DOWN	UP	UP	UP	DOWN
15	DOWN	DOWN	UP	UP	UP	UP
16	DOWN	UP	DOWN	DOWN	DOWN	DOWN
17	DOWN	UP	DOWN	DOWN	DOWN	UP
18	DOWN	UP	DOWN	DOWN	UP	DOWN
19	DOWN	UP	DOWN	DOWN	UP	UP
20	DOWN	UP	DOWN	UP	DOWN	DOWN
21	DOWN	UP	DOWN	UP	DOWN	UP
22	DOWN	UP	DOWN	UP	UP	DOWN
23	DOWN	UP	DOWN	UP	UP	UP
24	DOWN	UP	UP	DOWN	DOWN	DOWN
25	DOWN	UP	UP	DOWN	DOWN	UP
26	DOWN	UP	UP	DOWN	UP	DOWN
27	DOWN	UP	UP	DOWN	UP	UP
28	DOWN	UP	UP	UP	DOWN	DOWN
29	DOWN	UP	UP	UP	DOWN	UP
30	DOWN	UP	UP	UP	UP	DOWN
31	DOWN	UP	UP	UP	UP	UP
32	UP	DOWN	DOWN	DOWN	DOWN	DOWN
33	UP	DOWN	DOWN	DOWN	DOWN	UP
34	UP	DOWN	DOWN	DOWN	UP	DOWN
35	UP	DOWN	DOWN	DOWN	UP	UP
36	UP	DOWN	DOWN	UP	DOWN	DOWN

NOTE: For SW1, UP = ON and DOWN = OFF.

**Table 4. Time Slot Select for RFL NCM module**

Switch Code (Decimal)	Switch Settings					T1	E1
	SW2-1	SW2-2	SW2-3	SW2-4	SW2-5		
0	DOWN	DOWN	DOWN	DOWN	DOWN	*	*
1	DOWN	DOWN	DOWN	DOWN	UP	1	1
2	DOWN	DOWN	DOWN	UP	DOWN	2	2
3	DOWN	DOWN	DOWN	UP	UP	3	3
4	DOWN	DOWN	UP	DOWN	DOWN	4	4
5	DOWN	DOWN	UP	DOWN	UP	5	5
6	DOWN	DOWN	UP	UP	DOWN	6	6
7	DOWN	DOWN	UP	UP	UP	7	7
8	DOWN	UP	DOWN	DOWN	DOWN	8	8
9	DOWN	UP	DOWN	DOWN	UP	9	9
10	DOWN	UP	DOWN	UP	DOWN	10	10
11	DOWN	UP	DOWN	UP	UP	11	11
12	DOWN	UP	UP	DOWN	DOWN	12	12
13	DOWN	UP	UP	DOWN	UP	13	13
14	DOWN	UP	UP	UP	DOWN	14	14
15	DOWN	UP	UP	UP	UP	15	15
16	UP	DOWN	DOWN	DOWN	DOWN	16	16****
17	UP	DOWN	DOWN	DOWN	UP	17	17
18	UP	DOWN	DOWN	UP	DOWN	18	18
19	UP	DOWN	DOWN	UP	UP	19	19
20	UP	DOWN	UP	DOWN	DOWN	20	20
21	UP	DOWN	UP	DOWN	UP	21	21
22	UP	DOWN	UP	UP	DOWN	22	22
23	UP	DOWN	UP	UP	UP	23	23
24	UP	UP	DOWN	DOWN	DOWN	24**	24
25	UP	UP	DOWN	DOWN	UP	*	25
26	UP	UP	DOWN	UP	DOWN	*	26
27	UP	UP	DOWN	UP	UP	*	27
28	UP	UP	UP	DOWN	DOWN	*	28
29	UP	UP	UP	DOWN	UP	*	29
30	UP	UP	UP	UP	DOWN	*	30**
31	UP	UP	UP	UP	UP	*	31****

Notes: \* This setting is not allowed . Setting switches to this code will cause the module’s service to be disabled.  
 \*\*This setting is not valid in a T1 or E1 network utilizing fast reframing.  
 \*\*\* This setting is not valid in an E1 network utilizing inter-node communications (NMX).  
 \*\*\*\* This setting is not valid if signaling CAS is enabled in E1.

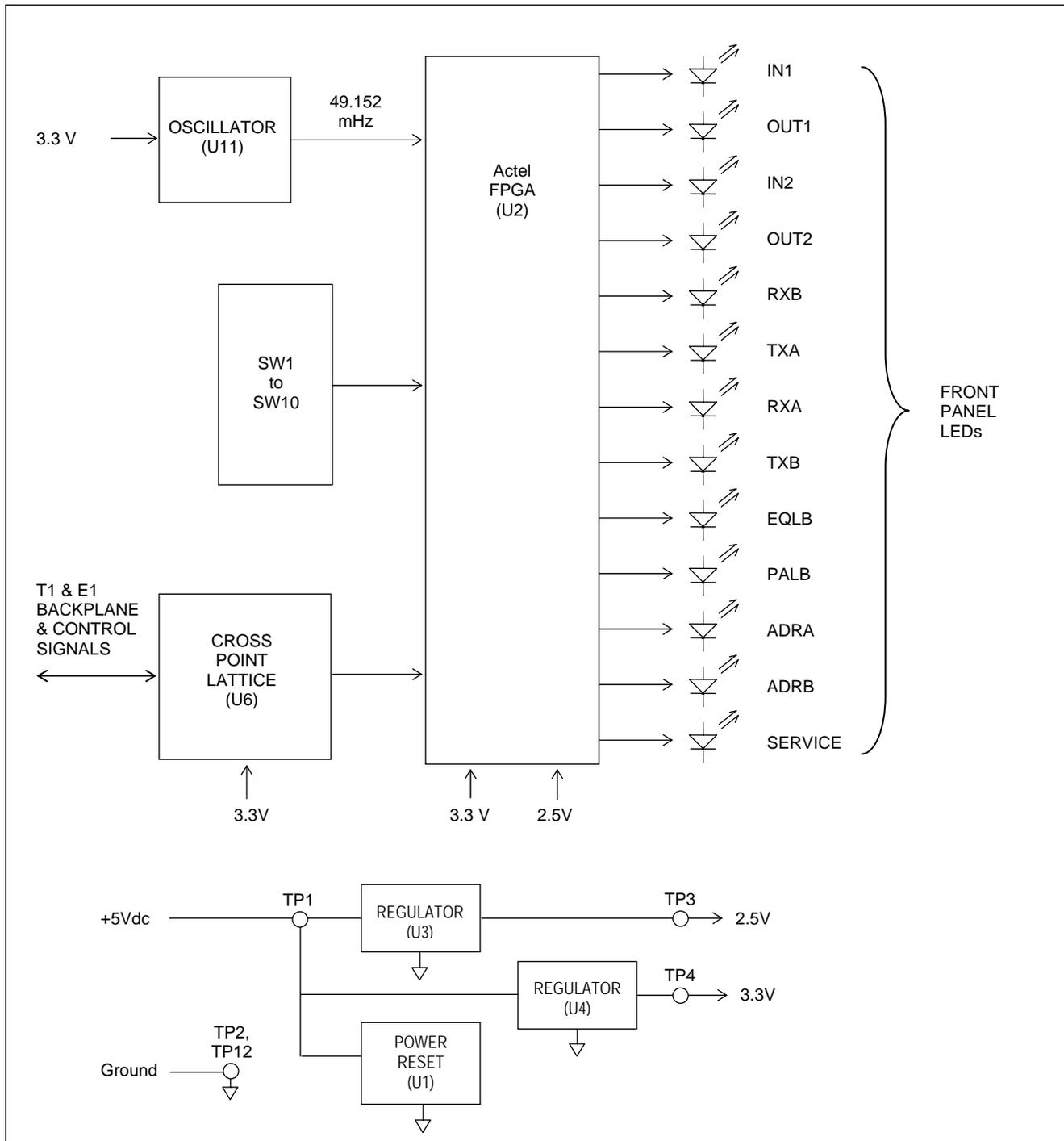
16. If you plan to operate the NCM module under local control, perform the following steps; otherwise, go to step 17 for remote control. Local control is recommended for NMS application mode.
  - a. Set to local control by placing DIP switch SW10-3 in the UP position.
  - b. Turn service on by placing DIP switch SW10-4 in the UP position.
  - c. Slide the module into the selected module slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
  - d. Go to step 18.
  
17. If you plan to operate the NCM module under remote control, perform the following steps:
  - a. Set to local control by placing DIP switch SW10-3 in the UP position.
  - b. Turn service off by placing DIP switch SW10-4 in the DOWN position.
  - c. Slide the module into the selected module slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
  - d. Wait 15 seconds for the NCM module's parameter settings to be loaded into the shelf Common Module.
  - e. Pull the module out of the shelf and set to remote control by placing DIP switch SW10-3 in the DOWN position.

**Do not move SW10-4.**
  - f. Slide the module back into the shelf.
  - g. Verify the module configuration through remote control by issuing a "CONFIG?" query. See the Remote Control Interface section of this Instruction Data Sheet for an explanation of the "CONFIG?" response.
  - h. Turn service on through remote control by issuing a "SRVC=ON" command.

**The operating parameters of the NCM module can now be changed by remote control. See the Remote Control Interface section of this Instruction Data Sheet for more information.**
  - i. Go to step 18.
  
18. On the Module Record Card located to the right of the shelf, record the channel bank type, time slot, and any other pertinent information.
  
19. The NCM module is now installed. If your multiplexer is set up for remote access and control, you can now change the operating parameters of the module by using simple commands. For more information on remote access and control, consult your multiplexer operation manual.

## FUNCTIONAL DESCRIPTION

Figure 8 is a block diagram of the RFL NMS module. It is provided to familiarize the user with the NMS signal flow and interfacing. The figure shows signal flow in the transmit and receive modes of operation.



**Figure 8. Block diagram, RFL NCM module.**

## SYSTEM OVERVIEW

The Network Communications Module (NCM) is an Asynchronous Data Module designed for RFL IMUX 2000 T1 and E1 Multiplexers. The NCM provides one DCE Half/Full-Duplex channel between an unlimited number of locations using a single 64 kbps DS0 time slot. The NCM provides an NMS communication path between nodes of a T1 or E1 network, and can also be used for party-line applications such as DNP and Modbus networking. The NCM automatically detects if the system is T1 or E1 and configures itself appropriately.

The NCM in NMS application mode is *not* required for T1, but could be utilized to speed up network communications, or provide a communication path to remote locations. The NCM is required for E1 systems, because an out of network communication path does not exist.

The NCM supports RS-232, RS-485 (2W and 4W), and Telnet interfaces with the MA-402I, MA-485 and MA-490 Telnet I/O respectively, and supports Equipment and Payload Loop-backs. The NCM does not support handshaking of any kind, and does not respond to RTS. The NCM uses Stop-bit reduction during transmission of asynchronous data as a means to compensate for received baud slightly greater than normal. For RS-232 applications, the NCM does keep CTS, RLSD and DSR active at all times for external equipment requiring these to be active.

The NCM supports either one or two ports depending on the interface installed. Each port includes a UART, and can transmit to and receive from the T1/E1 bus, and transmit to and receive from one another, depending on the configuration and application. The ports support 38.4k, 19.2k, 9600, 4800 and 2400 baud, support 7 or 8 data bits, and support Even, Odd, Mark Space and No Parity.

The NCM utilizes a proprietary communication protocol over T1/E1 consisting of two data and two idle/address frames. The two data frames make up the entire data package, and are transmitted and received in consecutive frames. The idle/address frames occur only during idle-time between data packages, and are also transmitted and received in consecutive frames. Only the NMS Mode currently supports addressing.

The NCM does not support signaling bits within the T1/E1 data stream, however, the CAS setting on the NCM module will “block” the selection of timeslot 16 for an E1 multiplexer using CAS, preventing the NCM from potentially disrupting other modules in the network.

The NCM supports “Address Passing” and “Character Pacing” in the NMS Mode of operation. “Address Passing” qualifies messages prior to sending them out of port (#2) to the CM-X module. “Character Pacing” emulation is done as a result of the “Address Passing” requirement.

A Rogue Control feature is available which prevents a rogue PC program or another module from “stepping” on the NCM time slot, and bringing down the entire NCM Path.

## **NCM BACKPLANE AND POWER CONNECTIONS**

The NCM occupies a single slot in the multiplexer chassis and conforms to the RFL IMUX 2000 back plane signal format. All T1 and E1 signals, and control signals passing through the back plane, interface with the cross point Lattice device (U6). All inputs and outputs of the Lattice Device are pulled up to 3.3V through approximately 50K Ohms.

The NCM requires digital +5Vdc and digital ground connections to the back plane. TP2 and TP12 are the ground test points. The digital +5V from the back plane is routed to the Hot Swap Controller (U1, which controls the ramp of the power to all of the ICs. The ramped digital +5V supply is only directly used to provide power to the LEDs, DS1 through DS13, and can be monitored at TP1.

Linear voltage regulators U3 and U4 step-down the +5V digital supply to produce +2.5V and +3.3V supplies respectively. The +2.5V is used exclusively to power the Actel FPGA (U2). The 3.3V is used to power the Lattice device (U6), the I/O of the Actel (U2), the 49.152mHz oscillator (U11), and the pull-up resistors on the module. The +2.5V and 3.3V supplies can be monitored at TP3 and TP4 respectively. All pins which connect to the back plane, except for voltages and grounds, are cut back to prevent components from being driven before the module is fully powered.

## **TX INPUT PORTS**

The NCM module supports one or two TX input ports depending on the interface adapter installed (i.e. MA-402I, MA-485, or MA-490). An asynchronous data signal is applied to a TX input of the appropriate interface adapter. The data signal is converted from RS-232, MA-485, or Ethernet to a logic signal on the interface adapter before being fed through the back plane to the NCM module. These logic signals pass through the Lattice device (U6), and are applied to the Actel's (U2) UART receive section. Indication of TX input activity can be observed at the IN1 and IN2 LEDs, and via the NMS software.

## **RX OUTPUT PORTS**

The asynchronous logic data signal is transmitted by the UART Transmit section of the Actel (U2), and passes through the Lattice device and back plane to the interface adapter. The interface adapter converts the logic signal to the appropriate interface format (i.e. RS-232, RS-485, or Ethernet), depending on the interface adapter installed. The CTS and RLSD are always active for RS-232 applications (MA-402I) that require these to be active. Indication of RX output activity can be observed at OUT1 and OUT2, and via the NMS software.

## **LOGIC ARRAY (ACTEL DESIGN)**

The Actel FPGA controls, processes, and coordinates all functions of the NCM. It interfaces switches, LEDs, SCB bus signals, T1/E1 bus signals, and I/O control lines. The Actel design can be broken down into the following nine functions: SCB, Application Modes and Interfaces, UART Receive, UART Transmit, T1 Transmit, T1 Receive, Rogue Control, Loop-backs, and Baud and Clock Generator.

## 1. SCB MODULE

The SCB circuit is used to generate the read, write, and address data necessary to transfer control and status data to and from the SCB bus. The SCB address is configured externally via SW1 and is selectable between 1 and 36. The SCB circuit also communicates to the Common Module the following information: Card Type (117), number of configuration bytes, and number of status bytes.

In LOCAL mode the position of configuration switches (SW1 through SW9) are “read” by the Common Module, and then converted into standard P code and S code format.

In REMOTE mode, the NCM module does not rely on the position of configuration switches (SW2 through SW9). Instead, the Common Module “writes” the configuration to the NCM. The NCM requires that it receives exactly the same information three consecutive times before it accepts the updated configuration information as correct.

NCM “Service” is qualified in order to minimize user setup error, and prevents operation if the quality of the bus signal prevents the logic from determining whether the multiplexer is T1 or E1. In general, E1 does not allow the use of TS0 and TS16 if CAS is enabled, and T1 does not allow the setting of TS0 or any setting greater than TS24. It is the users responsibility to be aware of the network setup before selecting a channel to use. This qualification does not detect or prevent “stepping” on a time slot previously in use, including those that may be used for Fast Reframing, or network communications (NMX in E1). NCM “Service” is also qualified for non-existent and invalid modes of operation.

## 2. APPLICATION MODES AND INTERFACES

NCM operation depends on the selected Application Mode, and the type of I/O interface installed. The NCM uses an I/O type ID to determine which I/O is installed. If the installed I/O is the MA-485, an additional bit is used to indicate whether it includes one or two ports. The two port version does not currently exist.

The NMS includes the following Application Mode settings, and I/O types

### Application Mode settings

- NMS Mode
- Broadcast Mode
- Master Mode
- D&I Slave Mode
- End Slave Mode

The purpose of the NMS Mode is to provide a high-speed communication path between nodes for NMS. The other application modes provide a communication path between an MTU and several RTUs. The NMS Mode of operation requires the use of the MA-402I with two RS-232 ports, or the MA-490 with two RS-232 ports and an Ethernet port. In respect to the NCM, Port 1 is the “Local” port and Port 2 is the “CM” port. The additional RS-232 port on the MA-490 is used to configure the local Ethernet Port. The NMS mode is a Broadcast-type application but includes “Address Passing” and “Character Pacing” circuits for the “CM” port.

In the Broadcast Mode of operation, all nodes receive the same data regardless of who is transmitting. The broadcasting applies to both ports of a two-port I/O.

The Master Mode of operation designates a particular NCM at a node, as the master. If the NCM is set up for TERM/DI-A or DI-B operation, and the I/O has only one port, the actual functionality is the same as the broadcast mode. If the NCM is set up for both DI-A and DI-B operation, the data received from either bus is terminated and is not passed back onto the bus. If the I/O has two ports, Port 2 is always the slave to the Port 1 master, and cannot transmit onto or receive from the T1 bus. Typically, the master transmits to and receives from all of the slave locations. Only one slave can transmit onto the T1 bus any time, otherwise the data received by the master will be corrupted.

The D&I Slave Mode of operation designates an NCM at a D&I node as slave that must pass data thru but only transmits to and receives from the master. Set for TERM/DI-A or DI-B operation towards the master location. Only one slave can transmit onto the T1 bus any time, otherwise the data received will be corrupted.

The End Slave Mode of operation designates the particular NCM at a node as the terminating point of a network that is not the master. The NCM is setup for TERM/DI-A or DI-B operation depending on the direction to be terminated. If the I/O has only one port, the actual functionality is the same as the broadcast mode. If the I/O has two ports, both ports are slaves that transmit to and receive from the master, but not with one another.

The NMS uses the following I/O Interface types:

I/O Types/Module Adapter  
RS-232 (or none)/ MA-402I  
Ethernet/ MA-490  
RS-485 4W/ MA-485  
RS-485 2W/ MA-485

The MA-485 I/O is used for both 2W and 4W RS-485 applications, and will support all of the NCM Application Modes except NMS mode. The jumper position on the I/O is set to either “2W” or “4W”, and sets the Type ID accordingly. The input and output serial data is routed as required for the selected RS-485 type. In “4W” mode, a jumper on the I/O will force the driver to always be enabled so that an idle condition produces a MARK output. The “2W” mode only supports half-duplex operation, while the “4W” mode supports both half and full duplex operation.

### **3. UART RECEIVE SECTION**

The UART receivers are programmed for the appropriate baud, number of data bits, and parity for the input data expected to be received. The input data, including start, stop, and parity, is sampled by a 64X nominal baud internal clock. The received parity bit is compared to the parity calculated by the UART. Once the data is recognized as valid, the data is latched and is ready for transmission. The UART receiver is reset if a framing error, parity error, or break indication is detected.

## **UART TRANSMIT SECTION**

The UART transmitters are programmed for the appropriate baud, number of data bits, and whether or not parity is to be enabled for the output data to be transmitted. This circuit reacts to a “Data Ready” flag, and latches the data into its 16-byte FIFO. The data is then loaded into the transmitter shift register, and is then shifted out. The parity is transmitted as received from the T1 receiver, and is not checked or regenerated. The end equipment is responsible for parity checking.

The NCM module utilizes two additional transmitter circuits that interface with the Common Module exclusively in NMS mode of operation. These circuits include “Address Passing” and “Character Pacing”. Typically, the NCM will allow messages meant for the particular node in which it is physically installed, to pass, and block all others. However, the NCM can be configured to pass “any address”, or a wide-range of addresses greater than or less than a specified address.

The Common Module is also given permission to talk to the bus in response to a message qualified as an address match. All other Common Modules in the network will be forced off the bus as a result of any valid address header but no address match. The most recent addressed Common Module will have control of the bus until any other Common Module is addressed.

“Character Pacing” is required so that the NCM does not saturate the Common Module port with a continuous data stream of characters following an address match. This prevents the Common Module processor from “missing” characters if they are received without idle time between consecutive characters.

## **5. T1 TRANSMIT MODULE**

The T1 transmit module acknowledges the “Data Ready” flag set by either local UART receivers, and latches the (character) data. The data is then transmitted in consecutive T1 frames at the proper time slot on the positive edge of the T1 clock. Indication of T1 transmit can be observed at the TXA and/or TXB LEDs, and via the NMS software.

If the NCM has both busses enabled, the data received from a T1 bus is re-transmitted back onto the same bus on the next frame. This pass-thru data has higher priority over the data from the local UART receivers.

The NCM, for all modes except NMS mode, transmits an idle pattern when data is not active at either UART receiver, or the T1 bus (if applicable). The idle pattern may be interrupted at any time when data is ready to be transmitted.

In NMS mode only, the NCM transmits an address pattern when data is not active at either UART receiver, or the T1 bus (if applicable). The address pattern may be interrupted at any time when data is ready to be transmitted. The address frames are received and terminated at the adjacent NCM in the network.

## **6. T1 RECEIVE MODULE**

The T1 receive module clocks in the receive data at the proper time slot on the negative edge of the T1 clock, and latches it one clock following the time slot. The data is decoded as being either data or idle/address frame, and as being low or high frame.

In NMS mode, the NCM will block all data until low and high address frames are received in consecutive T1 frames, decoded, and then determined to be a valid BCD address. Once low and high address frames are latched, the “Address Valid” signal is activated. Indication of “Address Valid” can be observed at the ADRA and/or ADRB LEDs, and via the NMS software. Indication of T1 receive can be observed at the RXA and/or RXB LEDs, and via the NMS software

## **7. ROGUE CONTROL**

The Rogue Control feature is used to prevent a rogue PC program or another module from “stepping” on the NCM time slot and bringing down the entire NCM path. If enabled, both the local input(s) and T1 receive inputs will monitor for rogue activity. The local port is squelched for at least two minutes once a continuous data stream lasting for greater than 60 seconds is detected. The T1 receive data is squelched for at least two minutes once a continuous data stream lasting for greater than 64 seconds is detected on the bus. The T1 rogue threshold is set intentionally higher than the local port to prevent all the nodes from reacting to a rogue at any of the local ports. However, a rogue occurring on the T1 can (initially) trip several of the rogue detectors because all of the nodes downstream “see” the same data pattern. (Note that the T1 received data is also squelched on a frame-by-frame basis if the T1 data/addressing protocol is not maintained. In the NMS mode, the data would remain squelched until valid a address is once again detected.) The 0.5 seconds RED/0.5 seconds OFF cadence indicates an active rogue at RXA, RXB, IN1 or IN2 LEDs. An active rogue status is also indicated for each input via the NMS software.

## **8. LOOP-BACKS**

When the NCM is enabled for Equipment loop-back, the serial data received at IN1 and/or IN2 is re-clocked by the UART receiver(s) and then re-transmitted out of OUT1 and/or OUT2 by the UART transmitter(s) respectively. The error status conditions are inactive, parity is not checked or re-generated, data is not transmitted onto the T1 bus, and the EQLB LED will be illuminated orange.

When the NCM is enabled for Payload loop-back, the UART transmitter is internally connected to the UART receiver input. The IN1 or IN2 local inputs are ignored. The OUT1 or OUT2 is held high. The error status conditions are active, parity is checked, and the data is re-transmitted back onto the T1 bus. The PALB LED will be illuminated orange. Only one port is activated for Payload Loop-back at a time. Note: In broadcast or NCM mode, all ports not in the test loop may receive corrupted data because data is received simultaneously from two sources.

## **9. BAUD AND CLOCK GENERATOR**

The Baud and Clock Generator module divides down the 49.152MHz frequency provided by the external board oscillator (U11). It generates the 64X Baud required for the UARTS, and clock frequencies used for synchronous timers by other modules in the Logic Array.

## TESTING

After the NCM module has been configured and installed, it should be tested for proper operation before it is put into service. At present, the only test necessary to verify NCM performance is the loop test in NMS mode. This test is performed when the module is installed to verify operational performance in terminal, DI-A, or DI-B configurations.

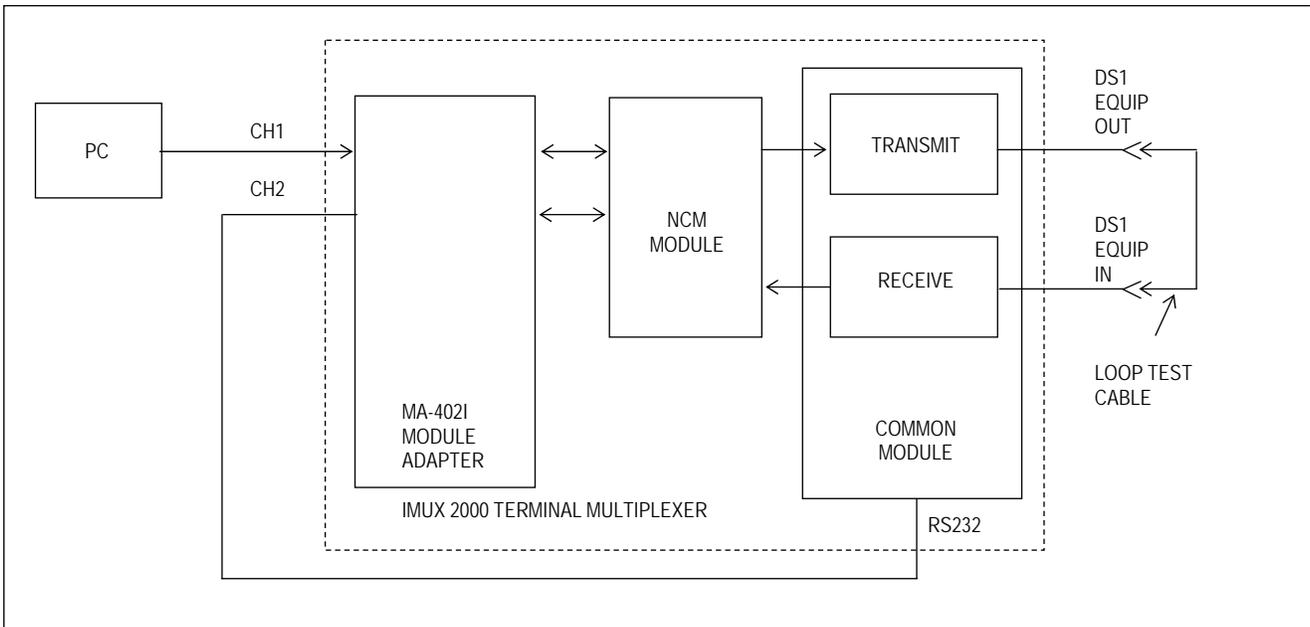
### TEST EQUIPMENT REQUIRED

1. PC with version 10.3 or greater of NMS.
2. IMUX 2000 Multiplexer.
3. Patch cord terminated in bantam jacks (2 required).
4. Male to female null modem RS-232 cable (RFL part number 303366-2 or equivalent)

### LOOP TEST PROCEDURE FOR RFL NCM MODULES IN NMS MODE INSTALLED IN TERMINAL MULTIPLEXERS

The following procedure is used to test NCM modules installed in IMUX 2000 terminal multiplexers.

1. Connect the male to female null modem RS-232 cable from CH2 of the MA-401I to the DB9 male connector on the CM I/O.
2. Open the door on the front of the IMUX 2000 multiplexer.
3. Connect a patch cord between the EQUIP-T1-OUT and EQUIP-T1-IN jacks on the front of the IMUX 2000 chassis. The jacks are located on the Common Module.
4. With power applied to the IMUX 2000, check the indicators on the front of the power supply module.  
**The POWER indicator should be lit.**
5. Check the Service LED (DS13) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The Service LED should be illuminated green.**
6. Check the ADRB LED (DS12) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The ADRB LED should be illuminated solid orange. (should not be red or green)  
Orange indicates the NCM is receiving its own address.**
7. Check the RXB LED (DS5) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The RXB LED should be illuminated red.**
8. Connect the PC to the CH1 RS-232 connector using the male to female RS-232 connector. At this point, the equipment should be connected as shown in Figure 9. Run the RFL NMS communications software and set the parameters exactly the same as the CM and the NCM.



**Figure 9. Simplified block diagram, loop test for RFL NCM module in NMS mode, installed in a terminal multiplexer.**

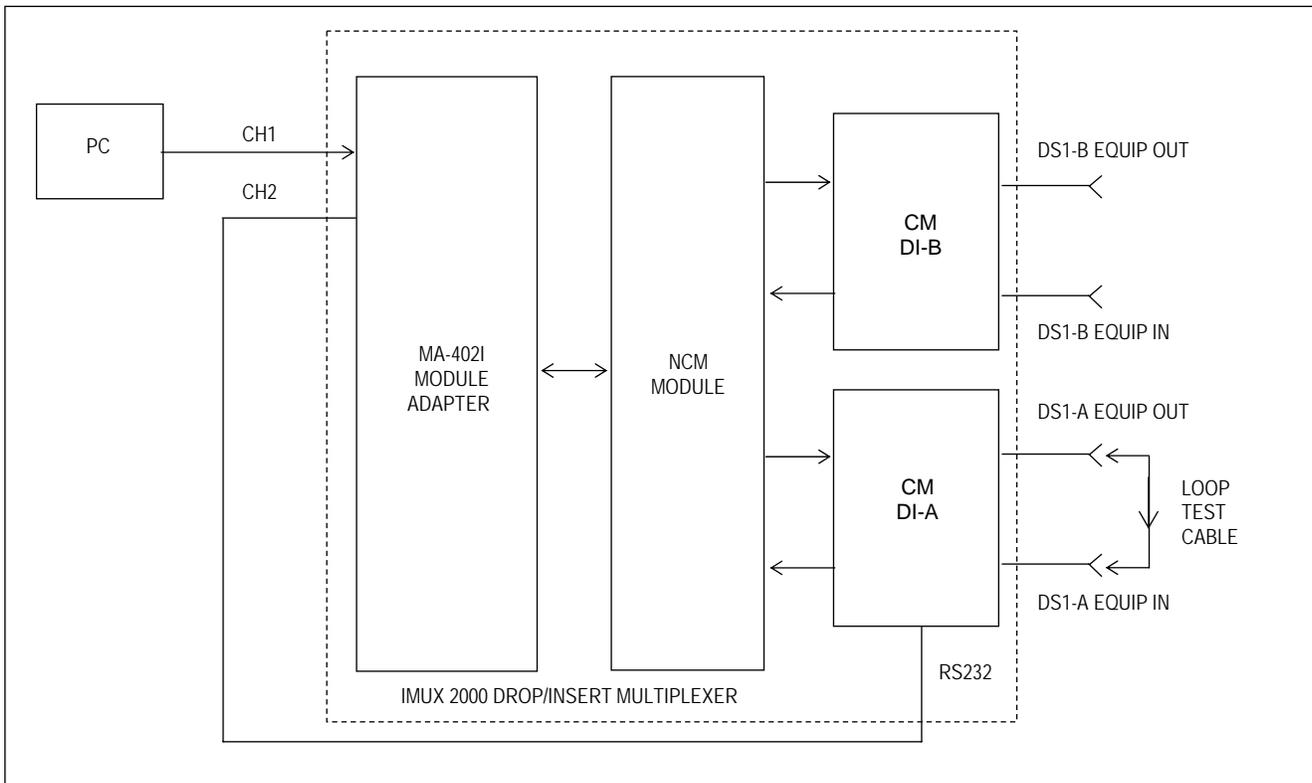
9. Go to “Setup” on the toolbar in NMS, and select “Communication Preferences”. Check the “Change Advanced Settings” box, and enter the NCM/CM address into the “Assume Communication Works/Comm to node #”. Click “OK”.
10. Check “Read” Icon and check the “Auto Configure” box. Then select Method 3 and then click “OK”. Then click “OK” again and proceed with the read. Commands sent to and responses from the CM (via the NCM) should be evident in the communications window. IN1 (DS1), OUT2 (DS2), IN2 (DS3), and OUT2 (DS4) will illuminate green when data is present at the respective port.
12. Once the Read of the node has concluded, click the NetVw Icon. The node corresponding to the NCM/CM address should be present. Select this node by clicking on it. Verify that the “NCM” module is present in the list.
12. Select “NCM” and click the view button. Verify that all NCM settings are correctly set. (i.e. address passing mode)
13. Disconnect the patch cord from the DS1 EQUIP OUT and DS1 EQUIP IN jacks on the front of the IMUX 2000, and close the front door.

If the above test procedure can be successfully completed, the RFL NCM module is functioning properly. If not, use standard troubleshooting procedures to isolate the problem to the module itself, to another module in the IMUX 2000, or to the T1 or E1 channel. If the problem lies in the RFL NCM module, replace it with a spare.

## **LOOP TEST PROCEDURE FOR RFL NCM MODULES IN NMS MODE INSTALLED IN DI-A CONFIGURED MULTIPLEXERS**

The following procedure is used to test RFL NCM modules installed in IMUX 2000, DI-A configured multiplexers. To test NCM modules installed in IMUX 2000 terminal multiplexers, use the procedure on page 27 of this instruction data sheet. Before performing this procedure, make sure the system is on-line and out-of-service.

1. Connect the male to female null modem RS-232 cable from CH2 of the MA-401I to the DB9 male connector on the CM I/O.
2. Open the door on the front of the IMUX 2000 multiplexer.
3. Connect a patch cord between the DS1-A EQUIP OUT and DS1-A-EQUIP IN jacks on the front of the IMUX 2000 chassis. The jacks are located on the Common Module.
4. With power applied to the IMUX 2000, check the indicators on the front of the power supply module.  
**The POWER indicator should be lit.**
5. Check the Service LED (DS13) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The Service LED should be illuminated green.**
6. Check the ADRB LED (DS12) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The ADRB LED should be illuminated solid orange. (should not be red or green)  
Orange indicates the NCM is receiving its own address.**
7. Check the RXB LED (DS5) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The RXB LED should be illuminated red.**
8. Connect the PC to the CH1 RS-232 connector using the male to female RS-232 connector. At this point, the equipment should be connected as shown in Figure 10. Run the RFL NMS communications software and set the parameters exactly the same as the CM and the NCM.



**Figure 10. Simplified block diagram, loop test for RFL NCM module in NMS mode, installed in a DI-A configured multiplexer.**

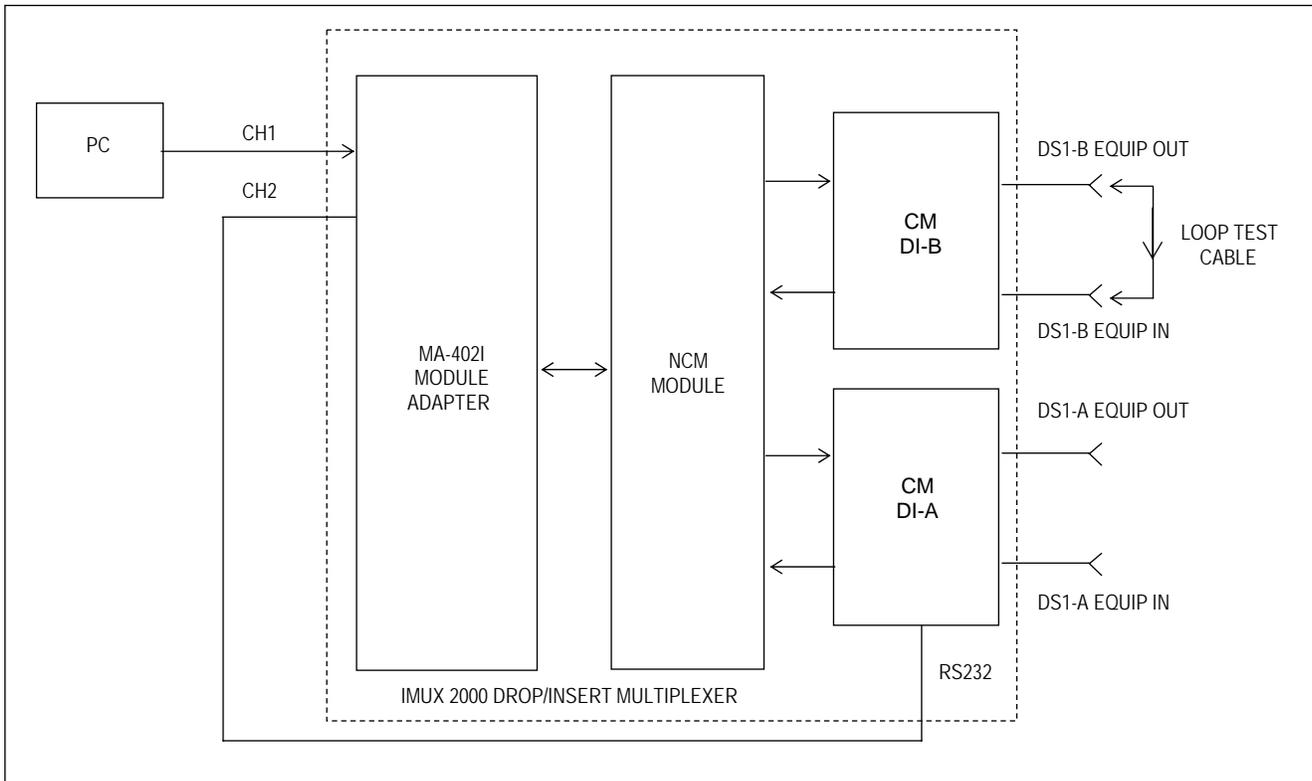
9. Go to “Setup” on the toolbar in NMS, and select “Communication Preferences”. Check the “Change Advanced Settings” box, and enter the NCM/CM address into the “Assume Communication Works/Comm to node #”. Click “OK”.
10. Check “Read” Icon and check the “Auto Configure” box. Then select Method 3 and then click “OK”. Then click “OK” again and proceed with the read. Commands sent to and responses from the CM (via the NCM) should be evident in the communications window. IN1 (DS1), OUT2 (DS2), IN2 (DS3), and OUT2 (DS4) will illuminate green when data is present at the respective port.
11. Once the Read of the node has concluded, click the NetVw Icon. The node corresponding to the NCM/CM address should be present. Select this node by clicking on it. Verify that the “NCM” module is present in the list.
12. Select “NCM” and click the view button. Verify that all NCM settings are correctly set. (i.e. address passing mode)
13. Disconnect the patch cord from the DS1-A EQUIP OUT and DS1-A EQUIP IN jacks on the front of the IMUX 2000, and close the front door.

If the above test procedure can be successfully completed, the RFL NCM module is functioning properly. If not, use standard troubleshooting procedures to isolate the problem to the module itself, to another module in the IMUX 2000, or to the T1 or E1 channel. If the problem lies in the RFL NCM module, replace it with a spare.

## **LOOP TEST PROCEDURE FOR RFL NCM MODULES IN NMS MODE INSTALLED IN DI-B CONFIGURED MULTIPLEXERS**

The following procedure is used to test RFL NCM modules installed in IMUX 2000, DI-B configured multiplexers. To test NCM modules installed in IMUX 2000 terminal multiplexers, use the procedure on page 27 of this instruction data sheet. Before performing this procedure, make sure the system is on-line and out-of-service.

1. Connect the male to female null modem RS-232 cable from CH2 of the MA-401I to the DB9 male connector on the CM I/O.
2. Open the door on the front of the IMUX 2000 multiplexer.
3. Connect a patch cord between the DS1-B EQUIP OUT and DS1-B EQUIP IN jacks on the front of the IMUX 2000 chassis. The jacks are located on the Common Module.
4. With power applied to the IMUX 2000, check the indicators on the front of the power supply module.  
**The POWER indicator should be lit.**
5. Check the Service LED (DS13) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The Service LED should be illuminated green.**
6. Check the ADRA LED (DS11) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The ADRA LED should be illuminated solid orange. (should not be red or green)  
Orange indicates the NCM is receiving its own address.**
7. Check the RXA LED (DS7) on the front panel of the NCM. See Figure 4 and Table 1 for location.  
**The RXA LED should be illuminated red.**
8. Connect the PC to the CH1 RS-232 connector using the male to female RS-232 connector. At this point, the equipment should be connected as shown in Figure 11. Run the RFL NMS communications software and set the parameters exactly the same as the CM and the NCM.



**Figure 11. Simplified block diagram, loop test for RFL NCM module in NMS mode, installed in a DI-B configured multiplexer.**

9. Go to “Setup” on the toolbar in NMS, and select “Communication Preferences”. Check the “Change Advanced Settings” box, and enter the NCM/CM address into the “Assume Communication Works/Comm to node #”. Click “OK”.
10. Check “Read” Icon and check the “Auto Configure” box. Then select Method 3 and then click “OK”. Then click “OK” again and proceed with the read. Commands sent to and responses from the CM (via the NCM) should be evident in the communications window. IN1 (DS1), OUT2 (DS2), IN2 (DS3), and OUT2 (DS4) will illuminate green when data is present at the respective port.
11. Once the Read of the node has concluded, click the NetVw Icon. The node corresponding to the NCM/CM address should be present. Select this node by clicking on it. Verify that the “NCM” module is present in the list.
12. Select “NCM” and click the view button. Verify that all NCM settings are correctly set. (i.e. address passing mode)
13. Disconnect the patch cord from the DS1-B EQUIP OUT and DS1-B EQUIP IN jacks on the front of the IMUX 2000, and close the front door.

If the above test procedure can be successfully completed, the RFL NCM module is functioning properly. If not, use standard troubleshooting procedures to isolate the problem to the module itself, to another module in the IMUX 2000, or to the T1 or E1 channel. If the problem lies in the RFL NCM module, replace it with a spare.

## REMOTE CONTROL USING NMS

There are two ways to program the NCM module, locally using DIP switches, or Remotely using NMS (Network Management Software). If your NCM module is to be used in NMS application mode, it is highly recommended to set-up the NCM module using the DIP switches only, since the NCM card in the NMS application mode is the vehicle for NMS communication.

Refer to the IMUX 2000 or IMUX 2000E Instruction Manuals for information on using NMS. Go to the NCM module using NMS. Go to the NCM General Configurations and Status window for node 1.

The NCM General Configurations and Status window for node 1 of a T1 system is shown in Figure 12. The General Configurations window is on the left and the Status window is on the right. The General Configurations window, on the left, is where the user can change the NCM configuration parameters. This window has three top-level pages selectable by the tabs at the top of the window as follows: General, Address and Serial Port. The following discussion covers the settings on the “General” page.

Note that there is one check box and six parameters that must be set. The box can be checked or unchecked and each of the six parameters must be set. The selections for each parameter can be viewed by using the up and down arrows. Then click on the desired parameter to make your selection.

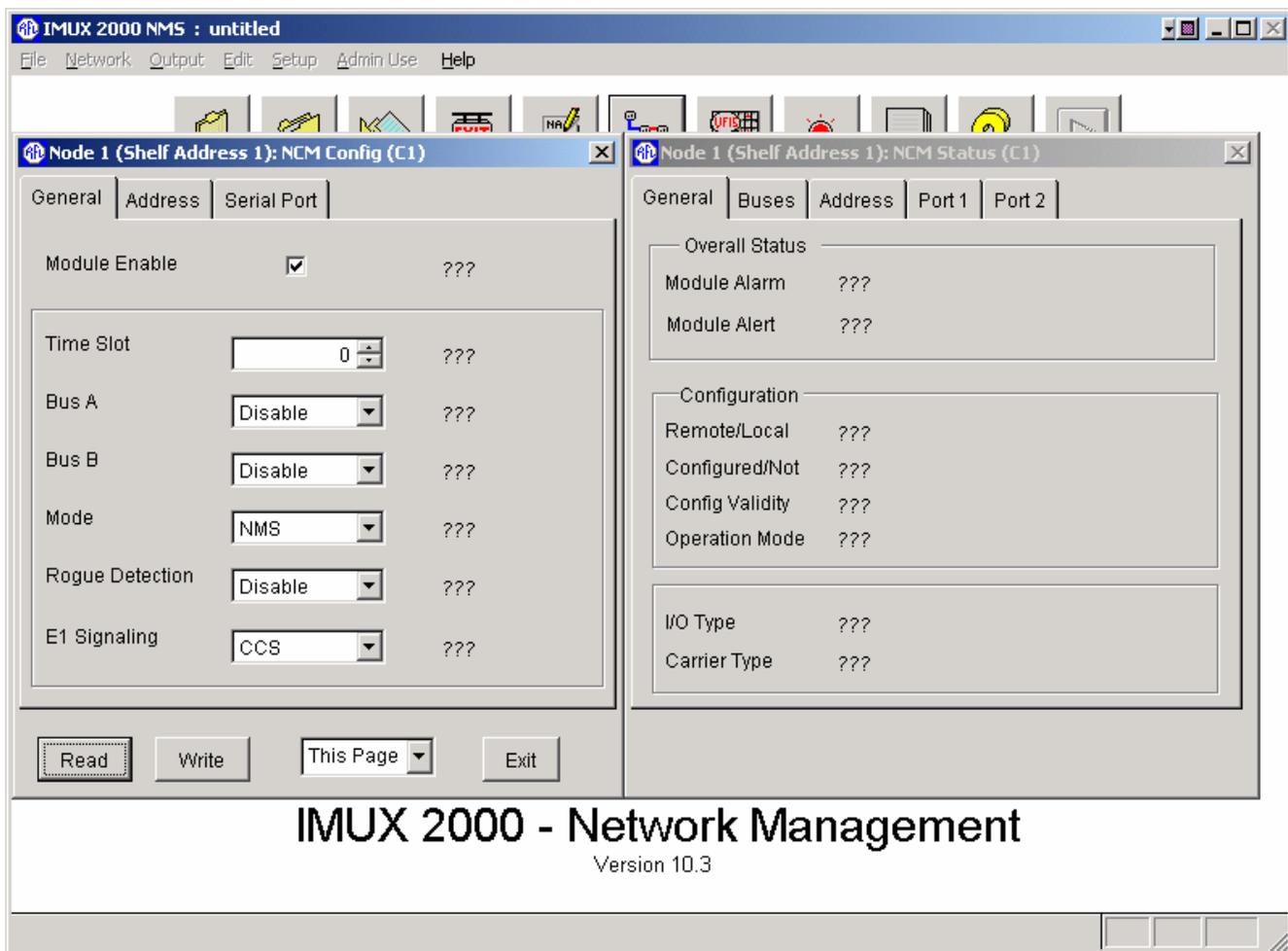


Figure 12. NCM General Configurations and Status window for Node 1

## 1. Module Enable

The Module Enable box can be checked or unchecked.

For the NCM module to be In Service, check the Module Enable box.

For the NCM module to be Out Of Service, uncheck the Module Enable box.

## 2. Time Slot

The Time Slot can be set from 1-24 for T1 networks and from 1-31 for E1 networks. Click on the up or down arrows to make the selection.

## 3. Mode

There are three basic types of network modes:

1. Broadcast mode
2. NMS mode
3. A combination of Master, D&I Slave and End Slave modes.

Each of these modes is described in the table below.

Mode		Description
1	Broadcast	In Broadcast mode each node transmits to and receives from all other nodes in the network. Typically when Broadcast mode is used, all nodes in the network are set to Broadcast mode. Refer to Figure 13a for more information.
2	NMS	Typically when NMS mode is used, all nodes in the network are set to NMS mode. In NMS mode each node transmits to all other nodes and each node selectively receives messages from all other nodes in the network based upon addressing. In addition to this, each node transmits its address to adjacent nodes during idle network time. Refer to Figure 13b for more information.
3	Master	Typically, when one of the nodes in a network is a master, the other nodes are slave nodes. There are two types of slave nodes: D&I slave nodes and End slave nodes. Refer to Figure 13c for a typical network using Master and Slave nodes. The Master node transmits to all other nodes in the network.
4	D&I Slave	The D&I slave node only receives from and transmits to the master node, and it also allows messages from the master to pass through to all other slaves. It also allows messages from other slaves to pass through to the master.
5	End Slave	The End slave node only receives messages from and transmits messages to the master node

## 4. E1 Signaling

E1 Signaling can be set to CCS or CAS. If this is a T1 network, the E1 Signaling setting is ignored. If this is an E1 network, set the E1 Signaling to match the local E1 multiplexer setting. For example, if the local E1 multiplexer is set to CCS, set the E1 Signaling to CCS. If the local E1 multiplexer is set to CAS, set the E1 Signaling to CAS. This locks out the use of time slot 16 for CAS (channel associated signaling).

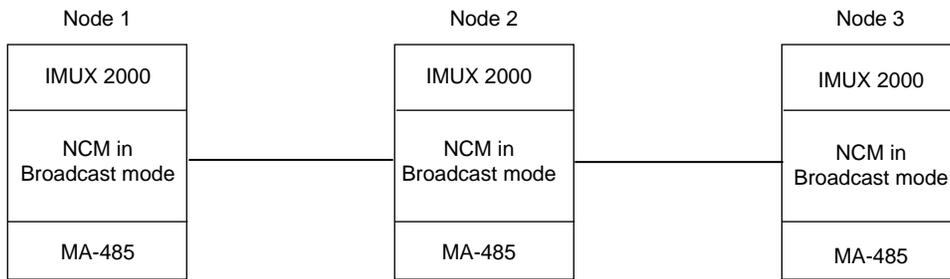


Figure 13a. Typical 3-node network using MA-485s (1 RS-485 port)

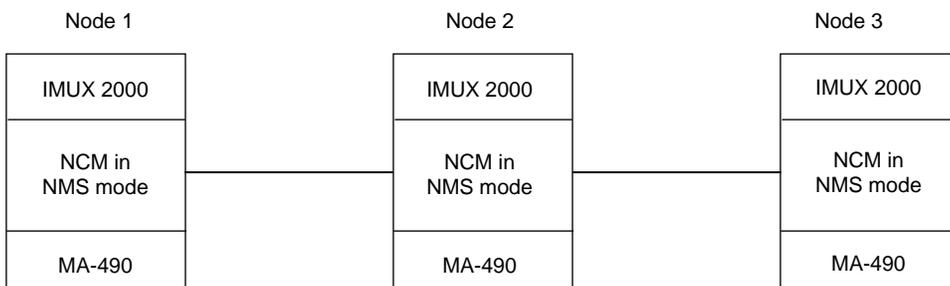


Figure 13b. Typical 3-node network using MA-490s (1 RS-232 port, and 1 Ethernet port)

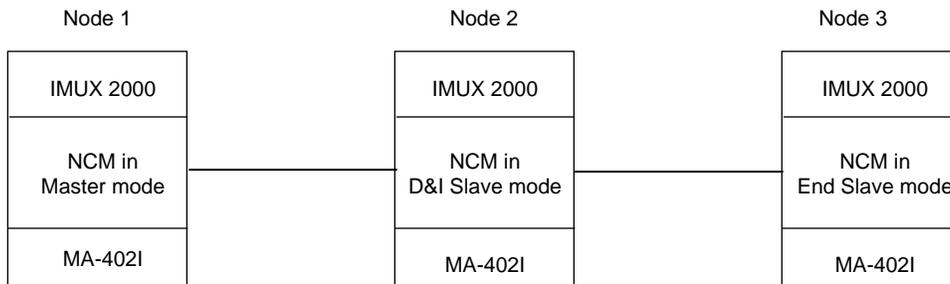


Figure 13c. Typical 3-node network using MA-402Is (2 RS-232 ports)

**Figure 13. Typical networks showing NCM module configured as Master, D&I Slave, End Slave, Broadcast and NMS.**

## 5. Bus A & Bus B

Bus A can be enabled or disabled, and Bus B can be enabled or disabled. Enabling or disabling Bus A and Bus B is mode dependent in accordance with the table below.

Mode	Bus A	Bus B	Application
Broadcast	enabled	disabled	The NCM mode will be Terminal broadcast or DI-A broadcast
	disabled	enabled	The NCM mode will be DI-B broadcast
	enabled	enabled	The NCM mode will be D&I broadcast
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
NMS	enabled	disabled	The NCM mode will be Terminal NMS or DI-A NMS
	disabled	enabled	The NCM mode will be DI-B NMS
	enabled	enabled	The NCM mode will be D&I NMS
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
Master	enabled	disabled	The NCM mode will be Terminal Master or DI-A Master
	disabled	enabled	The NCM mode will be DI-B Master
	enabled	enabled	The NCM mode will be D&I Master
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
D&I Slave	enabled	disabled	The NCM mode will be D&I Slave and the Master NCM node is in the A direction.
	disabled	enabled	The NCM mode will be D&I Slave and the Master NCM node is in the B direction.
	enabled	enabled	(Not a valid setting. The NCM module is disabled)
	disabled	disabled	(Not a valid setting. The NCM module is disabled)
D&I End	enabled	disabled	The NCM mode will be Terminal End Slave or DI-A End Slave
	disabled	enabled	The NCM mode will be DI-B End Slave
	enabled	enabled	(Not a valid setting. The NCM module is disabled)
	disabled	disabled	(Not a valid setting. The NCM module is disabled)

## 5. Rogue Detection

Rogue Detection can be enabled or disabled, and can be used in any mode but is typically used in NMS mode. When enabled it monitors the local ports and the receive T1 messages. Rogue Detection is used to prevent a rogue PC program or another module from “stepping on” the NCM time slot and bringing down the entire NCM path. If enabled, both the local input(s) and T1 receive inputs will monitor for rogue activity. The local input port is squelched for at least 2 minutes once a continuous data stream lasting for greater than 60 seconds is detected. The T1 receive data is squelched for 2 minutes once a continuous data stream greater than 64 seconds is detected on the bus. The T1 rogue threshold is set intentionally higher than the local port to prevent all the nodes from reacting to a rogue at any of the local ports.

After all settings are made on the General page (Figure 12), click on the Address tab to get to the Address window as shown in Figure 14.

The Address window has two major selections, CM Address Passing and Local CM Address. Both of these settings apply to NMS mode only. Set the local CM address first.

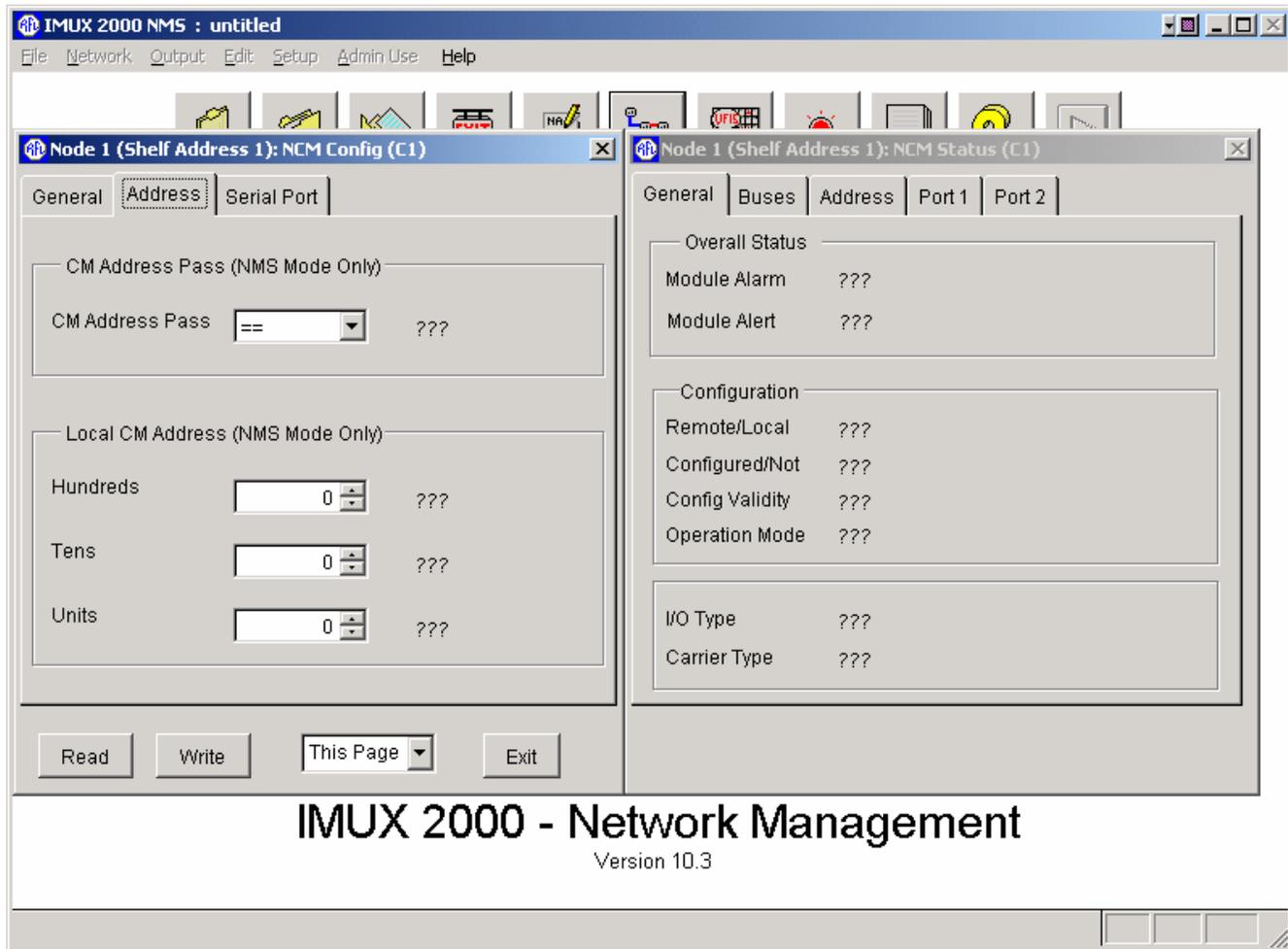


Figure 14. NCM Address Configurations and Status window for Node 1

### Local CM Address

The “Local CM Address” for the NCM module must be set to the same address as the local Common Module (CM3B, CM3C, CM3R, CM6B, or CM4). The NCM supports addresses from 1 to 999 (see note below) and is set by using the up and down arrows in the hundreds, tens and units boxes as shown in Figure 14. For example, if your CM4 is set to Address 351, the “CM Address” of the NCM must be set to 351. The next step is to set CM Address Passing.

#### NOTE

The CM3B, CM3C and CM6B support addresses from 1 to 99. The CM4 and CM6B support addresses from 1 to 500.

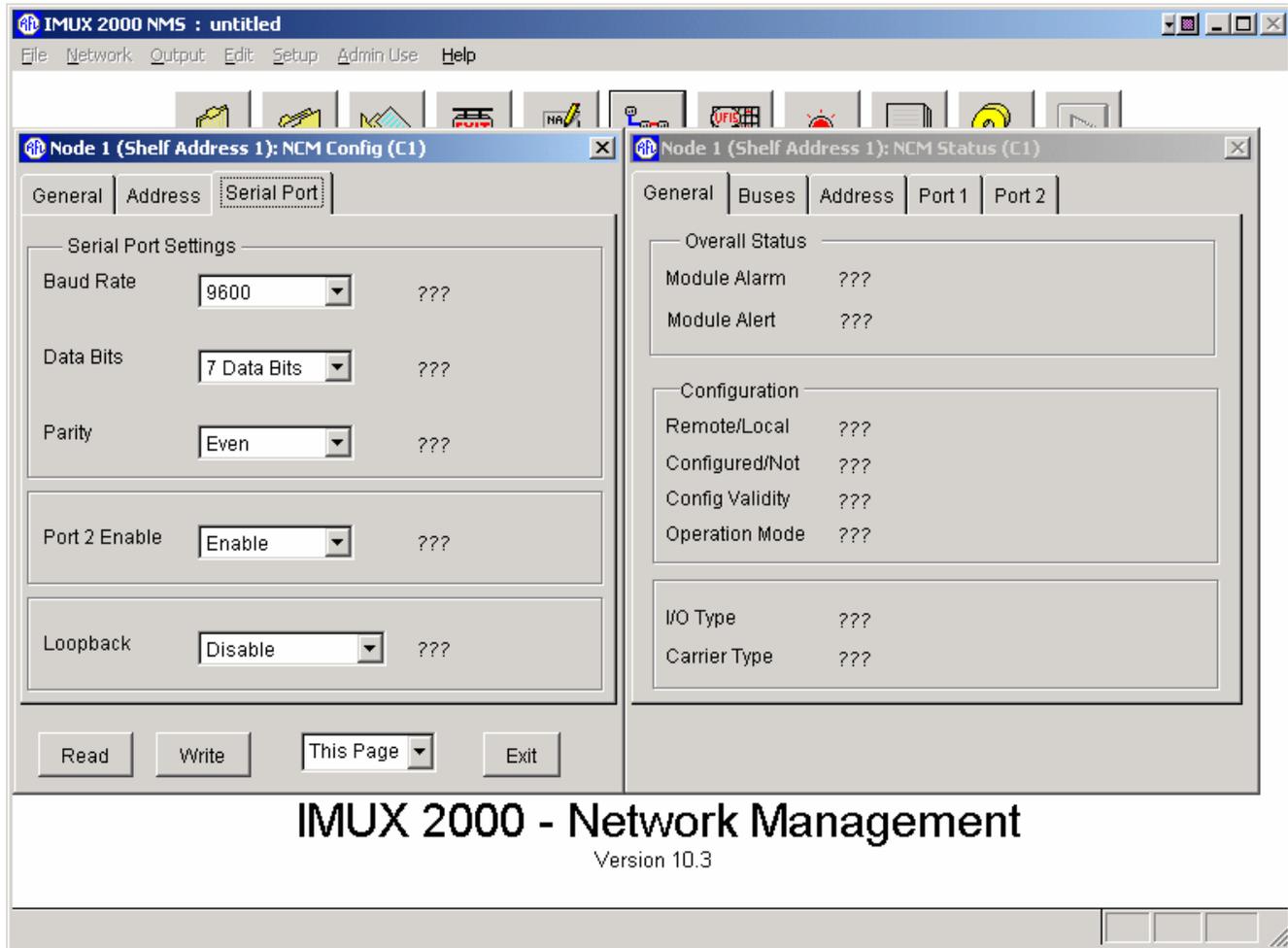
## CM Address Passing

The CM Address Pass setting controls the range of addressed messages that are allowed to pass from the NCM to the local common module in accordance with the table below. There are four CM Address Passing settings as follows, Any, = =, > =, and < = .

CM Address Pass		Description
1	Any	Will pass any messages regardless of the “Local CM Address” setting of the NCM. Messages without address headers are also passed.
2	= =	Will only pass messages with addresses equal to the “Local CM Address” setting of the NCM
3	> =	Will only pass messages with addresses greater than or equal to the “Local CM Address” setting of the NCM
4	< =	Will only pass messages with addresses less than or equal to the “Local CM Address” setting of the NCM

After all settings are made on the Address page, (Figure 14), click on the Serial Port tab to get to the Serial Port window as shown in Figure 15.

The Serial Port window shown in Figure 15 has three major settings, Serial Port Settings, Port 2 Enable and Loopback.



**Figure 15. NCM Serial Port Configurations and Status window for Node 1**

### **Baud Rate**

There are five Baud Rate settings (2400, 4800, 9600, 19200 and 38400) which can be viewed by clicking on the down arrow. Then click on the desired Baud Rate.

### **Data Bits**

There are two choices for the NCM Data Bit setting, 7 bits or 8 bits. These are set in accordance with Table 5.

### **Parity**

There are five choices for the NCM Parity setting, Even, Odd, Space, None or Mark. These are set in accordance with the table below. For Even, Odd or Mark parity, set the NCM parity to the same parity as the Common Module parity, and for seven Data Bits.

**Table 5. Valid NCM Parity and Data Bit Settings in NMS application mode**

<b>Common Module Parity Setting</b>	<b>NCM Parity Setting</b>	<b>NCM Data Bits Setting</b>
Even	Even	7
Odd	Odd	7
Space	Space	7
	None	8
Mark	Mark	7

### **Port 2 Enable**

For the interfaces that physically have two ports, port 2 can be enabled or disabled. The MA402I has two RS232 ports, one on port 1 and one on port 2. The MA490 has one RS485 port on port 1. The MA490 has one Ethernet port on port 1 and one RS232 port on port 2. For example if you are using MA402I, you can disable port 2 if it is not being used.

### **Loopback**

In normal operation all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are four loopback settings as follows:

1. Disable all loopbacks
2. Enable port 1 and port 2 equipment loopback
3. Enable port 1 payload loopback
4. Enable port 2 payload loopback

If the MA485 is configured as two wire, it does not support loopback.

After all NCM parameter selections have been made they must be written to the NCM card in the network. This is done by using the “WRITE” operation as described in Section 7 of The IMUX 2000 Instruction Manual.

## **TROUBLESHOOTING**

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use, and that transmit and receive configurations are identical.

Problems may occur at the common equipment or facility level that may affect the operation of this module. Refer to the “Maintenance” section in your multiplexer manual for system analysis procedures.

## REMOTE CONTROL USING SCL COMMANDS

When installed in an IMUX 2000 remote controllable shelf, the NCM module can be operated under local or remote control. When under remote control, certain configuration parameters can only be changed through the RS-232 remote port on the multiplexer. The remote interface for this module involves two codes: a “P” (parameter) code, and an “S” (status) code. See the IMUX 2000 instruction manual for more information on the remote control interface.

The NCM module reports itself as a “Type 117” module.

### “P” CODES

“P” codes, when used in the parameter field on a “SET” command, allow the user to set certain parameters on the module by remote control, just like setting the switches on a module under local control. “P” codes also appear in the response to a “CONFIG?” query, showing the current parameter settings on the module.

There are ten “P” codes for the NCM module: P01 through P10. Each of these P codes can be a decimal number from 0 to 255, which can also be represented as an eight-digit binary number (in parenthesis). The binary representation is more useful for setting and interpreting the “P” codes, since each binary digit (0 or 1) corresponds to the ON or OFF setting for a particular switch on the module. Table 6 describes the meanings of the “P” codes for the NCM module.

A typical NCM module response to a “CONFIG?” query looks like this:

```
* OK
CHANNEL CARD 3, TYPE 117
UNDER REMOTE CONTROL
SVCE = ON
P01 = 3 (B00000011)
P02 = 1 (B00000001)
P03 = 1 (B00000001)
P04 = 1 (B00000001)
P05 = 1 (B00000001)
P06 = 1 (B00000001)
P07 = 1 (B00000001)
P08 = 1 (B00000001)
P09 = 1 (B00000001)
P10 = 1 (B00000001);
```

**NOTE**

When using binary numbers with a SET command, they must be preceded by the letter “B” as shown in the following example:

**<MULTIPLEXER ADDRESS>:<CARD ADDRESS>:SET:P1 = B00000011;**

Besides using the P code, it is also possible to turn module service on or off by sending one of the following in the parameter field with a SET command:

**SRVC = ON**

**SRVC = OFF**

**Table 6. Remote configuration settings (“P” codes)**

<b>P Code</b>	<b>Digit(s) And Switch Equivalent</b>	<b>Value <sup>(1)</sup></b>	<b>Description</b>
P01	B 0 0 0 0 0 0 0 0 0 ↑ - - - - - - -	0	Bus A Disabled
	<b>BUS A SETTING</b>	1	Bus A Enabled
	B 0 0 0 0 0 0 0 0 0 - ↑ - - - - - -	0	Bus B Disabled
	<b>BUS B SETTING</b>	1	Bus B Enabled
	B 0 0 0 0 0 0 0 0 0 - - ↑ - - - - -	0	CAS Disabled for E1 MUX
	<b>CAS SETTING (E1 MUX ONLY)</b>	1	CAS Enabled for E1 MUX
	B 0 0 0 0 0 0 0 0 0 - - - ↑ ↑ ↑ ↑ ↑	00001 to 11000 T1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 24 in a T1 network. See Table 4 for a complete list of these values.
	<b>TIMESLOT SELECTION T1/E1</b>	00001 to 11111 E1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 31 in an E1 network. See Table 4 for a complete list of these values.
P02	B 0 0 0 0 0 0 0 0 0 - - - - ↑ ↑ ↑ ↑	From 0000 (0) to 1001 (9)	BCD Number (0 to 9) Local CM Address, Hundreds Position
	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ - - - -	...	Not used
P03	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ - - - -	From 0000 (0) to 1001 (9)	BCD Number (0 to 9) Local CM Address, Tens Position
	B 0 0 0 0 0 0 0 0 0 - - - - ↑ ↑ ↑ ↑	From 0000 (0) to 1001 (9)	BCD Number (0 to 9) Local CM Address, Units Position

>> table continues on next page <<

1. These are the only legal values for setting parameters. Setting a parameter to a value outside its specified range will produce unpredictable results.

Table 6. continued - Remote configuration settings (“P” codes)

P Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description
P04	B 0 0 0 0 0 0 0 0 ↑ ↑ - - - - - <b>PORT LOOPBACK SETTINGS</b>	00	Disable Loopbacks
		01	Enable Ports 1 & 2 Equipment Loopbacks
		10	Enable Port 1 Payload Loopback
		11	Enable Port 2 Payload Loopback
	B 0 0 0 0 0 0 0 0 - - ↑ ↑ ↑ ↑ ↑ ↑	...	Not used
P05	B 0 0 0 0 0 0 0 0 ↑ ↑ ↑ - - - - - <b>BAUD SETTINGS</b>	000	2400
		001	4800
		010	9600
		011	19,200
		100	38,400
		101	Undefined
		110	Undefined
		111	Undefined
	B 0 0 0 0 0 0 0 0 - - - ↑ ↑ ↑ - - <b>PARITY SETTINGS</b>	000	None
		001	Undefined
		010	Undefined
		011	Undefined
		100	Odd
		101	Even
		110	Mark
		111	Space
	B 0 0 0 0 0 0 0 0 - - - - - ↑ ↑ <b>WORD LENGTH SETTINGS</b>	00	7 Data Bits
		01	8 Data Bits
		10	Undefined
		11	Undefined

>> table continues on next page <<

Table 6. continued - Remote configuration settings (“P” codes)

P Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description	
P06	B 0 0 0 0 0 0 0 0 0 ↑ ↑ - - - - -	00	Any CM Address	
	<b>CM ADDRESS PASS SETTINGS (NMS MODE ONLY)</b>	01	Equal To	
		10	Equal To Or Greater Than (Force FDL Search)	
		11	Equal To Or Less Than (Force FDL Search)	
		B 0 0 0 0 0 0 0 0 0 - - - ↑ ↑ ↑ - -	000	Broadcast
	<b>APPLICATION MODE SETTINGS</b>	001	NMS	
		010	Master	
		011	D&I Slave (Bus Direction Points Towards Master)	
		100	End Slave (Bus Direction Points Towards Master)	
		101	Mode is undefined	
		110	Mode is undefined	
		111	Mode is undefined	
	B 0 0 0 0 0 0 0 0 0 - - - - - ↑ -	0	Port 2 Disabled	
	<b>PORT 2 ENABLE SETTINGS</b>	1	Port Enabled	
		B 0 0 0 0 0 0 0 0 0 - - - - - ↑	0	T1/E1 and Port Rogue Detection Disabled
	<b>ROGUE SETTINGS</b>	1	T1/E1 and Port Rogue Detection Enabled	
		B 0 0 0 0 0 0 0 0 0 - - ↑ - - - - -	...	Not used
	P07	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	...	Not used
	P08	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	...	Not used
	P09	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	...	Not used
P10	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	...	Not used	

## **“S” CODES**

“S” codes appear in response to a “STATUS?” query. There are eleven “S” codes for the NCM module: S01 through S11. Like the “P” code, this number is displayed in both decimal and binary form. The four least significant digits of the binary number represent the conditions shown in Table 7. The four most significant digits are not used.

A typical response to a “STATUS?” query looks like this:

```
* OK  
CHANNEL CARD 3, TYPE 117  
S01 = 3 (B00000011)  
S02 = 3 (B00000011)  
S03 = 3 (B00000011)  
S04 = 3 (B00000011)  
S05 = 3 (B00000011)  
S06 = 3 (B00000011)  
S07 = 3 (B00000011)  
S08 = 3 (B00000011)  
S09 = 3 (B00000011)  
S10 = 3 (B00000011)  
S11 = 3 (B00000011);
```

Table 7. Remote status messages (“S” codes)

S Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description
S01	B 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ <b>I/O TYPE ID</b>	111xxxxx	RS-232 Not Installed
		110xxxxx	Ethernet
		101xxxxx	RS-485 4-Wire
		100xxxxx	RS-485 2-Wire
	<b>PORT 1 AVAILABILITY</b>	xxx0xxxx	Port 1 Available
		xxx1xxxx	Port 1 Not Available
	<b>PORT 2 AVAILABILITY</b>	xxx0xxxx	Port 2 Available
		xxx1xxxx	Port 2 Not Available
	<b>PORT 1 EQUIPMENT LOOPBACK STATUS</b>	xxxx01xx	Port 1 Equipment Loopback Active
		xxxx00xx	Port 1 Equipment Loopback Inactive
		xxxx11xx	Port 1 Equipment Loopback Inactive
		xxxx10xx	Port 1 Equipment Loopback Inactive
	<b>PORT 1 PAYLOAD LOOPBACK STATUS</b>	xxxx10xx	Port 1 Payload Loopback Active
		xxxx01xx	Port 1 Payload Loopback Inactive
		xxxx00xx	Port 1 Payload Loopback Inactive
		xxxx11xx	Port 1 Payload Loopback Inactive
	<b>PORT 2 EQUIPMENT LOOPBACK STATUS</b>	xxx001xx	Port 2 Equipment Loopback Active
		xxx000xx	Port 2 Equipment Loopback Inactive
		xxx010xx	Port 2 Equipment Loopback Inactive
		xxx011xx	Port 2 Equipment Loopback Inactive
		xxx100xx	Port 2 Equipment Loopback N/A
		xxx101xx	Port 2 Equipment Loopback N/A
		xxx110xx	Port 2 Equipment Loopback N/A
	<b>PORT 2 PAYLOAD LOOPBACK STATUS</b>	xxx011xx	Port 2 Payload Loopback Active
		xxx001xx	Port 2 Payload Loopback Inactive
		xxx000xx	Port 2 Payload Loopback Inactive
		xxx010xx	Port 2 Payload Loopback Inactive
		xxx100xx	Port 2 Payload Loopback N/A
		xxx101xx	Port 2 Payload Loopback N/A
		xxx110xx	Port 2 Payload Loopback N/A
		xxx111xx	Port 2 Payload Loopback N/A
	<b>MUX TYPE &amp; CONFIGURATION STATUS</b>	xxxxxx1x	E1 Mux
		xxxxxx0x	T1 Mux
		xxxxxxx1	Configuration is Valid
		xxxxxxx0	Configuration is Invalid/MUX Problems

>> table continues on next page <<

Table 7. continued - Remote status messages (“S” codes)

S Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description
S02	B 0 0 0 0 0 0 0 0 0	xxx00	Both Busses Disabled – Mode Undefined
	- - - ↑ ↑ ↑ ↑ ↑	00001	Term/DI-A Broadcast Mode
	<b>APPLICATION CONFIGURATION STATUS</b>	00010	DI-B Broadcast Mode
		00011	D&I Broadcast Mode
		00101	Term/DI-A NMS Mode
		00110	DI-B NMS Mode
		00111	D&I NMS Mode
		01001	Term/DI-A Master
		01010	DI-B Master
		01011	D&I Master
		01101	D&I Slave - Master is in direction A
		01110	D&I Slave - Master is in direction B
		10001	End Slave - Master is in direction A
		10010	Slave End - Master is in direction B
		10011	Mode is undefined
		01111	Mode is undefined
		101xx	Mode is undefined
		11xxx	Mode is undefined
		<b>CM ADDRESSING SUPPORT</b>	000xx
	010xx		CM Addressing Not Supported
	011xx		CM Addressing Not Supported
	001xx		CM Addressing Is Supported
	<b>PORT 1 APPLICATION STATUS</b>	000xx	Port 1 is Broadcast Port
		001xx	Port 1 is Local User Port (Use RS-232 Only)
		010xx	Port 1 is Master Port
		011xx	Port 1 is a Slave Port
		100xx	Port 1 is a Slave Port
		101xx	Port 1 is Undefined
		11xxx	Port 1 is Undefined
	<b>PORT 2 APPLICATION STATUS</b>	000xx	Port 2 is Broadcast Port (If Available)
		001xx	Port 2 is CM Port (Use RS-232 Only)
		010xx	Port 2 is Slave of Port 1 Master (If Available)
		011xx	Port 2 is a Slave Port (If Available)
		100xx	Port 2 is a Slave Port (If Available)
		101xx	Port 2 is Undefined
		11xxx	Port 2 is Undefined
	B 0 0 0 0 0 0 0 0 0	...	Not used
	↑ ↑ ↑ - - - - -		

>> table continues on next page <<

Table 7. continued - Remote status messages (“S” codes)

S Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description
S03	B 0 0 0 0 0 0 0 0 0	11	RXA CM Address is Valid
	- - - - - ↑ ↑	10	RXA CM Address is Not Valid
	<b>RXA REMOTE CM ADDRESS</b>	0x	RXA CM Address is Not Applicable
	B 0 0 0 0 0 0 0 0 0	11	RXB CM Address is Valid
	- - - - ↑ ↑ - -	10	RXB CM Address is Not Valid
	<b>APPLICATION CONFIGURATION STATUS</b>	0x	RXB CM Address is Not Applicable
	B 0 0 0 0 0 0 0 0 0	From 0001	From Rev 1 to Rev 15
	↑ ↑ ↑ ↑ - - - -	To 1111	
	<b>CURRENT ACTEL REV</b>		
S04	B 0 0 0 0 0 0 0 0 0	...	For RFL Use Only
S05	B 0 0 0 0 0 0 0 0 0	...	For RFL Use Only
S06	B 0 0 0 0 0 0 0 0 0	...	For RFL Use Only
S07	B 0 0 0 0 0 0 0 0 0	...	For RFL Use Only

>> table continues on next page <<

Table 7. continued - Remote status messages (“S” codes)

S Code	Digit(s) And Switch Equivalent	Value <sup>(1)</sup>	Description
S08	B 0 0 0 0 0 0 0 0 0	xxxx0	Port 1 Output Idle
	- - - ↑ ↑ ↑ ↑ ↑	xxxx1	Port 1 Output Active
	<b>PORT 1 INPUT/OUTPUT STATUS</b>	xxx0x	Port 1 Output Data Status - No Errors
		xxx1x	Port 1 Output Data Status - Errors
		xx0xx	Port 1 Input Idle
		xx1xx	Port 1 Input Active
		x0xxx	Port 1 Input Rogue Control Not Active
		x1xxx	Port 1 Input Rogue Control Active
		0xxxx	Port 1 Input Data Status - No Errors
		1xxxx	Port 1 Input Data Status - Errors
		B 0 0 0 0 0 0 0 0 0	...
↑ ↑ ↑ - - - - -			
S09	B 0 0 0 0 0 0 0 0 0	xxxx0	Port 2 Output Idle
	- - - ↑ ↑ ↑ ↑ ↑	xxxx1	Port 2 Output Active
	<b>PORT 2 INPUT/OUTPUT STATUS</b>	xxx0x	Port 2 Output Data Status - No Errors
		xxx1x	Port 2 Output Data Status - Errors
		xx0xx	Port 2 Input Idle
		xx1xx	Port 2 Input Active
		x0xxx	Port 2 Input Rogue Control Not Active
		x1xxx	Port 2 Input Rogue Control Active
		0xxxx	Port 2 Input Data Status - No Errors
		1xxxx	Port 2 Input Data Status - Errors
		B 0 0 0 0 0 0 0 0 0	...
↑ ↑ ↑ - - - - -			

>> table continues on next page <<

**Table 7**  
**. continued - Remote status messages (“S” codes)**

<b>S Code</b>	<b>Digit(s) And Switch Equivalent</b>	<b>Value <sup>(1)</sup></b>	<b>Description</b>
S10	B 0 0 0 0 0 0 0 0 0 - - - ↑ ↑ ↑ ↑ ↑ <b>TXA/RXB STATUS FOR T1/E1</b>	xxxx0	TXA Data Path Idle
		xxxx1	TXA Data Path Active
		xx0xx	RXB Data Path Idle
		xx1xx	RXB Data Path Active
		x0xxx	RXB Rogue Control Not Active
		x1xxx	RXB Rogue Control Active
		0xxxx	RXB Data Status – No Errors
		1xxxx	RXB Data Status - Errors
	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ - - - - -	...	Not used
S11	B 0 0 0 0 0 0 0 0 0 - - - ↑ ↑ ↑ ↑ ↑ <b>TXB/RXA STATUS FOR T1/E1</b>	xxxx0	TXB Data Path Idle
		xxxx1	TXB Data Path Active
		xx0xx	RXA Data Path Idle
		xx1xx	RXA Data Path Active
		x0xxx	RXA Rogue Control Not Active
		x1xxx	RXA Rogue Control Active
		0xxxx	RXA Data Status – No Errors
		1xxxx	RXA Data Status - Errors
	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ - - - - -	...	Not used

## **NOTICE**

The information in this publication is proprietary and confidential to RFL Electronics Inc. No part of this publication may be reproduced or transmitted, in any form or by any means (electronic, mechanical, photocopy, recording, or otherwise), or stored in any retrieval system of any nature, unless written permission is given by RFL Electronics Inc.

This publication has been compiled and checked for accuracy. The information in this publication does not constitute a warranty of performance. RFL Electronics Inc. reserves the right to revise this publication and make changes to its contents from time to time. We assume no liability for losses incurred as a result of out-of-date or incorrect information contained in this publication.

Publication No. ID NCM  
Printed in U.S.A.  
Revised November 6, 2007

**RFL Electronics Inc.**  
353 Powerville Road  
Boonton Township, NJ 07005-9151  
Phone: (973) 334-3100  
Fax: (973) 334-3863