USER'S MANUAL

Maxiflex Conet NIM
M1586A
User's Manual

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SCOPE

This User Manual provides information on how to install, configure and use the Maxiflex Conet NIM module.

This manual does not cover the fundamentals of the EziForth programming language.

This manual covers the following product Models:

Model	Description
M1586A	Conet NIM with Conet/c Port

Introduction

The MAXIFLEX Conet NIM is designed specifically for industrial telemetry and remote I/O applications in conjunction with the M124x, M125x, M126x range of CPUs (i.e. T2, T3 and P3 CPUs respectively), combining powerful industrial network communications features with ease of use. In addition, the NIM module is programmable (using the EziForth programming language) allowing applications to be run on the NIM device completely separate from the Maxiflex CPU.

Following the ISO OSI 7-layer model, the NIM module, combined with the Maxiflex CPU, includes a powerful inter-network routing capability for communicating over multiple networks, in very large geographically spread installations. This capability allows many dissimilar network types to be linked to create a seamless factory “intranet”, quite often without the need to lay special network cabling.

The Conet NIM comes standard with the proprietary Conet/c protocol (also referred to as Conet twisted pair or Conet Classic), available in both the Normal and Slow Baud Rates. It can also be used to extend the reach of existing Conet/c networks already in place.

Table of Contents

1. GENERAL ARRANGEMENT

1.1 LED Indicators:

LED Legend	LED Colour	Description
NIM OK	GREEN	ON - NIM is healthy OFF or Flashing – CPU Faulty or no power applied
RUN	GREEN	ON – User application software program is running. OFF – No User application software is running Flashing – Terminal interaction with CPU
Rx	YELLOW	ON – data is being received on Conet/c port OFF – Conet/c port receiver is idle
Tx	RED	ON – data is being transmitted on Conet/c port OFF – Conet/c port transmitter is idle
TOKEN	GREEN	ON – network not connected or setup incorrectly OFF – network not connected or setup incorrectly FLASHING EVENLY – network is connected

1.2 Conet/c Port:

This port provides the connection to the Conet/c network. Conet/c is a true peer-to-peer local area network (LAN) that allows fast secure data transfer over long distances (up to 10km) using a conventional twisted pair of wires.

1.3 Programming Port:

The Conet NIM does not include a built-in programming port but is accessed via the programming port of the Maxiflex CPU module fitted on the same rack. Details on configuring the NIM module via the CPU programming port are provided later.

2. Installing the Conet NIM

2.1 Installing the Conet NIM on the Maxiflex base

Install the Conet NIMs into the **I/O** position of a Maxiflex Base ONLY.

Refer to the Maxiflex bases General Instructions (PN 98-8952-930-XXX) for more detail on base layout, module insertion and module removal. Please refer to Figure 2.1 for the I/O Module position.

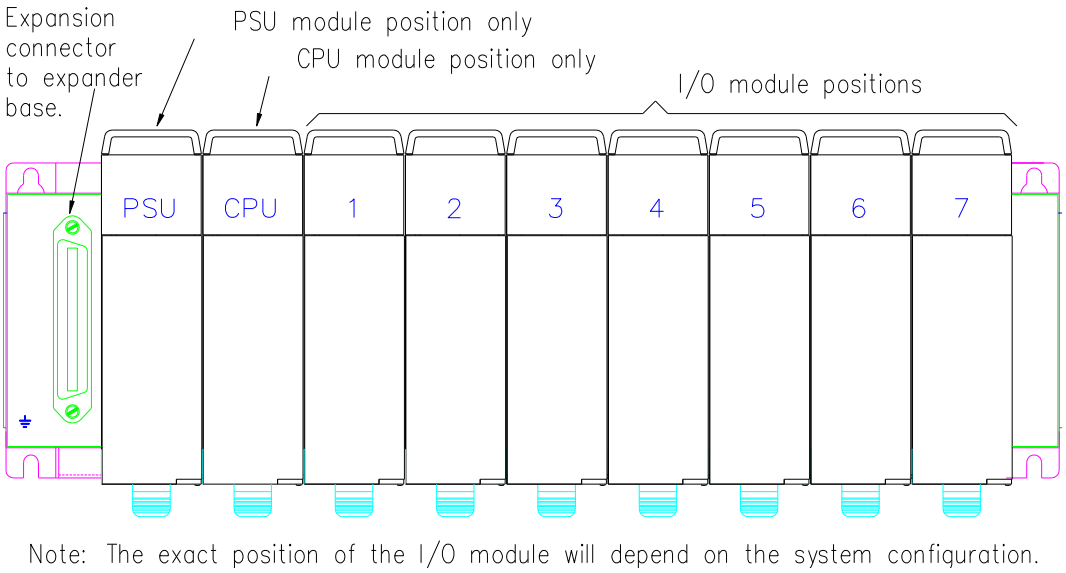


***Figure 2.1*: Layout of the 7I/O Master Base**

2.2 Connecting the Conet/c network port:

Pin number	Description
2	Signal +
5	Cable screen (S)
8	Signal -
1, 3, 4, 6, 7 and 9	No connection

Table 2.1: Pin allocation of Conet/c port connector on M1586A Conet NIM

2.3 Applying power for the first time

Once the Conet NIM has been installed into a Maxiflex rack along with a Maxiflex CPU module, apply power and the NIM OK LED will turn ON and remain steady ON until power is removed. If the NIM OK LED remains OFF, then check the power connections to the PSU module and the

LED indication of the PSU module. Refer to the Installation Guide of the PSU module to verify it's correct.

The RUN LED will only turn ON at first power up if this NIM was shipped with a user application set to begin operating at start-up. Normally, there is no user application installed and the LED will remain OFF.

If the NIM module has been connected to the Conet/c network, at the time of power up, please refer to the section Configuring the Conet/c Network in order to asses the appropriate behaviour of the NETWORK LEDs.

3. Conet NIM and the MAXIFLEX Architecture

3.1 Conet NIM Functions

The Conet NIM contains the following functions:

3.1.1 FORTH User Program

While not necessary in the majority of applications due to the rich set of other features in this Conet NIM, the FORTH programming language can be used to customise any part of the system to suit the application, from simple data scaling, to complex data manipulation.

3.1.2 Data Interchange Table

The Data Interchange Table (or DIT) in the Conet NIM is the crossroads for data. Any exchange of data between functions in the Conet NIM and with the outside world takes place through the DIT. The DIT is an array of 16 bit registers accessible from any function or communications port in the system for the purpose of interchanging data.

3.1.3 Subscription Service

Central to many applications involving communications across networks is the need to replicate data between nodes on the network. This feature provides an easy to use but powerful data replication service between DIT's in the system, whether they are local or remote. This service provides change-of-state detection and error reporting for optimum performance and reliability.

3.1.4 Network Routing Service

Many systems are constructed of multiple networks to overcome the difficulties of topology or communication protocol conversion. The Routing service provides a means to seamlessly interconnect these networks into an integrated intranet so that any node in the system may be globally addressed from any other with no regard for its physical location.

3.1.5 Communications Status Monitoring

The Data Interchange Table contains a group of communication status registers that may be used for diagnostic purposes. These registers monitor communications activity on each port. The local and global addresses for each port may also be accessed from this group of registers.

3.1.6 Remote Programming

Whilst the NIM is typically programmed using the dedicated programming port of the Maxiflex CPU, the network routing function makes it possible to configure/program every NIM in a Maxiflex intranet from a single programming point in the Conet intranet. This function significantly reduces system downtime and improves maintenance efficiency and therefore life-cycle costs.

4. Configuring a Conet NIM

4.1 Using OMNISET or DITview to configure the Conet NIM

Most of the features available on the Conet NIM are easily accessible and can be setup with the minimum of effort by writing to Data Interchange Registers in the NIM, as well as dipswitch selection of the Conet NIM hardware.

The best method to manually configure a Conet NIM is to use either the Microsoft Windows95/98/NT/2000 compatible OMNISET or DITView utility via a Maxiflex CPU, although it is possible to configure a Conet NIM through its Conet/c port that also has access to the NIM's "Data Interchange Table".

The OMNISET utility is supplied free of charge for this purpose. The DITView utility is supplied separately or as part of the EziForth Programmer's Workbench, which is required for programming of the NIM using EziForth.

For simplicity, when the OMNISET is referred to below, DITView can be equally applied.

To setup the Conet NIM through the Maxiflex CPU's programming port using OMNISET, follow this procedure (NOTE: you will need a Maxiflex CPU installed on the rack as well):

1. Ensure that the OMNISET software utility is running on your Laptop or PC. (For more information on the installation and operation of OMNISET, please consult the Help File shipped with the software.)
2. Open the template file named "015601*nn*(M1586A).dvx" supplied with OMNISET. (The *nn* is replaced with the version number of the latest available dvx file).
3. If you are using DITView, ensure that the Logical Port Selected is setup for the Conet/s protocol. OMNISET users will not need to worry as the port is automatically set by the template file.
4. Ensure that the Target Address is set to "Local Slot n" where n is the I/O Slot number of the NIM. This is shown in the centre of the status bar of OMNISET. To change this address refer to Section 4.3 Addressing the NIM using the Programming Port.
5. The Product Information Group should now be properly displayed, showing the Product Name as "M1586 Conet NIM". The Alive Counter in DIT Register 23 should be counting up to indicate that the NIM is "Alive" and connected to the PC, via the CPU's programming port.
6. You are now ready to view or change any of the parameters in the Conet NIM, or to view the internal dynamic data in the product.

4.2 Configuring the Conet/c Port

The Conet/c Port selection switch is located on the left inside the front door of the NIM (under the Conet/c DB9 connector). Use this switch to configure the Node address of the NIM on the Conet/c network and the desired Conet/c baud rate (Normal or Slow).

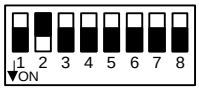
Communications Protocol	Conet/c Address switch setting
Conet/c (Normal mode): Baud rate: 62,500 baud	**Switches 1-7: Conet/c ID**  (Set in binary Switch 1 = LSB Switch 7 = MSB) **Switch 8: Baud Rate** Switch 8 OFF = 62.5 kBaud [Switch shown set to Address 2, Normal baud rate]
Conet/c (Slow mode): Baud rate: 7,800 baud	Switches 1-7: Conet/c ID  Switch 8: Baud Switch 8 ON = 7.8 kBaud [Switch shown set to Address 2, Slow baud rate]

Table 4.1: Conet/c Port Address switch settings

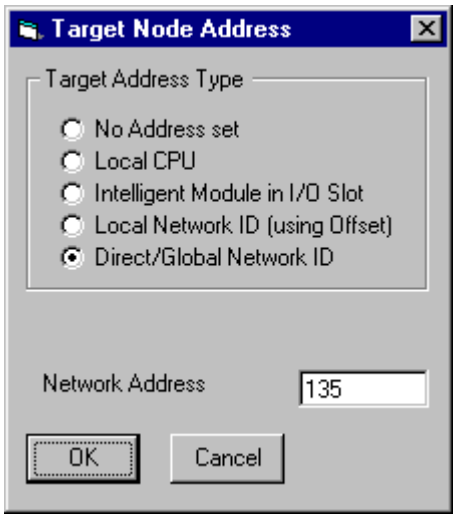
Please refer to the Conet Installation Guide and Conet Protocol Datasheet for more information on the Conet/c network.

4.3 Addressing a NIM Module through the Programming Port of the Maxiflex CPU

The first step when starting to configure a Conet NIM in a Maxiflex System with a Maxiflex CPU is to select the address of the module. In Omniset and DITView, select the module to be addressed using the pull-down menus as follows:

From the pull-down menu select “Remote”, then “File Target Address…”, “Group Target Address” or “Target Address…” whichever is displayed on the menu. (These variations are explained in the Omniset and DITView Help files, and are not relevant to the selection of the Target Address as discussed here.)

A Selection Window as shown below will be displayed:



The different options are described below:

4.3.1 No Address set

This mode is used in Omniset or DITview, when the Group Selected is required to follow the File settings. ie. All Groups use the same Target Address setting as set in

the File Header. If another setting is chosen for the Group, then this setting will override the File setting.

4.3.2 Local CPU

Select this option to communicate directly with the Maxiflex CPU to which the programming tool is connected.

4.3.3 Intelligent Module in I/O Slot

Select this option to communicate with an intelligent I/O module (typically a NIM) on the same base as the CPU to which the programming tool is connected. Enter the Slot number in the text box provided. USE THIS OPTION TO ACCESS THE Conet NIM MODULE IN THE RELEVANT SLOT.

4.3.4 Local Network ID (using Offset)

This option uses the network routing facility in the CPU to communicate with remote nodes through the programming port of the CPU.

Select this option to communicate with another node connected to a network that is connected to this NIM. For further information consult the relevant CPU User Guide on how to setup Routing.

4.3.5 Direct/Global Network ID

If the CPU to which you are connected has had its Network Routing Table configured, then all nodes in the system will have been allocated Global Addresses (in the range 127 to 254). Use this option to select any target node in the system using its Global Address. Consult the CPU User Guide on Conet Routing.

4.4 Programming the Conet NIM

Please refer to the separate EziForth Programmer's Guide.

5. The Data Interchange Table explained

5.1 DIT Table Layout

The Data Interchange Table (or DIT) in the Conet NIM is a table of up to 4000 16-bit data registers used for reading and writing all configuration and dynamic data to the NIM.

NIM Dynamic DIT

DIT registers 0 to 2999 comprise the Dynamic Data Space and this memory is non-volatile. This means that data stored in this area will be lost on power down. These DIT registers are automatically cleared to zero on power up. This area is intended for run-time dynamic data only.

NIM Configuration DIT

DIT registers 3000 to 3999 comprise the Configuration Data Space and this memory non-volatile and data stored in this section is retained during power fail. NIM configuration such as Subscription setup is stored in this area.

There is also a “scratch pad” area available in this section to the User for application specific configuration that will remains fixed for the life of the application.

Writing to this area of the DIT is slow, and continuous writing to this area during normal system operation should be avoided.

The T2 CPU now supports up to 65500 DIT registers to cater for I/O module access. The following table shows the address map of the DIT table for an entire MAXIFLEX system as viewed from the T2 CPU:

Maxiflex Master Rack									
Maxiflex Slot:	**CPU Dynamic Data Space**	**CPU Config Data Space**	**I/O Slot 1**	**I/O Slot 2**	**I/O Slot 3**	**I/O Slot 4**	**I/O Slot 5**	**I/O Slot 6**	**I/O Slot 7**
DIT Start Address:	0	64000	4000	8000	12000	16000	20000	24000	28000
DIT End Address:	3999	65499	7999	11999	15999	19999	23999	27999	31999

Maxiflex Expansion Rack								
Maxiflex Slot:	**I/O Slot 8**	**I/O Slot 9**	**I/O Slot 10**	**I/O Slot 11**	**I/O Slot 12**	**I/O Slot 13**	**I/O Slot 14**	**I/O Slot 15**
DIT Start Address:	32000	36000	40000	44000	48000	52000	56000	60000
DIT End Address:	35999	39999	43999	47999	51999	55999	59999	63999

Table 5.1: DIT Address Map of the T2 CPU:

The map is different for the M125x T3 CPUs and the M126x P3 CPUs as these CPUs have more dynamic data. This narrows the address space available for NIM modules. The T3 and P3 CPUs can view the DIT tables of NIMs in I/O slots in blocks of 2000 DITs per slot or blocks of 4000 DITs per slot. Please consult the relevant CPU User Guide for further details on this.

6. The Subscription Service Explained

6.1 Introduction to Subscriptions

Central to many applications involving communications across networks is the need to replicate data between nodes on the network.

Examples include a SCADA system acquiring data from remote telemetry units in the field; or a point-to-point telemetry application, where inputs are transmitted from one location to outputs at another location.

In all these cases, the traditional method is for a controlling master node to poll the slave nodes regularly for data in case something has changed. This crude method is an inefficient use of the limited network bandwidth, and is inherently slow in typical update times. It also limits the number of master nodes in the system to one.

The Maxiflex Conet NIM provides a far superior mechanism to accomplish this commonly used function through its Subscription Service. This Service operates as follows:

The node requiring the data sets up a subscription with the source node, very much like you would subscribe to a magazine through your newsagent. You establish a magazine subscription by telling the newsagent which magazine you want, your home address, and how often you want it, and then the newsagent takes the responsibility on himself to send you the magazine whenever a new issue becomes available.

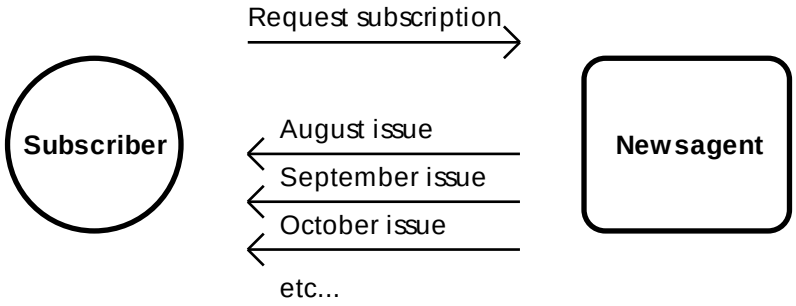


Figure 6-2 The Magazine Subscription Analogy.

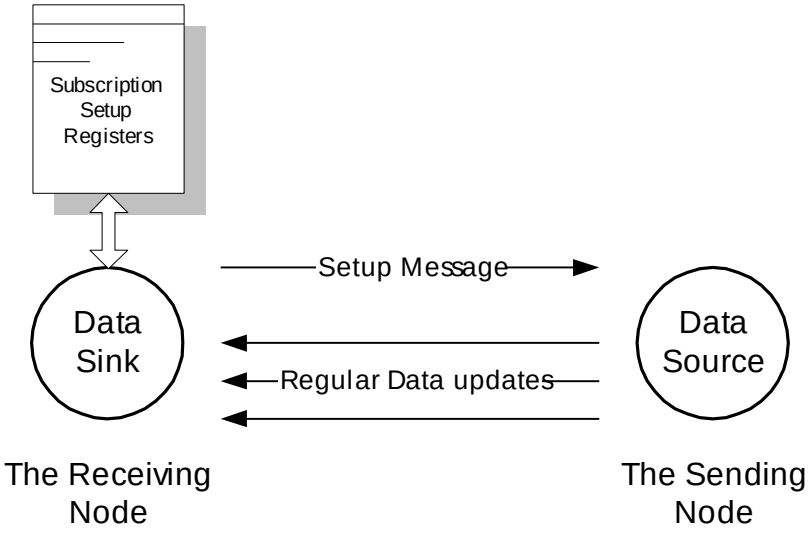
In the same way, the Conet NIM's Subscription Service allows the NIM (acting as a node on the network) to subscribe to a range of DIT registers on a remote node.

The remote node will then send the data at an agreed time interval, plus, if required, when the data changes state. The receiving node expects these regular updates, and will flag an error if the subscribed data is interrupted for any reason.

6.2 Setting up subscriptions

Just like the magazine subscription, the receiving NIM (or any other Conet/c device supporting the Subscription service) is responsible for setting up and maintaining subscriptions with other nodes to replicate data across the network. The advantages of using subscriptions over regular polling mechanisms are as follows:

1. Only one message is required on the network for a data update as opposed to two in a Request/Reply method. This reduces network overhead allowing more data throughput on the network.
2. The regular data updates can be much slower than the response time required for the system by using change-of-state detection. The Source node will send data immediately there is a change of state, providing the optimum system response, without the need to have a fast regular update time. This reduces network overhead allowing more/faster data throughput on the network when something does change.
3. On peer-to-peer networks multiple subscriptions can be setup between nodes in different directions, each of which would operate independently of any other. This provides far more flexibility than typical Poll/Response methods.



The node acting as a data “source” (the transmitting node) requires no user setup to participate in a subscription contract with another node. The node acting as data “sink” (the receiving node) is setup by the user with the required data. Thereafter the “sink” node automatically manages the subscription including setting up the data source, and managing errors in the process.

The following table shows the configuration required to setup the subscription:

ITEM	DESCRIPTION	VALID RANGE
Source Node Address	This is the network address of the sending or source node from which the required data originates. This can be expressed as a local network address plus the local slot and port to which the network is connected, or it can be expressed as a global network address if network routing is configured in the CPU.	Local network addresses: 1 – 126 Global network addresses: 127 – 254
Local Port Number	This is the Network Port number on the network module in the local system to which the network containing the source node is connected. This item is only required if a local network ID is specified for the Source Node Address, otherwise it should be set to 0.	0 only for the Conet NIM
Destination DIT Start Address	This is the DIT register address where the data will start to be written in this NIM acting as the data sink.	0 – 65535
Data Range	This is the number of 16 bit DIT registers that will be transferred in the subscription	1 – 120
Source DIT Start Address	This is the DIT register address of the first register in the block of registers to be sent from the source node.	0 – 65535
Update time	This is the time between regular updates of data that will be sent whether the data has changed or not.	1 – 120 seconds
Change-of-State Required	This sets whether the subscription data block will be sent when any data in the block changes.	Yes/No

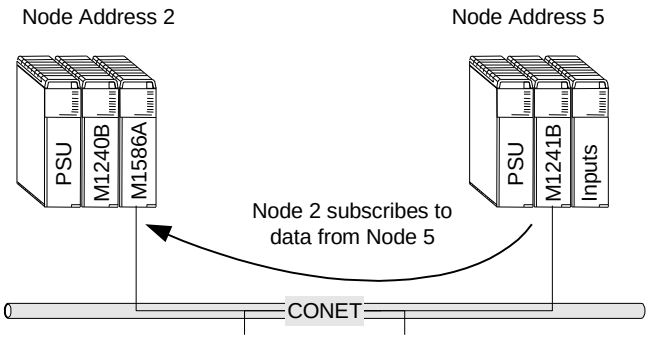
6.3 Number of subscriptions allowed

There is a limit to the number of subscriptions that a NIM can receive, and a limit to the number of subscriptions that it can send. The NIM can be configured to receive subscriptions from a maximum of eight other nodes and can send subscriptions to a maximum of eight other receiving nodes.

In other words each NIM can act as data sink for 8 subscriptions, and data source for 8 subscriptions simultaneously.

6.4 Subscription Application Example

Refer to the diagram of a simple network below:



Remote node 5 (CPU module) on the Conet/c network has digital information in DIT registers 620 to 627. The Central Node 2 (NIM module) needs to monitor these digital inputs. A regular update time of every 10s is quite satisfactory to determine that the remote system is still connected and functioning if nothing changes, but the data should be sent immediately if any of the digital inputs changes state.

Node 2 is the Destination node (it sets up the subscription and receives the data). Node 5 is the sending node, and requires no user configuration to participate in the subscription process.

Fill in the following data into one of the eight subscription blocks in the Subscription Table in the NIM to configure this function:

NAME	VALUE	DESCRIPTION
Source Node Address	5	The local CONET ID on the Conet network
Local Port Number	0	The Conet/c network is Port 0 on the NIM
Destination DIT Start Address	100	This is the DIT Address where we want to start writing the received data.
Data Range	8	We require 8 DIT registers to be sent
Source DIT Start Address	620	The Source Data start at DIT address 620
Update Time	10	The regular updates can be 10 seconds apart.
Change of State Required	Yes	The data will also be sent whenever any bit the DIT registers in the range 620-627 changes.

When configured, Node 2 automatically requests a subscription with the following data from Node 5 on the Conet/c network connected to the NIM.

Node 5 undertakes to send the contents of its own DIT registers 620 to 627 over the network to Node 2 whenever any of the registers changes, or every 10s if no change occurs in that time. The information will be placed in Node 2's DIT registers 100 to 107.

7. Appendix: Conet NIM Detailed DIT Layout:

7.1 Conet NIM Dynamic Data Area DIT Register Assignment

(DIT Registers 0 – 2999)

DIT Number	Description
0 – 23	**Conet NIM System Information**
0	**Product Code** Unique Number in BCD format that reflects the type of product as follows: 156 – M1586A Conet NIM
1	**DIT Revision Number** Version Number of the DIT Layout supported by the NIM.
2	**Kernel Version Number** Version number of the NIM Kernel. BCD format.
3	**Supported Services Flags** Network related services supported by the Kernel: Bit 0: DIT service Bit 1: Subscription service Bit 2: Queue service Bit 3: Datagram service Bit 4: Routing service Bit 5: Reserved Bit 6: Programming service Bit 7: Reserved Bits 8-15: Reserved Bits set indicate which service is supported.
4-7	**User Tag** User configurable string of DIT registers in ASCII format. The user is able to write up to 8 ASCII characters into these DIT registers (two characters per register) to uniquely identify each CPU.
8-21	RESERVED
22	**System Register** Indicates the following conditions current in the NIM: Bit 0: Application program HALTED (0) or RUNNING (1) Bits 1-15: Reserved
23	**Alive Counter** Free running counter in the NIM. Useful for communications diagnostics. While this register is incrementing, the Operating System is running. If this register is static, the NIM has halted or communications has failed.
24 – 68	RESERVED
69 – 78	**Networking Information**

DIT Number	Description
	Status Information for the available network ports on the CPU hardware.
69	**Subscriber Status** A bit map indicating the status of 8 receive subscriptions in the system as follows: Bit 0: link healthy (0) or unhealthy (1) or not configured (1) for Subscription 1 Bit 1: link healthy (0) or unhealthy (1) or not configured (1) for Subscription 2 Bit n: link healthy (0) or unhealthy (1) or not configured (1) for Subscription n+1 Bit 7: link healthy (0) or unhealthy (1) or not configured (1) for Subscription 8 Bits 8-15: Reserved Note: Link Healthy means that the receiving node is happy that subscriptions are being received from the transmitting node at the required intervals. Link Unhealthy means that the receiving node has not received subscriptions from the transmitter and flags an error condition. Should the transmitting node resume transmissions, the flag will be cleared to indicate healthy link dstatus
70	RESERVED
71	RESERVED
72	**Conet Port Inactivity** A seconds counter that is reset to zero every time there is active communications on the Conet Port. If there is no valid communications, the counter is incremented every second.
73	RESERVED
74	RESERVED
75	RESERVED
76	**Conet/c Port Local ID** The local ID setting for the Conet Port as set on the Conet Port dipswitch, swtiches 1 to 6.
77	**Conet/c Port Global ID** Global ID of the CPU on the Conet Port. Only applies if the Network Routing Table is configured to include this port. Note that as the default Network Routing Table does not include this port, the default Global ID setting is set to 255 which is an invalid Global ID.
78	RESERVED
79	**Conet/c Port dipswitch setting**
80 - 87	**System Timers** System count down timers decremented by the Operating System until zero is reached. Values entered are decremented by 1 every 10 milliseconds. For example, enter 100 to time for 1 second. The largest timer available is 655350 ms or about 11 minutes.
80	System Timer 0
81	System Timer 1
82	System Timer 2
83	System Timer 3
84	System Timer 4
85	System Timer 5

DIT Number	Description
86	System Timer 6
87	System Timer 7
88 – 109	RESERVED
110 – 2999	**User Data Area**

7.2 Conet NIM Configuration Data Area DIT Register Assignment

(DIT Registers 3000 – 3999)

This DIT area is maintained in the NIM as non-volatile memory. All configuration of NIM functions is therefore implemented here so that configuration is not lost during power down. In addition, there are some registers available for the User to place some configuration parameters for application programs.

DIT Number	Description
3000 – 3014	**Application Information** This is a scratch pad of non-volatile memory for the User to place application information.
3000 – 3013	**Application Name** The User may write up to 28 ASCII characters for the name of the application.
3014	**Application Version** The User may write the version number of the application in Hex format.
3015 – 3199	RESERVED
3200 – 3247	**Subscription Blocks Table** These registers contain the data that allows the NIM to subscribe to data on another device on the network. The subscription mechanism allows this NIM so “subscribe” to a block of data on another device on the network. That block of data will be written automatically to the specified location on this NIM on a regular basis as well as on a change of state of the remote data. Up to 8 subscriptions may be setup on any NIM as the recipient (and up to 8 subscriptions may be received from other devices on the network, although this requires no setup and operates transparently.) A Status register monitors the performance of subscriptions, and if communication is lost with the remote node, then an alarm can be generated.
3200-3205	**Subscription Block 1**
3200	Remote ID Set the local ID of the remote node from which data is required.
3201	Local Port Number Set the Port Number on this NIM through which the remote node can be found. The Conet/c port number is 0 for the Conet NIM.
3202	Local Start DIT Set the start address of the destination DIT block in this CPU where you would like the

DIT Number	Description
	remote data to be written.
3203	Range Set the number of DIT registers to be transferred in the subscription (64 maximum)
3204	Remote Start DIT Set the Start Register Number in the remote node where the source data is located.
3205	Update time Set the time interval for regular updates of the data.
3206-3211	**Subscription Block 2**
3206	Remote ID
3207	Local Port Number
3208	Local Start DIT
3209	Range
3210	Remote Start DIT
3211	Update time
3212-3217	**Subscription Block 3**
3212	Remote ID
3213	Local Port Number
3214	Local Start DIT
3215	Range
3216	Remote Start DIT
3217	Update time
3218-3223	**Subscription Block 4**
3218	Remote ID
3219	Local Port Number
3220	Local Start DIT
3221	Range
3222	Remote Start DIT
3223	Update time
3224-3229	**Subscription Block 5**
3224	Remote ID
3225	Local Port Number
3226	Local Start DIT
3227	Range
3228	Remote Start DIT
3229	Update time
3230-3235	**Subscription Block 6**
3230	Remote ID
3231	Local Port Number
3232	Local Start DIT
3233	Range
3234	Remote Start DIT

DIT Number	Description
3235	Update time
3236-3241	**Subscription Block 7**
3236	Remote ID
3237	Local Port Number
3238	Local Start DIT
3239	Range
3240	Remote Start DIT
3241	Update time
3242-3243	**Subscription Block 8**
3242	Remote ID
3243	Local Port Number
3244	Local Start DIT
3245	Range
3246	Remote Start DIT
3247	Update time
64248 – 64999	RESERVED
65000-65499	**User Area** This area of 500 DIT registers is available to the User for non-volatile storage.