OPERATIONS MANUAL

Nx64-MUX

High-Speed 16-Port TDM Multiplexer

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SAFETY WARNING

Always observe standard safety precautions during installation, operation and maintenance of this product. To avoid the possibility of electrical shock, be sure to disconnect the power cord from the power source before you remove the IEC power fuses or perform any repairs.

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1 Introduction

The Nx64-MUX is a modular, 16 Port TDM multiplexer for high-speed serial data terminal equipment. It is designed to work in a paired, point-to-point configuration over a single synchronous composite clear-channel link of up to 2,048Kbps.

The system may be configured with from 4 to 16 channel ports, operating at rates up to 38.4 Kbps asynchronous, or up to 784Kbps synchronous.

The system is configured and managed by the user through an RS-232 Console port terminal interface to either a computer/laptop running a terminal emulation program, or a standard ASCII dumb terminal.

1.1 Network Configurations

The Nx64-MUX may be used in Point-to-point applications with different types of equipment and circuits. As long as the circuit between the two units is synchronous and provides transparent data transport, the link should operate. Even geosynchronous satellite delays up to 0.5 sec are tolerated without any problem.

Figure 1 shows an example of utilizing a service provider's digital carrier service. In most such applications, the carrier's equipment provides a clock timing source at some multiple of 64 Kbps. If needed, the Nx64-MUX can provide timing at many n x 64Kbps rates, up to 2,048Kbps from an internal oscillator on one end of the link, and synchronize to that rate on the other end. This is also helpful when connecting units back-to-back in limited distance applications.

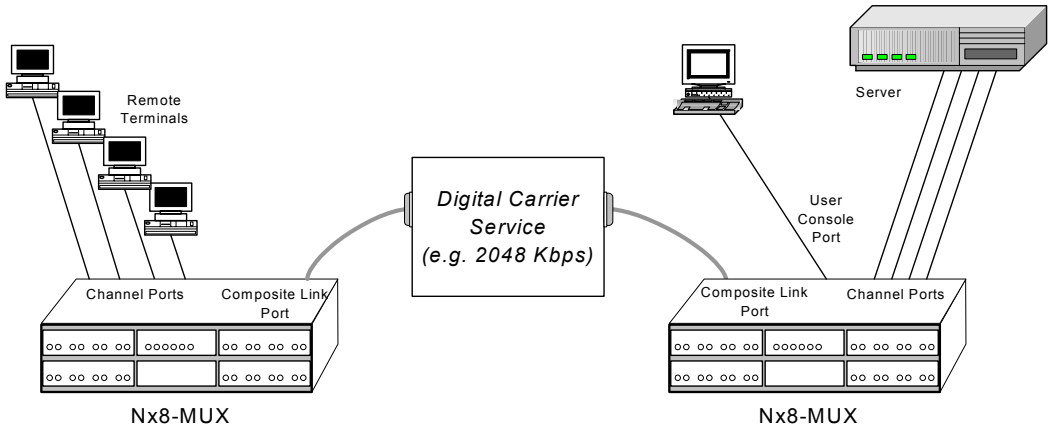


Figure 1 Point-to-point Link using Digital Carrier

The Nx64-MUX may also be used in conjunction with higher-rate multiplexing equipment as a sub-multiplexer. An example of this is shown in Figure 2. The Nx64-MUX units may each be assigned a port on the larger multiplexer and those ports programmed for operation at any of the selectable n x 64Kbps rates.

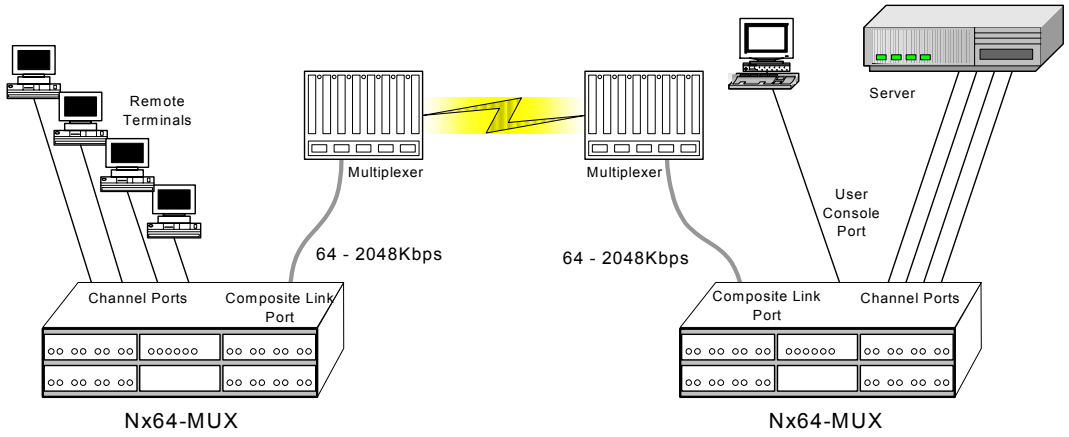


Figure 2 Point-to-point Link as Sub-multiplexer

1.2 Planning

The network administrator must determine how the Nx64-MUX units will work in the network and understand the applications that will utilize each of the available channels. Some of this work is made easier by the fact that link bandwidth requirements are easily determined by summing the bandwidth needs of each channel port that is planned to be used, and adding the fixed overhead. Inband control signal transport should also be considered when needed, as some bandwidth is required to support this function.

Additionally, the network administrator should have in mind other considerations that are factors in planning for the installation. Some of these are:

1) Power requirements, including redundancy
2) Ventilation and cooling
3) Rack space requirements
4) Cabling & distances between equipment
5) Ease of access for maintenance

2 Key Functions

This section presents the functional operation and concepts of the Nx64-MUX. Readers should familiarize themselves with this section before proceeding to the Installation section.

Feature Summary

The major features of the Nx64-MUX are outlined in the following table:

Composite Port Interface (DTE)
Software-selectable interface types: RS-232, EIA-530, V.35*, RS-422/449*, X.21* *(via cable adapter)
Selectable clock rates: 64Kbps to 2,048Kbps, with convenient Nx64Kbps rates: 64K, 128K, 192K, 256K, 384K, 512K, 640K, 768K, 1024K, 1344K, 1472K, 1536K, 1792K, 1920K, 1984K, & 2048K
Internal Clock for local or back-to-back operation
Channel Port Interface (DCE)
Software-selectable interface types on ports 1, 5, 9 and 13: RS-232, EIA-530, V.35*, RS-422/449*, X.21* *(via cable adapter)
Programmable Asynchronous (RS-232 only), or Synchronous operation on a per-port basis
Async data rates: 9.6K, 14.4K, 19.2K, 28.8K, 38.4K (bits per second)
Synchronous data rates: all async data rates + 56K, 64K, 128K, 256K, 384K, 512K, & 768K (bits per second)
Programmable RTS to CTS delay: 0, 3, 7, 13, 26, or 53 (milliseconds)
Transmit data clock selection: TxC or TxCE
Multiplexing
Non-disruptive channel configuration / reconfiguration
Fixed overhead limited to 8000bps, for framing and in-band management channel (2000bps)
Option for in-band transport of RTS for remote DCD
System Features
Console port for reconfiguration of linked local and remote systems via terminal
Universal AC power input, 85 – 264 VAC, 50/60Hz
Power Supply Redundancy option
Downline loading of firmware revisions
Backup and Restoral of configurations to/from PC
Hot-swappable, modular cards and power supply

Table 1 – Nx64-MUX Major Features

2.1 Multiplexer Operation

The central hardware element of the Nx64-MUX is a multiplexer/demultiplexer function through which all end-to-end user and management information flows. The drawing of Figure 3 provides a high-level reference diagram for this function. Other functions such as clock synthesis and synchronization, control paths and programming, and user interfaces are not included.

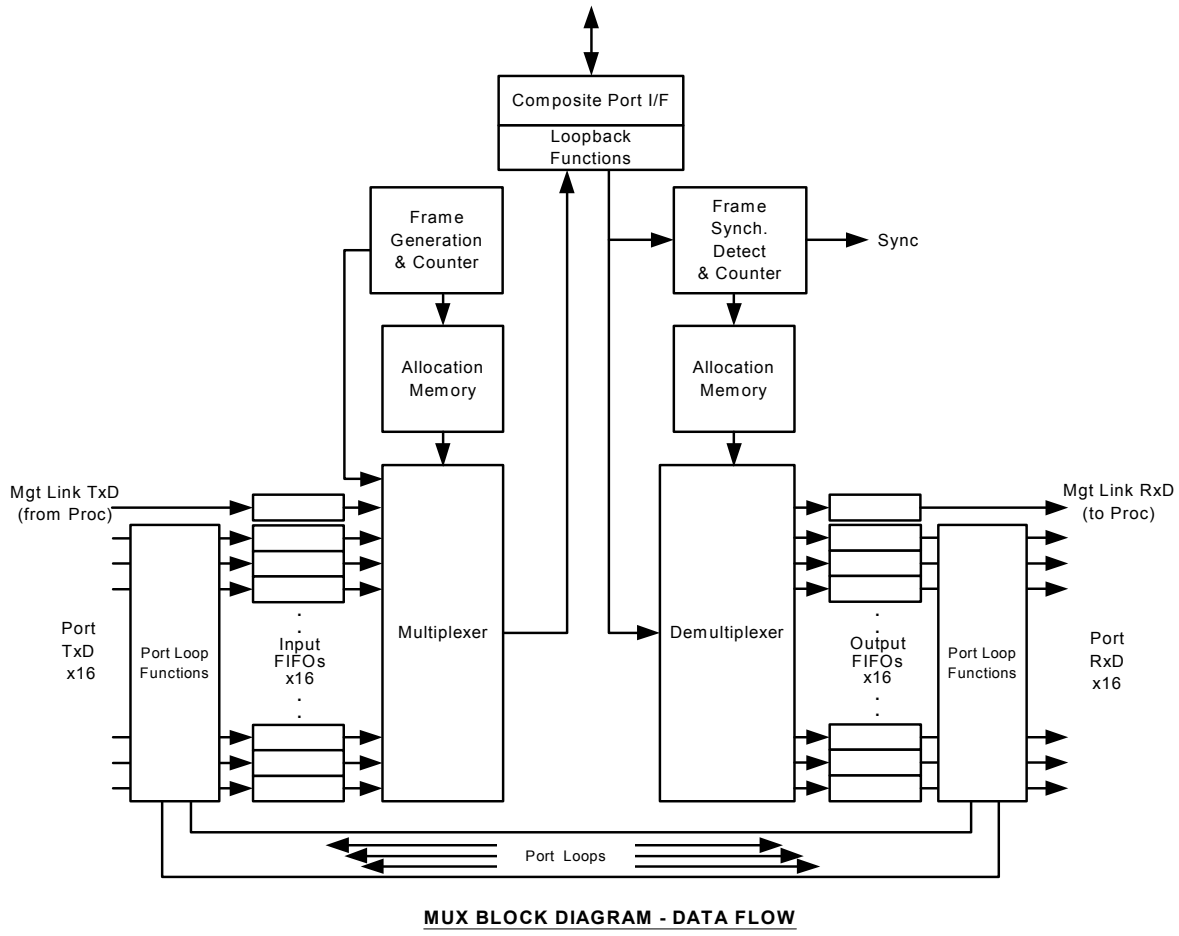


Figure 3 MUX Data Flow Diagram

2.1.1 Multiplexer

The Nx64-MUX incorporates both the ability to multiplex outbound data over the composite link as well as demultiplex the same inbound data stream. Multiplexing is achieved by generating a “frame”, which is a fixed-length, repetitive data pattern.

The frame consists of a frame bit followed by a fixed number of “timeslot” bits, each of which is assigned to a specific data port that has been allocated. As the multiplexer scans across the frame a bit at a time, it inserts a serial bit from the port buffer to which that timeslot bit is assigned. Therefore, the bits forming a channel are always in the same position from frame to frame.

2.1.1.1 Super-Frame

In addition to the basic frame structure, the Nx64-MUX also implements a “super-frame”, which is a fixed whole number of basic frames in a fixed and repetitive pattern. The purpose of the super-frame is twofold: 1) to establish a secondary set of sub-rates which are not a whole-number divisor of the basic frame rate, and 2) to create a sub-channel in the framing bit pattern for transporting management information across a link.

Using a super-frame, frame #1 is transmitted first, followed by frame #2, then frame #3, and so on. When all the frames comprising the super-frame have been transmitted, the process repeats, and the next super-frame is transmitted in exactly the same format.

2.1.1.2 Timeslots and Channel Rates

The number of timeslots assigned to a channel determine the bandwidth of the channel, Since the frame rate is constant, the greater the number of channel bits in the frame, the greater the port rate that can be supported.

The basic frame rate is 8,000 frames-per-second, and each channel bit, or timeslot in the frame provides 8KHz of bandwidth available for allocation to a channel. This allows port rates that are multiples of 8KHz to be supported. For example, 64KHz is 8 x 8KHz, and therefore requires 8 timeslots per frame. In this case, the super-frame format is not involved in multiplexing or demultiplexing the channel port.

Other port rates however are not whole number multiples of 8KHz. These port rates can be considered instead as multiples of 400Hz. By example, 14.4KHz does not divide evenly by 8KHz, but does by 400Hz.

It is the Nx400Hz rates that require the facility of the super-frame. The super-frame is comprised of 20 basic frames in sequential order. Therefore, the super-frame rate is 8KHz / 20, or 400 super-frames-per-second. By indexing to the beginning of the super-frame, a channel can be constructed that uses only specific channel bits in a timeslot to achieve an Nx400Hz rate.

The above concepts are illustrated in the diagram of Figure 4. In this case, a channel port rate of 9.6KHz is shown to occupy two timeslots comprising a total channel bandwidth of 16KHz. Each timeslot has a fixed mapping of used and unused bits depending on its position in the super-frame. In this case there are 24 channel bits in the super-frame that are utilized to construct the 9600bps data channel to the port. An additional bit is also available for transporting control information, and when used, does not require the allocation of an additional 8KHz timeslot.

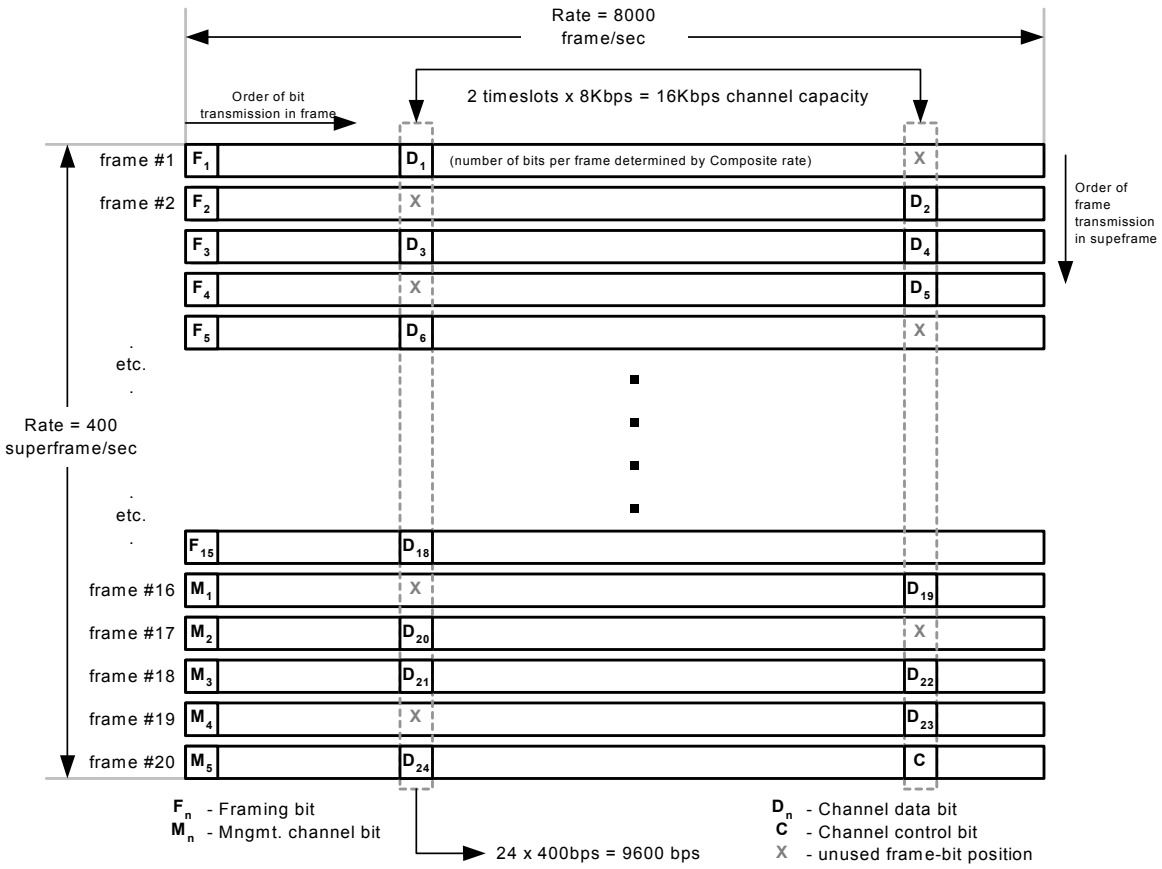


Figure 4 – Frame and Super-frame Multiplexing

All 16 ports may be time-division multiplexed on the composite link, provided there is sufficient link speed to support bandwidth requirements of each channel. A fixed, 8000bps is consumed for the overhead of framing and the embedded management channel. The remaining bandwidth associated with the composite link may be completely allocated among the channel ports.

2.1.2 Demultiplexer

Demultiplexing of the composite data stream is accomplished using the same timeslot channel mapping as used for multiplexing. One difference is that the demultiplexer must first locate the super-frame bit pattern in the data stream as a reference point for all other timeslots that follow. Once the repetitive super-frame bit pattern has been recognized and located, the demultiplexer is said to be in “synchronization” with the remote multiplexer.

Having located the super-frame bit pattern, the demultiplexer can send each arriving bit following the framing bit to the specific channel port buffer to which it is assigned, including the management channel.

2.1.3 FIFO Buffers

Timeslots comprising a single channel need not be evenly distributed throughout the frame (and in fact, seldom are). For this reason, serial data bits associated with a given port are often transmitted and received in patterns of bursts and lulls that is much different than the fixed bit rate of the port.

While the average rate of channel bits on the composite link will always equal that at the port, it is necessary to buffer a small number of bits for each channel between the port and the composite link. These buffers, referred to as “FIFOs” (First-In, First-Out buffers) are memory arrays used for the purpose of regulating the flow of data.

2.1.4 Channel Allocation / De-allocation

Channels are associated with a corresponding port number; thus Port 7 is tied to Channel 7, for example. The user determines which ports to utilize, their interface speeds, and other parameters associated with the port interface or the channel, and then goes about configuring them.

Prior to the channel being allocated, the user is able to freely modify these parameters. However, until the channel is allocated, no data can be exchanged between the two ports at each end of the link. When the channel is allocated, the bandwidth and timeslots are assigned and the port becomes active.

All of the channel and port parameters may be modified after a channel has been allocated. In those cases where the channel bandwidth is altered, either by changing the channel rate or modifying the transport of control status, the system will automatically de-allocate the channel and then subsequently re-allocate the same channel with the new parameters. This will result in a momentary interruption or loss of data while the process takes place, but minimizes the duration of the interruption and eliminates the need for the operator to manually enter the sequence of commands.

The Nx64-MUX has an additional feature that re-allocates channels to new timeslots when the composite link rate is changed by the user. This is particularly important when the composite link rate is decreased, with a corresponding reduction in the size of the timeslot allocation memory. Without re-allocating the port channels to fit in the smaller allocation memory, many of the channels would lose the ability to pass end-to-end data.

2.1.4.1 Non-disruption of Channels

The process of configuration of any particular channel is non-disruptive to the flow of data among other active (allocated) channels. Thus any channel may be allocated, de-allocated, or modified in any of it’s parameters, without risk of disrupting data among those ports which are in use and do not require reconfiguration.

2.1.4.2 Total Bandwidth Availability

Channels are allocated by their required bandwidth, and the total composite bandwidth needed to support all active channels is simply the sum of the channel bandwidth requirement, plus the fixed overhead of 8000bps for framing and the management channel.

When a channel is de-allocated it makes available that same bandwidth, added to any available pre-existing bandwidth, to be used by other channels at a later reconfiguration point.

2.1.5 Management Channel

The Nx64-MUX reserves a fixed sub-channel of 2000 bps for end-to-end, embedded communication between a pair of linked systems. Once both units have become synchronized, this channel is used for system management functions. These functions include remote user configuration, message and command acknowledgments, status reporting, program downloading, and test/maintenance commands.

2.1.6 Composite Port Operation

The composite port carries all end-to-end information between the systems comprising a linked pair of multiplexes. As a DTE interface, a data clock signal(s) at the port is a required input from an attached DCE device. The clock rate must be one of several selectable multiples of 64kHz (see Table 1). Additionally, the Nx64-MUX composite port must be configured to that same rate in order for the internal port clock generators to work properly.

2.1.6.1 Internal Source Clock Timing

It is possible to use the Nx64-MUX as a source of timing on one end of a link. This requires a special cable arrangement as shown in Figure 5 and performing the required configuration steps to program the composite port. In this example, multiplexer 1, on the left, generates a clock signal on TXCE based on the internal crystal oscillator. This clock is used to clock out TxD. On the opposite side, the transmit clock and data signals are crossed over to the receive side and the clock is used to latch RxD. As received, the RxC signal on multiplexer 2 is looped back to the clock source block, and used as the outgoing TXCE. The transmit clock and data signals are crossed over again in the same manner as RxC and RxD, respectively. Thus all clocks are derived from a single source.

COMPOSITE DTE to DTE CONNECTION DIAGRAM

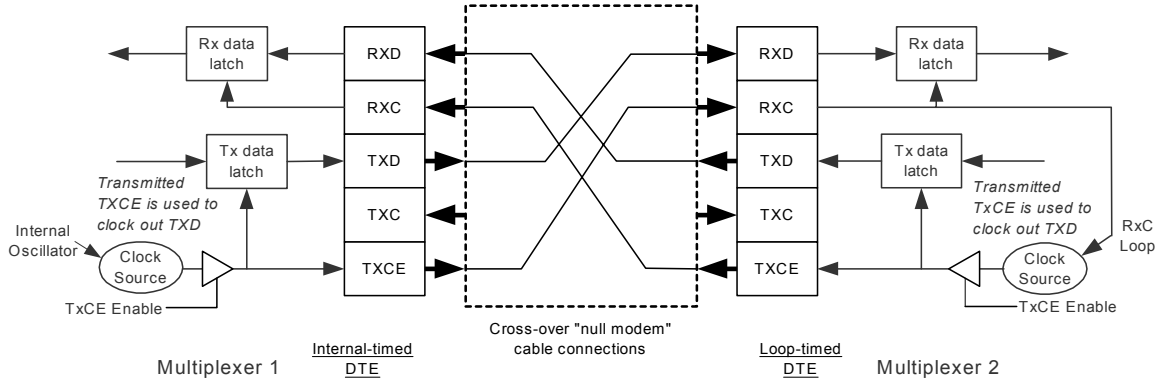


Figure 5 Composite port cable diagram for DTE-to-DTE connections

Other non-symmetrical arrangements based on this approach to connect with transmission equipment requiring an external timing source are possible.

2.1.6.2 Hardware Interface Options

The composite port is configurable for three different electrical interface standards:

1) RS-232
2) V.35 (V.11 and V.24)
3) EIA-530 (also includes RS-449 and X.21 with cable adapter)

These options are programmable and do not require the setting of hardware straps or switches. However, support for standard connectors for V.35, RS-449, and X.21 requires cables, which adapt between the native composite DB-25 connector and the desired interface connector.

2.1.6.3 Link State Option

The composite link may be enabled or disabled by command. When the link is disabled, no information is transmitted, and received data is ignored. Since received data is not recognized, synchronization as reflected in the SYNC status is reset and synchronization is lost. No information can be exchanged between systems via the management channel when the composite link is disabled.

When the composite link is enabled, complete frames are transmitted along with the management channel. The received data is accepted, and if a valid framing pattern is detected, the system will synchronize and begin receiving the management channel data from the remote system.

2.1.6.4 Link Rate Option

The operator may modify the expected received clock rate of the composite port. This may be done on either the local or remote system. In either case, a system that is in synchronization will lose sync until the actual DCE matches the selected rate. Once completed on remote system, a change in the selected clock rate will result in the loss of the management channel and the ability to send any subsequent commands to the remote system until the remote DCE clock matches the selected rate.

For the Nx64-MUX, any parameter entry to the composite link rate causes the system to 1) resize the timeslot allocation memory map to the new frame size, 2) re-allocate all channels with non-zero clock rates to fit in the new allocation map, and 3) stores the complete configuration in non-volatile memory. Channels that have been previously de-allocated, but have a rate assigned to them other than zero, will be re-allocated at the rate assigned, beginning with channel 1 and proceeding in an ascending order up to channel 16.

Should there be insufficient composite bandwidth at the new rate to accommodate all channels at their assigned rates, the system will de-allocate those channels by number higher than last channel allocated, but will leave their assigned rate unchanged. Thus for example, if channels 1 through 12 fit into the new capacity of the composite link at their assigned rates, but channel 13 will not, then channels 13 through 16 will be de-allocated and their assigned rate will remain unchanged. If at a later time, the composite link rate is increased and one or more of channels 13 through 16 can be accommodated, they will be allocated bandwidth at their previously-assigned rate.

As a result of the above channel re-allocation, all channels will potentially be disrupted and cannot be returned to service until both local and remote systems have been given equivalent commands to modify the composite link rate. Even then, unless the channel bandwidth parameters in both systems are identical, channel timeslots will not match. In such cases, the operator should use the “Copy Mixed Configuration to Remote” command (see section 2.2.6.3).

2.1.6.5 Control Signal Leads

The state of the RTS lead on the composite port may be selected by configuration option.

The DTR lead is set ON when electrical power is applied to the system.

2.1.6.6 Composite Port Loop Options

The Composite Port may be put into one of two loop configurations by user command. These two loop modes are termed Receive loopback and Transmit Loopback and are mutually exclusive.

The diagram of Figure 6 illustrates both modes. In receive loopback (left), the same data that is received at the composite port is also sent to the transmit side of the interface in place of the data that is normally sent on the TxD lead.

In transmit loopback (right), the same data that is transmitted at the composite port is also returned to the receive side of the interface in place of the data that is normally received on the RxD lead.

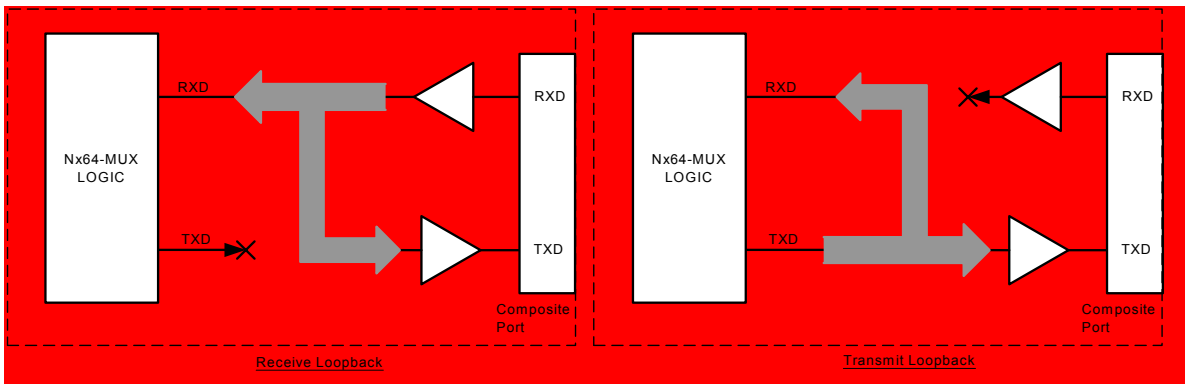


Figure 6 – Composite Port Receive and Transmit Loopback Modes

2.1.7 Channel Port Operation

The 16 channel ports may be configured individually according to their various port options. All ports are implemented as DCE interfaces and provide clocking to the attached terminal equipment.

Any supported channel rate may be configured on any channel, from 9600 bps to 128Kbps, and 9600 bps to 768Kbps for channels 1, 5, 9 and 13. The only remaining limitation being that the aggregate channel rate of all ports may not exceed the available user bandwidth of the composite link. The channel rate applies to both channel port pairs and both ports must operate at the same rate.

2.1.7.1 Hardware Interface Options

Any of the 16 channel ports will operate as RS-232 interface types. In addition, each of the four quad I/O port cards possesses a single port that can be configured as an EIA-530 interface, or a V.35 type interface (RS-449 and X.21 port connectors are supported through an attached adapter cable with EIA-530 operation; V.35 requires an adapter cable for a compatible port connector.)

2.1.7.2 Sync and Async Timing Modes

Each channel port may be configured for operation in either RS-232 synchronous or asynchronous mode. For asynchronous mode, in order to properly set up the port, the user must be aware of the character size and stop, start, and parity settings of the terminal equipment. The bandwidth required on the composite link for asynchronous channels is equal to the baud rate.

Both ports comprising a channel must be configured in identical timing modes (i.e., both sync or both async).

If a channel port is set to operate as an EIA-530 or V.35 interface, it must use synchronous timing.

2.1.7.3 Clocking Option

Although the channel ports cannot accept asynchronous clock timing from an attached device, each port can be configured to receive the transmit clock on the TxCE lead and use this signal for clocking in the data on the TxD lead.

In this case, it is up to the user to configure the attached equipment to synchronize with the outgoing RxC or TxC, otherwise data errors will occur.

2.1.7.4 RTS / CTS Delay Option

An option exists on each channel port to configure the CTS control lead signal level output to follow the RTS control lead signal level input at the port. Various delays may be selected, from zero delay up to 53mS. Additionally, the CTS control lead may be set to either an ON state or an OFF state.

2.1.7.5 DCD Source Option

The DCD (RLSD) control signal lead at the channel port may be configured for one of two modes.

In the first and default mode, the DCD signal follows the state of the composite synchronization detector. Thus if SYNC is ON, DCD at the channel port is ON, and OFF if SYNC is OFF.

In the second mode, the DCD signal may be configured to respond according to the state of the corresponding channel port RTS input at the far end of the link. This configuration option may be set at either end, or both ends of the channel as needed. If the option is set at one end of the channel, the other may be freely set to one of the other two modes.

2.1.7.6 Channel Port Loop Options

Each channel port may be selectively put into three loop mode configurations. The two loop modes are termed Local Loopback and Remote Loopback and may be used singly, or in combination.

The diagrams of Figure 7 illustrate the data paths followed for each of the three combinations of loop modes. In local loopback (top, left), the data that is received at the channel port TxD lead is sent to the RxD lead of the interface in place of the data that is normally sent, while a constant “Mark” signal is sent to the transmit side of the channel.

In remote loopback (top, right), the data that is received from the channel is sent back to the transmit side of the channel in place of data that is normally input from the port TxD lead, while a constant “Mark” signal is sent to the RxD lead.

When both local and remote loopback are invoked, the two loop functions are overlaid with the resulting loop paths as shown in the bottom diagram of Figure 7.

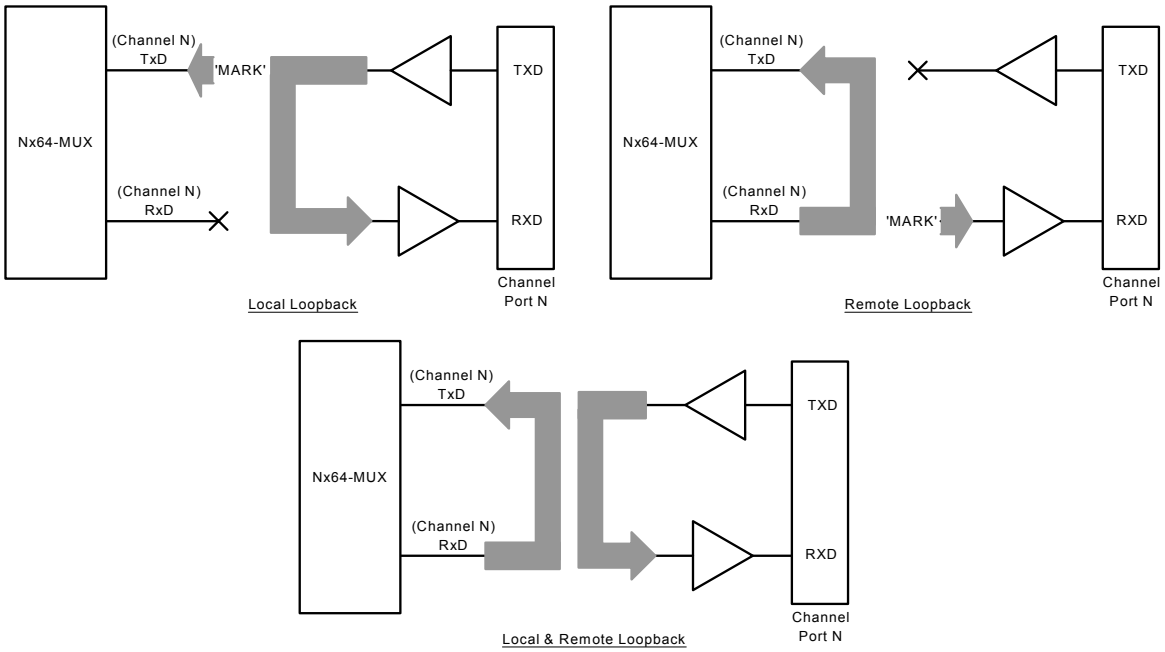


Figure 7 Three Channel Port Loopback Modes

2.2 System Operation

2.2.1 Configuration Management Functions

The configuration management functions are those features to which an operator has access for the purpose of installing, and configuring a working end-to-end multiplexer link. Many of these functions are self-explanatory and are thoroughly addressed in Section 4.2-Console Operation.

However, certain fundamental aspects of the configuration management process are noteworthy and are discussed in the following sections.

2.2.1.1 Local / Remote Systems

When configuring a linked pair of systems, the operator will be using a console attached to one system or the other. Since there are no built-in distinctions between a local and a remote multiplexer, the reference point of local or remote is solely dependent on the point of view from the operator's console. The local system is the one to which the console terminal is attached, and the far-end system is the remote system.

2.2.1.2 Composite Port Configuration

The composite port configuration is critical to the configuration process as a first step for two reasons:

First, by configuring the composite ports and establishing a link between two attached multiplexers, both systems may be configured simultaneously and with compatible parameters.

Second, the composite port rate determines the aggregate bandwidth (and frame size) available to the channels. If channels are allocated prior to establishing the composite port

rate, then they must be re-allocated (repeat de-allocate/allocate steps) in order to map them into the new multiplexer frame size.

Because it is expected that the operator will perform much of the configuration process on linked systems, the ability to configure the composite port on a remote system is restricted. Thus the potential for an operator to inadvertently bring down the link (and the in-band management channel) to a non-recoverable state is reduced.

The ability to change a remote systems composite link rate is not restricted however. The use of this function should be approached very cautiously, as a change in the programmed link rate has the same effect as changing the link clock, i.e., the link will immediately become inoperative until a new common clock has been re-established at the same rate as programmed in both multiplexers.

As another exception for troubleshooting purposes, the Receive Loopback function on the remote composite port is allowed since it can be controlled once invoked.

2.2.1.3 Channel and Port Configuration

While a channel is an end-to-end entity, a port is physically independent and separately configurable on each end of the channel. This distinction is important, because it means that the operator need only make changes to channel parameters (i.e., rate and channel state) once on linked systems, and there is no local or remote viewpoint for these parameters.

One exception to the above statement is that of the option for the DCD source on any Nx8K (i.e., 56Kbps and higher) channel rates (see section 2.1.7.5 – DCD Source Option). When the DCD source for a port is selected to follow the far-end RTS, an additional 8Kbps of channel bandwidth is added to carry the control signal end-to-end. While bandwidth is added in both directions, only the port selected to respond to the RTS from the opposite end of the channel will operate in this mode. If this option is changed while the channel is allocated, there will be a momentary disruption of the channel data as the system re-configures the channel.

For port parameters, local and remote ports must be configured separately. However, both local and remote ports may be configured in the same session from either end of the multiplexer link.

NOTE: Two unlinked systems, whose channels have been configured with identical parameters in separate sessions, may not pass end-to-end channel data correctly when they are subsequently linked. Without coordinating the channel allocation sequence between linked systems via the management channel, multiplexer frame maps are not likely to match.

2.2.2 Non-volatile Parameter Storage

Operating configuration parameters for the Nx64-MUX that are modified by the user are first written in random-access-memory (RAM). As long as the power is not turned off or the mux is not reset, the system will continue to work with these parameters in effect. This is referred to as the “working configuration”.

When the user is satisfied with the working configuration parameters as they are set, or simply wishes to save the working configuration for a later editing session, that configuration may be stored in non-volatile (FLASH) memory. Once saved, the same configuration will be restored to RAM each time the power is turned on or a system reset occurs. This configuration is called the “stored configuration”.

One exception to the preceding paragraph occurs in the case of channel loopback functions. Both local and remote channel loops when put into effect by the user via a menu option, are immediately stored in FLASH memory. Therefore, it is not necessary to save a channel loopback state to preserve it’s status in the event of a power loss to the system.

Other commands available to the user also result in storing the working configuration to FLASH memory. These include the commands “Copy Configuration to Remote”, “Enter Node ID”, and modifying the Composite Link Rate. In most cases, the storing of configuration information is synchronized on both Local and Remote systems, via the management channel.

A diagram illustrating the operations which result in changes to the working and stored configurations and the effect on both local and remote systems may be found in Appendix section 5.4-Configuration Storage.

2.2.3 Null Configuration Reset

A working configuration may be erased and returned to a default non-functional condition through a null configuration reset. This operation de-allocates all channels, resets all channel ports to a standard default condition, and disables the composite port on the local system.

This operation does not erase the configuration stored in FLASH memory

NOTE: The null configuration reset operation affects only the LOCAL system. Thus channels that are allocated on the remote system will appear unallocated on the local system. This command should only be used as a last resort in order to re-initialize a configuration that cannot be easily rectified. In most cases, this operation should be performed on both local and remote systems before proceeding to build a new configuration.

2.2.4 System Reset

A system reset results from either 1) powering up the system, or 2) a *System Reset* command. A system reset command performs identically the same functions as a power-on reset, without having to cycle the power.

When a system reset occurs, the firmware containing the operational programs, including the program for the hardware, are loaded from FLASH memory into both RAM and the FPGA, respectively, where they are executed and reside until the power is removed.

Upon a system reset, configuration data is also loaded from FLASH memory into the working configuration maintained in RAM, where it may be modified under user control over the course of operation. If a modified working configuration has not been previously stored in FLASH memory, the modification will be lost after a subsequent system reset command.

2.2.5 Configuration Backup and Restoral to File

Two separate processes allow the working configuration of an Nx64-MUX system to be stored to a disk file on a computer, and, to allow a previously stored disk file to replace the stored configuration within a system. Together these two processes constitute configuration backup and restoral and are useful to reduce the time required to configure a system that does not conform to a desired configuration.

The process of configuration backup and restoral is detailed in sections 4.2.6.2 and 4.2.6.3.

2.2.6 Configuration Copy Commands between Local and Remote Systems

A configuration stored on a system may be copied by command to a remote system across an operating link. Before this operation may take place, both systems must be in synchronization with each other to allow the management channel to transport the configuration data from one system to the other.

2.2.6.1 Copying the Local Configuration to the Remote System

Using this command, all parameters of the local system’s working configuration are sent to the remote system and copied into that system’s stored configuration. At the same time the

local system also performs a store operation of the working configuration, such that both systems have identical stored configurations.

It should be noted that individual port configuration parameters are also copied to the remote system and duplicated, as these will often need to be configured differently on local and remote ends of the channel. See section 2.2.6.3.

2.2.6.2 Copying the Remote Configuration to the Local System

Using this command, all parameters of the remote system's working configuration are requested and received by the local system and copied into that system's stored configuration. . At the same time the remote system also performs a store operation of the working configuration, such that both systems have identical stored configurations.

It should be noted that individual port configuration parameters are also copied to the local system and duplicated, as these will often need to be configured differently on local and remote ends of the channel.

2.2.6.3 Copying a Mixed Configuration from a Local to Remote System

Using this command, the configuration parameters of the local system are copied to the remote in a similar manner as described in section 2.2.6.1 above, with the following difference:

Remote port parameters that have been stored in non-volatile memory on the local system and which may differ from those of the local system, are sent to the remote system to become that system's new port parameters.

The stored parameters for the remote system are gathered by the local system automatically and periodically while the systems are linked, but are only stored in non-volatile memory as the result of an operator command. Therefore, the restoral of remote port parameters using this command, will only be to the state that existed prior to the most recent working configuration store operation.

The automatic gathering of remote port parameters as described applies to both systems, as either may be regarded as remote or local at different times, relative only to the end of the link at which commands are entered.

2.2.7 Copying the Operating Systems from a Local to Remote System

Three menu commands provide the ability to update the operating system (firmware) on a remote system. Because of the possibility of a download of such a large file and the difficulty of reversing an update to the operating system once it has been committed to FLASH memory, the command for copying the operating system across the management channel does not store the result in FLASH memory.

To completely update the operating system on the remote system, the operator must first execute the Copy Local Operating System to Remote command. This saves a copy of the local operating system in a temporary area of RAM. **NOTE**: If this step fails to complete properly, the operator should not attempt to soft boot the remote system.

If the first step completes successfully, the next step is to execute the Soft Boot Remote System command. This results in the just-saved firmware replacing the operating system in RAM, and restarting execution with the new operating system. **NOTE**: If the remote system does not give an indication that it has accepted the soft boot and is working normally, the operator may revert to the current remote operating system by insuring that the remote system is reset, either by command, or a power cycle. The remote system will then re-boot from FLASH memory.

Once the remote system has successfully soft booted and is operating in sync with the local system, the final command to Copy Remote Operating System to Flash is executed. This step preserves the new operating system in non-volatile memory, such that it will always be executed after a reset or a power cycle. **Note**: An operator should never execute this final if there is any doubt that the new operating system is functioning correctly

2.2.8 Time and Day Clock

Each system possesses a day and 24-hour time clock that is initialized with a system reset (by command or power-on), or by explicitly setting the time manually via a menu selection and entry.

Since the clock is not an internal battery-backed calendar clock, the system reset initializes the time to “000 00:00:00.00”, based on a format of: ddd hh:mm:ss.ss. Days are numbered sequentially in decimal notation, beginning with day 000.

When the time is set manually, only the hour (0-23) and minute (0-59) fields may be set by the operator.

2.2.9 Node ID Information

A unique node name, of up to 20 alphanumeric ASCII characters, may be entered into the non-volatile memory of each system in order to identify that system in the customer’s network.

The node id is displayed on the second line of every menu screen.

2.2.10 Log-In, Log-Off and Change Password

When the system is powered-on, or after a reset command, the operator must login in order to access the management system. Once logged in, the operator may change the password at any time via the Change Password command on the Log In Menu.

The system is initially programmed with the password “default” when shipped from the factory. This permits the operator the means to initially login and establish a personal password.

If the password is lost, the customer should contact East Coast Datacom, Inc. for instructions on how to gain access to the Change Password screen entry function.

3 Hardware Installation

The Nx64-MUX system hardware is designed for ease of installation and maintenance. The following sections provide important details on the physical design of the system and proper utilization of these design features. Front and rear views of the complete Nx64-MUX system are shown in Figure 8. Systems with optional power supply redundancy are shown in Figure 9. Redundant systems differ from non-redundant systems only in physical dimensions and the number of power supplies and AC power connectors.

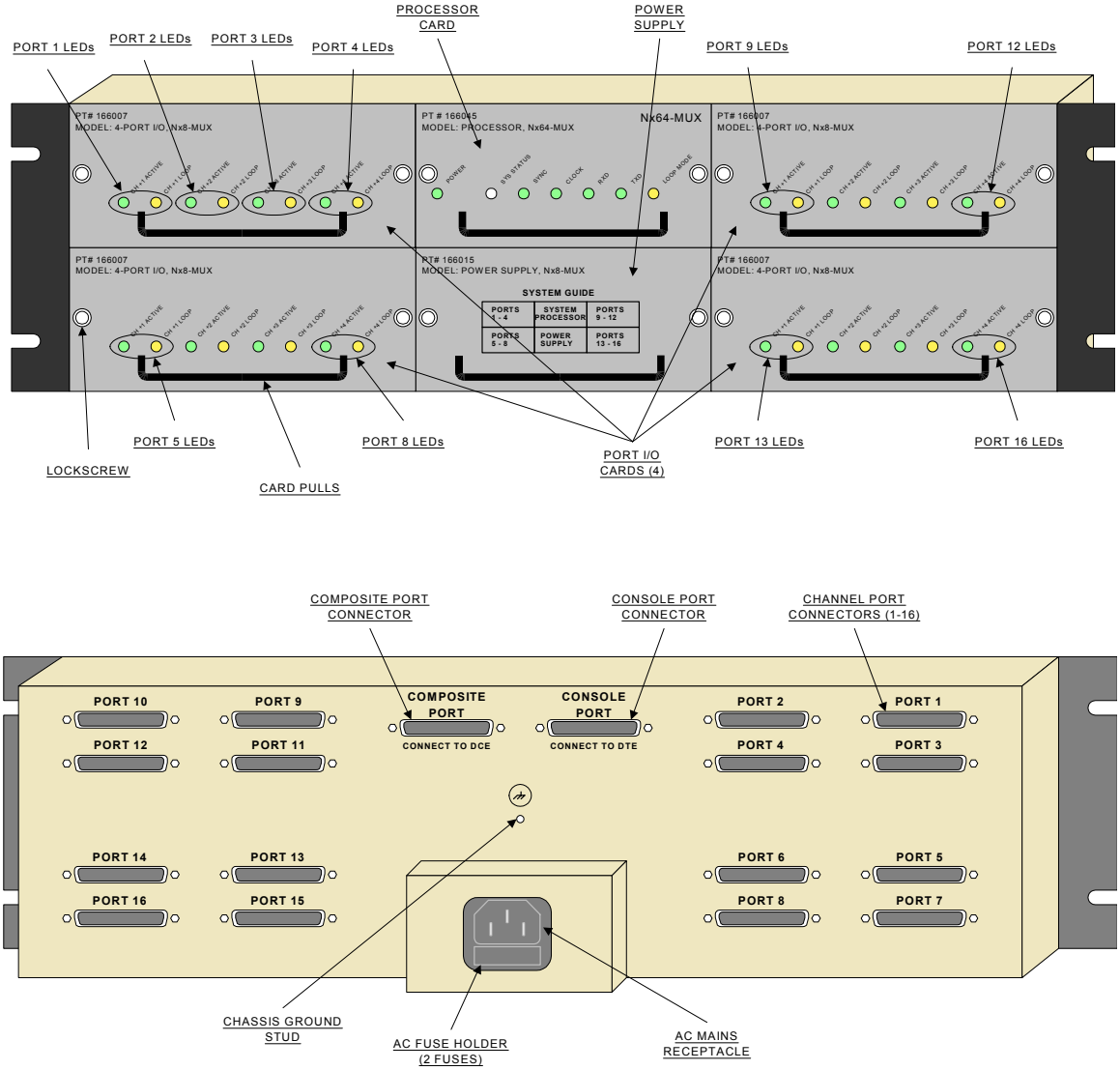


Figure 8 Front and Rear Views of the Nx64-MUX

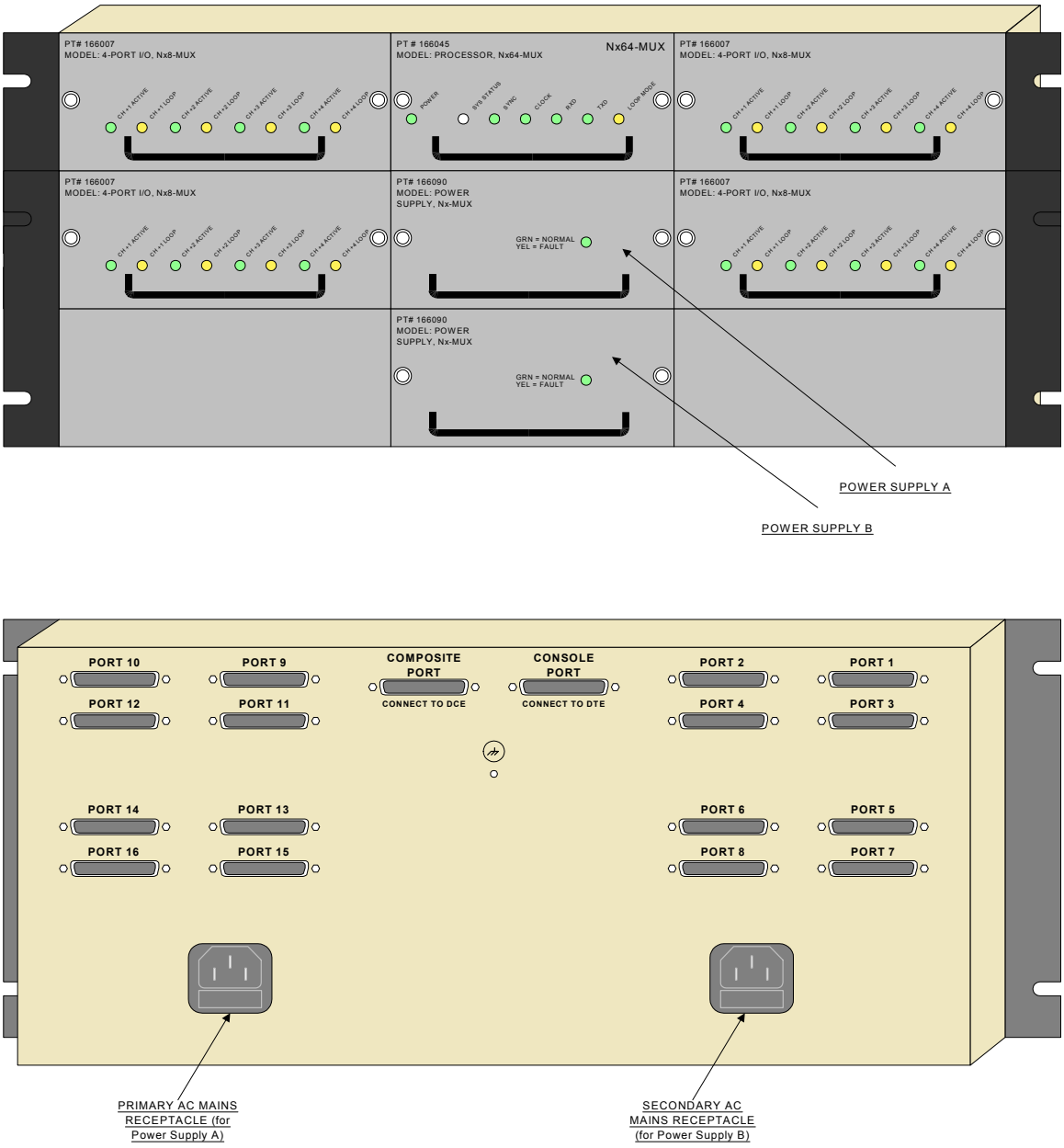


Figure 9 Front and Rear Views of the Nx64 MUX with optional Power Supply Redundancy

The Nx64-MUX system is comprised of the following user-accessible modules:

Main Chassis
Power Supplies (1 or 2)
Processor Card, Nx64
Port I/O Cards (4)

3.1 Main Chassis

The main chassis includes support for AC mains power entry and distribution, backplane interconnections of signals and DC power, external port connectors, and mechanical support for all replaceable cards. Other than the fuse holder, no part of the main chassis should be disassembled or removed by the user at any time

3.1.1 AC Mains Power

The Nx64-MUX accepts power from 85 to 264 VAC, and from 47 Hz to 63 Hz. Power entry is by means of a standard 3-prong AC line cord with an Earth ground as the 3rd conductor.

NOTE: It is very important that the Earth ground be connected to a suitably grounded outlet.

The IEC Power Entry Module also contains a dual fuse holder. The following fuse ratings are required for proper and safe operation:

90 - 250V AC, 50/60 Hz:

3.15 Amp, Slow-Blow, Low Clearance, 5mm x 20mm

3.1.2 Chassis rack-mounting

The main chassis is supplied with integral mounting brackets for 19-inch rails. Four mounting bolts are needed to fasten the unit in the rack. The chassis requires 3U (5.25”) of vertical rack space for the standard system, and 5U (8.75”) for the redundant power system.

Optional brackets for 23” rails are available from East Coast Datacom, Inc.

3.1.3 Thermal requirements

No special or external forced-air cooling is required. The Nx64-MUX system is designed to be convection-cooled, provided that the ambient temperature meets the system specification and that airflow at the bottom and top cooling vents are not obstructed.

To prevent obstruction, a solid horizontal surface should not be present any closer than 0.5 “ to the bottom of the chassis, nor any closer than .25” to the top of the chassis. In addition, care should be taken to insure that airflow from the at least three sides of the unit is preserved when obstructing surfaces are present. The diagram of Figure 10 depicts obstructions above and below an Nx64-MUX and shows that three sides are open to allow inflow and outflow of ambient air.

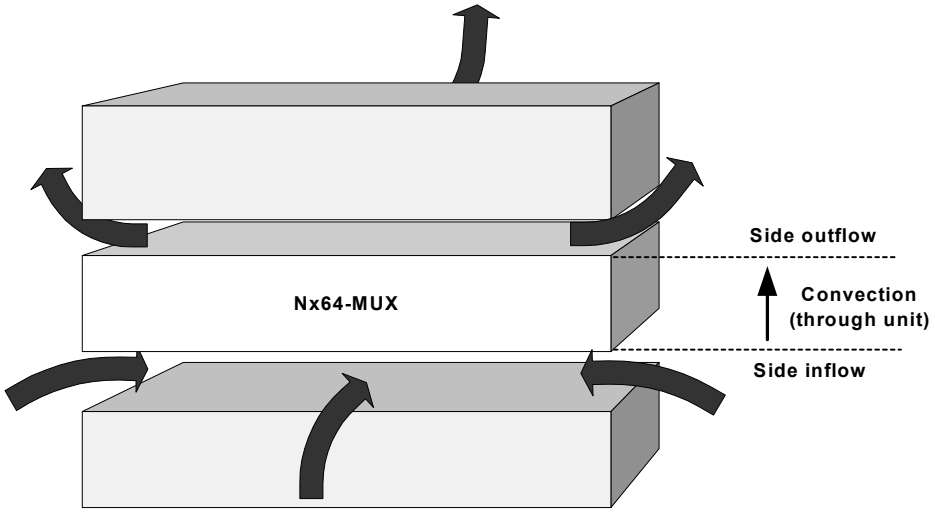


Figure 10 Airflow around obstructions

3.2 Power Supply Modules

The power supply is a user-replaceable, plug-in module that furnishes DC power to the system derived from the AC power source. All power buses that interconnect the system modules are distributed via the internal backplane. Power supplies may be either single, or 1:1 redundant, depending on the type of system shipped.

In non-redundant power systems, the power supply module also has a system guide printed on it's front panel to assist the operator in the relative location of the six modules and their respective ports as viewed from the front of the system.

3.2.1 Power Supply Replacement

NOTE: Except for Redundant Power systems, AC power to the supply must be disconnected prior to removing a power supply module from, or inserting a power supply module into the main chassis.

The power supply may be removed by unlocking the plug-in module via the two front panel locking screws, and pulling on the handle to slide the module out of the chassis.

Upon replacement of the power supply the user should insure that the power supply slide rails are inserted into the rails on either side of the power supply slot position in the main chassis. Once aligned in this way, the power supply may be pushed completely into the main chassis. The power supply must then be securely fastened in place by tightening the two front panel locking screws.

3.3 Processor Card

The processor card provides storage and execution of all programmable system and multiplexing functions, except those related to the channel port electrical interfaces and converters. The processor card maintains in its memory the program and configuration data in non-volatile storage. Although power cycles will not result in loss of this data, replacement of the processor card with another card will introduce the program and configuration stored on the new card, which may be different from that stored on the original card.

3.3.1 Processor Card Replacement

The processor card may be replaced with power applied to the system, but it is recommended that the process of removal and insertion be carried out with **AC power OFF**. There is no information preserved by keeping the AC power on the system while the processor card is replaced.

The processor card may be removed by unlocking the plug-in via the two front panel locking screws, and pulling on the U-shaped card pull mounted on the front panel.

Upon replacement of the processor card the user should insure that the card edges are aligned with and inserted into the card guides on either side of the processor card slot position in the main chassis. Once aligned in this way, the processor card may be pushed completely into the main chassis. The processor card must then be securely fastened in place by tightening the two front panel locking screws.

3.4 Port I/O Cards

The port I/O cards (4 per system) comprise the circuits that provide electrical conversion between the channel ports and the multiplexer logic, and perform some of the data formatting (e.g., Sync-Async conversion).

3.4.1 Port I/O Card Replacement

The port I/O cards are designed to be hot-swappable. While power is applied and the Nx64-MUX system is operational, the user may remove and replace a port I/O card without disruption to the normal flow of data across other active channels and the composite port. After replacement, the system will re-program the new port I/O card according to the working configuration stored in RAM on the processor card.

The port I/O card may be removed by unlocking the plug-in via the two front panel locking screws, and pulling on the U-shaped card pull mounted on the front panel.

Upon replacement of the port I/O card the user should insure that the card edges are aligned with and inserted into the card guides on either side of the port I/O card slot position in the main chassis. Once aligned in this way, the port I/O card may be pushed completely into the main chassis. The processor card must then be securely fastened in place by tightening the two front panel locking screws.

3.5 Troubleshooting

The intent of troubleshooting the Nx64-MUX is to isolate a problem and determine if it may be resolved through the replacement of a system module or cable rather than the entire system.

3.5.1 Basic System Checks and Operation

The decision tree of Figure 11 illustrates the steps to determine the corrective action for a basic system fault. Most problems of this nature can be resolved by exchange of one of the replaceable plug in sub-assemblies. In rare instances, the system may need to be returned to the factory for repair.

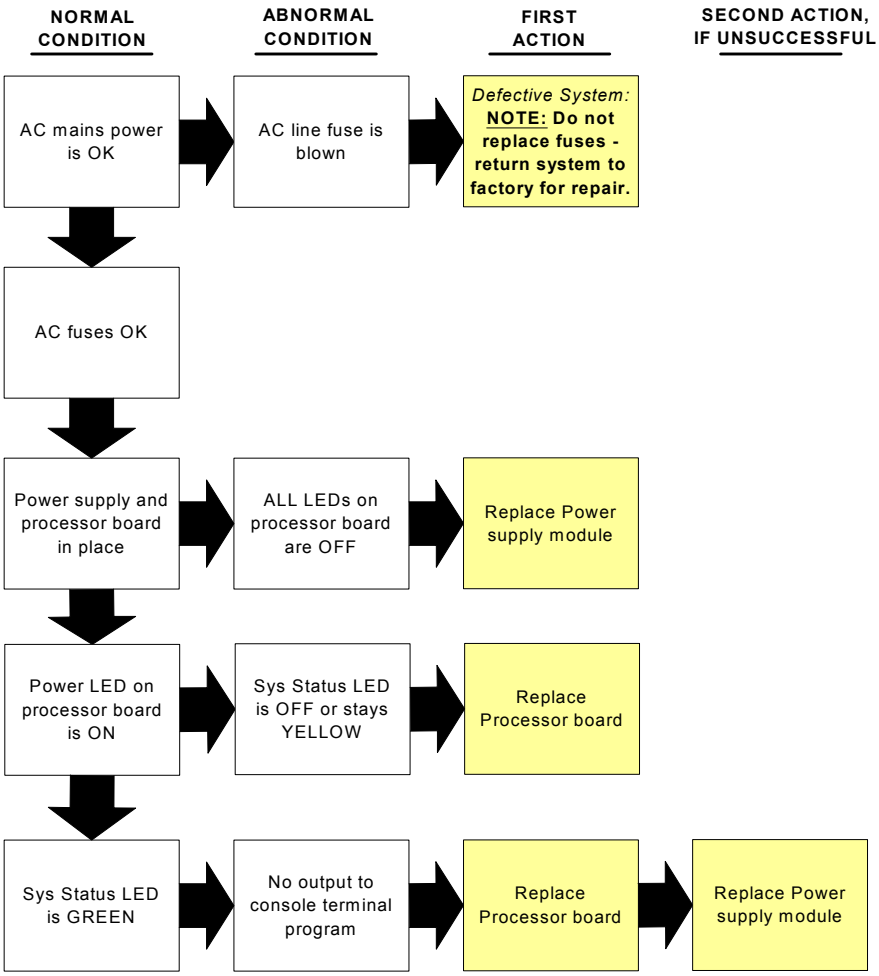


Figure 11 Basic System Troubleshooting

Once the system is capable of communication with the user via the console terminal port, problems related to composite and channel port I/O can often be isolated to a single port.

It is important to always check the operating configurations of the Nx64-MUX and attached terminal and communications equipment as a first step in determining the source of a problem, since compatibility errors are easy to create by incorrectly entering parameters or placing strapping options.

Often cables may be quickly checked by swapping with known good ports of identical configuration and testing for similar behavior.

Should a problem be suspected to exist in the port hardware of the Nx64-MUX, it is reasonable that the user would replace the card in question, either the port I/O card for a channel port, or the processor card for the composite port, in an attempt to resolve the problem.

When replacing cards in the system, the user should always try to replace the suspected card or module with one that is known to be in working order.

4 User Interface

4.1 Indicators

4.1.1 Processor Card

The Processor card has seven LED indicators on its front panel as shown in Figure 12. Each indicator's definition is as follows:

POWER (Green) – When ON indicates that the power supply is providing regulated DC power to the system. **IMPORTANT NOTE: If this indicator is OFF, the operator should check before assuming that AC Mains power is not applied to the system.**

SYS (Bi-color; Yellow and Green) – General system status. When Green, indicates the system is functioning in the absence of detected faults. When Yellow, indicates that the system has detected an operational fault, or, is in the process of determining system status following a power-on cycle or system reset. When OFF, the system is either in a continuous reset state, or has failed and is non-functional.

SYNC (Green) – When ON indicates that the received composite link framing signal has been correctly detected and the local unit is in synchronization with the remote unit.

COMP CLOCK (Green) – When ON indicates the presence of BOTH a receive and transmit data clock on the Composite port interface. If this indicator is OFF, then either one or both clocks are missing.

COMP RX DATA (Green) – When ON indicates the presence of signal activity on the Composite port interface receive data lead. A constant mark or space condition on the data lead will result in the indicator turning OFF.

COMP TX DATA (Green) – When ON indicates the presence of signal activity on the Composite port interface transmit data lead. A constant mark or space condition on the data lead will result in the indicator turning OFF.

COMP LOOP (Yellow) – When ON indicates that the composite port is either in the Transmit or Receive Loopback Mode. When Flashing (~ 1 sec.) indicates that the corresponding *remote* composite port is in either Transmit or Receive Loopback Mode.

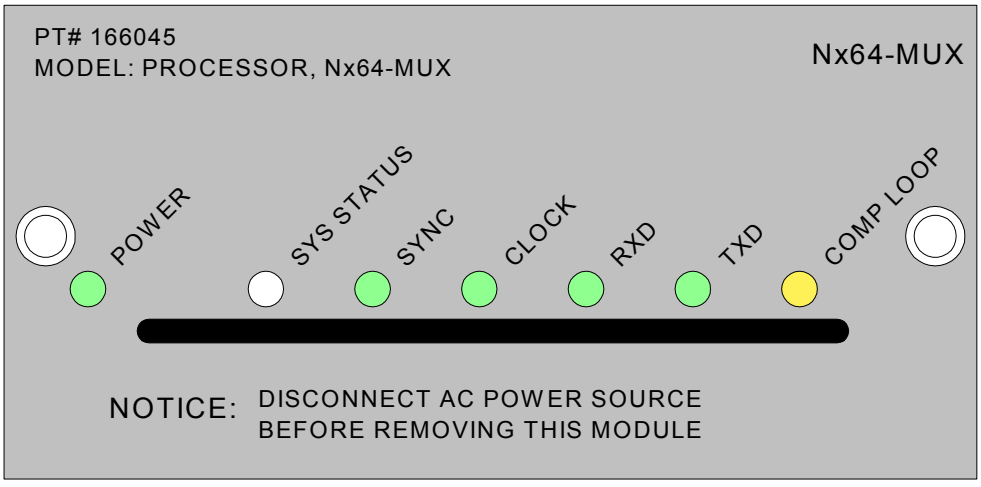


Figure 12 Processor Card Front Panel

4.1.2 Port I/O Card

The Processor card has eight LED indicators on it's front panel as shown in Figure 13, arranged in four groups of two LED's each. The meaning of each pair of indicators is the same, although each pair applies to a different port. Each pair of indicator's definition is as follows:

CH +n ACTIVE (Green) – When ON indicates that the corresponding port is allocated end-to-end channel space, or bandwidth, by the multiplexer. When Flashing (~ 1 sec.) indicates the same as ON except that SYNC is not valid and therefore inbound data cannot be demultiplexed. In this case the channel received data at the port and the transmitted data to the multiplexer is substituted with a MARK condition.

CH +n LOOP (Yellow) – When ON indicates that the corresponding *local* channel port is in one or both of the Local or Remote channel loopback modes. When Flashing (~ 1 sec.) indicates that the corresponding *remote* channel port is in one or both of the Local or Remote channel loopback modes

The notation of "+n" refers to the index number associated with each pair of indicators. These numbers may be added to the Port I/O card group number (i.e., 0, 4, 8, and 12) to determine the port number to which the indicator corresponds.

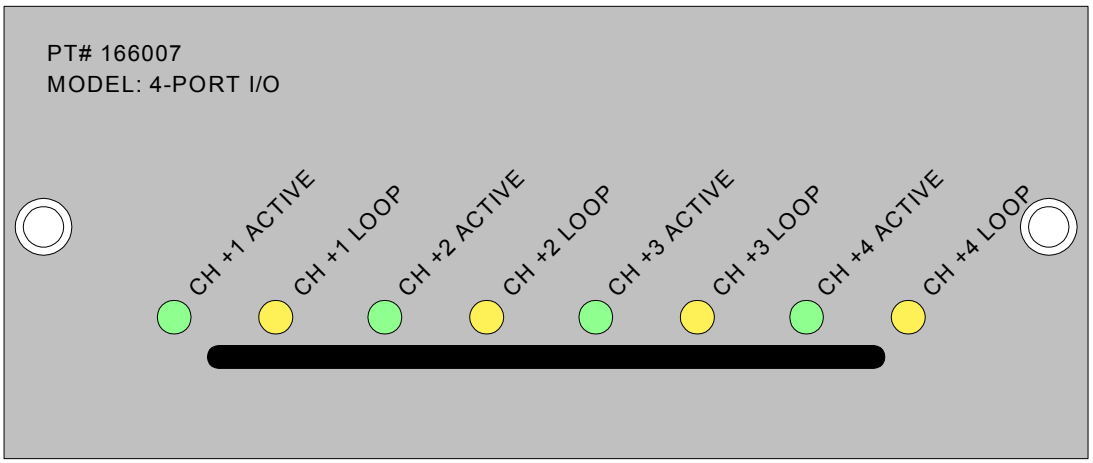


Figure 13 Port I/O Card Front Panel

4.1.3 Redundant Power Supply

In systems configured with redundant power supplies, the front panel of each supply has a single two-color (green/yellow) LED that indicates the operational state of the associated DC power supply.

When the indicator is Green, the power supply is functioning normally and is capable of powering the system alone should the alternate supply fail. When the indicator is Yellow, the power supply has either failed or has lost the ability to provide sufficient DC power.

4.2 Console Operation

Managing the operation, configuration and status of the Nx64-MUX requires the connection of a terminal via the Console Port. Through the terminal interface, the user is presented a series of hierarchical menus through which options are selected.

The hierarchical menu structure is depicted in Figure 14. Menu choices are either additional menus providing a further detail of user choices, or are parameter options. The diagram displays menus that lead to further menus as rectangles with pointed bottoms, whereas menus allowing parameter selection are rectangles with the parameter options listed directly beneath the rectangle.

4.2.1 Console Setup

The Console Port of the Nx64-MUX has hardware interface characteristics as shown in the following table, which may be noted when configuring a terminal emulation program such as HyperTerminal:

Elec. Interface	RS-232, DCE
Timing	9600 Baud
Connector	DB-25, Female
Format	Async, 8bit data, No parity, 1Stop bit
Flow Control	None

Table 2 – Console Terminal Interface Settings

Additionally, the Nx64-MUX console interface is designed to echo characters as they are received from the terminal, therefore the terminal or emulation program should not locally display characters as they are sent.

4.2.1.1 Console Connection and Session Initiation

A standard RS-232 modem interface cable between the Nx64-MUX and the PC or terminal is used for console connectivity. Once connected, with the terminal or emulation program running and the Nx64-MUX powered on, communication between the operator and the system is enabled.

Upon power-up of the system, the Nx64-MUX outputs an initialization banner to the console, similar to the following:

16-Port Nx64 Multiplexer Firmware Rev N.n

East Coast Datacom Jan. 1, 2003

Initializing...Configuring Hardware...

At this point the system executes a self-checking and initialization process for several seconds, during which the SYS STATUS indicator on the front panel is illuminated yellow. At the end of this process if everything has proceeded normally, the SYS STATUS indicator is

changed to green and the system outputs the Top-level System Menu, similar to the following:

```
TOP-LEVEL SYSTEM MENU (Nx64)
NODE ID = xxx

[1] - Composite Configuration Menu
[2] - Channel Selection Menu
[3] - Test/Maintenance Menu
[4] - System Functions Menu
[5] - Menu Help

STATUS: Sync Status: Not Synced
TIME:   Day 000  0:00:13.97
 ENTER: _
```

NOTE: If the console connection is made or the terminal window is brought up after the Nx64-MUX system has been powered-up, the terminal window will not likely show any message activity until the operator sends an appropriate keystroke sequence to the system. If the system is operating correctly, entering a <RETURN> key is the most direct method to cause the system to resend a new menu screen to the terminal.

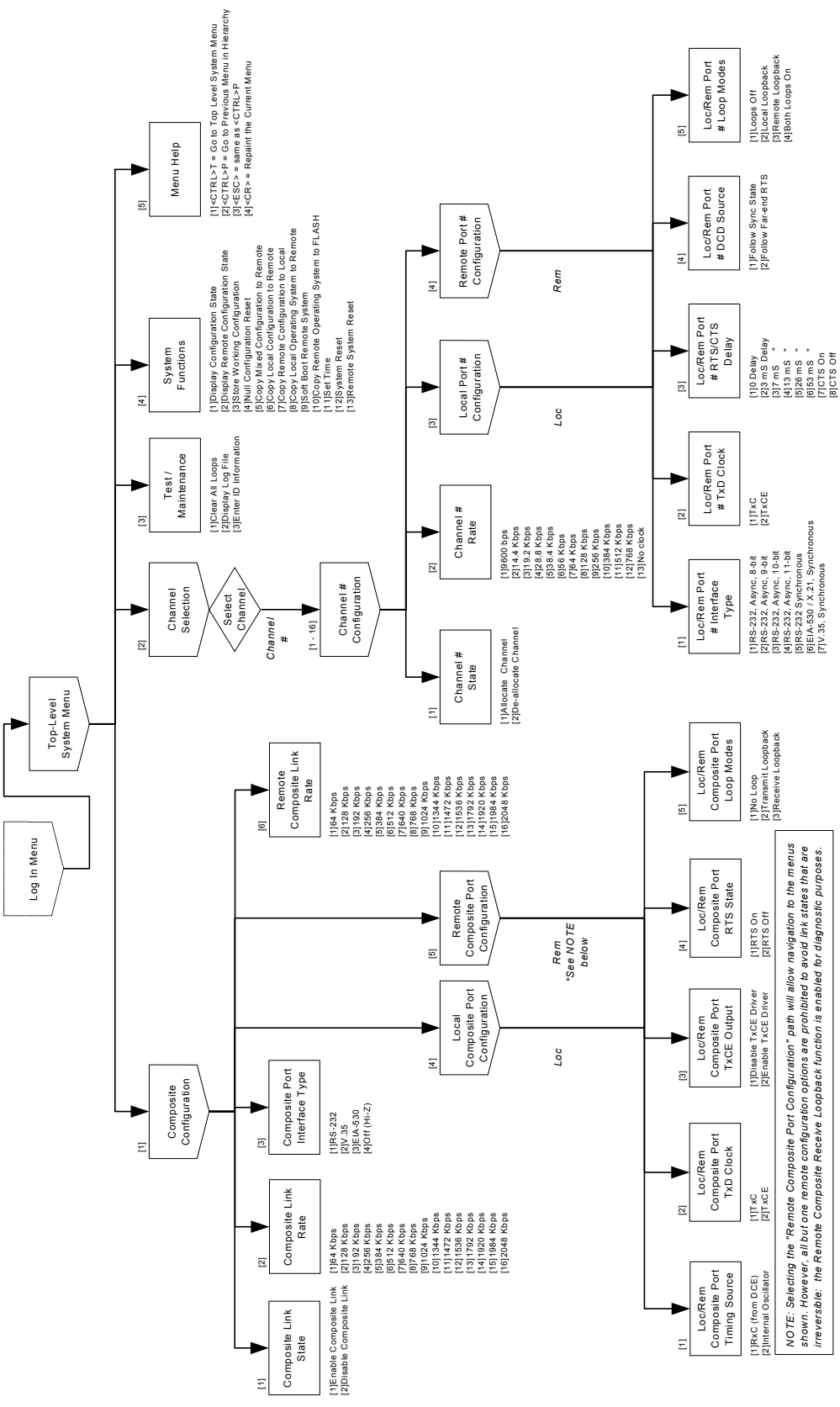


Figure 14 Menu Hierarchy

4.2.2 Menu Screens and Navigation

The following diagrams of this section represent information that is displayed in the terminal window of a terminal emulation running on a PC, or the screen of a dumb terminal. Each "menu" that is selected replaces the previous menu, and offers additional selection options.

The user may move from one menu to another by making selections, following the hierarchical flow depicted in Figure 14, or may use certain control codes to "jump" between menu screens. The control codes are as follows:

<CTRL>T – Return to the Top-Level System Menu

<CTRL>P or <ESC> – Return to the Previous menu in the hierarchy

<RETURN> - Repaint the Current menu

4.2.2.1 Top-Level System Menu

TOP-LEVEL SYSTEM MENU (Nx64)
NODE ID=xxx

[1] – Composite Configuration Menu
[2] – Channel Selection Menu
[3] – Test / Maintenance Menu
[4] – System Functions Menu
[5[- Log Off
[6] – Help

STATUS: Sync Status
TIME:

ENTER: _

4.2.2.2 Composite Link Configuration Menu

COMPOSITE CONFIGURATION
NODE ID=xxx

[1] – Link State
[2] – Link Rate
[3] – Port Type
[4] – Local Composite Port Configuration
[5] – Remote Composite Port Configuration
[6] – Remote Composite Link Rate

STATUS: Sync is <ON/OFF>

ENTER: _

4.2.2.3 Composite Link State Menu

COMPOSITE LINK STATE MENU NODE ID=xxx [1] – Enable Composite Link [2] – Disable Composite Link
STATUS: Link is <ENABLED/DISABLED>
ENTER: _

4.2.2.4 Composite Link Rate Menu

COMPOSITE LINK RATE NODE ID=xxx [1] – 64 Kbps [2] – 128 Kbps [3] – 192 Kbps [4] – 256 Kbps [5] – 384 Kbps [6] – 512 Kbps [7] – 640 Kbps [8] – 768 Kbps [9] – 1024 Kbps [10] – 1344 Kbps [11] – 1472 Kbps [12] – 1536 Kbps [13] – 1792 Kbps [14] – 1920 Kbps [15] – 1984 Kbps [16] – 2048 Kbps
STATUS: Current Local Rate = <COMP_RATE>
ENTER: _

Note 1: The Composite Link Rate menu will only modify the link rate of the local multiplexer.

Note 2: After modifying this parameter, the local system will re-allocate channels in ascending order, and store the local configuration.

4.2.2.5 Composite Port Interface Type Menu

COMPOSITE PORT INTERFACE TYPE NODE ID=xxx [1] – RS-232 [2] – V.35 [3] – EIA-530 [4] – OFF (Hi – Z)
STATUS: Composite Port Type = <C_PORT_TYPE>
ENTER: _

4.2.2.6 Local/Remote Composite Port Configuration Menu

<LOCAL/REMOTE> COMPOSITE CONFIGURATION MENU NODE ID=xxx [1] – Timing Source [2] – TxD Clock Signal [3] – ExtClk/TT Clock Driver [4] – RTS Signal State [5] – Loop Modes
STATUS: Configuring <Local/Remote> Unit
ENTER: _

4.2.2.7 Local Composite Port Timing Source Menu

LOCAL COMPOSITE PORT TIMING SOURCE NODE ID=xxx [1] – RxC (from DCE) [2] – Internal Oscillator
STATUS: Local Source = <RxC / Internal>
ENTER: _

4.2.2.8 Local Composite Port TxD Clock Selection Menu

LOCAL COMPOSITE PORT TXD CLOCK NODE ID=xxx [1] –TxC [2] –TxCE
STATUS: Local TxD Clock = <TxC / TxCE>
ENTER: _

4.2.2.9 Local Composite Port TxCE Output Menu

LOCAL COMPOSITE PORT TXCE OUTPUT NODE ID=xxx [1] – Disable TxCE Driver [2] – Enable TxCE Driver
STATUS: TxCE Clock Driver is <Enabled/Disabled>
ENTER: _

4.2.2.10 Local Composite Port RTS State Menu

LOCAL COMPOSITE PORT RTS STATE NODE ID=xxx [1] – RTS On [2] – RTS Off
STATUS: RTS State = <Off/On>
ENTER: _

4.2.2.11 Local Composite Port Loop Modes Menu

LOCAL COMPOSITE PORT LOOP MODES NODE ID=xxx [1] – No Loop [2] – Transmit Loopback [3] – Receive Loopback
STATUS: Loop Mode = <OFF/TxLoop/RxLoop>
ENTER: _

4.2.2.12 Remote Composite Port Timing Source Menu

This menu will appear but operation will be inhibited, with the status line: “Remote Configuration not allowed”.

4.2.2.13 Remote Composite Port TxD Clock Selection Menu

This menu will appear but operation will be inhibited, with the status line: “Remote Configuration not allowed”.

4.2.2.14 Remote Composite Port TxCE Output Menu

This menu will appear but operation will be inhibited, with the status line: “Remote Configuration not allowed”.

4.2.2.15 Remote Composite Port RTS State Menu

This menu will appear but operation will be inhibited, with the status line: “Remote Configuration not allowed”.

4.2.2.16 Remote Composite Port Loop Modes Menu

```
REMOTE COMPOSITE PORT LOOPBACK MODES
NODE ID=xxx

[1] – No Loop
[2] – Transmit Loopback
[3] – Receive Loopback

STATUS: Loop Mode = <OFF/TxLoop/RxLoop>

ENTER: _
```

Note: The user may select options [1] or [3] for the listed operation. Option [2] – Transmit Loopback is inhibited, with the status line: “Remote Composite Transmit Loop not Allowed !”.

4.2.2.17 Remote Composite Link Rate Menu

```
REMOTE COMPOSITE LINK RATE
NODE ID=xxx

[1] – 64 Kbps
[2] – 128 Kbps
[3] – 192 Kbps
[4] – 256 Kbps
[5] – 384 Kbps
[6] – 512 Kbps
[7] – 640 Kbps
[8] – 768 Kbps
[9] – 1024 Kbps
[10] – 1344 Kbps
[11] – 1472 Kbps
[12] – 1536 Kbps
[13] – 1792 Kbps
[14] – 1920 Kbps
[15] – 1984 Kbps
[16] – 2048 Kbps

STATUS: Current Remote Rate = <???/Remote_Rate>

ENTER: _
```

Note 1: Modifying the remote composite link rate will render the entire link including the management channel inoperative until a new common clock has been re-established at the same rate as programmed in both multiplexers.

Note 2: After modifying this parameter, the remote system will re-allocate channels in ascending order, and store the remote configuration.

4.2.2.18 Channel Selection Menu

CHANNEL SELECTION
NODE ID=xxx

[1] – Channel 1 Configuration
[2] – Channel 2 Configuration
[3] – Channel 3 Configuration
[4] – Channel 4 Configuration
[5] - Channel 5 Configuration
[6] - Channel 6 Configuration
[7] - Channel 7 Configuration
[8] - Channel 8 Configuration
[9] - Channel 9 Configuration
[10] - Channel 10 Configuration
[11] - Channel 11 Configuration
[12] - Channel 12 Configuration
[13] - Channel 13 Configuration
[14] - Channel 14 Configuration
[15] - Channel 15 Configuration
[16] - Channel 16 Configuration

STATUS: Select Channel

ENTER: _

4.2.2.19 Channel # Configuration Menu

CHANNEL <CH_SEL> CONFIGURATION
NODE ID=xxx

[1] – Channel State
[2] – Channel Rate
[3] – Local Port Configuration
[4] – Remote Port Configuration

STATUS: Current Channel <CH_SEL>

ENTER: _

4.2.2.20 Channel # State Menu

CHANNEL <CH_SEL> STATE
NODE ID=xxx

[1] – Allocate Channel
[2] – De-allocate Channel

STATUS: Channel is <Allocated/De-allocated>

ENTER: _

4.2.2.21 Channel Rate Selection Menu

CHANNEL <CH_SEL> RATE SELECTION MENU
NODE ID=xxx

[1] – 9600 bps
[2] – 14.4 Kbps
[3] – 19.2 Kbps
[4] – 28.8 Kbps
[5] – 38.4 Kbps
[6] – 56 Kbps
[7] – 64 Kbps
[8] – 128 Kbps
[9] – 256 Kbps
[10] - 384 Kbps
[11] – 512 Kbps
[12] – 768 Kbps
[13] – No Clock

STATUS: Channel <CH_SEL> Rate = <RATE>

ENTER: _

4.2.2.22 Local Port Configuration Menu

LOCAL PORT <CH_SEL> CONFIGURATION
NODE ID=xxx

[1] – Port Type
[2] – TxD Clock
[3] – RTS / CTS Delay
[4] – DCD Source
[5] – Loop Modes

STATUS: Current Channel: <CH_SEL>

ENTER: _

4.2.2.23 Remote Port Configuration Menu

```
REMOTE PORT <CH_SEL> CONFIGURATION
NODE ID=xxx

[1] – Port Type
[2] – TxD Clock
[3] – RTS / CTS Delay
[4] – DCD Source
[5] – Loop Modes

STATUS: Current Channel: <CH_SEL>

ENTER: _
```

4.2.2.24 Local/Remote Port Interface Type Menu

The following menu screen format is identical for both Local and Remote Port Configuration menu entries, with the context established via the selection of the Local Port Configuration Menu, or the Remote Port Configuration Menu.

```
<Local/Remote> PORT <CH_SEL> INTERFACE TYPE
NODE ID=xxx

[1] – RS-232, Async, 8-bit
[2] – RS-232, Async, 9-bit
[3] – RS-232, Async, 10-bit
[4] – RS-232, Async, 11-bit
[5] – RS-232, Synchronous
[6] – EIA-530 / X.21, Synchronous (Ports 1,5,9, and 13 only)
[7] – V.35 Syncrhonous (Ports 1,5,9, and 13 only)

STATUS: <Local/Remote> Channel <CH_SEL> = <TYPE/MODE>

ENTER: _
```

4.2.2.25 Local/Remote Port TxD Clock Menu

The following menu screen format is identical for both Local and Remote Port Configuration menu entries, with the context established via the selection of the Local Port Configuration Menu, or the Remote Port Configuration Menu.

<Local/Remote> PORT <CH_SEL> TXD CLOCK NODE ID=xxx [1] – TxC [2] – TxCE
STATUS: TxD Clock Source= <TxC / TxCE>
ENTER: _

4.2.2.26 Local/Remote Port RTS/CTS Delay Menu

The following menu screen format is identical for both Local and Remote Port Configuration menu entries, with the context established via the selection of the Local Port Configuration Menu, or the Remote Port Configuration Menu.

<Local/Remote> PORT <CH_SEL> RTS/CTS DELAY NODE ID=xxx [1] – 0 delay [2] – 3 mS delay [3] – 7 mS delay [4] – 13 mS delay [5] – 26 mS delay [6] – 53 mS delay [7] – CTS On [8] – CTS Off
STATUS: <Local/Remoter> Port <CH_SEL> RTS/CTS Delay = <RTSCTS_DEL>
ENTER: _

4.2.2.27 Local/Remote Port DCD Source Menu

The following menu screen format is identical for both Local and Remote Port Configuration menu entries, with the context established via the selection of the Local Port Configuration Menu, or the Remote Port Configuration Menu.

<Local/Remote> PORT <CH_SEL> DCD SOURCE NODE ID=xxx [1] – Follow SYNC State [2] – Follow Far-end RTS
STATUS: DCD Source : <DCD_SRC>
ENTER: _

4.2.2.28 Local/Remote Channel Loop Modes Menu

The following menu screen format is identical for both Local and Remote Port Configuration menu entries, with the context established via the selection of the Local Port Configuration Menu, or the Remote Port Configuration Menu.

<Local/Remote> PORT <CH_SEL> LOOP MODES NODE ID=xxx [1] – Loops OFF [2] – Local Loopback [3] – Remote Loopback [4] – Both Loops ON
STATUS: <Local/Remote> Port <CH_SEL> Loop Mode : <OFF/Local/Remote>>
ENTER: _

Note: Invoking any of the channel loop options shown above causes the loop parameter change to be stored directly into non-volatile configuration memory. See section 2.2.2 – Non-volatile Parameter Storage.

4.2.2.29 Test / Maintenance Menu

TEST / MAINTENANCE NODE ID=xxx [1] – Clear All Loops [2] – Display Log File [3] – Enter ID information
STATUS:
ENTER: _

Note: Invoking the “Clear All Loops” option shown above results not only in the clearing of working loops, but also causes all loop parameters stored in non-volatile memory to be cleared. See section 2.2.2 – Non-volatile Parameter Storage.

4.2.2.30 System Functions Menu

```
SYSTEM FUNCTIONS
NODE ID=xxx

[1] – Display Configuration State
[2] – Display Remote Configuration State
[3] – Store Working Configuration
[4] – Null Configuration Reset
[5] – Copy Mixed Configuration to Remote
[6] – Copy Local Configuration to Remote
[7] - Copy Remote Configuration to Local
[8] – Copy Local Operating System to Remote
[9] – Soft Boot Remote System
[10] – Copy Remote Operating System to FLASH
[11] – Set Time
[12] – System Rest
[13] – Remote System Reset

STATUS: <Day>   <Time>

ENTER: _
```

4.2.2.31 Help Menu

```
MENU HELP
NODE ID=xxx

[1] <CTRL>-T = Go to Top Level System Menu
[2] <CTRL>-P = Go to Previous Menu in Hierarchy
[3] <ESC> = Same as <CTRL>-P
[4] <CR> = Repaint Current Menu
[5] (Support contact information)

STATUS: This is a read-only menu

ENTER: _
```

4.2.3 Alarm Messages

There are two types of Alarm messages generated by the Nx64 Multiplexer: Sync Up/Down and Power Supply Failure/Restoral. Alarm messages are unsolicited and sent via the console port to a terminal device regardless of the current menu display selected.

4.2.3.1 Sync Up/Down Alarm

Two output alarm messages are provided to indicate the Up/Down transition of the SYNC status flag. These messages pre-empt any other terminal window communications or context, and can be used for the purpose of external trapping of alarm conditions.

The message formats are:

SYNC Up message: **** In Sync: <Day> <Time>

SYNC Down message: **** Sync Lost: <Day> <Time>

4.2.3.2 Power Supply Failure/Restoral

The power supply alarm messages are only generated on systems possessing redundant power supplies. Two alarm messages are provided to indicate the status change of power supply modules on either remote or local multiplexer systems.

The power supply failure message formats are:

Local supply Fail message: "Failure, Local Supply A(*or B*)".

Remote supply Fail message: "Failure, Remote Supply A(*or B*)".

While a local or remote redundant power supply continues in a failed state, or has been removed pending replacement, the above message is repeated at one minute intervals until the failed condition is corrected.

The power supply restoral message formats are:

Local supply Restoral message: "Restoral, Local Supply A(*or B*)".

Remote supply Restoral message: "Restoral, Remote Supply A(*or B*)".

Restoral messages are sent only once, upon detection of restored power.

4.2.4 Over-allocation Message

Whenever a request is made to allocate a new channel, or to increase the channel rate of a previously allocated channel, the system will first determine if sufficient bandwidth through the composite link is available. If the bandwidth is available the channel will be allocated with the requested bandwidth and acknowledged.

If there is insufficient bandwidth for the new or changed channel rate, the following message line will appear after the attempt:

INSUFFICIENT BW AVAILABLE

Upon making the request, however, the channel rate parameter (or DCD Source = RTS, since this selection also increases bandwidth overhead), will be set to the requested value but the channel will be left in the de-allocated state. This permits the operator to make channel assignments for which there is not sufficient bandwidth for later activation by either increasing composite link rate or de-allocating or down-speeding other channels.

4.2.5 Configuration State and Revision Display

The System Functions Menu provides an option to display the configuration state and the firmware revisions of the multiplexer of either the local system or the remote system. Through this display, the operator can view a tabular summary of the configuration for the composite link and all 16 channels and their associated ports.

The first line of the summary reads out the revision levels for the system firmware and the hardware logic field-programmabe gate array (FPGA). These revision levels are important when determining if the system has the latest codes installed.

In addition to the channel reference, status, port speed and type, and loop modes, the display includes activity snapshots for Tx and Rx data leads on the channel ports. A “_/_” indicates that at the time of the snapshot, at least one transition from mark to space, or space to mark, was detected on the corresponding data lead in the prior 1-2 seconds.

The final summary line indicates 1) the available unallocated bandwidth remaining on the composite port, rounded to the nearest 1kbps, and, 2) the status of each power supply, in redundant power supply systems.

```
16 PORT Nx64 MUX STATUS ---  SYS REV n.nn  ------- FPGA REV nn.nn ----------  000  2:20:43.26
CHANNEL     STATUS  SPEED    PORT-TYPE                    NEAR     FAR       TX   RX
                                                          LOOPS    LOOPS  DATA  DATA
COMP        Ena     1024 Kb  RS-232  Sync                 None     None      n/a  n/a
CH 1        Alloc   56 kb    RS-232  Sync                 None     None     _/\_ _/\_
CH 2        Alloc   19200 b  RS-232  Sync                 None     Local    ---- ----
CH 3        Alloc   4800 b   RS-232 Async/10  bits        None     None     _/\_ _/\_
CH 4        Alloc   19200 b  RS-232 Async/10  bits        None     None     _/\_ _/\_
CH 5        Alloc   256 kb   V.35  Sync                   Remote   None     ---- ----
CH 6        D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 7        D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 8        D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 9        D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 10       D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 11       D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 12       D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 13       D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 14       D-Alloc No Clk   RS-232 Async/10  bits        None     None     ---- ----
CH 15       D-Alloc 9600 b   RS-232  Sync                 None     None     ---- ----
CH 16       D-Alloc No Clk   RS-232  Sync                 None     None     ---- ----
Bandwidth  = 1024 k      Bandwidth Available  = 669 k  Power   A=Good   B=Good

ENTER:_
```

Figure 15 – Configuration State Display

4.2.6 System Monitor Screen

The system monitor screen provides a means to perform system-related accesses, functions, and actions for a skilled operator or technician. This screen is not presented as an option on the system menus, and can only be reached via a particular set of keystrokes.

Currently, the only actions for which an operator has need to invoke the system monitor screen is to complete the process of downloading revised firmware modules into FLASH memory, or to backup and restore configurations held in a computer file.

To access the system monitor screen the user must type: “<CTRL>ecd”. The set of three characters following the control key may be either uppercase or lowercase, and may be in any sequence. To leave the system monitor screen the user must type: “menu” or “MENU”.

Once on the system monitor screen, the terminal window will display a “>” prompt at the beginning of each line, indicating that it is waiting for the next command to be entered.

4.2.6.1 Firmware Download Procedure

There are two types of firmware modules: *program* and *fpga*. Each type of firmware module is downloaded as separate files, and it is not usually necessary to update both firmware modules at the same time. The user should understand which type of firmware file is being downloaded and the reason why a firmware update is needed.

In order to download the firmware files, a terminal emulation program which supports the 1Kxmodem file transfer protocol is required. The following procedure assumes the user utilizes the **HyperTerminal** emulation program installed on most Windows PC platforms.

Step 1:

After receiving the firmware download modules, make sure the appropriate .bin file (either program or fpga) is in a known location, either on the system hard drive or other removable media. This location must be accessible from the terminal emulation program.

Invoke the system monitor program (see section 4.2.6).

Step 2:

At the command prompt, type the following:

x1kr<Enter>

The command line will indicate that it is ready and waiting to begin accepting a file by generating this message followed by a string of characters about one second apart:

Initiate Xmodem1k Send
CCCCC…….

(The waiting period will eventually time out after about 60 seconds. If it does so before the next step is completed, simply repeat this step.)

Step 3:

Center the mouse on the “Transfer” pull-down menu on the HyperTerminal menu bar. Click and move down to “Send File …”.

A dialog box will appear requesting the filename, and the protocol. Browse to the appropriate directory and locate the appropriate .bin file to be downloaded and select “Open”. Make sure that 1KXModem is selected as the protocol.

Click on “Send”.

A window will appear showing the progress of the file download. When the file has been transmitted correctly to the Nx64-MUX, the command screen will display “Transmit Complete”.

Step 4:

This step will vary depending on whether the downloaded module is *program* or *fpga*.

At the prompt, type the following if the downloaded file is *program*:

prg <Enter>

Type the following if the downloaded file is *fpga*:

stfpga <Enter>

The Nx64-MUX will begin to store the firmware file into the appropriate sectors of FLASH reserved for the module, and should respond with a message similar to the following when completed. DO NOT attempt to interrupt the process or enter data until both of the following steps have been completed.

Erasing FPGA flash stores..done
Updating Flash...done

At this point the old firmware has been overwritten and the new revision has been installed. However, the new firmware will not be loaded into executable form until a system power cycle is completed.

Step 5:

With the firmware now safely stored in non-volatile memory, it is necessary to perform a system reset in order to load and start the new firmware program(s).

Perform a system reset by either,

1) Selecting *System Reset* on the System Functions Menu, or

2) Cycling the power to the system. This will cause the system to load from non-volatile memory, using the stored configuration.

4.2.6.2 Configuration Backup Procedure

The following procedure provides step-by-step instructions for backing up a working configuration to a disk file:

Step 1:

Invoke the system monitor program (see section 4.2.6).

Step 2:

At the command prompt, type the following:

x1kt<Enter>

The command line will indicate that it is ready and waiting to begin uploading a file by generating this message and entering a waiting period for further operator action:

Initiate Xmodem1k Receive

(The waiting period will eventually time out after about 60 seconds. If it does so before the next step is completed, simply repeat this step.)

Step 3:

Center the mouse on the “Transfer” pull-down menu on the HyperTerminal menu bar. Click and move down to “Receive File …”.

A dialog box will appear requesting the destination folder, and the protocol. Browse to the appropriate directory and confirm “OK”. Make sure that 1KXModem is selected as the protocol. Click on “Receive”.

A dialog box will appear to specify a filename and extension into which to store the data. Enter a valid filename (e.g., ‘Config.bin’) and click “OK”.

A window will appear showing the progress of the file download. When the file has been transmitted correctly to the Nx64-MUX, the command screen will perform a carriage return and a new command prompt: “>”.

The configuration is now stored in the backup file.

4.2.6.3 Configuration Restoral Procedure

The following procedure provides step-by-step instructions for restoring a configuration from a disk file:

Step 1:

Invoke the system monitor program (see section 4.2.6).

Step 2:

At the command prompt, type the following:

x1kr<Enter>

The command line will indicate that it is ready and waiting to begin downloading a file by generating this message followed by a string of characters about one second apart:

Initiate Xmodem1k Send

CCCCC…….

(The waiting period will eventually time out after about 60 seconds. If it does so before the next step is completed, simply repeat this step.)

Step 3:

Center the mouse on the “Transfer” pull-down menu on the HyperTerminal menu bar. Click and move down to “Send File …”.

A dialog box will appear requesting the filename, and the protocol. Browse to the appropriate directory and locate the configuration file to be downloaded and select “Open”. Make sure that 1KXModem is selected as the protocol.

Click on “Send”.

A window will appear showing the progress of the file download. When the file has been transmitted correctly to the Nx64-MUX, the command screen will display “Transmit Complete”, and return a new prompt.

Step 4:

The configuration has now been retrieved from the file and resides in a temporary memory area of the Nx64-MUX. However the stored configuration has NOT been replaced. The following command must be performed to complete the restoral procedure.

At the prompt, type the following:

stconfig <Enter>

Step 5:

With the configuration now safely stored in non-volatile memory, it is necessary to perform a system reset in order to implement the stored configuration as the working configuration.

Perform a system reset by either,

1) Selecting *System Reset* on the System Functions Menu, or

2) Cycling the power to the system. This will cause the system to load from non-volatile memory, using the stored configuration.

5 Appendix

5.1 Factory Default Configuration (Null Configuration)

Systems are shipped with a factory-default configuration to provide a starting point for the operator to configure the system and establish limited, basic functionality of the hardware. The factory default configuration may be restored in working configuration memory at any time by executing the Null *Configuration Reset* command.

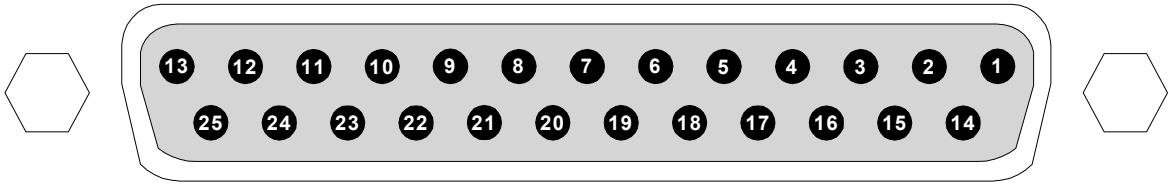
Table 3 summarizes the settings stored in systems upon shipping to the customer.

	Composite Port	**All Channels / Ports (1-16)**
State	Disable	De-allocated
Rate	768Kbps	0 (No Clock)
Port Type	Off	RS-232 Async, 10bits
Loops	None	None
Timing Source	RxC (f/DCE)	*N/A*
TxD Clock	TxC	TxC
DCD Source	*N/A*	Follow Sync
TxCE Output	Disabled	*N/A*
Password	"default"	

Table 3 – Nx64-MUX Factory Default (Null) Configuration Settings

5.2 Connector Pinout Diagrams

5.2.1 Channel Port Connectors (DCE)



25-pin Sub-Miniature D-type Connector with Sockets (female)

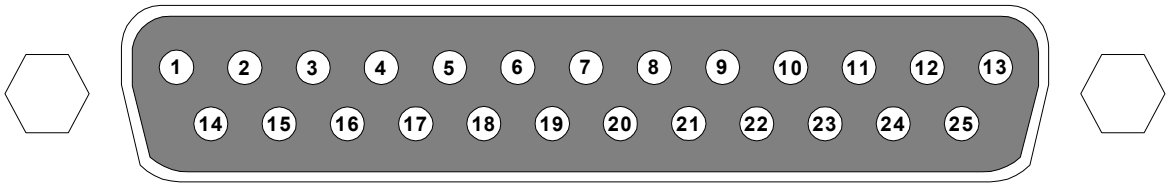
Pin No.	Signal		
	RS-232 Mode	**EIA-530 Mode (Ports 1, 5, 9, & 13 only)**	**V.35 Mode * (Ports 1, 5, 9, & 13 only)**
1	Frame GND	Frame GND (Shield)	Frame GND (Shield)
2	TxD	TxD +	SD +
3	RxD	RxD +	RD +
4	RTS	RTS +	RTS
5	CTS	CTS+	CTS
6	DSR	DSR+	DSR
7	Signal GND	Signal GND	Signal GND
8	DCD	DCD+	RLSD
9		RxC -	SCR -
10		DCD -	
11		TxCE -	SCTE -
12		TxC -	SCT -
13		CTS -	
14		TxD -	SD -
15	TxC (Sync Only)	TxC +	SCT +
16		RxD -	RD -
17	RxC (Sync Only)	RxC +	SCR +
19		RTS -	
22		DSR -	
24	TxCE (Sync Only)	TxCE +	SCTE +

* - Applies only to Ports 1, 5, 9 and 13

Note: undesignated pin No.'s are *Unconnected*

Table 4 - Channel Port Connector Pinouts

5.2.2 Composite Port Connector (DTE)



25-pin Sub-Miniature D-type Connector with Pins (male)

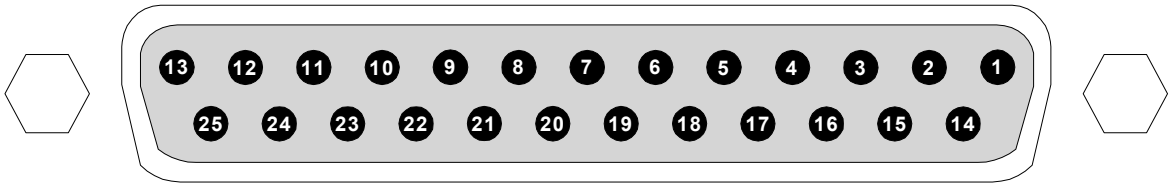
	Signal		
Pin No.	**RS-232 Mode**	**EIA-530 Mode**	**V.35 Mode ***
1	Frame GND	Frame GND (Shield)	Frame GND (Shield)
2	TxD	TxD +	SD +
3	RxD	RxD +	RD +
4	RTS	RTS +	RTS
5	CTS	CTS+	CTS
6	DSR	DSR+	DSR
7	Signal GND	Signal GND	Signal GND
8	DCD	DCD+	RLSD
9		RxC -	SCR -
10		DCD -	
11		TxCE -	SCTE -
12		TxC -	SCT -
13		CTS -	
14		TxD -	SD -
15	TxC (Sync Only)	TxC +	SCT +
16		RxD -	RD -
17	RxC (Sync Only)	RxC +	SCR +
19		RTS -	
20	DTR	DTR+	DTR
22		DSR -	
23		DTR-	
24	TxCE (Sync Only)	TxCE +	SCTE +

Note: undesignated pin No.'s are *Unconnected*

Table 5 - Composite Port Connector Pinouts

5.2.3 Console Port Connector

RS-232 Async DCE



25-pin Sub-Miniature D-type Connector with Sockets (female)

Pin No.	Signal
1	Frame GND
2	TxD
3	RxD
4	RTS
5	CTS
6	DSR
7	Signal GND
8	DCD
20	DTR

Note: undesignated pin No.'s are *Unconnected*

Table 6 - Console Port Connector Pinouts

5.3 Adapter Cables

5.3.1 Composite Port V.35 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between the Nx64-MUX Composite port and a standard V.35 cable, or DCE device.

V.35 mode 25-pin Female Sub-miniature D					**V.35 34-pin Male M-Block**	
Signal	**Pin**				**Pin**	**Signal**
TXD+	2	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	P	SD+
TXD-	14	/		\	S	SD-
RXD+	3	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	R	RD+
RXD-	16	/		\	T	RD-
TXC+	15	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	Y	SCT+
TXC-	12	/		\	AA	SCT-
RXC+	17	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	V	SCR+
RXC-	9	/		\	X	SCR-
TXCE+	24	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	U	SCTE+
TXCE-	11	/		\	W	SCTE-
RTS	4	-	==========	-	C	RTS
CTS	5	-	==========	-	D	CTS
DSR	6	-	==========	-	E	DSR
CD	8	-	==========	-	F	RLSD
DTR	20	-	==========	-	H	DTR
Ground	7	-	==========	-	B	Ground
Shield	1	-	==========	-	A	Shield

Table 7 - Composite Port to V.35 Adapter

5.3.2 Composite Port X.21 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between the Nx64-MUX Composite port and a standard X.21 cable, or DCE device.

EIA-530 mode 25-pin Female Sub-miniature D					**X.21 15-pin Male Sub-miniature D**	
Signal	**Pin**				**Pin**	**Signal**
TXD+	2	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	2	Transmit+
TXD-	14	/		\	9	Transmit-
RXD+	3	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	4	Receive+
RXD-	16	/		\	11	Receive-
RXC+	17	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	6	Timing+
RXC-	9	/		\	13	Timing-
TXC+	15	\	*Short this pair to RXC+ / RXC-, respectively*			
TXC-	12	/				
RTS+	4	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	3	Control+
RTS-	19	/		\	10	Control-
CTS+	5	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	5	Indication+
CTS-	13	/		\	12	Indication-
Ground	7	-	==========	-	8	Ground
Shield	1	-	==========	-	1	Shield

Table 8 - Composite Port to X.21 Adapter

5.3.3 Composite Port RS-449 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between the Nx64-MUX Composite port and a standard RS-449 cable, or DCE device.

EIA-530 mode 25-pin Female Sub-miniature D					**RS-449 37-pin Male Sub-miniature D**	
Signal	**Pin**				**Pin**	**Signal**
TXD+	2	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	4	SD+
TXD-	14	/		\	22	SD-
RXD+	3	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	6	RD+
RXD-	16	/		\	24	RD-
TXC+	15	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	5	SCT+
TXC-	12	/		\	23	SCT-
RXC+	17	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	8	SCR+
RXC-	9	/		\	26	SCR-
TXCE+	24	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	17	SCTE+
TXCE-	11	/		\	35	SCTE-
RTS+	4	-	==========	-	7	RS+
RTS-	19	-	==========	-	25	RS-
CTS+	5	-	==========	-	9	CS+
CTS-	13	-	==========	-	27	CS-
DSR+	6	-	==========	-	11	DM+
DSR-	22	-	==========	-	29	DM-
CD+	8	-	==========	-	13	RR+
CD-	10	-	==========	-	31	RR-
DTR+	20	-	==========	-	12	TR+
DTR-	23	-	==========	-	30	TR-
Ground	7	-	==========	-	19	Ground
Shield	1	-	==========	-	1	Shield

Table 9 - Composite Port to RS-449 Adapter

5.3.4 Channel Port V.35 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between any Nx64-MUX Channel port operating in V.35 mode and a standard V.35 cable, or DTE device.

V.35 mode 25-pin Male Sub-miniature D					**V.35 34-pin Female M-Block**	
Signal	**Pin**				**Pin**	**Signal**
TXD+	2	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	P	SD+
TXD-	14	/		\	S	SD-
RXD+	3	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	R	RD+
RXD-	16	/		\	T	RD-
TXC+	15	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	Y	SCT+
TXC-	12	/		\	AA	SCT-
RXC+	17	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	V	SCR+
RXC-	9	/		\	X	SCR-
TXCE+	24	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	U	SCTE+
TXCE-	11	/		\	W	SCTE-
RTS	4	-	==========	-	C	RTS
CTS	5	-	==========	-	D	CTS
DSR	6	-	==========	-	E	DSR
CD	8	-	==========	-	F	RLSD
DTR	20	-	==========	-	H	DTR
Ground	7	-	==========	-	B	Ground
Shield	1	-	==========	-	A	Shield

Table 10 – Channel Port to V.35 Adapter

5.3.5 Channel Port X.21 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between any Nx64-MUX Channel port operating in EIA-530 mode and a standard X.21 cable, or DTE device.

EIA-530 mode 25-pin Male Sub-miniature D					**X.21 15-pin Female Sub-miniature D**	
Signal	**Pin**				**Pin**	**Signal**
TXD+	2	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	2	Transmit+
TXD-	14	/		\	9	Transmit-
RXD+	3	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	4	Receive+
RXD-	16	/		\	11	Receive-
RXC+	17	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	6	Timing+
RXC-	9	/		\	13	Timing-
RTS+	4	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	3	Control+
RTS-	19	/		\	10	Control-
CTS+	5	\	<><><><><><><><><> Twisted Pair <><><><><><><><><>	/	5	Indication+
CTS-	13	/		\	12	Indication-
Ground	7	-	==========	-	8	Ground
Shield	1	-	==========	-	1	Shield

Table 11 – Channel Port to X.21 Adapter

5.3.6 Channel Port-to-Console Adapter Cable

Any Nx64-MUX channel port, with a management terminal attached, may be used to directly access the menu-driven user interface on a remote Nx64-MUX by cabling the corresponding channel port on the remote system to the console port. Once the end-to-end channel is configured properly, an operator at the local end of the link can perform menu operations on the remote system.

An illustration of this configuration is shown in Figure 16

The following diagram illustrates an RS-232 Async null-modem cable suitable for a Port-to-Console connection. Note: Standard null-modem cables with additional control circuit connections may also be used.

RS-232 mode 25-pin Male Sub-miniature D					**RS-232 mode 25-pin Male Sub-miniature D**	
Signal	**Pin**				**Pin**	**Signal**
TxD	2	-		-	3	RxD
RxD	3	-		-	2	TxD
Ground	7	-	==========	-	7	Ground
Shield	1	-	==========	-	1	Shield

Table 12 – Channel Port-to-Console Port Adapter Cable

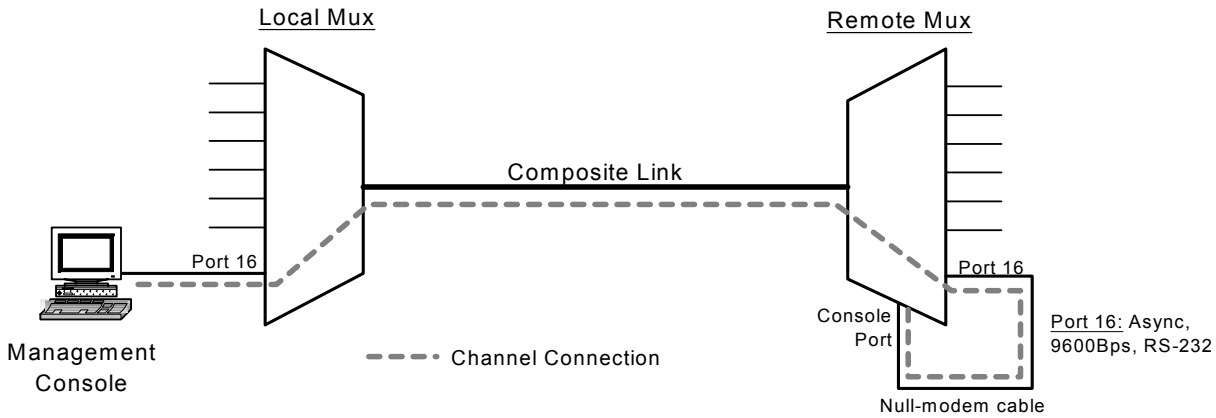


Figure 16 – Remote Console Setup and Configuration

5.4 Configuration Storage

The diagram of Figure 17 illustrates the various user-invoked operations that affect the alteration of configuration data stored in the Nx64-MUX system, either as the working configuration or the stored configuration, or, configuration data stored on a computer file (i.e. backup and restoral).

Changing configuration data is based on the existence of a configuration “source”, which can be either individual parameter changes entered via menu options or an existing configuration, and responding by placing the resulting changes in one of threee configuration “destinations”.

Except where noted, the listed operations work only on the local system to which the system console is attached. *Port Loop* commands, for example, may operate on a local **or** remote system, consequently the working and stored configurations are changed only on the local **or** remote system, respectively. On the other hand, the *Clear All Loops* command, operates on both local **and** remote systems, hence both local **and** remote configurations are stored.

Some commands are two-step operations on both working and stored configurations. In these cases, such as the *Enter ID* command, the change to the working configuration is completed before the working configuration is stored.

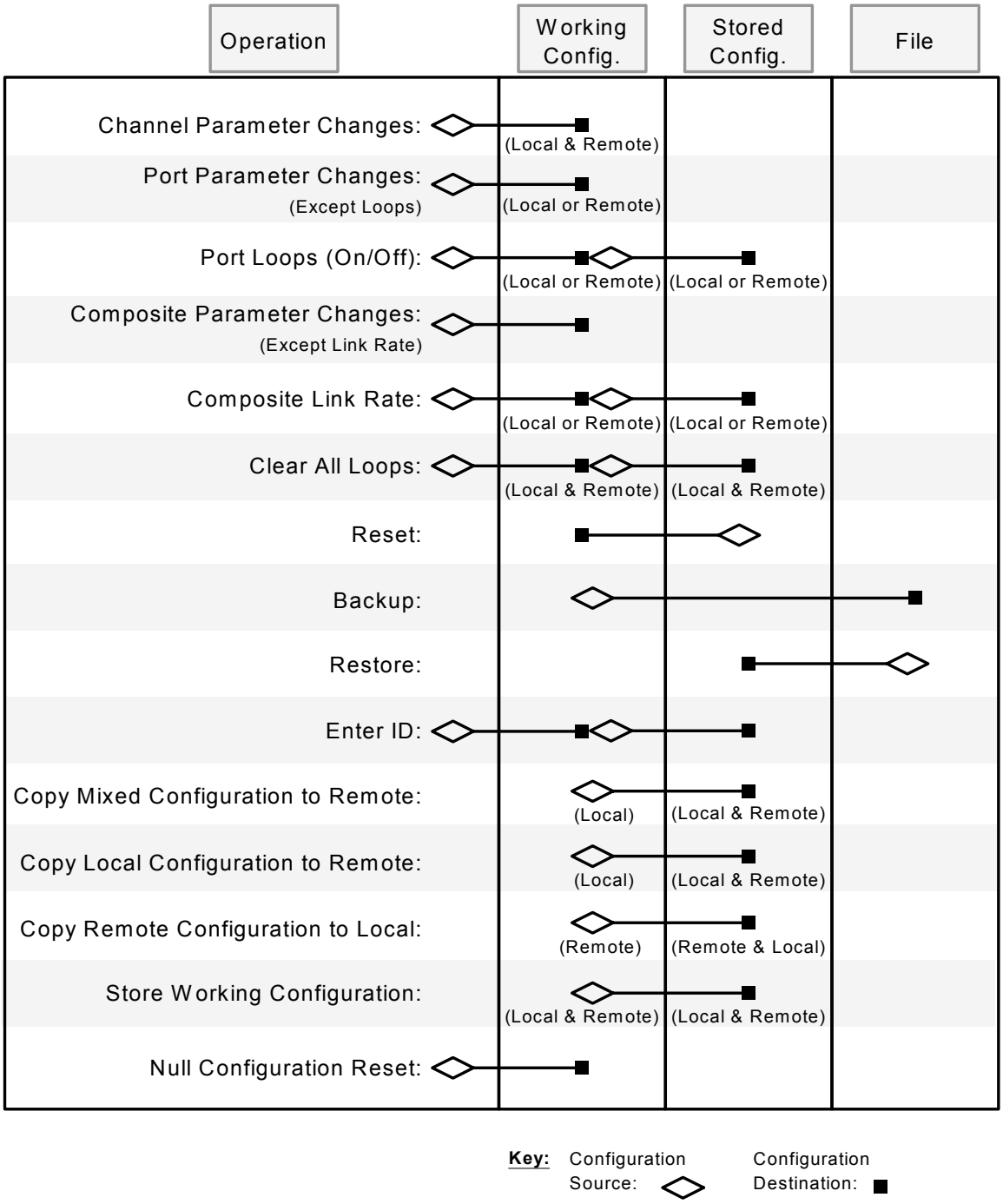


Figure 17 – Configuration Storage Diagram

5.5 Configuring an Nx64-MUX Link for Simplex Operation

The Nx64-Mux may be used to support Simplex network traffic. Since the multiplexer is designed to normally provide full duplex operation, simplex configurations are by nature, special cases, and certain features of the multiplexer will be unavailable or inoperative. Also, because the multiplexers at each end of the link are not equivalent in function, the differences must be accounted for when setting up and configuring the systems.

The simplex link is comprised of a sending system and a receiving system. Because there is no path for "upstream" data to the sending system, the inband management channel of the multiplexer only works in one direction. This implies that for two systems to be configured over a simplex link, the configuring terminal must be placed on the sending system.

Figure 18 illustrates a typical simplex network configuration.

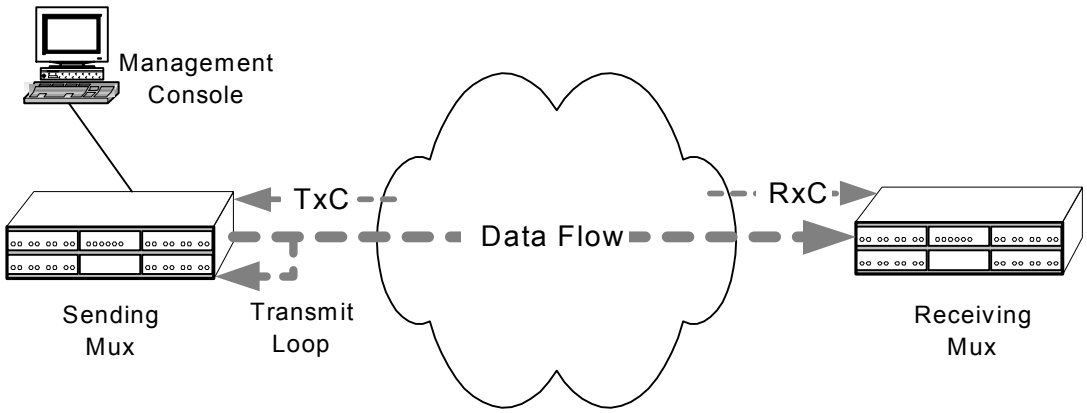


Figure 18 – Multiplexers in Simplex Network Configuration

In the above network, the sending multiplexer requires, at a minimum a transmit data path, a transmit clock, and a loop of the transmit data to the receive data input on the composite port. This latter condition is imposed by the need to keep the sending mux in a synchronized state; this is achieved in the looped condition by receiving it's own transmitted framing pattern. While this may be implemented by means of a specially-wired cable, it is more readily accomplished by using the transmit loopback feature of the sending multiplexer and a standard cable.

The receiving multiplexer requires only the receive data path and a receive clock. From this, the receiving mux is able to synchronize to the downstream framing pattern, receive inband management channel configuration commands, and demultiplex the channel data.

5.5.1 Behavior of System Management in Transmit Loopback

Due to the transmit loopback at the sending end of the link, messages sent via the management channel to the remote system are also received by the sending system. This can cause unintended states to be entered unless some forethought is given to the effect of the sending multiplexer receiving it's own commands. For example, invoking a channel loopback on the receiving (remote) system will cause the same channel loopback to be implemented on the sending (local) system. **In general, any menu option sent to the remote system to change a configuration parameter will be mirrored on the local system.** As long as the parameter in question is the same desired value or setting on both the remote and local systems, no problem should be encountered. When the are different, however, the user may have to take extra steps to insure the desired configuration is achieved.

One method to work around the problem of implementing differing local and remote channel parameters, is to remove the transmit loop at the sending end of the link for the duration of the configuration change. While the transmit loop is down, the sending end will neither send nor receive user channel data, but will continue to produce a framing pattern along with the inband management channel. The management channel can then be used to make any configuration changes separately on the local or remote system, after which, the transmit loop may be re-established to enable the flow of user data.

Another method is to make the configuration change addressed to the remote system first. While this may also change the local system's corresponding configuration parameter to the same value as a result of the transmit loop, the local system can subsequently be modified to the desired value without affecting the remote system.

The situation described above may present itself in selecting configuration options from the following menu screens:

1. Remote Port (#) Interface Types
2. Remote Port (#) TxD Clock
3. Remote Port (#) RTS/CTS Delay
4. Remote Port (#) DCD Source
5. Remote Port (#) Loop Modes

Considering the options available in the preceding menu screens, it is likely that only 1) and 2) would ever be modified from the default setting in a simplex data transmission environment.

5.6 Technical Specifications

Application
Multiple Sync or Async DTE devices time-division-multiplexed onto a single synchronous DCE communication link and demultiplexed by an identical unit at the far end.

Timing
System Timing: External via Composite Port or Internal Timing for back-to-back connections
Each sub-channel Port capable of accepting external TXC to clock TXD for DCE to DCE crossover

Port Capacity
Composite : One port
Channels: Up to sixteen ports

Data Format
Data transparent at all data rates. Async data converted to synchronous format internally

Data Rates
Composite Port: 64Kbps to 2,048Kbps in16 steps, at common Nx64K rates.

Channel Ports:
ASYNC & SYNC Rates(bps): 9.6K, 14.4K, 19.2K, 28.8K, 38.4K.
SYNC-Only Rates(bps): 48K, 56K, 64K, 128K, 256K, 384K, 512K, 768K.
Async Support: configurable for 8, 9, 10 and 11 bit data on a per channel basis.

Composite Port Interface
One Port: DB-25 Male, Software selectable for RS-232, RS-530, V.35*, RS-422/449* and X.21* (*- Adapter cable required for connector standard)

4-Port (Channel) I/O Card(s)
Four Ports: DB-25 Females, Four ports RS-232, one port Software Selectable for RS-232, RS-530, V.35*, RS-422/449* and X.21* (*- Adapter cable required for connector standard)
Maximum 4 cards per chassis, 16 channel ports per chassis

Control Leads Passed
Options for none or RTS to DCD in-band

Cascade Port
Via any sub-channel port

Indicators
Power, System Status, Sync, TX Data, RX Data, RX Clock, Loopback Modes

Power Source
85-264 VAC @10%, 47-440 Hz, IEC Power Inlet, (2) 5mm Fuses, 1:1
Optional Redundant Power Inlet and Redundant DC Power Module

Environmental
Operating Temperature....32º to 122º F (0º to 50º C)
Relative Humidity.....5 to 95% Non-Condensing
Altitude.....0 to 10,000 feet

Dimensions
Height ..... 5.25 inches (13.32 cm)
Width ..... 17.00 inches (43.18 cm)
Length ..... 9.00 inches (22.86 cm)

Weight
9 pounds (4.2 Kg)

Warranty
Three Years, Return To Factory

5.7 Ordering Information

Part Number: 166000
Model: MUX-16PCH
Description: 16-Port Base Chassis,
Nx8-MUX or Nx64-MUX

Part Number: 166003
Model: 128K Processor Board
(8K-128K composite rates), Nx8-MUX
Qty Req: 1

Part Number: 166007
Model: Port I/O Board, 4-Port
Nx8-MUX or Nx64-MUX
QTY Req.: 1 to 4 per Mux chassis

Part Number: 166015
Model: Power Supply
Nx8-MUX or Nx64-MUX
QTY Req.: 1

Part Number: 166045
Model: 2048K (Hi-Speed) Processor Board
(64K-2048K composite rates), Nx64-MUX
Qty Req: 1

For further detailed technical information on this product, contact East Coast Datacom Technical Assistance toll free in the US at (800) 240-7948 or (321) 637-9922 or Email: info@ecdata.com