OPERATIONS MANUAL

Nx8- Dual Composite MUX

High-Speed 16-Port TDM Multiplexer

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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.

PROPRIETARY NOTICE

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1 Introduction

The Nx8-DualMUX is a modular, 16 Port Dual-composite TDM multiplexer for high-speed serial data terminal equipment. It is designed to work in a paired, point-to-point configuration over one or two synchronous composite clear-channel links of up to 128Kbps each.

The system may be configured with from 4 to 16 channel ports, operating at rates up to 38.4 Kbps asynchronous, or up to 64Kbps 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 Nx8-DualMUX may be used in Point-to-point applications with different types of equipment and circuits. As long as the circuits 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 Nx8-DualMUX 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.

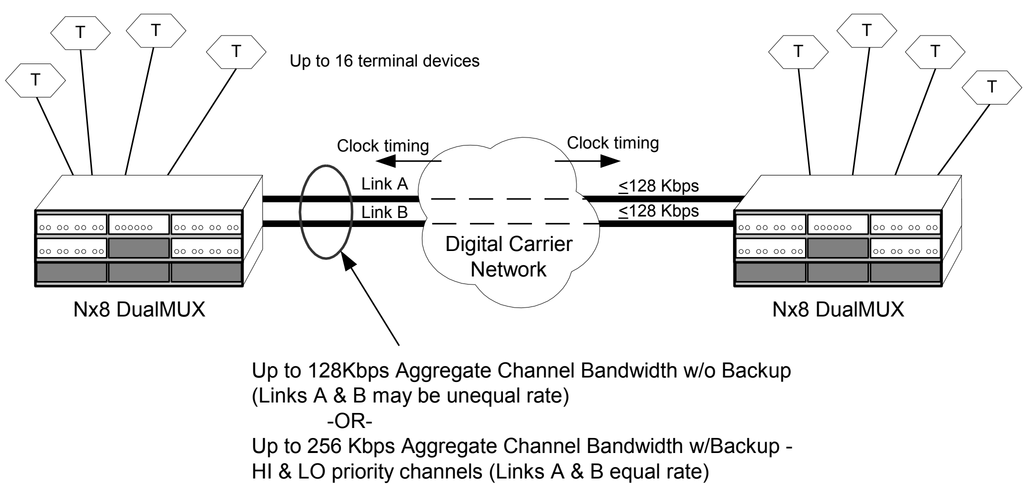


Figure 1 Point-to-point Link using Digital Carrier

The Nx8-DualMUX 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 Nx8-DualMUX units may each be assigned one or two ports on the larger multiplexer and those ports programmed for operation at any of the selectable n x 8Kbps rates.

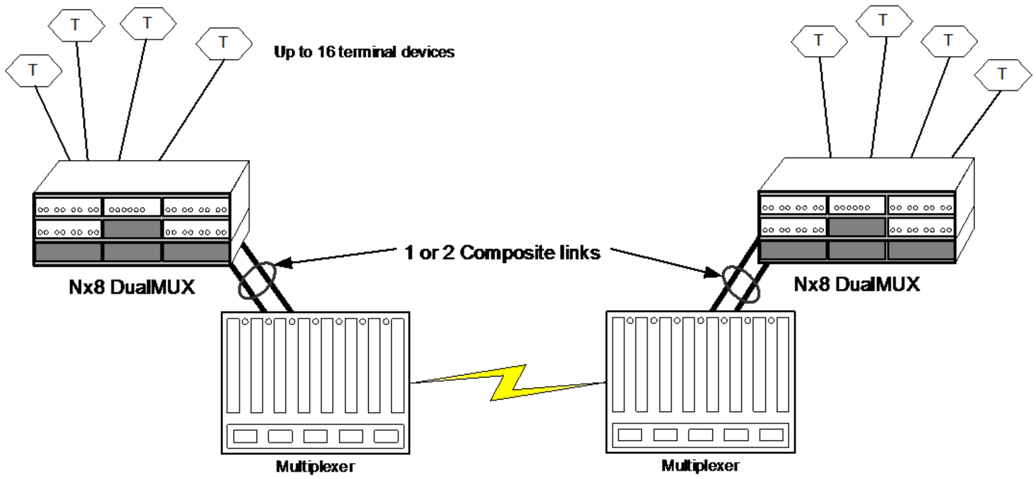


Figure 2 Point-to-point Link as Sub-multiplexer

1.2 Planning

The network administrator must determine how the Nx8-DualMUX 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-DualMUX. Readers should familiarize themselves with this section before proceeding to the Installation section.

Feature Summary

The major features of the Nx8-DualMUX 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: 8Kbps to 128Kbps, in increments of 8Kbps
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: 1200, 2400, 4800, 7200, 9600, 14.4K, 19.2K, 28.8K, & 38.4K (bits per second)
Synchronous data rates: all async data rates + 16K, 24K, 32K, 40K, 48K, 56K, & 64K (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 1600bps, for framing and in-band management channel (1200bps)
Option for in-band transport of RTS for remote DCD
Composite Link Backup and Restoral
Per-Channel Recovery and Priority Options
Measurement of composite link error performance
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 – Nx8-DualMUX Major Features

2.1 Multiplexer Operation

The central hardware element of the Nx8-DualMUX 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, backup and restoral of channels and links, control paths and programming, and user interfaces are not included.

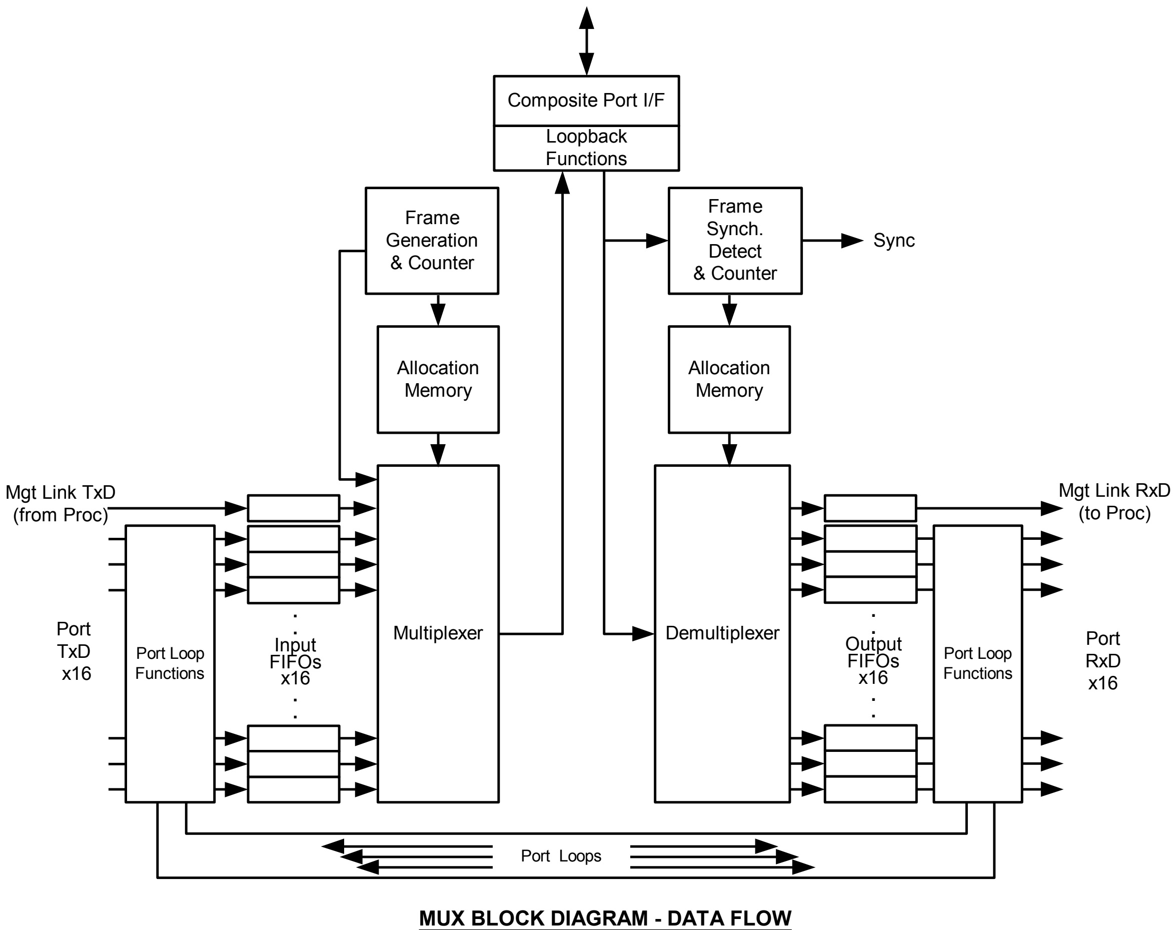


Figure 3 MUX Data Flow Diagram

2.1.1 Multiplexer

The Nx8-DualMUX 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 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 400 frames-per-second, and each channel bit, or timeslot in the frame provides 400 Hz of bandwidth available for allocation to a channel. This allows port rates that are multiples of this rate to be supported. For example, 19.2KHz is 48 x 400 Hz, and therefore requires 48 timeslots per frame.

Timeslots are assigned in a manner that distributes their placement throughout the frame. The purpose of this method is to insure that the rate of arrival or departure of channel bits on the composite port is approximately matched to the bit rate of the channel port, and therefore minimizes the requirement for an elastic storage buffer for each channel.

In addition, by not requiring a pre-determined timeslot map for each channel or channel rate, channels may be allocated and de-allocated from time to time without disrupting the operation or data flow of other channels. In other words, newly allocated channels are fit into the timeslot map wherever there are available timeslots, but do not affect those already assigned.

The above concepts are illustrated in the diagram of Figure 4. In this simple case, the composite frame is 20 bits, corresponding to an 8KHz link. The frame size could be chosen as large as 320 bits (128KHz), but for simplicity 8KHz is chosen. Given that the frame bit occupies 1 bit (400Hz), and the management channel 3 bits (1200Hz), 16 bits are left in which to assign channel bandwidth.

The first channel, “a”, is 2400Bps and is assigned available timeslot positions 5, 6, 9, 12, 15, and 18. (The pattern is unimportant, but noteworthy that the timeslots are distributed throughout the frame, and their location in the timeslot map allocates them to channel “a”. When channel “b” is allocated, also 2400Bps, the timeslots are chosen from among the remaining available timeslots, but in a different placement and pattern. None of the timeslots of channel “a” are disturbed in the process. When complete, there are still 4 timeslots remaining corresponding to 1600Hz of bandwidth, enough for a 1200Bps channel, for example.

Although this is a very simple example (8KHz composite is usually insufficient), higher link rate examples may be configured and are assigned in the same way. All 16 ports may be time-division multiplexed on the composite link given sufficient bandwidth. The 1600Hz required for the framing bit and the management channel is fixed however, and must be considered when planning channel allocation.

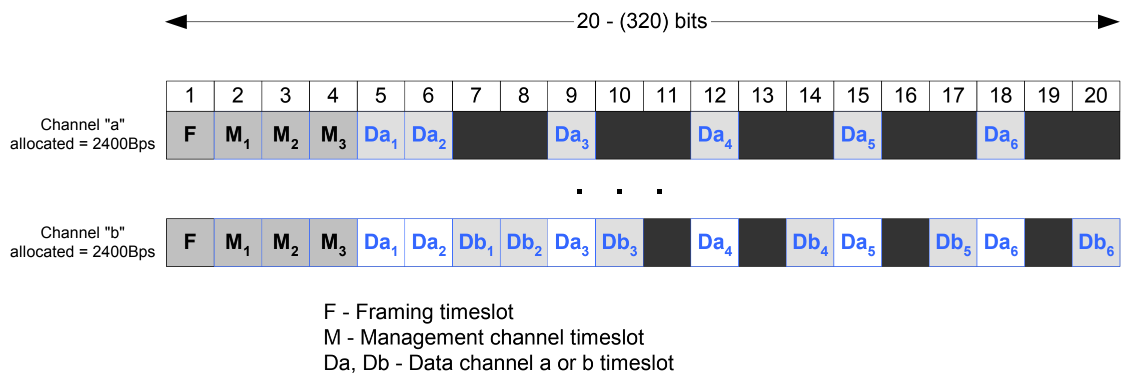


Figure 4 – Frame and Super-frame Multiplexing

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 Nx8-DualMUX 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 one 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 Nx8-DualMUX reserves a fixed sub-channel of 1200 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 8kHz (see Table 1). Additionally, the Nx8-DualMUX 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 Nx8-DualMUX 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

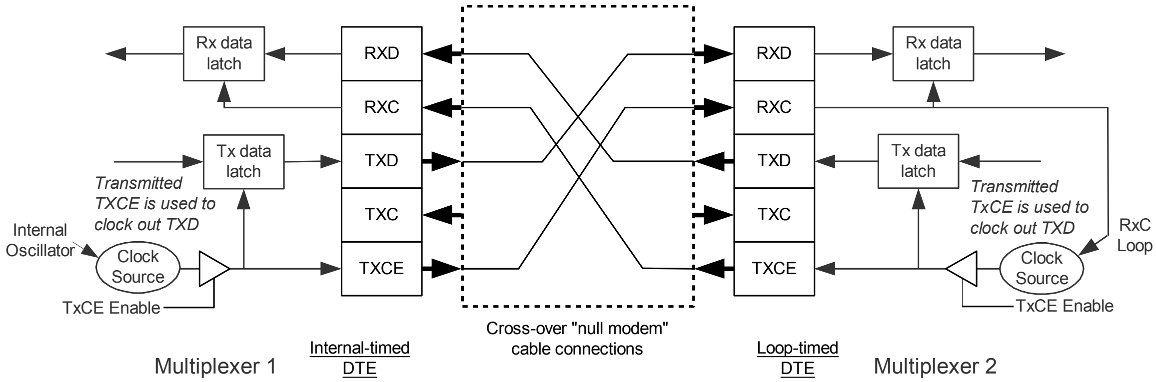


Figure 5 Composite port cable diagram for DTE-to-DTE connections

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 Nx8-DualMUX, 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.

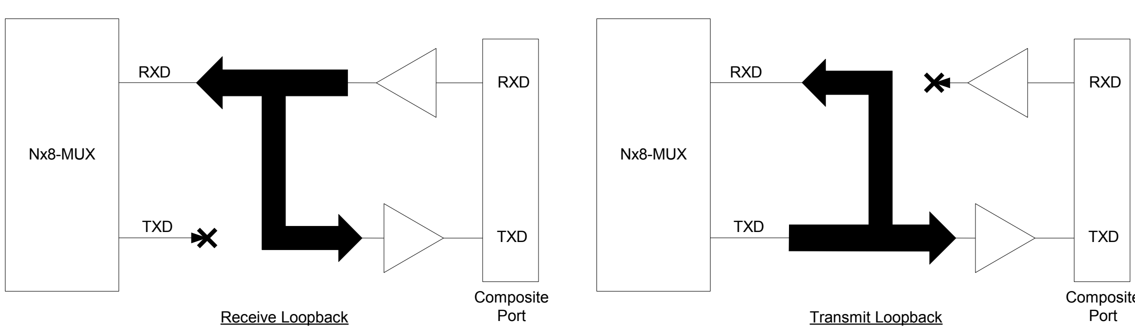


Figure 6 – Composite Port Receive and Transmit Loopback Modes

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 1200 bps to 64Kbps. 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.

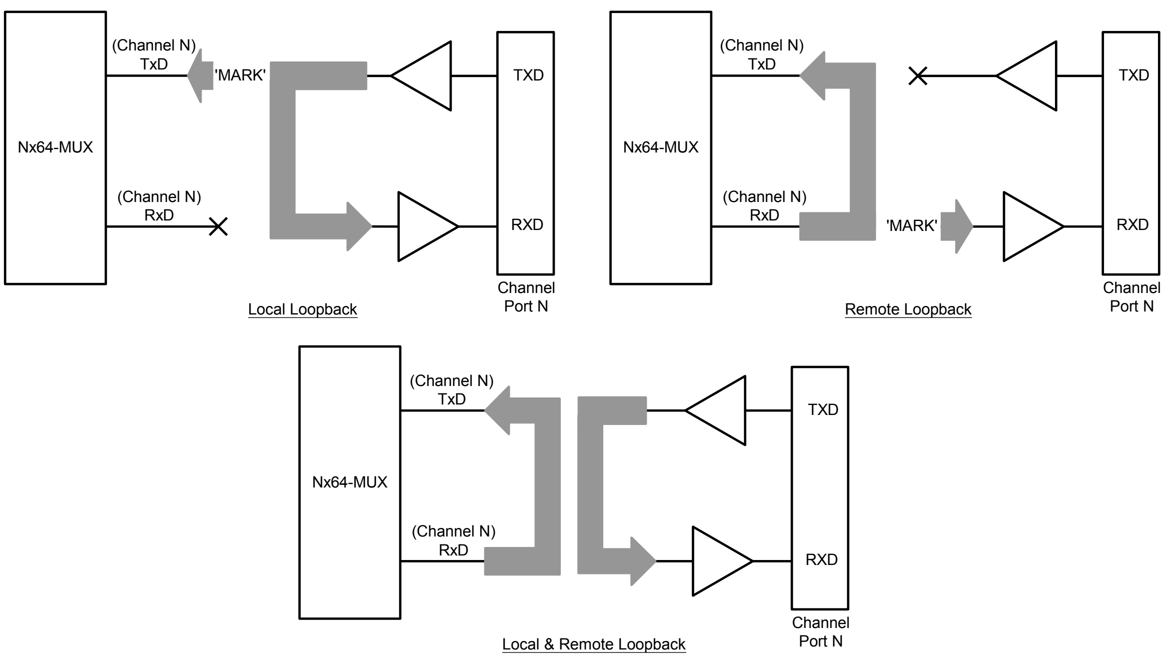


Figure 7 Three Channel Port Loopback Modes

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 Nx8-DualMUX 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 **Error! Reference source not found.-Error! Reference source not found.**.

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 Nx8-DualMUX 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 **Error! Reference source not found.** and **Error! Reference source not found.**.

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.

2.3 Backup, Restoral, and Bandwidth Assignment Operations

The Nx8-DualMUX allows for the distribution of channel bandwidth over two aggregate links, and for the restoral of specific channels to an operational link under single-link failure conditions. The flexibility of bandwidth distribution and fault-tolerance offers many options to configuring a system. This section will address this facet of operation and some of the possible configuration scenarios.

2.3.1 Channel Failover Modes and Associated Parameters

Before considering system configurations, it is important to understand channel failover mode assignments. Channel failover modes determine under what conditions a channel is switched to the alternate composite link from it's home composite link (the one to which it is originally assigned). Priorities also determine if a channel circuit is to be bumped for a higher priority channel. Other parameters associated with the channel affect the backup clock rate and restoral time.

2.3.1.1 Failover Modes

There are two priority attributes, each with two possible values. These can best be represented in the following matrix and together define the failover modes:

Table 2

	LOW	HIGH
SEEKS BACKUP	CAN BE BUMPED	CANNOT BE BUMPED
NO BACKUP (FIXED)	CAN BE BUMPED	CANNOT BE BUMPED

PRIORITY MATRIX (FAILOVER MODES)

The High/Low attribute determines whether a channel can be bumped or not, to make room for another channel. High priority channels cannot be bumped, even by another high priority channel. Low priority channels may only be bumped by high priority channels.

The Seek Backup/No Backup attribute defines whether a channel will be switched to the backup link subject to available bandwidth and priority.

2.3.1.2 Failover Port Clock Rate

The failover rate is a channel port clock rate which may be different, typically lower, than the channel rate on the primary, or home link. The purpose of this option is to allow a greater number of backed-up channels to be accommodated on a single surviving link where available bandwidth becomes more critical.

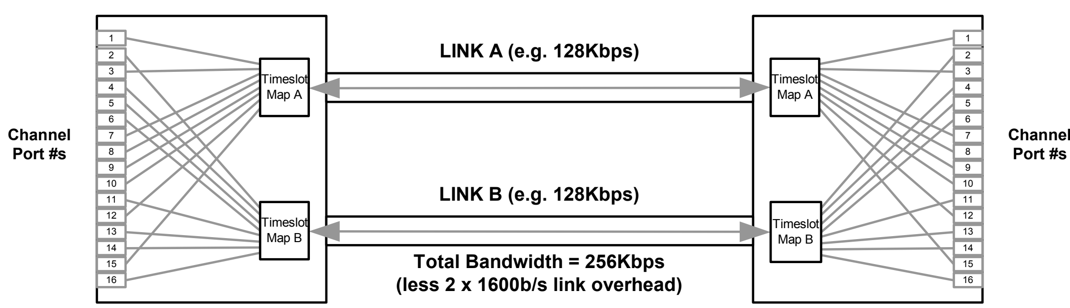
2.3.1.3 Channel Restoral Timer

Each channel may be configured with a timer that determines how and when the channel is restored to it's home link when that link returns to service. This helps alleviate a channel hopping back and forth under intermittent composite link conditions and creating circuit disruptions to the terminal device.

In addition to time settings for this option ranging from immediate to one hour, a manual choice is available. For this option, the channel will not be restored until either 1) the user modifies the timer to a finite delay, or 2) the composite link on which the channel is currently backed-up fails, AND the home link on which the channel was originally assigned is in service.

2.3.2 Expanded Bandwidth Configuration

One of the simplest configurations using the dual link support in the Nx64 Dual Mux is that of expanding the aggregate link capacity of the multiplexer up to 4.096 Mbps. With two links between units, each channel may be assigned to either Link A or Link B, until the total bandwidth available on both composites is consumed.



EXPANDED BANDWIDTH CONFIGURATION

Figure 8

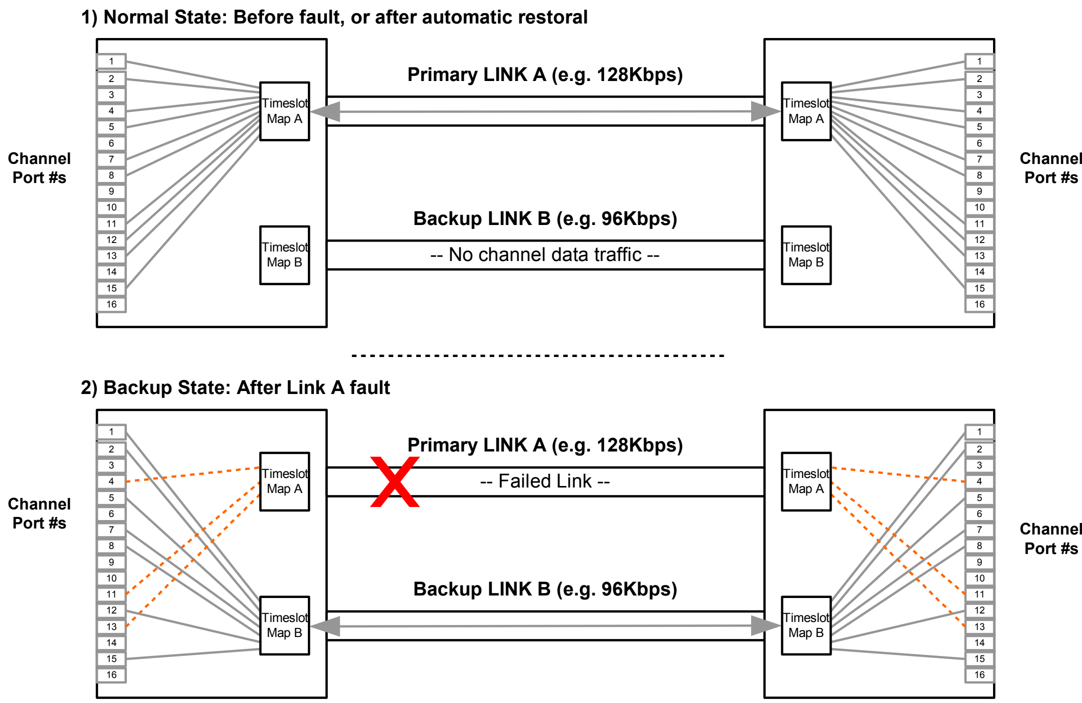
In the figure above, channels are assigned as needed to either of the composite links. It is not required that the two links be of equal rate since the need may simply be for more aggregate channel bandwidth than is available on a single link. In this example, channels 1, 3, 7, 8, 9, 10, 12, and 15 are assigned to Link A and channels 2, 4, 5, 6, 11, 13, 14 and 16 are assigned to Link B.

Assuming no channel backup switching is required, all channels should be configured for a failover mode such that they do not seek backup, i.e., their assignment to either Link A or Link B is fixed, regardless of the state of those links. In such a case, high or low priority will not matter, since there is no channel switching activity.

2.3.3 Redundant (or Hot Standby) Link Configuration

Another simple configuration example, but quite different than the previous, is that of the redundant link, shown in Figure 9. In this case, one link, the primary link, carries all channel traffic under normal conditions. The other link is defined as a backup, or hot standby, available to accept channels switched over should a failure occur on the primary link.

The backup link does not necessarily need to be of equal rate as the primary, but certainly should not be greater. If the backup capacity is less than the primary, then some channels may not be accommodated on the backup should a loss of the primary link occur.



REDUNDANT LINK CONFIGURATION

Figure 9

In the figure above, all channels are assigned to a single primary link, in this case Link A. In the normal state, both links are in service and all channel traffic is on the primary link. Should a failure occur on Link A in this example, the system will switch channels to the backup link, assuming it is operational.

If the backup link has the same rate as the primary link, a switch-over of all channels may occur. In this example, since Link B has a lower rate and channel capacity, some channels may not fit in the bandwidth available. As shown, channels 4, 11, and 13 are out of service and are not switched to the surviving link.

To configure this example, the operator would set channels 1, 2, 5, 7, 8, 12, and 15 to seek backup, while channels 4, 11, and 13 would be fixed. Again, the setting of high or low priority does not matter since no channels will be bumped.

2.3.3.1 Failover Rate Options

As an alternative to dropping some channels in the above example, channel rates on the backup link may be selectively lowered to fit in the available bandwidth. Synchronous terminal equipment in some cases may operate effectively with reduced throughput or response time by lowering the channel port clock rate. By utilizing this option, one or more ports may be maintained in service after a primary link failure that would otherwise need to be dropped.

2.3.3.2 Restoral Options

When the primary link becomes operational after a failure and switchover, the system is designed to follow configuration settings on a per-channel basis to determine when each channel is restored to the primary link. Most of these settings are in terms of a time delay from when a failed primary link, Link A in this example, becomes operation (defined by a SYNC condition).

The longer the time delay, the longer the continuous in-service period must be before the channel is switched back to the home link. It is important to note that the timer is reset when the link is declared failed and then restarts when the link is returned to service.

For the above example, using a “Manual” setting of the restoral timer for all channels results in the channels remaining in the backup state even after the primary link is returned to service. Without operator intervention, all channel circuits on the backup link would continue operating until a backup link failure occurs. If the primary link is in service, the channels would automatically switch back to their home link.

2.3.4 Backup with Prioritized Channels

In many cases, the most efficient balance between fault-tolerance and bandwidth utilization results from using all the flexibility provided in the dual-composite multiplexer system. However, it should be said that the tradeoffs to obtain good utilization of composite and channel bandwidth, before and after link failures, may require considerable planning, as the following examples will demonstrate.

Link and channel configurations which place different failover modes, rates, and restoral times on channels distributed over two links look much like the configuration of Figure 8 in a normal state when both links are in service. However, what happens when a loss of one link occurs can be much different. Knowing how the system scans for available bandwidth and bumps channels is important to help the operator choose channel parameters.

In order to illustrate a possible scenario, channel rates and failover modes must be attached to each channel assigned. When referring to bandwidth, channel and link rates will be normalized to the number of 400 Hz timeslots rather than the actual clock rate – this simplifies the arithmetic and makes the result more clear.

Using the channel assignments of Figure 8, the following table augments the configuration with channel bandwidth assignments, in timeslots, and denotes by column the failover mode. The total number of user timeslots for each link is shown at the top and is calculated by dividing the composite clock rate by 400Hz and subtracting four timeslots for overhead. Where two numbers separated by a “/” in a table cell are shown, the first number indicates the number assigned on the home link, and the second the number used when switched over to the backup link (failover channel rate). So for example, 64/4 means the channel port will run at 512 Kbps on its assigned home link, and 32 Kbps when backed up on the alternate link.

Table 3

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			6	
2				
3	24			
4				
5				
6				
7				12
8				12
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16				

34 **remaining free timeslots**

Key
hs: High priority, seeking
hf: High priority, fixed
ls: Low priority, seeking
lf: Low priority, fixed

LINK B: 236 **total user timeslots**

	hs	hf	ls	lf
1				
2			12/6	
3				
4	18			
5	24/18			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	72/18			

68 **remaining free timeslots**

2.3.4.1 Example: Link A Failure

In this example, Link A, running at 128Kbps, provides 316 user channel timeslots (+4 for link overhead). The total allocated timeslots over all 8 channels takes 282 timeslots, leaving 34 unused.

Link B runs at 96Kbps, provides 236 channel timeslots of which 168 are assigned and 68 are unused.

The following figures detail sequentially what happens when a link fails. First considered will be a failure on Link A.

Table 4

LINK A: *fail* **total user timeslots**

	hs	hf	ls	lf
1			6	
2				
3	24			
4				
5				
6				
7				12
8				12
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16				

0 **remaining free timeslots**

LINK B: 236 **total user timeslots**

	hs	hf	ls	lf
1				
2			12/6	
3	24			
4	18			
5	24/18			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	72/18			

44 **remaining free timeslots**

In the first step in Table 4 above, the system attempts to find timeslots on Link B to backup the high-priority channels seeking backup (failover mode="hs"). It begins with channel #1 in an ascending count and finds channel 3 is “hs”. Since there were 68 timeslots unused on Link B, the channel is reallocated onto Link B (shaded box), now leaving 44 timeslots unused.

Table 5

LINK A: *fail* **total user timeslots** **LINK B:** 236 **total user timeslots**

	A: hs	A: hf	A: ls	A: lf		B: hs	B: hf	B: ls	B: lf
1			6						
2								12/6	
3	-24-					24			
4						18			
5						24/18			
6							12		
7				12					
8				12					
9	-96-				downspeed →	24			
10		24							
11								6	
12				12					
13									12
14							12		
15	96/24								
16						72/18			

0 **remaining free timeslots** 20 **remaining free timeslots**

In the second step, channel 9 is found to be seeking backup. This channel has a failover rate of 24 timeslots (i.e., a drop from 38.4Kbps to 9.6Kbps). Since this fits within the 44 timeslots available, the channel is reallocated onto Link B, leaving 20 timeslots.

Table 6

LINK A: *fail* **total user timeslots** **LINK B:** 236 **total user timeslots**

	A: hs	A: hf	A: ls	A: lf		B: hs	B: hf	B: ls	B: lf
1			6						
2								-12-	
3	-24-					24			
4						18			
5						24/18			
6							12		
7				12					
8				12					
9	-96-					24			
10		24							
11								6	
12				12					
13									12
14							12		
15	-96-				downspeed →	24			
16						72/18			

0 **remaining free timeslots** 8 **remaining free timeslots**

In the third step, the next high-priority channel seeking backup is channel 15. As in the previous channel, there is a downspeed to 24 timeslots; but, there are only 20 timeslots available. At this point the system searches for low-priority channels on Link B to bump and free up timeslots, needing a minimum of 4 timeslots (24 – 20). Low priority channels are numbered 2, 11, and 13. Channel 2 is first, and is bumped in order to claim 12 more timeslots. Then channel 15 is reallocated to Link B, leaving 8 timeslots.

Table 7

LINK A: *fail* **total user timeslots**

	hs	hf	ls	lf
1			-6-	
2				
3	-24-			
4				
5				
6				
7				12
8				12
9	-96-			
10		24		
11				
12				12
13				
14				
15	-96-			
16				

0 **remaining free timeslots**

LINK B: 236 **total user timeslots**

	hs	hf	ls	lf
1			6	
2			-12-	
3	24			
4	18			
5	24/18			
6		12		
7				
8				
9	24			
10				
11			6	
12				
13				12
14		12		
15	24			
16	72/18			

2 **remaining free timeslots**

In the final step, once the "hs" channels have been dealt with, the system looks for low-priority channels seeking backup. There is only one in this case, channel 1. Low-priority channels cannot bump any channel in the process of switching to a backup link, but fortunately, there are 8 timeslots available. So, channel 1 is reallocated to Link B, with just 2 timeslots remaining.

Fixed channels on Link A, whether high or low priority, are out-of-service until such time as Link A returns to service and these channels have met their restoral timer period.

2.3.4.2 Example: Link B Failure

The following tables detail sequentially what happens when Link B fails.

Table 8

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			6	
2				
3	24			
4	18			
5				
6				
7				12
8				12
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16				

16 **remaining free timeslots**

LINK B: *fail* **total user timeslots**

	hs	hf	ls	lf
1				
2			12/6	
3				
4	-18-			
5	24/18			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	72/18			

0 **remaining free timeslots**

In the first step, channel 4 is found to be the first high-priority channel seeking backup on Link A. The number of free timeslots initially is 34, so the channel is reallocated onto Link B (shaded box), now leaving 16 timeslots unused.

Table 9

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			-6-	
2				
3	24			
4	18			
5	18			
6				
7				12
8				12
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16				

4 **remaining free timeslots**

downspeed

LINK B: *fail* **total user timeslots**

	hs	hf	ls	lf
1				
2			12/6	
3				
4	-18-			
5	-24-			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	72/18			

0 **remaining free timeslots**

In the second step, the reallocation of channel 5 is attempted. Channel 5 has a failover rate of 18 timeslots. . The number of free timeslots is 16, so the system begins bumping low-priority channels beginning with channel 1 to claim 6 more timeslots. Together with the original 16 this provides 22 timeslots, sufficient for channel 5. After channel 1 is bumped, channel 5 is reallocated to Link A, leaving 4 unused timeslots.

Table 10

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			-6-	
2				
3	24			
4	18			
5	18			
6				
7				-12-
8				-12-
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16	18			

10 **remaining free timeslots**

downspeed

LINK B: *fail* **total user timeslots**

	hs	hf	ls	lf
1				
2			12/6	
3				
4	-18-			
5	-24-			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	-72-			

0 **remaining free timeslots**

In the next step, the last high-priority channel is channel 16, which requires 18 timeslots for backup. There are only 4 unused timeslots from the previous iteration, so the system must again look for one or more low-priority channels to find the additional 14 timeslots required. Channels 7 and 8 are bumped to yield 24 timeslots (channel 7 alone is insufficient). Once channel 16 in reallocated to Link A, there are 10 timeslots remaining.

Table 11

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			-6-	
2			6	
3	24			
4	18			
5	18			
6				
7				-12-
8				-12-
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16	18			

4 **remaining free timeslots**

downspeed (Link B channel 2 → Link A channel 2)

LINK B: *fail* **total user timeslots**

	hs	hf	ls	lf
1				
2			-12-	
3				
4	-18-			
5	-24-			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	-72-			

0 **remaining free timeslots**

The system proceeds to scan the low-priority channels seeking backup in the next step. The first one, channel 2 has a failover rate requiring 6 timeslots. There are 10 timeslots left over from the previous step, which is sufficient. Therefore, channel 2 is reallocated, leaving 4 unused timeslots.

Table 12

LINK A: 316 **total user timeslots**

	hs	hf	ls	lf
1			-6-	
2			6	
3	24			
4	18			
5	18			
6				
7				-12-
8				-12-
9	96/24			
10		24		
11				
12				12
13				
14				
15	96/24			
16	18			

4 **remaining free timeslots**

blocked, insufficient BW (Link B channel 11)

LINK B: *fail* **total user timeslots**

	hs	hf	ls	lf
1				
2			-12-	
3				
4	-18-			
5	-24-			
6		12		
7				
8				
9				
10				
11			6	
12				
13				12
14		12		
15				
16	-72-			

0 **remaining free timeslots**

In the final step, the system attempts to find bandwidth on Link A for channel 11, the remaining low-priority channel seeking backup. With only 4 timeslots free, and it's inability to bump any other channels, channel 11 is blocked from reallocation to Link A.

The blocking of a channel backup due to link failure can be the result of a miscalculation in planning. Although all other channels backed up will operate as expected on the surviving link, without any other changes to port and link rates, channel 11 will not. As such, it should have been coded as low-priority, fixed (lf) since it will never get the opportunity to be backed up without manual intervention.

It should be apparent that the user responsible for network planning will need to consider each link failure scenario in order to avoid situations like that above. It cannot be assumed that simply because a channel is set to seek bandwidth, even if it is high-priority, that it will be backed up in the event of a link failure. Given the flexibility in channel failover settings, channel rates and link speeds, a favorable configuration balancing efficient bandwidth utilization and backup under failure is usually possible.

3 Hardware Installation

The Nx8-DualMUX 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 Nx8-DualMUX system with configurable power supply redundancy are shown in Figure 10. Redundant systems differ from non-redundant systems only in the number of power supplies and AC power connectors.

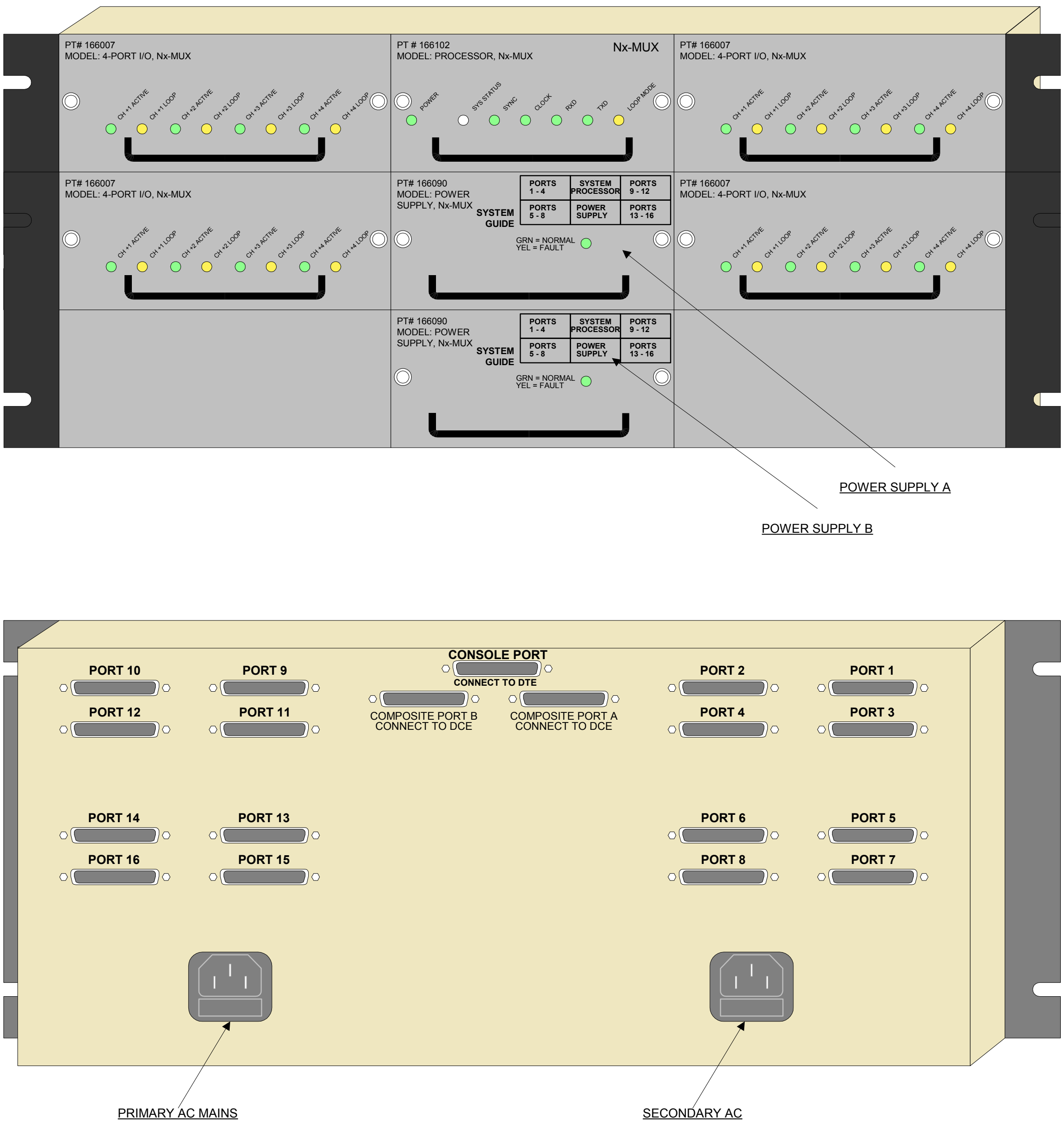


Figure 10 Front and Rear Views of the Nx8-DualMUX with configurable Power Supply Redundancy

The Nx8-DualMUX 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 Nx8-DualMUX 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 Nx8-DualMUX 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 11 depicts obstructions above and below an Nx8-DualMUX and shows that three sides are open to allow inflow and outflow of ambient air.

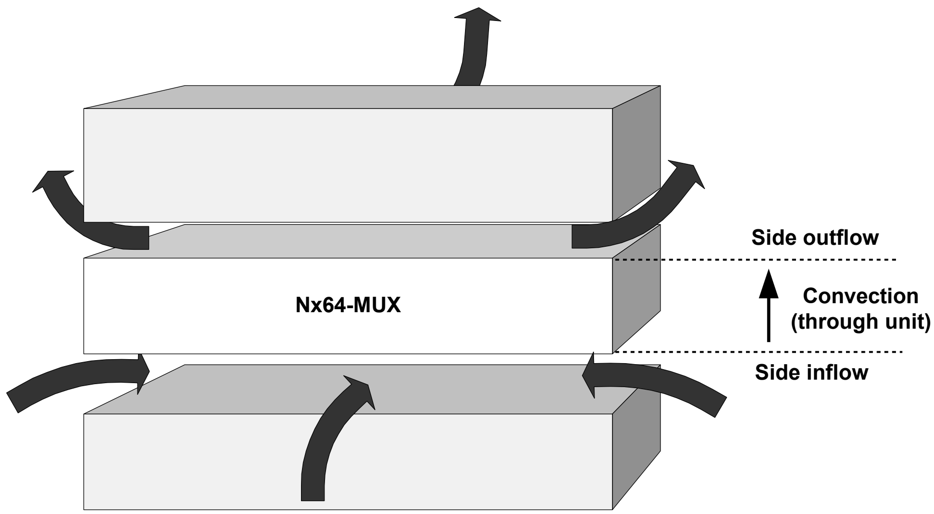


Figure 11 Airflow around obstructions

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 Nx8-DualMUX 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 Nx8-DualMUX 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 12 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.

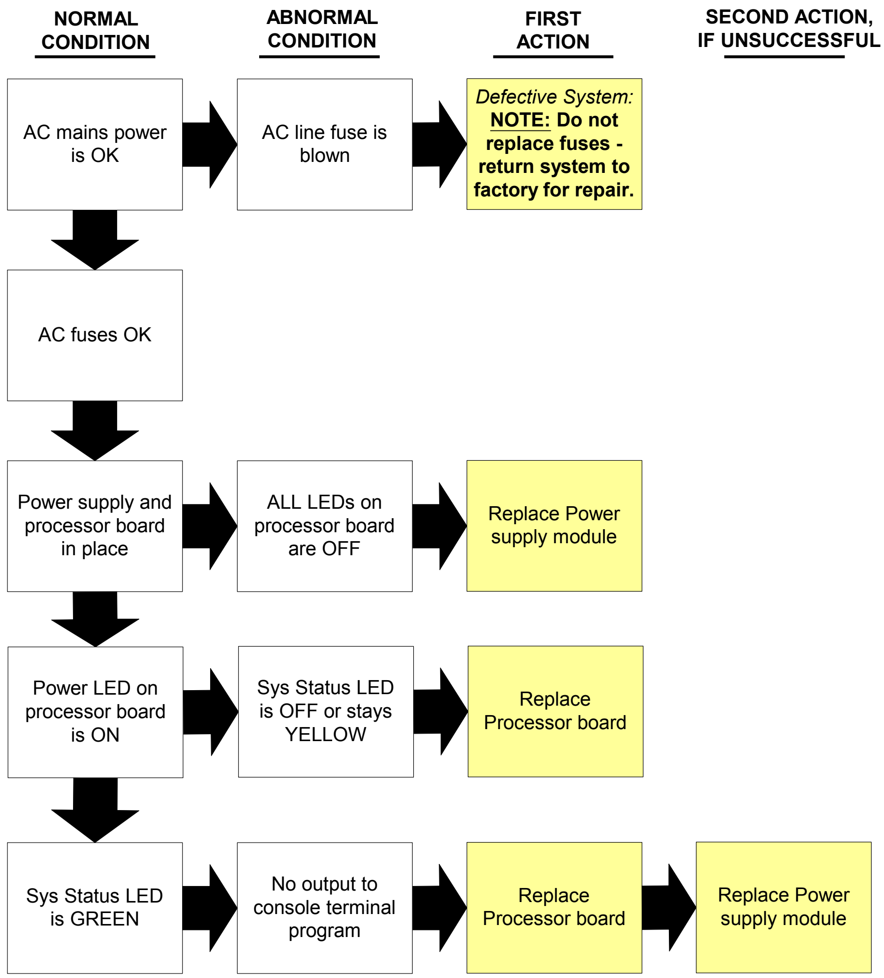


Figure 12 Basic System Troubleshooting

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 Nx8-DualMUX 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-DualMUX, 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 fourteen LED indicators on its front panel as shown in Figure 13. 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 (Bi-color; Yellow and Green) – When ON indicates that the received link framing signal has been correctly detected on the corresponding composite port and the local unit is in synchronization with the remote unit. (The upper LED is for composite port A and the lower for composite port B.)

TXC (Bi-color; Yellow and Green) – When Green indicates the presence of transmit data clock on the corresponding Composite port interface. If this indicator is Yellow, then the clock is not present. (The upper LED is for composite port A and the lower for composite port B.)

RXC (Bi-color; Yellow and Green) – When Green indicates the presence of receive data clock on the corresponding Composite port interface. If this indicator is Yellow, then the clock is not present. (The upper LED is for composite port A and the lower for composite port B.)

RX D (Green) – When ON indicates the presence of signal activity on the corresponding Composite port interface receive data lead. A constant mark or space condition on the data lead will result in the indicator turning OFF. (The upper LED is for composite port A and the lower for composite port B.)

TX D (Green) – When ON indicates the presence of signal activity on the corresponding Composite port interface transmit data lead. A constant mark or space condition on the data lead will result in the indicator turning OFF. (The upper LED is for composite port A and the lower for composite port B.)

COMP LOOP (Yellow) – When ON indicates that the corresponding 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. (The upper LED is for composite port A and the lower for composite port B.)

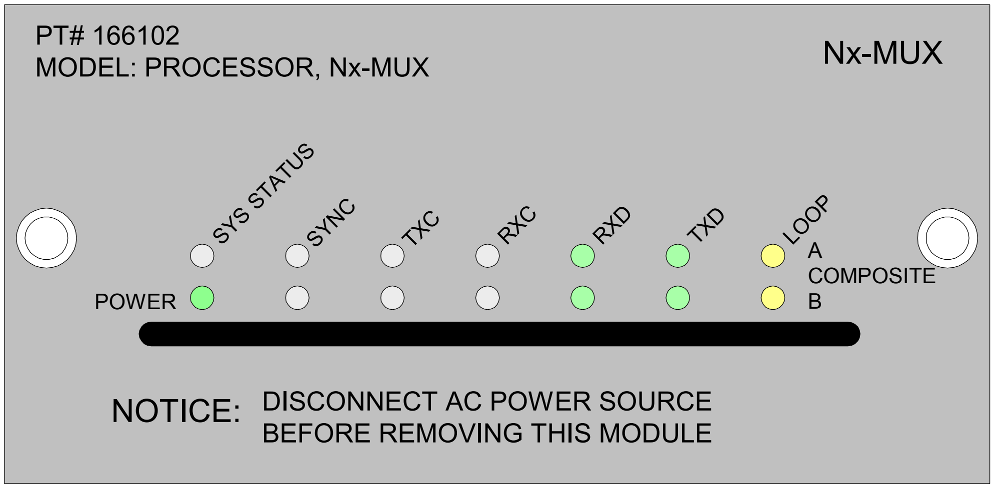


Figure 13 Processor Card Front Panel

4.1.2 Port I/O Card

The Processor card has eight LED indicators on it's front panel as shown in Figure 14, 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.

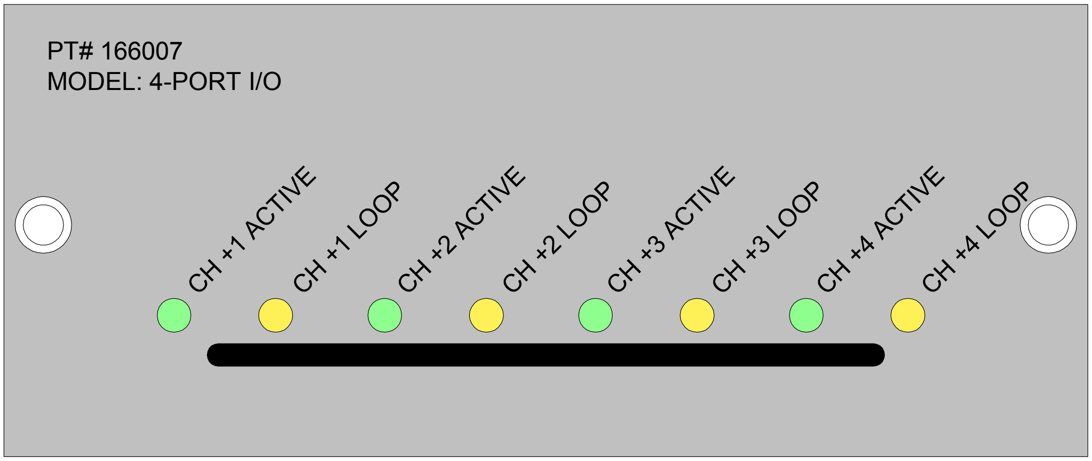


Figure 14 Port I/O Card Front Panel

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 Nx8-DualMUX 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 **Error! Reference source not found.**. 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 Nx8-DualMUX 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 13 – Console Terminal Interface Settings

Additionally, the Nx8-DualMUX 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 Nx8-DualMUX and the PC or terminal is used for console connectivity. Once connected, with the terminal or emulation program running and the Nx8-DualMUX powered on, communication between the operator and the system is enabled.

Upon power-up of the system, the Nx8-DualMUX outputs an initialization banner to the console, similar to the following:

```
--------------------------------------------------------
16-Port Nx8 Multiplexer Firmware Rev N.n
East Coast Datacom Jan. 1, 2003
--------------------------------------------------------
Initializing...Loading FPGA Image...
```

NOTE: If the console connection is made or the terminal window is brought up after the Nx8-DualMUX 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.

4.3 Power-Up Login & Logoff

When the Nx64 DualMUX is powered up, the operator is asked to enter a password before any further operations are allowed. The default factory password is '*default*'. Once changed, the default password is no longer valid.

The following screen is presented on power-up, and whenever there is no active session logged on.

```
~  Nx8 ID: xxxxx              Sys:3.2 FPGA:3.2 Ser:0        00000:00:00
~+ CpA=X CpB=X   Channels: X X X X  X X X X  X X X X  X X X X  LPwr=+x RPwr=nn
 --------------------------------------------------------------------------



Nx64 LOG IN

Please Log In [password is case sensitive]:
```

Figure 15 – Login Menu

The operator is automatically logged off the system when there is no terminal keyboard activity for a period of 30 minutes. The operator may also perform a Log Off command by selecting option [6] on the Top-level menu screen.

4.4 Menu and Screen Format

All menu screens adhere to the display format of Figure 16 (as shown for the Hyperterminal application).

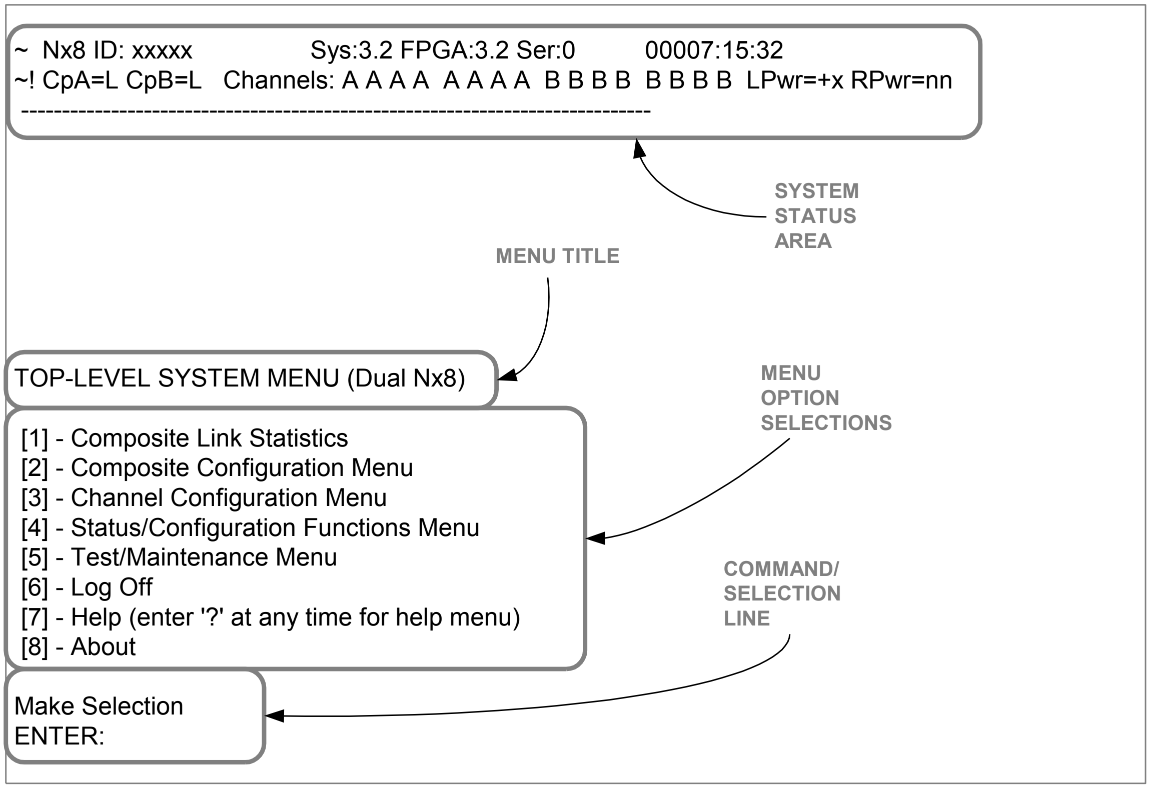


Figure 16

4.5 Menu Structure

In order to illustrate the menu hierarchy in an abstract way, a graphical representation of the menu structure is used in this document. The following diagram shows the general symbols used in these illustrations and how they are used to construct a menu tree.

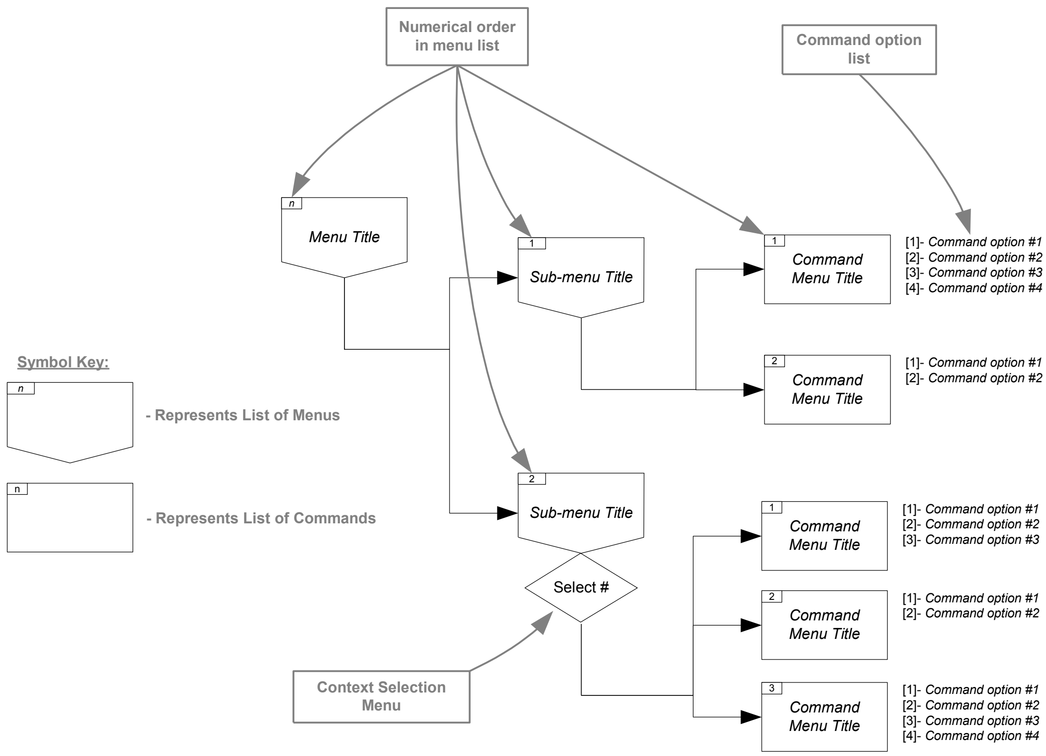


Figure 17

In the diagram of Figure 17, each box represents a menu screen that is called up by selecting in the prior menu the option number in the top-left corner of the box. The title of the menu is contained in the box.

In general, five-sided boxes are menus which lead to other menus via the selection of option indexes, and rectangular boxes are menus which are composed entirely of commands. For commands, the options are listed to the right of the menu box.

4.6 Help Menu

The Help Menu (option [7] on the Top-level menu screen) provides information on interpreting the status area of the screen and commonly used menu navigation functions. The operator should be familiar with the contents of the Help menu, shown in Figure 18 and refer to it frequently when learning to operate the system.

```
~  Nx8 ID: xxxxx                 Sys:3.2 FPGA:3.2 Ser:0          00000:17:59
~+ CpA=L CpB=L   Channels: A A A A  A A A A  B B B B  B B B B  LPwr=+x RPwr=nn
 |     |     |             \_________Channel Status:_______/        \|      \|
 | Composite Status:            A = running on composite A.          |       |
 |  S = in sync.                B = running on composite B.          |       |
 |  s = in sync with errors.    a = backed up on Comp A.             |       |
 |  X = out of sync.            b = backed up on Comp B.             |       |
 |  L = loopback locally.       * = bumped.                  Local <--'       |
 |  R = loopback at remote.     X = on downed Comp link.      Remote <--------'
 |  N = ntwk in loopback.       L = loopback locally.          Pwr Supplies:
 |  n = lost contact with rmt.  R = loopback at remote.         + = OK.
 |  o = out of service.         o = out of service.             x = failed.
 |                              s = suspended.                  n = not present.
 |                                                              . = no data.
 `----> Config       - = remote database not available.
        Databases:  ? = remote and local config databases DO NOT match
                    ! = remote and local timeslot tables DO NOT match.
                     + = OK

 ------------------------------ MENU CONTROL KEYS ---------------------------
<CTRL>T = Go to Top Level System Menu                <CTRL>L = Local Config
<CTRL>P = Go to Previous Menu in Hierarchy           <CTRL>R = Remote Config
<CTRL>N = Go to Next Menu (certain menus only)       <CTRL>B = Backup Config
<CTRL>C = Go to Next Channel (setting menus only)       ?    = This help menu
<Enter> = Accept input and/or Refresh Screen           <ESC>  = Exit Screen
```

Figure 18

4.7 Top-Level Menu

The top-level menu provides eight optional menus from which to set-up and conduct system operations, as shown in Figure 19 below.

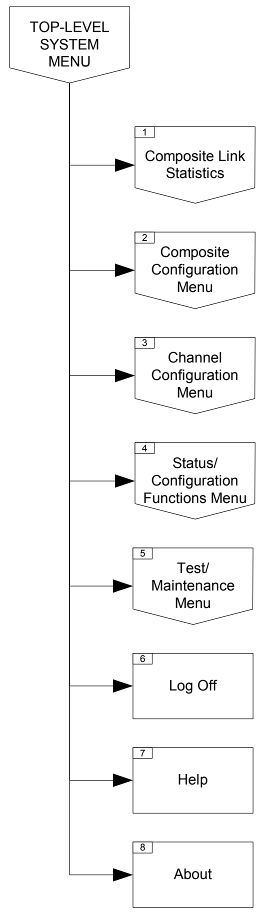


Figure 19

The following sections outline choices 1 through 5, enumerated by the menu option number.

4.7.1 Composite Link Statistics [1]

Selecting menu option [1] from the top-level menu produces an informational screen summarizing composite link error thresholds, including error and sync loss events. The display format is shown in Figure 20.

```
~  Nx8  ID: xxxxx                 Sys:3.1 FPGA:2.2 Ser:0         00017:21:51
~- CpA=L CpB=L   Channels: A A A A  A A A A  B B B B  B B B B  LPwr=x+ RPwr=..
 -----------------------------------------------------------------------------
COMPOSITE LINK ERRORS
         WHEN IN SYNC         Link A RX    Link A TX    Link B RX    Link B TX

   Link hits in last minute:         0            0            0            0
 Hits over last 00017:21:51:         0            0            0            0
       Hits since box reset:         0            0            0            0
Sync losses since box reset:         0            0            0            0


Link A hits per minute thresholds for Backup/Recovery:    300 / 125
Link B hits per minute thresholds for Backup/Recovery:    250 / 100


[1] - Set Composite A Backup  Threshold
[2] - Set Composite A Recover Threshold
[3] - Set Composite B Backup  Threshold
[4] - Set Composite B Recover Threshold
[5] - Clear 'Hits over last xxxxx:xx:xx' Counters

Make Selection                                            [FLASH NOT UPDATED]
ENTER:
```

Figure 20

“Link hits” are typically single-bit errors that are detected in the framing pattern that do not result in loss of synchronization. The hit/minute threshold is the level at which the system will declare a link alarm regardless of the state of the Sync signal for that link.

When determining the threshold, consideration should be given to the fact that the composite link bandwidth over which the error-detection circuit is working is 6Kb/s. Therefore a link BER of 10-4, for example, would result in an average of about 36 hits per minute (6000 bps x 10-4BER x 60sec/min).

Transmit data (TX) link hits are detected by the remote multiplexer and provided via the in-band management channel back to the local multiplexer for display.

4.7.1.1 Composite Link Statistics Menu options

The following illustrates the menu options for the Status/Configuration Functions Menu:

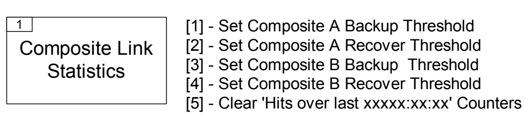


Figure 21

Choosing each option performs the following commands:

Option [1] : Set Composite A Backup Threshold
Sets the error rate per minute threshold at which the Composite Link A Alarm is raised.

Option [2] : Set Composite A Recover Threshold
Sets the error rate per minute threshold at which the Composite Link A Alarm is lowered.

Option [3] : Set Composite B Backup Threshold
Same as option [1], but applies to Composite link B.

Option [4] : Set Composite B Recover Threshold
Same as option [2], but applies to Composite link B.

Option [5] : Clear 'Hits over last xxxxx:xx:xx' Counters
Clears the 2nd line of error count registers and restarts the elapsed timer.

4.7.2 Composite Configuration Menu [2]

The Composite Configuration Menu allows the operator to set up all parameters associated with the operation of both composite ports, including those of the remote system when linked.

The following diagram depicts the menu tree for the Composite Configuration Menu:

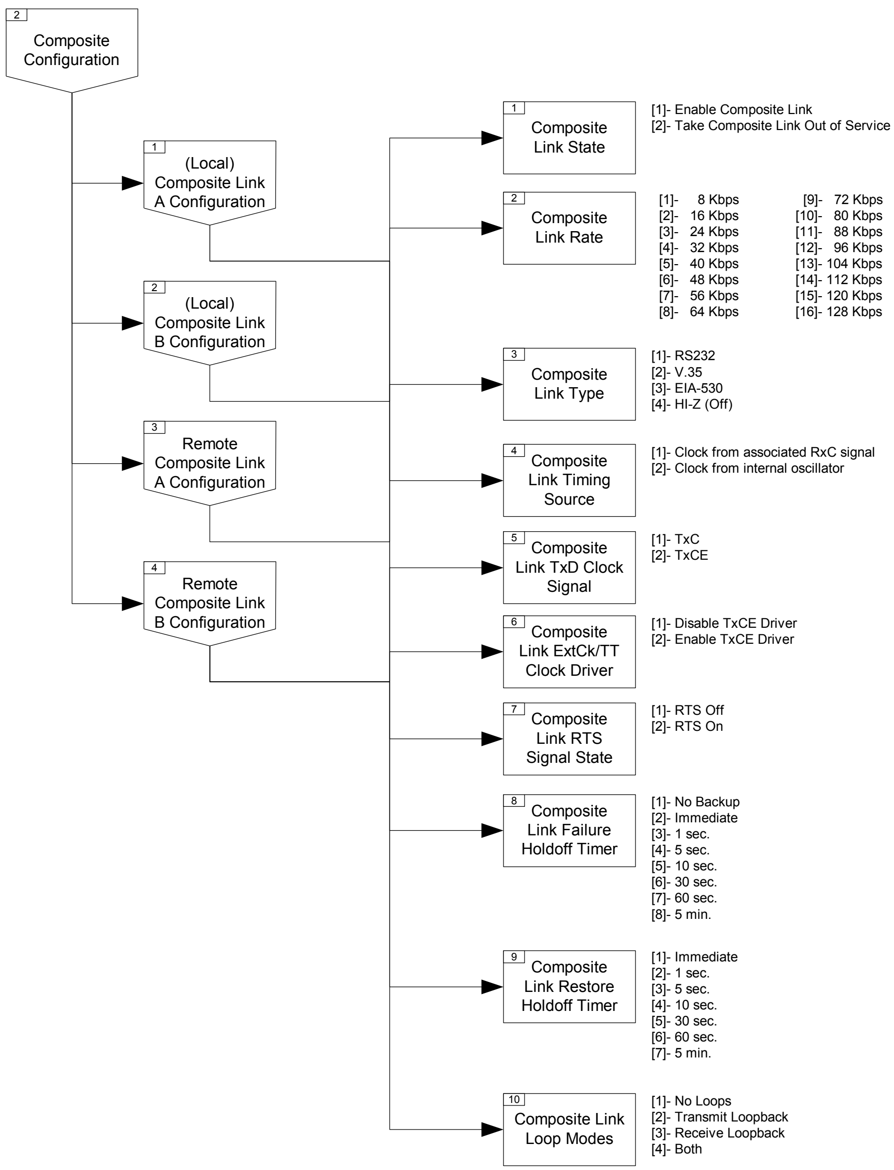


Figure 22

In this menu the operator begins by choosing the composite port to which subsequent menu operations and commands will be directed. Once this selection is made the command menu options, 1 through 10 are presented. In this way, the operator may set unique parameters for Local versus Remote systems, and Composite A versus Composite B.

Some of the menu selections however, automatically update the corresponding parameter on both Local AND Remote systems. This prevents situations in which the two systems cannot communicate short of manual intervention at both sites.

4.7.2.1 Composite Link State [1]

This menu allows selection of the enabled/disabled state of the composite link and affects both the Local and Remote systems. Choosing each option performs the following commands:

Option [1] : Enable Composite Link.
This command puts the composite link into service. If the remote composite port is physically connected, the link should synchronize at both ends and begin exchanging data. Any channel ports allocated to this link will be connected as a result.

Option [2] : Take Composite Link Out of Service.
This command removes the composite link from service. Channel ports allocated to this link will be switched over to backup channels when configured as such.

4.7.2.2 Composite Link Rate [2]

This menu allows selection of the composite port clock rate. This rate must agree with the clock provided by the attached DCE, unless timing is derived from the internal oscillator. If the internal oscillator is selected, the option selected in this menu will force the composite clock to run at the selected frequency.

The available options are:

Option [1] : 8 Kbps
Option [2] : 16 Kbps
Option [3] : 24 Kbps
Option [4] : 32 Kbps
Option [5] : 40 Kbps
Option [6] : 48 Kbps
Option [7] : 56 Kbps
Option [8] : 64 Kbps
Option [9] : 72 Kbps
Option [10] : 80 Kbps
Option [11] : 88 Kbps
Option [12] : 96 Kbps
Option [13] :104 Kbps
Option [14] :112 Kbps
Option [15] :120 Kbps
Option [16] :128 Kbps

4.7.2.3 Composite Link Type [3]

This menu allows selection of the electrical interface standard to which the composite port will comply. For V.35, an cable adapter is required.

Option [1]- RS232

Option [2]- V.35

Option [3]- EIA-530

Option [4]- HI-Z (Off)
Selecting this last option turns off the Composite port interface drivers.

4.7.2.4 Composite Link Timing Source[4]

This menu allows selection of the source of the timing for the composite link. Clocks for all channels are derived from this source. When the TxCE driver is enabled, it's clock input is taken from the clock selected in this menu.

Option [1] - Clock from associated RxC signal
Selecting this option causes the system to derive all composite link timing from the composite interface receive clock (RxC) signal.

Option [2] - Clock from internal oscillator
Selecting this option causes the system to use it's internal oscillator to generate a composite timing signal at a frequency selected in the Composite Link Rate menu.

4.7.2.5 Composite Link TxD Clock Signal [5]

This menu allows selection of the timing signal from which to clock out transmit data.

Option [1] – TxC
This selects the Transmit Clock input (TxC) as the signal for clocking out transmit data.

Option [2] – TxCE
This selects the Transmit Clock output (TxCE or TT) as the signal for clocking out transmit data.

4.7.2.6 Composite Link ExtClk/TT Clock Driver [6]

This menu allows setting the TxCE/TT clock driver On or Off.

Option [1] - Disable TxCE Driver

Option [2] - Enable TxCE Driver
When the TxCE driver is enabled, the clock source is either RxC or the internal oscillator, depending on the timing source selected (see subsection 4.7.2.4 above).

4.7.2.7 Composite Link RTS Signal State [7]

This menu allows setting the composite port RTS signal driver On or Off.

Option [1] - RTS Off

Option [2] - RTS On

4.7.2.8 Composite Link Failure Holdoff Timer [8]

This menu allows setting the time period after which a fault alarm will be declared due to a loss of link synchronization (SYNC).

Option [1] - No Backup
Option [2] – Immediate
Option [3] - 1 second
Option [4] - 5 seconds
Option [5] - 10 seconds
Option [6] - 30 seconds

Option [7] - 60 seconds
Option [8] - 5 minutes

4.7.2.9 Composite Link Restore Holdoff Timer [9]

This menu allows setting the time period after link synchronization (SYNC) returns before the link is declared to be in service and available for re-assignment of channels

Option [1] – Immediate
Option [2] - 1 second
Option [3] - 5 seconds
Option [4] - 10 seconds
Option [5] - 30 seconds
Option [6] - 60 seconds
Option [7] - 5 minutes

4.7.2.10 Composite Link Loop Modes [10]

Option [1] - No Loops
Clears all loops on the selected Composite port

Option [2] - Transmit Loopback
This option implements a loopback of transmit data output to the composite receive data input. The normal transmit data signal to the network is unaffected.

Option [3] - Receive Loopback
This option implements a loopback of receive data input to the transmit data output. The normal receive data signal to the multiplexer is unaffected

Option [4] – Both
Selecting this option causes both transmit and receive data paths to be broken and looped such that the output of the multiplexer is looped to the input, and the input (RxD) from the network is looped to the output (TxD).

4.7.3 Channel Configuration Menu [3]

The Channel Configuration Menu allows the operator to set up all parameters associated with the operation of each of the subchannel ports, including those of the remote system when linked to the local system.

The following diagram depicts the menu/options tree for the Channel Configuration Menu:

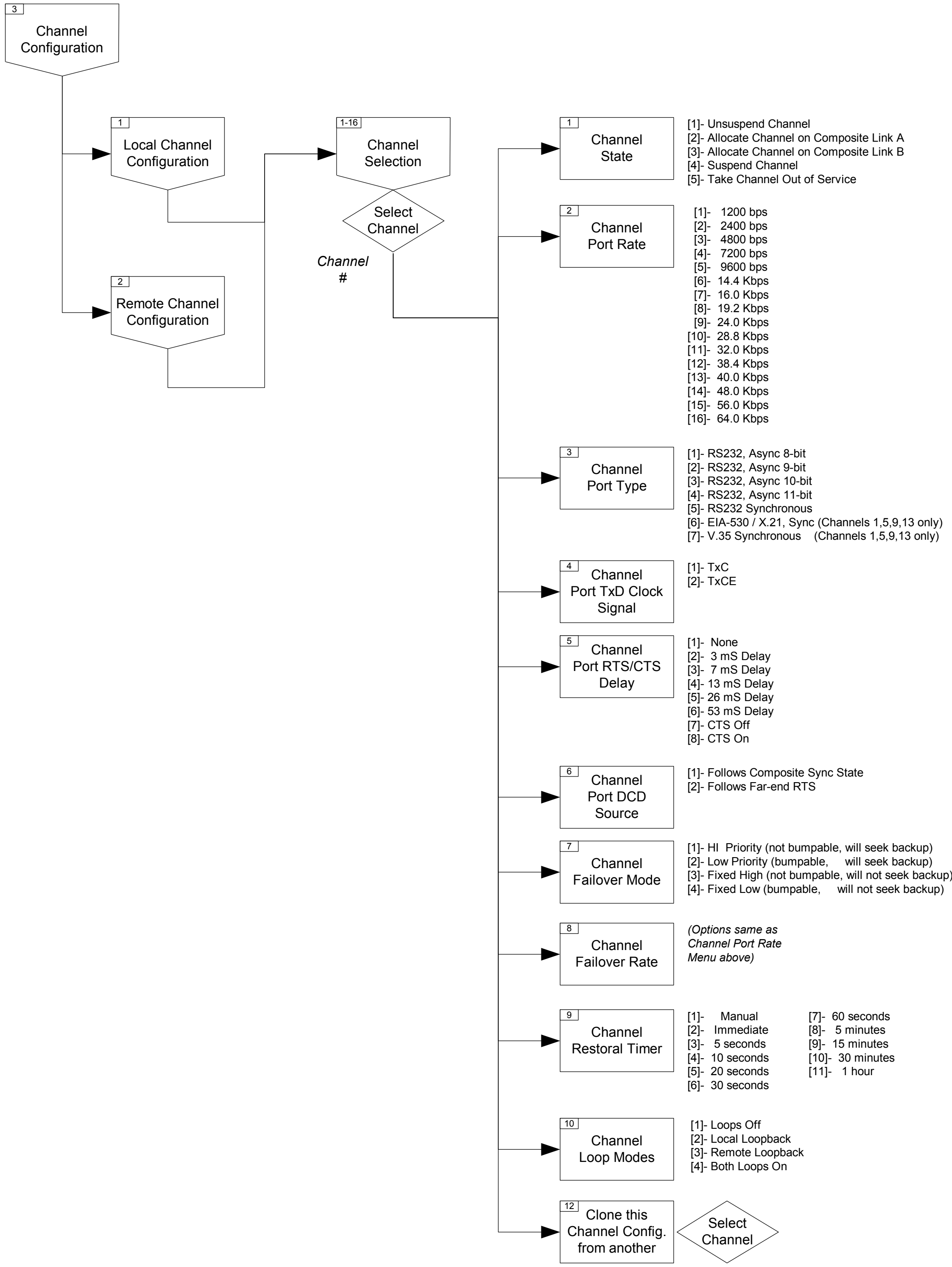


Figure 23

In this menu the operator begins by first choosing whether to operate on Local channel parameters, or Remote channel parameters. This is important when dealing with port-specific configuration, such as the type of electrical interface of the port, which may be different on the local side from the remote side. On the other hand, most channel parameters, for example, channel rate, apply to both local and remote ports.

After choosing a local or remote context, the operator then chooses the channel number to which subsequent commands will be directed. Once this selection is made the command menu options, 1 through 12 are presented and the commands will only apply to that channel.

The following subsections outline each of the command menus comprising the Channel Configuration.

4.7.3.1 Channel State [1]

This menu allows setting a selected channel in an operational mode, or either of two offline states.

Option [1] - Un-Suspend Channel (also used to activate MANUAL restoral channels)
This option returns a suspended channel to active service with it's previously defined configuration on the composite link to which it was allocated.

Option [2] - Allocate Channel on Composite Link A

Option [3] - Allocate Channel on Composite Link B

Option [4] - Suspend Channel
This option deactivates a channel and removes it's allocation from the composite link to which it was assigned. However the channel parameters are saved so that the channel can be un-suspended.

Option [5] - Take Channel Out Of Service
This option removes a channel from service along with any parameters assigned to it.

4.7.3.2 Channel Port Rate [2]

Selecting any of the channel port rate options configures the channel for operation at that bit rate. This selection applies to not only the channel, but also to ports at both ends of the link.

The available options are:

Option [1] - 1200 bps
Option [2] - 2400 bps
Option [3] - 4800 bps
Option [4] - 7200 bps
Option [5] - 9600 bps
Option [6] - 14.4 Kbps
Option [7] - 16.0 Kbps
Option [8] - 19.2 Kbps
Option [9] - 24.0 Kbps
Option [10] - 28.8 Kbps
Option [11] - 32.0 Kbps
Option [12] - 38.4 Kbps
Option [13] - 40.0 Kbps
Option [14] - 48.0 Kbps
Option [15] - 56.0 Kbps
Option [16] - 64.0 Kbps

4.7.3.3 Channel Port Type [3]

This menu allows the selection of the type of port interface standard used at the selected port. RS-232 is available on all ports, whereas EIA-530, X.21 and V.35 are available only on the first port of each port card. It is not required that the port electrical type be the same for a given channel on each end of the link, but it is not possible to apply async and synchronous formatted data on opposite ends of the same channel.

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

4.7.3.4 Channel Port TxD Clock Signal [4]

This option permits the selection of the clock signal used to clock the TxD input to the multiplexer. TxC is the default, however, if the DTE returns the TxC signal as TxCE, it may be used as an alternative clock. This may be necessary on longer cables running at higher clock rates, to maintain timing margins between TxD and it's clock signal.

Option [1] - TxC

Option [2] - TxCE

4.7.3.5 Channel Port RTS/CTS Delay [5]

Selection of this option determines the response of the channel port's CTS control signal. CTS may be set steadily ON or OFF, or, may be set to follow the port's RTS signal input, with or without a delay as specified in the options below.

Option [1] - No Delay
Option [2] - 3 mS Delay
Option [3] - 7 mS Delay
Option [4] - 13 mS Delay
Option [5] - 26 mS Delay
Option [6] - 53 mS Delay
Option [7] - CTS Off
Option [8] - CTS On

4.7.3.6 Channel Port DCD Source [6]

This option controls the behavior of the port's DCD control signal output.

Option [1] - Follows Composite Sync State
Selection of this option causes the DCD signal to follow the SYNC state of the composite to which the channel is assigned. This is the default mode

Option [2] - Follows Far-end RTS
Selection of this option causes the port's DCD signal to follow the RTS control lead input on the far-end multiplexer, providing the composite SYNC state is ON as in Option 1 above.

NOTE: When a composite port is put into a LOOP mode (transmit or receive), all DCD signals of channels active on that port's link are disabled, regardless of which above mode is chosen.

4.7.3.7 Channel Failover Mode [7]

The Channel Failover Mode determines the priority a channel has under conditions where a composite link has failed and channels are re-assigned to the backup link. Low Priority and Fixed Low channels on a non-failed link may be "bumped", or suspended from service when a High Priority channel is re-allocated from a failed link. Any channel that is in "fixed" mode (Options 3 & 4), will not move to a surviving link should it's home link fail.

Channels are bumped only when there is not enough available bandwidth on a surviving link to support channels that are re-allocated from a failed link. Channels are searched in ascending order, from 1 to 16, for both bumping and re-allocation until all channels seeking backup on the surviving link are re-allocated, or the link bandwidth is exhausted.

Option [1] - HI Priority (not bumpable, will seek backup)

Option [2] - Low Priority (bumpable, will seek backup)

Option [3] - Fixed High (not bumpable, will not seek backup)

Option [4] - Fixed Low (bumpable, will not seek backup)

4.7.3.8 Channel Failover Rate [8]

The selections in this menu allow for setting a new channel rate should the channel be re-allocated to a surviving link as a result of a failure of it's home link.

The available options are:

(See section 4.7.3.2 for rates)

4.7.3.9 Channel Restoral Timer [9]

Selection of this option controls when a channel that has been re-allocated to a surviving link is restored to it's home composite link after that link has been returned to service (subject to the Composite Link Restore Holdoff Timer). A selection of "Manual" (Option 1) means that the channel will remain active on the backup link and not be restored on it's home link until the operator un-suspends it via the Channel State menu, Option 1.

The available options are:

Option [1] - Manual
Option [2] - Immediate
Option [3] - 5 seconds
Option [4] - 10 seconds
Option [5] - 20 seconds
Option [6] - 30 seconds
Option [7] - 60 seconds
Option [8] - 5 minutes
Option [9] - 15 minutes
Option [10] - 30 minutes
Option [11] - 1 hour

4.7.3.10 Channel Loop Modes [10]

The options of this menu control individual loop modes of the channel port.

[1] - Loops Off

[2] - Local Loopback
Selecting this option causes transmit data from the attached DTE to be looped back to the

receive data signal of the DTE in place of that from the multiplexer port. While this loop is in effect, a continuous MARK signal is provided to the transmit data input of the port.

[3] - Remote Loopback
Selecting this option causes receive data from the multiplexer port to be looped back to the transmit data signal of the same multiplexer port in place of that from the DTE. While this loop is in effect, a continuous MARK signal is provided on the receive data output to the DTE.

[4] - Both Loops On
Selecting this option causes both the multiplexer port data and DTE data to be looped to themselves.

4.7.4 Status & Configuration Functions Menu [4]

The following illustrates the menu options for the Status/Configuration Functions Menu:

```
6
Status/
Configuration
Functions

 [1] - Display Configuration Status
 [2] - Display Remote Configuration Status
 [3] - Display Link Recovery Configuration
 [4] - ---------------------------------------
 [5] - Save Current/Active Configuration to Disk
 [6] - Load Configuration from Disk (does local & remote)(Flash is not updated)
 [7] - -----------------------------------------------------------------------
 [8] - Store Local and Remote Configurations to each Flash
 [9] - Reload Local and Remote Configurations from their Flash
[10] - -----------------------------------------------------------------------
[11] - Copy-Common Configuration to Remote   (Corrective)(Flash is not updated)
[12] - Copy-All Local Configuration to Remote           (Flash is not updated)
[13] - Copy-All Remote Configuration to Local           (Flash is not updated)
[14] - Reset to Null Configuration      (does local only)(Flash is not updated)
```

Figure 24

4.7.4.1 Display Configuration Status [1 & 2]

Selecting either of these two options presents an information screen in tabular format that displays the status of either local or remote systems. These include the state, speed, type, available bandwidth, and loops in effect for each composite port, and, the state, speed, type, loops in effect, and data activity for each channel port.

4.7.4.2 Display Link Recovery Configuration [3]

Selecting this option presents an information screen in tabular format that displays the failure timer and restore timer settings for each composite link, and, the failover mode (priority), backup rate, restore timer setting, and time remaining until restore, for each channel

4.7.4.3 Save Current/Active Configuration to Disk [5]

Selecting this option allows the operator to save the current active local and remote configuration to a file on the PC or network to which the PC is attached. The system will prompt the operator for each step of this operation. If the current active configuration has been modified and has not been stored in FLASH, the saved file and the FLASH configurations will be different.

4.7.4.4 Load Configuration from Disk [6]

Selecting this option allows the operator to load a configuration from a file on the PC or network to which the PC is attached. In this operation, both the local system and the remote system, when linked up, is loaded from the file. The configuration is NOT stored to FLASH memory by this command

4.7.4.5 Store/Reload Local and Remote Configurations to/from each Flash [8 & 9]

Selecting either of these two options will cause the current active configuration to be either stored to FLASH memory, or to be reloaded from FLASH memory, respectively. This command operates on both local and remote systems.

When powering up a system, FLASH memory is used to retrieve the last saved configuration. Any other active configuration that is not stored in FLASH memory is lost when the system is powered down.

4.7.4.6 Copy-Common Configuration to Remote

This option causes most parameters of the current active local configuration to be copied to the remote system's active configuration. What is excluded, are any port-specific and system-specific parameters, for example, port type, DCD source, and channel loopbacks. Those configuration parameters that are common to both ends of the link and for which end-to-end operation depend, are sent to the remote system.

4.7.4.7 Copy-All Local Configuration to Remote

This option is similar to the preceding one, except that all configuration parameters are sent to the remote system and it's current active configuration is updated. This means that all channel and composite port configuration settings are duplicated on the remote system exactly as they are on the local system. This option should be used with care.

4.7.4.8 Copy-All Remote Configuration to Local

This option performs a command identical to the Copy-All Local Configuration to Remote command above, but in the reverse direction, that is, from the remote system to the local system. This option should also be used with care.

4.7.4.9 Reset to Null Configuration

Selecting this option causes the current active local configuration to the reset to a “null” configuration. The following image of the configuration status display (Figure 25) indicates the state of the local system in a null configuration:

```
~  Nx8 ID: xxxxx                 Sys:3.2 FPGA:3.2 Ser:0         00007:34:32
~- CpA=o CpB=o   Channels: X X X X  X X X X  X X X X  X X X X  LPwr=+x RPwr=..
 ----------------------------------------------------------------------------
 LOCAL                                             NEAR     FAR     TX     RX
CHANNEL  STATUS    SPEED       ATTRIBUTES          LOOPS    LOOPS   DATA   DATA
Comp A    Off      64 Kbps   62.4K unused,   HI-Z  None     None    n/a    n/a
Comp B    Off      64 Kbps   62.4K unused,   HI-Z  None     None    n/a    n/a
CH 1    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 2    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 3    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 4    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 5    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 6    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 7    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 8    Alloc-A  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 9    Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 10   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 11   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 12   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 13   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 14   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 15   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
CH 16   Alloc-B  4800  bps   RS-232, Async, 10-bit None     None    ----   ----
<ESC> to exit, <Enter> to refresh:                      [FLASH NOT UPDATED]
```

Figure 25

4.7.5 Test & Maintenance Menu [5]

This menu presents several options for collecting information on the system status of the local and remote systems, and allows control over some “housekeeping” functions.

The following illustrates the menu options for the Test & Maintenance Menu:

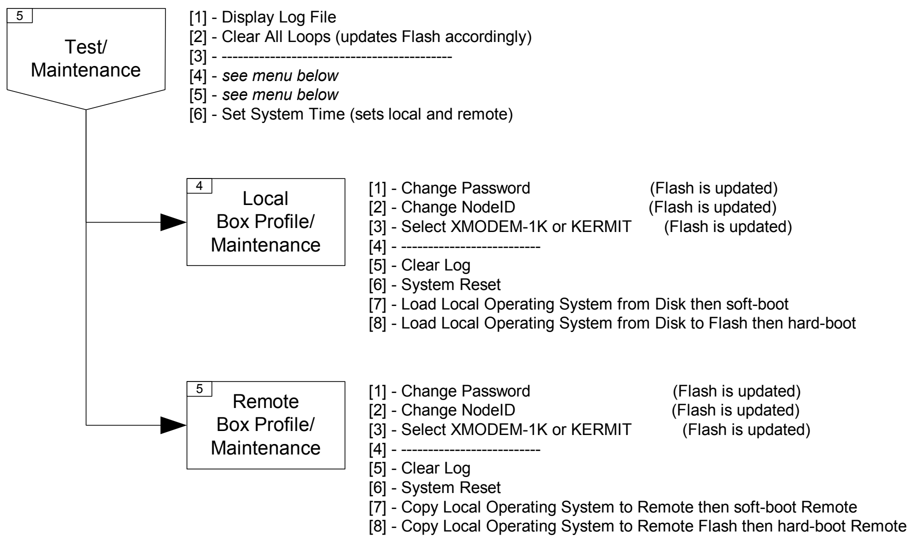


Figure 26

4.7.5.1 Display Log File [1]

This command displays the most recent 18 log file entries on a screen page. Successive <*ENTER*> key presses will cause the display to scroll up to view prior log entries, while <*BACKSPACE*> causes the display to scroll down. The log file stores a maximum of the last 2048 entries.

4.7.5.2 Clear All Loops [2]

Selecting this option causes all data loops, whether on composite or channel ports, and whether on local or remote system, to be cleared.

4.7.5.3 Set System Time [6]

This option allows the operator to set a system time on both local and remote systems, in the format hhhhh:mm:ss. Note that this is not a calendar or 24-hour clock, but rather an elapsed time.

4.7.5.4 Local/Remote Box Profile/Maintenance [4 & 5]

Two menus, one for the local system, and one for the remote system permit a few additional maintenance functions to be performed.

4.7.5.4.1 Change Password [1]

This option allows an operator who is logged in, to change the password on the selected system. Passwords may be different on local and remote systems. When changed, the password is updated immediately in FLASH memory.

4.7.5.4.2 Change NodeID [2]

This command allows the NodeID to be changed. Valid characters include upper and lower-case alphabetical characters, numerals, and underscore. Invalid characters may be typed but are not accepted. When changed, the NodeID is updated immediately in FLASH memory.

4.7.5.4.3 Select XMODEM-1K or KERMIT [3]

This option allows the operator to set the file transfer protocol to be used when downloading or uploading files between the multiplexer system and the PC hosting the terminal program. On many PC using a terminal emulation program such as HyperTerminal both protocols are supported and either may be selected via this option. The default factory setting is XMODEM-1K.

4.7.5.4.4 Clear Log [5]

This command erases all entries in the Log file.

4.7.5.4.5 System Reset [6]

Selecting this command performs a system reset, which causes the system to re-boot exactly as it would from a power-on. All non-volatile memory settings are restored, however any current active configuration options different from those stored in FLASH at the time of this command, are lost. This option should be used with care.

4.7.5.4.6 Load Local Operating System from Disk then soft-boot [7, On Local Only]

This command causes operating firmware to be loaded into the system executable RAM from a selected disk file, followed by a re-boot. Because the operating firmware is stored only in RAM, performing a subsequent system reset will restore the firmware state to that revision stored in FLASH memory.

4.7.5.4.7 Load Local Operating System from Disk to Flash then hard-boot [8, On Local Only]

This command causes operating firmware to be loaded into the system FLASH memory from a selected disk file, followed by a hard re-boot (i.e., boot from FLASH memory). Once complete, this command will result in loss of the firmware revision previously stored in FLASH memory.

4.7.5.4.8 Copy Local Operating System to Remote then soft-boot Remote [7, On Remote Only]

This command performs a similar operation as in section 4.7.5.4.6, except that the source file is not a disk file, but rather the local system.

4.7.5.4.9 Copy Local Operating System to Remote Flash then hard-boot Remote [8, On Remote Only]

This command performs a similar operation as in section 4.7.5.4.7, except that the source file is not a disk file, but rather the local system.

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.

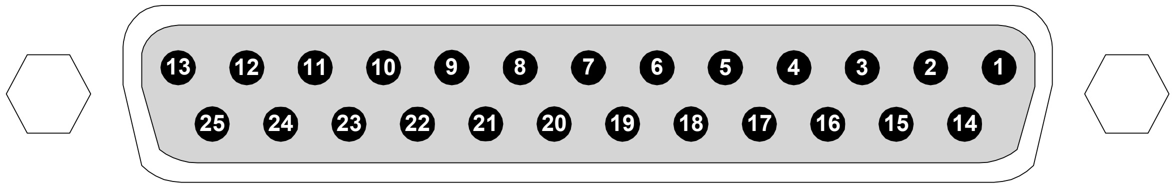
Table 14 summarizes the settings stored in systems upon shipping to the customer.

	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 14 – Nx8-DualMUX 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)

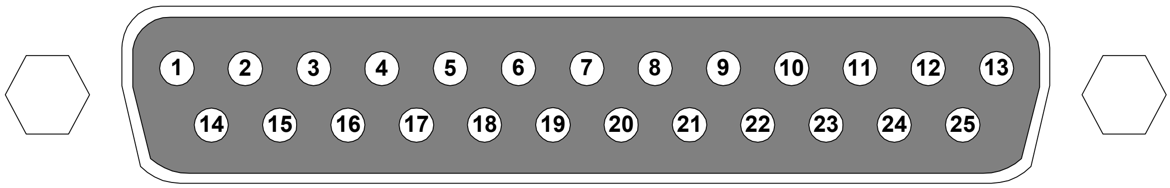
Pin No.	Signal RS-232 Mode	EIA-530 Mode (Ports 1, 5, 9, & 13 only)	V.35 Mode * (Ports 1, 5, 9, & 13 only)
1	Frame GND	Frame GND (Shield)	Frame GND (Shield)
2	TxD	TxD +	SD +
3	RxD	RxD +	RD +
4	RTS	RTS +	RTS
5	CTS	CTS+	CTS
6	DSR	DSR+	DSR
7	Signal GND	Signal GND	Signal GND
8	DCD	DCD+	RLSD
9		RxC -	SCR -
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 15 - Channel Port Connector Pinouts

5.2.2 Composite Port Connector (DTE)



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

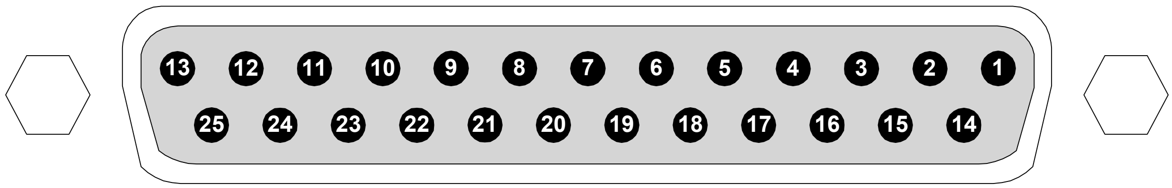
	Signal		
Pin No.	**RS-232 Mode**	**EIA-530 Mode**	**V.35 Mode ***
1	Frame GND	Frame GND (Shield)	Frame GND (Shield)
2	TxD	TxD +	SD +
3	RxD	RxD +	RD +
4	RTS	RTS +	RTS
5	CTS	CTS+	CTS
6	DSR	DSR+	DSR
7	Signal GND	Signal GND	Signal GND
8	DCD	DCD+	RLSD
9		RxC -	SCR -
10		DCD -	
11		TxCE -	SCTE -
12		TxC -	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 16 - 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 17 - 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 Nx8-DualMUX 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 18 - 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 Nx8-DualMUX 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 19 - 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 Nx8-DualMUX 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 20 - 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 Nx8-DualMUX 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 21 – 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 Nx8-DualMUX 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 22 – Channel Port to X.21 Adapter

5.3.6 Channel Port RS-449 Adapter Cable Connection Diagram

Use the following diagram when constructing or specifying an adapter cable between any Nx8-DualMUX Channel port operating in EIA-530 mode and a standard RS-449 cable, or DTE device.

EIA-530 mode 25-pin Male Sub-miniature D					**RS-449 37-pin Female 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 23 - Channel Port to RS-449 Adapter

5.3.7 Channel Port-to-Console Adapter Cable

Any Nx8-DualMUX channel port, with a management terminal attached, may be used to directly access the menu-driven user interface on a remote Nx8-DualMUX 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 27

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 24 – Channel Port-to-Console Port Adapter Cable

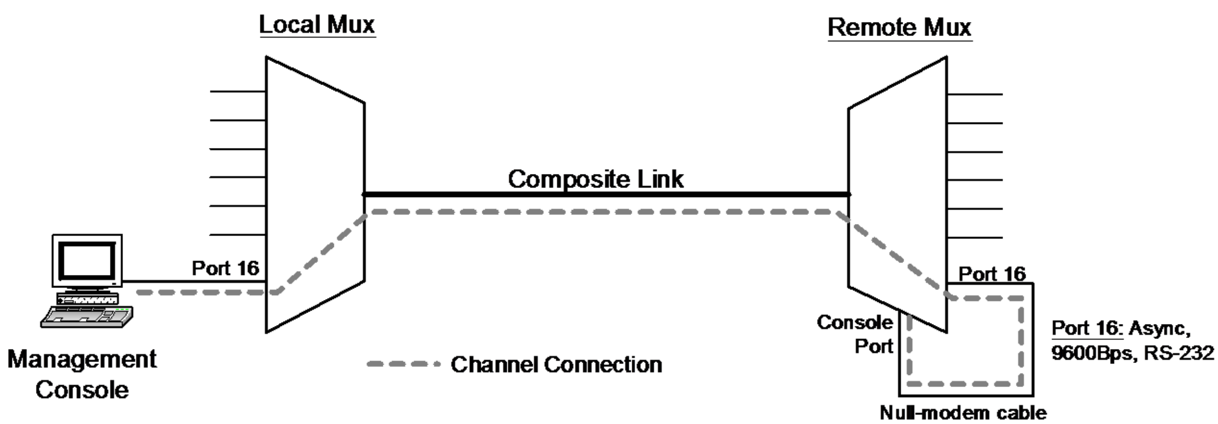


Figure 27 – Remote Console Setup and Configuration

5.4 Configuring an Nx8-DualMUX Link for Simplex Operation

The Nx8-DualMUX 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 28 illustrates a typical simplex network configuration.

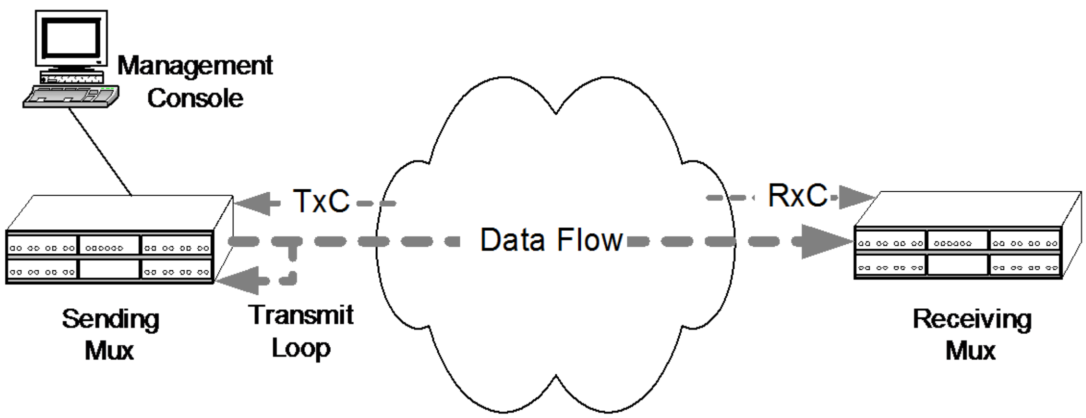


Figure 28 – Multiplexers in Simplex Network Configuration

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.

5.4.1 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. <u>Remote Port (#) Interface Types</u>

2. <u>Remote Port (#) TxD Clock</u>

3. <u>Remote Port (#) RTS/CTS Delay</u>

4. <u>Remote Port (#) DCD Source</u>

5. <u>Remote Port (#) Loop Modes</u>

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.

5.5 Technical Specifications

Application
Multiple Sync or Async DTE devices time-division-multiplexed onto one or two synchronous DCE communication links 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 or Two Ports
Channels: Up to sixteen ports

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

Data Rates
Composite Ports(2): 8Kbps to 128Kbps in16 steps, of Nx8K rates. Fixed overhead of 1600 bps for framing and in-band management.

Channel Ports(16):
ASYNC & SYNC Rates(bps): 1.2K, 2.4K, 4.8K, 7.2K, 9.6K, 14.4K, 19.2K, 28.8K, 38.4K. Async Support: configurable for 8, 9, 10 and 11 bit data on a per channel basis.
SYNC-Only Rates(bps): 16K, 24K, 32K, 40K, 48K, 56K, 64K.

Composite Port Interface
Two Ports: DB-25 Male, Each 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, Dual IEC Power Inlets, w/ 5mm Fuses, 1:1 Optional Redundant DC Power Module with system failure notification.

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 .... 8.72 inches (22.10 cm)
Width .... 17.00 inches (43.18 cm)
Length .... 9.00 inches (22.86 cm)

Weight
15 pounds (6.8 Kg)

Warranty
Three Years, Return To Factory

5.6 Ordering Information

Part Number: 166100
Model: Nx-MUX_DD
Description: 16-Port Dual Composite, Dual Power Chassis
QTY Req: 1

Part Number: 166106
Model: Nx-Dual Composite
Description: Nx8-Dual Composite Processor Card
Qty Req: 1

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

Part Number: 166080
Model: Nx-SRPS
Description: Nx-MUX, Single Redundant Power Supply
QTY Req.: 1 or 2

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