EMERGENCY - 1-800 - 344 - 3544
SCHAUMBURG - 1-708 - 706 - 8389

The ASCII Tandy 200 terminal must be set to the correct communication parameters to allow it to communicate with the DDM-1000, the 3X50 and the FMT 150.

You must complete the following steps:

1) Connect the terminal to the multiplexer using one of the following RS 232 cords:

   A. The DDM 1000 requires a 25 pin standard cord.

   B. The Rockwell 3X50 requires a 25 pin to 9 pin cord.

   C. The FMT 150 requires a 25 pin standard cord and a Null Modem.

2) Turn the power switch on the terminal to on.

3) Press the reset switch next to RS 232 port at rear of terminal.

4) Using cursor position key, move cursor to column titled TELCOM and press return key.

5) One of the following formats may be displayed: If not, you will have to set the correct communication parameters.

The required communication parameters are:

A. The DDM 1000 requires 57~~N~~E1DNI.

B. The Rockwell 3X50 requires 58N1DNN.

C. The Northern Telecom requires 88 N1ENN.

6) If the terminal does not display the correct parameter, press the F3 function key and the word stat will appear after Telcom.

7) Enter the correct communication parameter which is used for that multiplexer and press the enter key.

Note: You don't need to enter 0, 10 PPS as the terminal will add that information.

8) The cursor will move to the next line and display Telcom.

9) Press the F4 function key once the cursor moves to the next line and you are ready to communicate with the multiplexer.

10) Refer to AT&T 363-206-100 DDM 1000 user manual section commands and reports for the syntax required to communicate with the system.

11) Refer to the Rockwell manual the operations section 370-009-300 table 8 on page 18 for the selection of menus.

12) Refer to the Northern Telecom practices 321-3211-301 or the NT user guide section 8 operational procedures for the list of alarm information.

DDM-1000

1) Access the DDM-1000 using the correct communication parameters listed in the job aid in the front of this book.

2) Using the 363-206-100 commands and reports section including the correct synopsis, do the following items:

   a) REPT-FAIL: will list current failures.

   b) REPT-HSTY: will list the last items that have occurred.

   c) EXCT-SW-HS: This will make or break a high-speed or low-speed protection switch.

   d) Note in the commands, the [ ] brackets are optional but the { } braces must be entered.

Any questions?

3X50

1) Access the 3X50 using the correct communication parameter listed in the job aid int he front of this book.

   a) After pushing the F4 key, push the Enter key.

   b) The system will display the Rockwell logo and ask you to logon.

   c) Type Logon and push the Enter key. If you are using a VT100 terminal, you must also type Logon VT100. The system will ask for a password.

   d) The password is Eagle. Type Eagle and push Return. The system will report the local shelf address is D9A or D9B.

   e) Push the return and the master menu is displayed.

   f) Using the reference material, menu screens and 3X50 trouble clearing hints try several of the items.

Any questions?

3X50 Trouble Clearing Hints.

1) To locate any troubles on the DML 3X50, you must first select REPORT from the Master Menu. It may be necessary to select several items from the Report Command Menu to isolate a trouble, i.e., Report-Alarm, Report-Configuration or Report-Provisioning Data.

   A) Report-Alarm will indicate any alarm in the 3X50.

   B) Report-Configuration will list the type of boards physically located in the left or right subsystem.

   C) Report-Provisioning Data will list the provisioning placed in the software in the left or right subsystem.

2) To locate a configure alarm, you <u>must</u> always do Test Provisioning.

3) All changes made in the muldem sub-system software and hardware must be reported to the serial interface board by an Execute - Normalize MUX Configuration command.

4) MUX Set Command Menu, Set Channel alarm inhibit <u>on</u> will prevent alarm and switching of that channel. If low-speed card is plugged in slot, you must inhibit all unequipped channels or put up a DS1 loop back at the DSX.

5) MUX Set Command Menu, Set lockout on channel to <u>on</u> will prevent switching of that channel.

6) Four L.W. high-speed or MUX low-speed switches within ten minutes will cause a 24 hour lock-in. This condition will result in a flashing history LED. Use the L.W. or MUX Set Commands to Set Error Counter Clear.

7) The Set New Supervisor Password command will allow that supervisor to complete all tasks in the menu. The Set New User Password will allow that user to only report menus and not change items.

8) Loop Back DS3 and DS1.

The DS3 loops toward the far end. To check a failed DS3, set DS3 loop back at far end, connect DS3 test set to failed system DSX-3 high speed side. You can now check your DS3 interface card, lightwave, far end lightwave and DS3. (You looped the DS3 back to yourself.)

The DS1 loops toward the near end. To check a failed DS1, set the DS1 loop back at the near end. It will loop the DS1 signal back toward your DSX-1 cross-connect. Using a DS1 test set, you can check for bit errors, etc.

9) To set shelf address:

   1) Set master off all shelves in system.

   2) Change option straps on all shelves (must all be the same alpha numeric, example: F1A, F1B, etc.).

   3) From designated master, set all shelf addresses.

10) Set commands, set software options, i.e., set MUX or set L.W.

Install commands. Install the hardware in memory.

FMT 150

1) Access the FMT 150 using the correct communication parameter listed in the job aid in the front of this book.

   a) After pushing the F4 key, push the Enter key three times.

   b) Enter terminal type. Enter 3 for Tandy 200 and push Enter key.

   c) Login is displayed. Push Enter key and the FMT logo will be displayed.

   d) Push the Label key to remove label information.

   e) Push shift and ? question mark together to obtain a list of options. To recall last screen push shift and ! baseball bat together.

   f) Refer to the Quick Reference Guide in this book to try various commands, i.e., switch group to protect, Report Alarms, etc.

GENERAL NOTES TO THE STUDENT

SCOPE

This manual is intended for classroom use only in conjunction with the Transmission FMT-150B/C/D Operations and Maintenance Course. It is important to note this limitation, as this course material will not be updated as other documentation related to the contents of this course is updated. *This manual is a classroom tool only.*

Due to time limitations and other considerations, certain information is deemed beyond the scope of this course and is therefore not addressed. Included in this category are detailed maintenance procedures, feature availability, system pricing, component level design, and supporting system software and programming. Students interested in more detailed information should investigate other courses offered at the Training Center, or contact your NTI marketing representative.

COURSE AUDIENCE

The FMT-150B/C/D Operations and Maintenance course is intended for Carrier and Central Office personnel directly respansible for maintaining and operating FMT-150B/C/D systems.

PREREQUISITES

None

EVALUATION

We in Technical Training invite student comments on the content and overall effectiveness of this course. We encourage each student to complete an evaluation form upon course completion.

TABLE OF CONTENTS

Northern Telecom Practices for the FMT-150B/C/D System

AGENDA

COURSE #112

Day 1

Lesson Title	Time Req'd
Orientation and Course Objectives	0.5 Hours
Introduction to Fiber Optic Communtcation	0.5 Hours
Basic Digital Transmission Theory	1.5 Hours
Introduction to the FMT-150B/C/D System	1.75 Hours
FMT-150 B/C/D Bay and Shelf Description	1.75 Hours
FMT-150B/C/D Circuit Pack Description	1.0 Hours

Day 2

Lesson Title	Time Req'd
FMT-150B/C/D Protection Switching	0.75 Hours
Alarm Telemetry and Orderwire	0.5 Hours
DM-13 Monitor Operational Procedures	0.5 Hours
Explanation of FMT-150B/C/D CRT Functions	1.0 Hours
CRT Functions Lab	1.0 Hours
Option Settings	0.5 Hours
Option Settings Lab	0.75 Hours
Acceptance Tests Lab	1.0 Hours

Day 3

Lesson Title	Time Req'd
Local Troubleshooting Lab	2.0 Hours
Network Troubleshooting	4.0 Hours

INTRODUCTION TO FIBER OPTIC COMMUNICATION

PURPOSE

The purpose of this section is to introduce the student to the concept of fiber optic transmission and to provide a basic understanding of lightwave transmission.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. List and briefly describe the advantages of fiber optics
2. List the three factors influencing viability of fiber optics
3. Identify the two types of optical sources generally available and briefly describe each
4. Identify the two types of optical detectors available and briefly describe each
5. List and briefly describe the three types of optical fiber
6. Identify several causes of signal impairments in optical transmission

INTRODUCTION TO FIBER OPTIC COMMUNICATION

Table of Contents

The Electromagnetic Spectrum

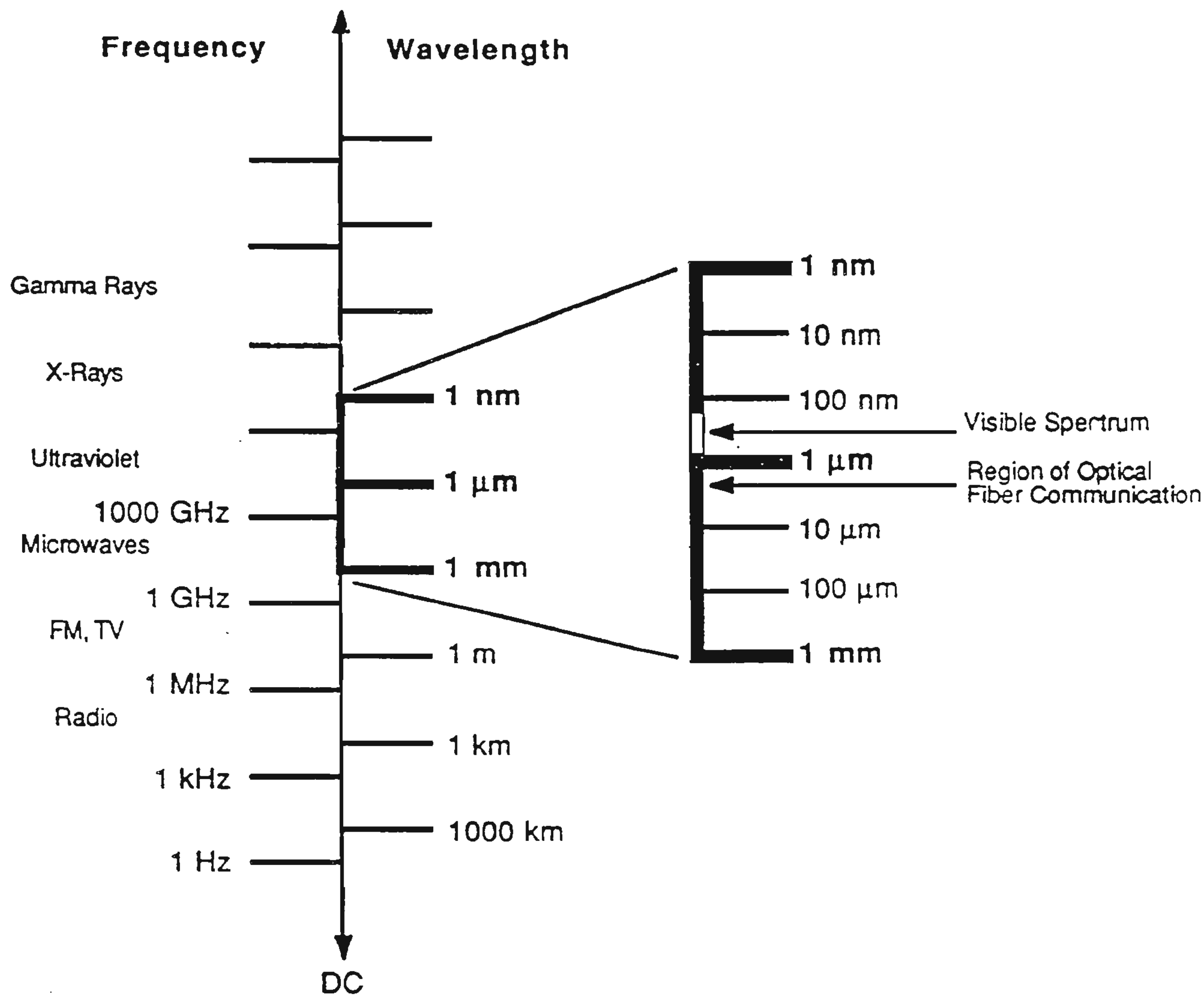


Figure 1

FMT-150 SYSTEMS

WHY FIBER OPTICS?

Ref. Figure 1

In the last decade, optical fiber transmission systems have come to dominate the market for high-bit-rate transmission systems. Indeed, they have redefined "high-bit-rate", a term which used to apply to 45 Mbps systems, but now might apply to systems carrying a billion bits (gigabit) of information per second.

Optical fiber has begun replacing older carriers such as copper wire, coaxial cable, and microwave radio due to its incredible *bandwidth.* Bandwidth is the information capacity of any carrier, and is roughly proportional to the frequency of that carrier. The higher you go in the electromagnetic spectrum, the more information you can transmit. With present technology, lightwaves are as far as we can go in transmitting useful information.

EARLY EXAMPLES OF OPTIONAL COMMUNICATION

There have been many attempts to harness lightwaves for communications purposes. Some were more successful than others:

- Smoke signals by North American Indians
- British naval flag signaling system
- Alexander Graham Bell's "Photophone"

The above methods all shared one common disadvantage - they were using the Earth's atmosphere as the transmission medium. The atmosphere is terribly unpredictable and rain or fog can block the communications path. Line-of-sight communication is usually required, which places a sharp limit on distance. Finally, high-intensity optical sources can pose a hazard to the public.

BEGINNINGS OF FIBER OPTIC COMMUNICATIONS

The first indication that "light pipes" might be possible came in the late 1870's. A British physicist, John Tyndall, discovered that a jet of water could guide a beam of light through gentle curves. This was explained by another British physicist, James Clerk Maxwell, with his invention of electromagnetic theory. He proved that, under certain boundary conditions between different substances (such as water and air), light would exhibit *total internal reflection.*

Naturally, 19th century technology did not permit development of fiber optic transmission systems. By the 1960's, the boom in solid-state technology led to a new look at optical communications. Within a decade, three separate pieces of the puzzle came together. Photodiodes allowed the detection of very weak light pulses in a compact and rugged package. Semiconductor lasers provided tiny but very intense sources of monochromatic (single-color) light. And material scientists specializing in the properties of glass learned how to mass-produce very thin, very transparent glass fibers.

The first "low-loss" fiber was manufactured in the early 1970's. (20 dB/km may not be low-loss today, but it was a breakthrough at the time.) Improvements followed rapidly, so that fiber attenuations of well below 0.5 dB/km are readily available today. These exceptional transparencies allowed the design of transmission systems with regenerator spacings far beyond anything available with copper carriers.

ADVANTAGES OF FIBER OPTICS

Consequently, fiber optic systems were brought to market with two great driving forces. First, the incredible bandwidth of optical systems meant that transmission networks could now plan on megabits - or gigabits - where they had used kilobits before. Second, fiber systems could attain regenerator (repeater) spacing of up to 30 miles - compared to approximately one mile for copper.

In addition; however, there were many "bonus" features of using fiber optic transmission systems. These included:

- Small size cable eased installation in crowded ducts,
- Lightweight cables allowed longer runs
- Immunity to electrical interference (crosstalk, induction, etc.),
- Security from unauthorized tapping,
- Upgradeability to higher bit rates as electronics improved,and
- Low cost (as economies of scale came into play).

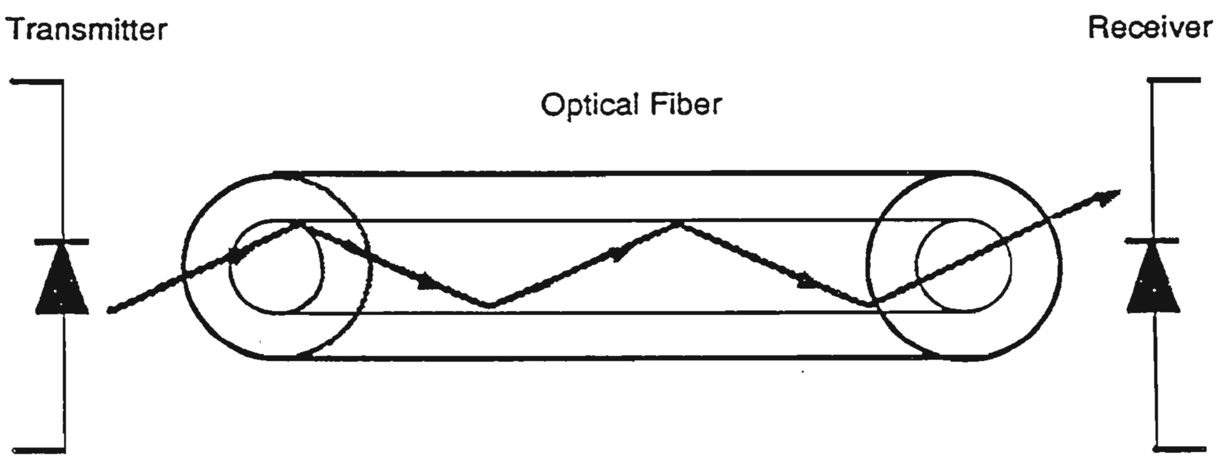


Figure 2

BASIC FIBER TRANSMISSION SYSTEM

Ref. Figure 2

Any fiber optic transmission system must contain these three basic components, a transmitter, a receiver, and optical fiber. For systems used in telephony applications, the optical transmitter is usually a semiconductor laser (although light-emitting diodes may be used in short-haul systems). The optical receiver may be a PIN diode or an avalanche photodiode. Finally, almost all telecommunications fiber installed today is single-mode (although there is a great deal of multimode fiber in the outside plant).

FACTORS INFLUENCING VIABILITY

Any transmission system must make economic sense before it can be justified. Some of the factors that had to be addressed before fiber optics became feasible included:

Sources	Speed Size Cost Reliability Environmental Stability Output Power
Detectors	Speed Size Cost Reliability Environmental Stability Sensitivity
Medium (fiber cable)	Size Loss Physical Integrity Cost Splicing Technology Connector Technology Manufacturability

OPTICAL SOURCES

Optical sources convert electrical signals to optical signals for transmission over the fiber path. There are two types of sources generally available: LED's and semiconductor lasers.

LED's

LED's are quite inexpensive and relatively rugged. However, they suffer from low power (around -18 dBm), large chromatic width (40-50 nm), and resistance to high-speed modulation. For these reasons, LED's have found their market in military or industrial applications where high bit rate or long transmission links are not required.

Semiconductor Lasers

Semiconductor lasers correct the failing of LED's: they have very high output power (up to a milliwatt, or 0 dBm), very narrow chromatic width (2-5 nm), and very high modulation speed (in excess of 1 GHz). However, they are quite expensive and relatively sensitive to environmental effects (such as temperature). For most telecommunication applications, however, the benefits of using lasers far outweigh any drawbacks.

OPTICAL DETECTORS

Optical detectors perform the reverse function - they convert incoming optical signals into electrical signals that can be processed with conventional circuitry. Again, there are two types of detectors commercially available:

PIN Diodes

PIN diodes (Positive-Intrinsic-Negative) have long been the mainstay of the fiber communications industry. They are relatively inexpensive and do not require great amounts of power. However, they are limited in sensitivity. For a long time the only choice, PIN diodes are still an appropriate choice for many systems.

Avalanche Photodiodes (APDs)

Avalanche photodiodes include amplification circuitry, so that very weak light pulses may be easily detected. They also can respond faster than traditional photodiodes, so that higher bit rates may be transmitted. Drawbacks include higher noise levels, increased power requirements, and significantly greater cost.

Other detection systems are currently being tested. Some, such as coherent technology, promise to greatly increase receiver sensitivities in the near future.

TYPES OF OPTICAL FIBER

Listed below are three basic types of optical fiber in use today:

- *Step-index multimode* fiber is mostly of historical interest in this course, although it still finds many uses in industries less demanding than telecommunications.
- *Graded-index multimode* first brought optical fiber out of the laboratory and into the telephone network.
- *Singlemode* fiber has in only two or three years come to totally dominate the telecommunications marketplace, promising ever higher bit and repeater spacing.

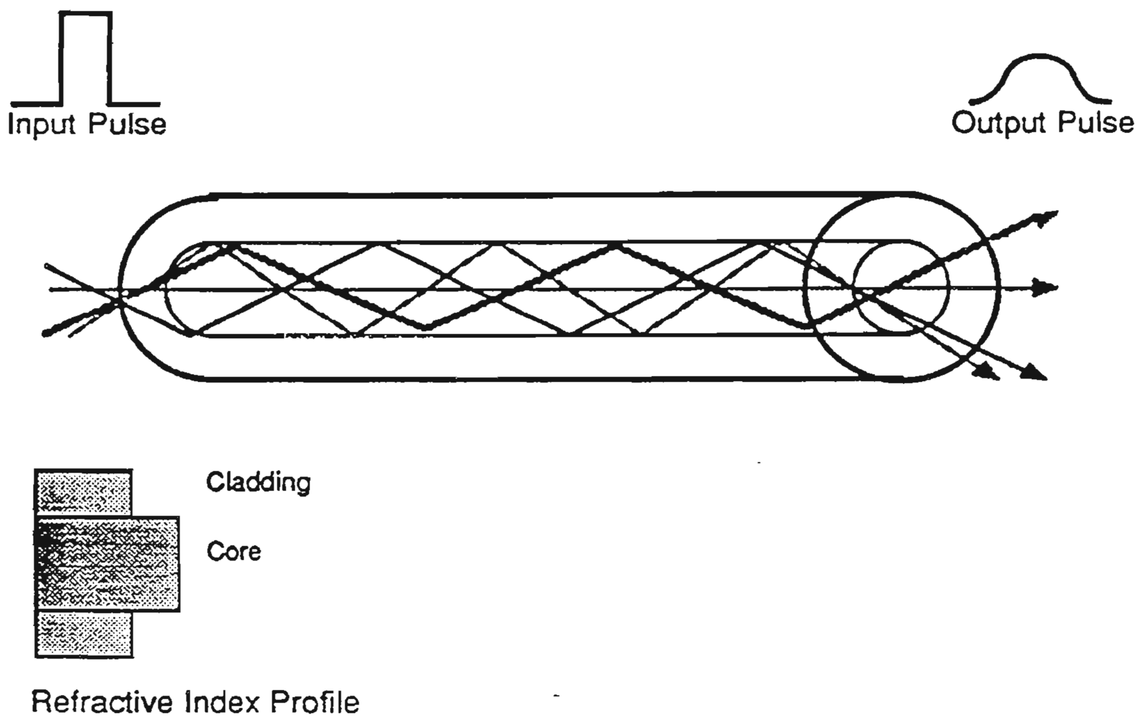

Input Pulse
Output Pulse
Cladding
Core
Refractive Index Profile

Figure 3

STEP-INDEX MULTIMODE FIBER

Ref. Figure 3

Step-index multimode is an older type of fiber that is seldom used in telecommunication links today. It is still used in data communication and light-pipe applications; however, it may be fabricated of plastic or glass.

The difference paths shown through the fiber are different "modes." Obviously, since the paths have different lengths, transit times will vary between modes. This problem of "differential mode delay" severely limits the bandwidth available with this type of fiber.

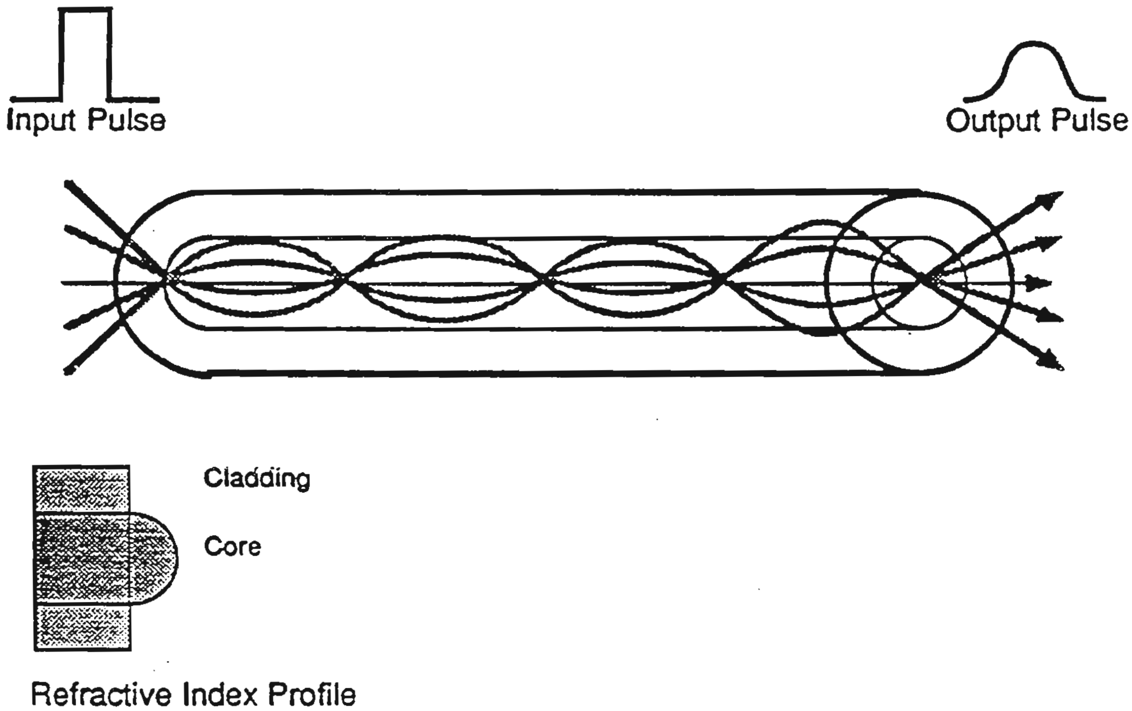

Input Pulse
Output Pulse
Cladding
Core
Refractive Index Profile

Figure 4

GRADED-INDEX MULTIMODE FIBER

Ref. Figure 4

Graded-index multimode fiber was developed to avoid the problems of differential mode delay. The refractive index (measurement of speed of light) of the core now varies with the distance from the center of the fiber. (A higher index indicates a lower speed of light.) Now, therefore, the path (mode) through the center is still the shortest, but is in the region of slowest travel. Paths near the edge of the core are longer, but the light travels faster. When correctly optimized, the transit time of all modes is equal.

A great deal of multimode fiber was installed in the late 1970's and early 1980's. However, the information capacity (bandwidth) was limited to approximately 150 Mbps.

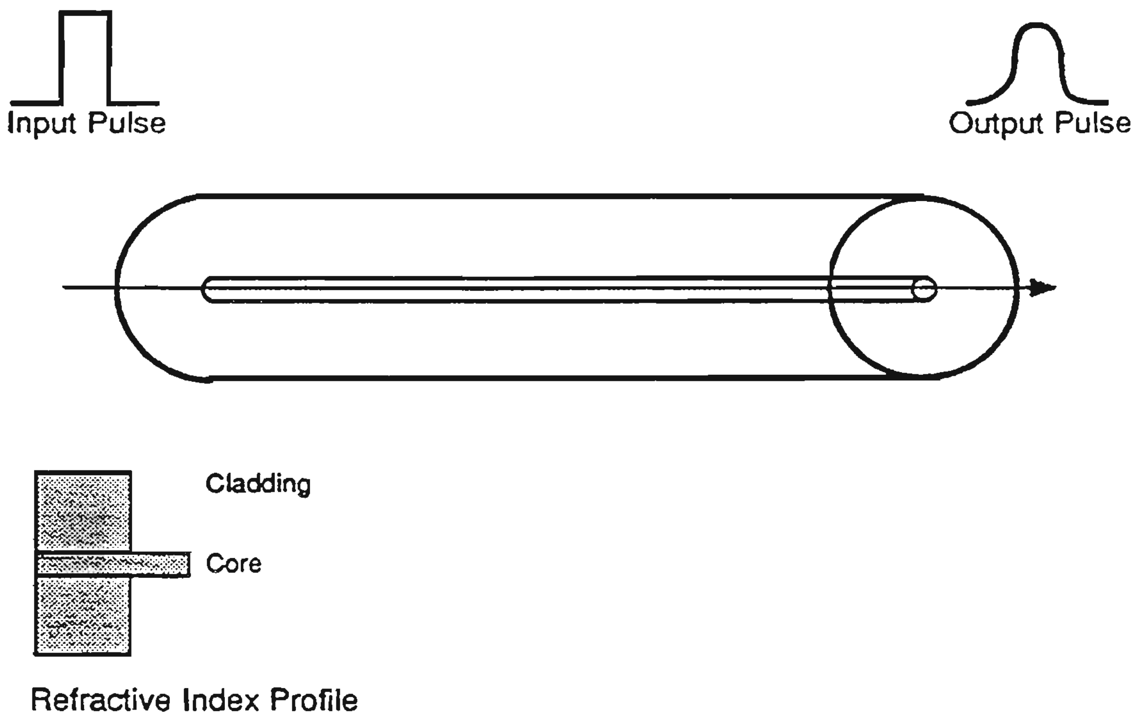

Input Pulse
Output Pulse
Cladding
Core
Refractive Index Profile

Figure 5

SINGLE MODE FIBER

Ref. Figure 5

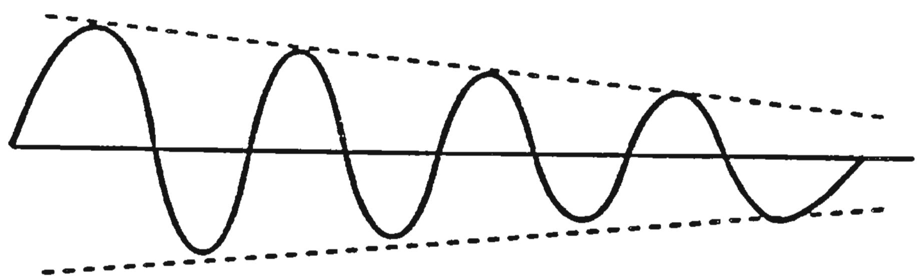
Single-mode fiber represents the current state of the art in fiber manufacture. Since its commercial introduction in the early 1980's, it has come to totally dominate all fiber applications in the telecommunications industry.

By dramatically shrinking the fiber core, the number of possible paths through the fiber is reduced to one. With only single mode being transmitted, the self-interference of differential mode delay is eliminated.

The bandwidth of single-mode fibers is exceptionally high. Transmission systems have been demonstrated operating at many gigabits per second (1 gigabit = 1 billion bits).

SOURCES OF SIGNAL IMPAIRMENTS

Attenuation
Loss of Signal Power over Distance



Dispersion
Spreading of Light Pulses with Time

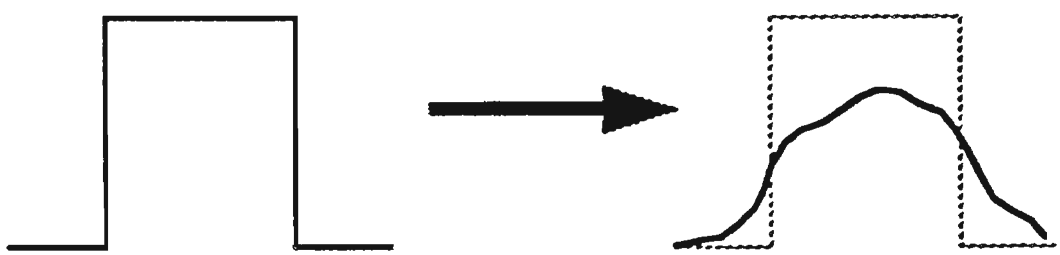


Figure 6

SIGNAL IMPAIRMENTS

Ref. Figure 6

There are many causes of signal impairments in optical transmission. These can be generally divided into *attenuation* (loss) and *dispersion.*

Attenuation

Attenuation, or loss, simply indicates that the amount of light received depends on the length of the fiber being used. Attenuation may be caused by *absorption* (for example the OH- hydroxyl ion has a strong absorption peak near 1300 nm), by *scattering* from impurities, or from *radiation* (light leakage or microbending). In most cases, attenuation problems have been overcome by increased precision and quality control during the manufacturing phases.

Dispersion

Dispersion is the tendency of light pulses to get "blurry" after travelling through a fiber. This limits the bandwidth of the fiber, since in extreme cases pulses begin to overlap and information is lost. In multimode fiber, very high dispersion values are caused by *differential mode delay* - there are hundreds of possible paths for the light to follow through the fiber, and each path takes a slightly different amount of time. This problem is eliminated in singlemode fiber, so dispersion values are orders of magnitude lower. However, there is still a problem with *chromatic dispersion.* The speed of light is slightly different for different wavelengths of light. Although lasers are nearly monochromatic, they actually put out a narrow range of wavelengths. The different travel times for these components will eventually limit the amount of information that can be transmitted over singlemode fiber.

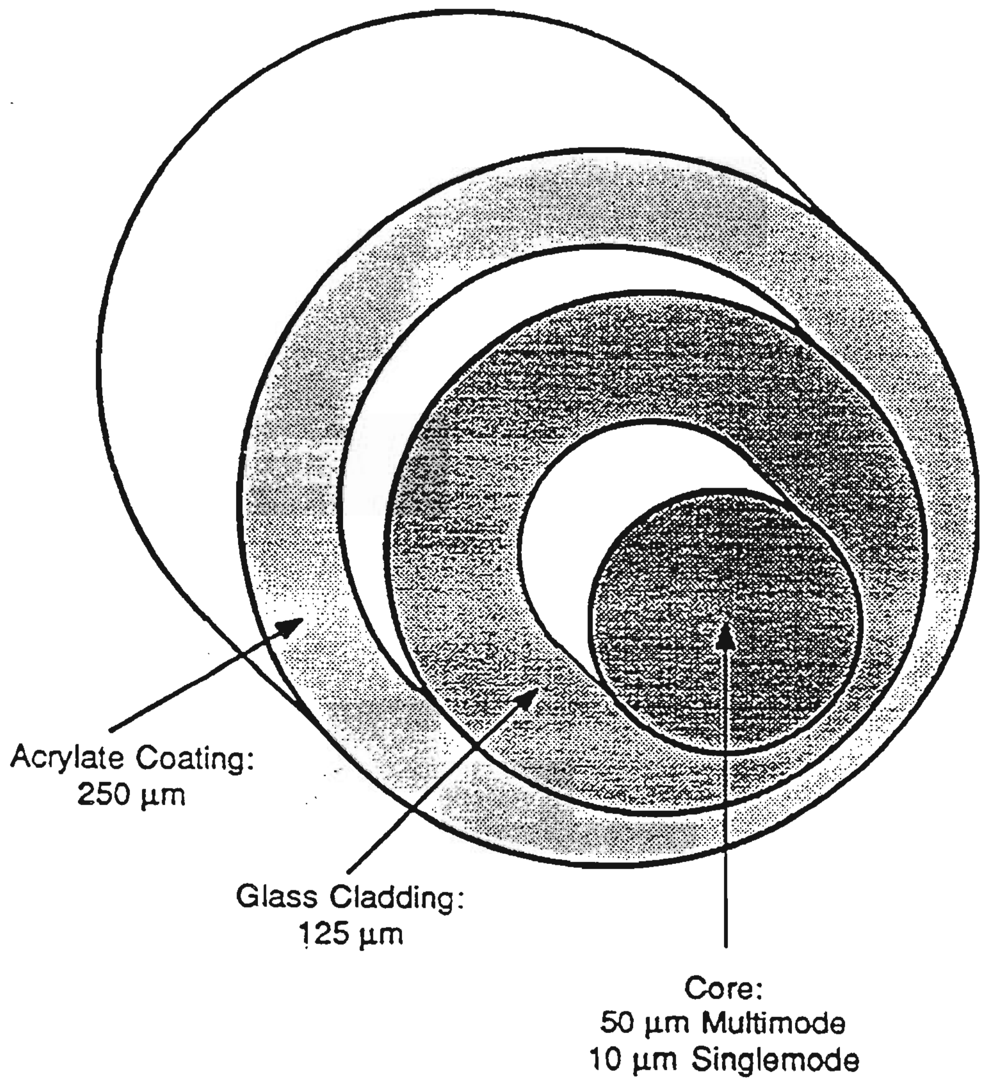

Acrylate Coating:
250 μm
Glass Cladding:
125 μm
Core:
50 μm Multimode
10 μm Singlemode

Figure 7

FIBER FABRICATION

Ref. Figure 7

Currently, most fiber in North America is manufactured by Modified Chemical Vapor Deposition (MCVD). This process has two major steps:

- Vapor deposition inside glass preform
- Fiber drawn from collapsed preform

Once the fiber is spooled and tested, it may be assembled into cables for aerial, buried or ducted installation.

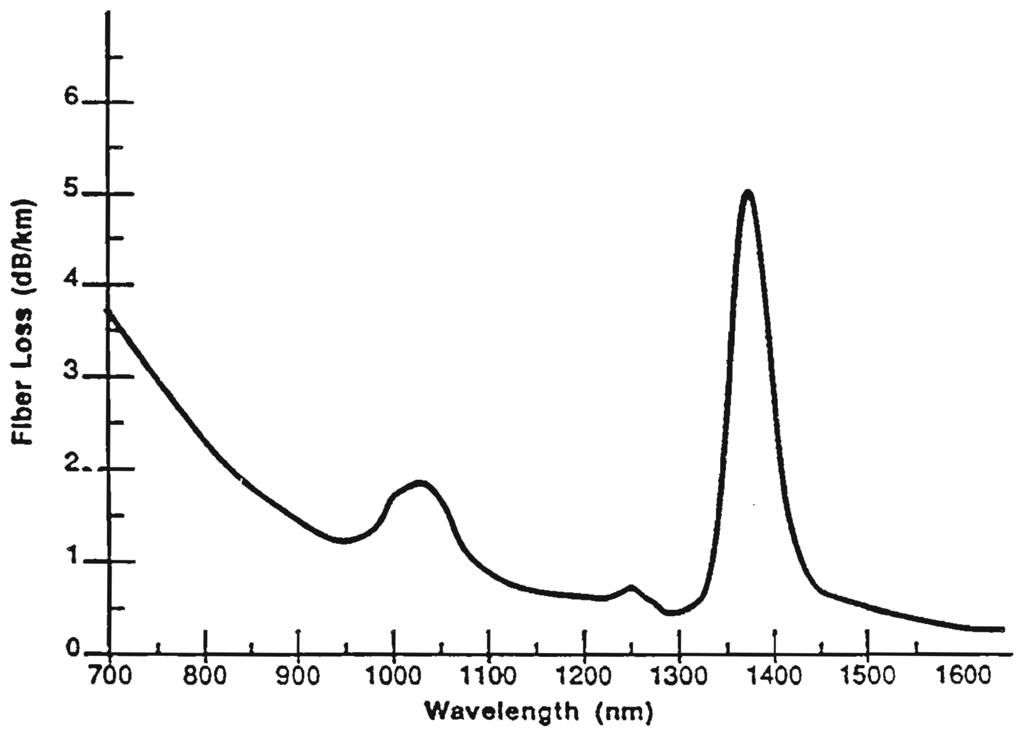

Fiber Loss (dB/km)
6
5
4
3
2
1
0
700
800
900
1000
1100
1200
1300
1400
1500
1600
Wavelength (nm)

Figure 8

TYPICAL ATTENUATION CHARACTERISTIC

Ref. Figure 8

This graph of loss vs. wavelength shows why there are certain wavelengths preferred for optical transmission. At visible wavelengths (400-800 nm, off to the left of the chart), silica-based glass exhibits very high loss. The first fiber systems operated near 840 nm, since sources and detectors for that wavelength were readily available. As soon as possible, manufacturers began to concentrate on the 1300 nm "window" of exceptionally low loss. Future systems may operate at even higher wavelengths, near 1550 nm.

The sharp peak just past 1300 nm is the "hydroxyl peak" - a region of heavy absorption. The curve figure 8 demonstrates a low-quality fiber (vintage 1979). Current production fiber controls the peak values more sharply, producing a much smoother curve.

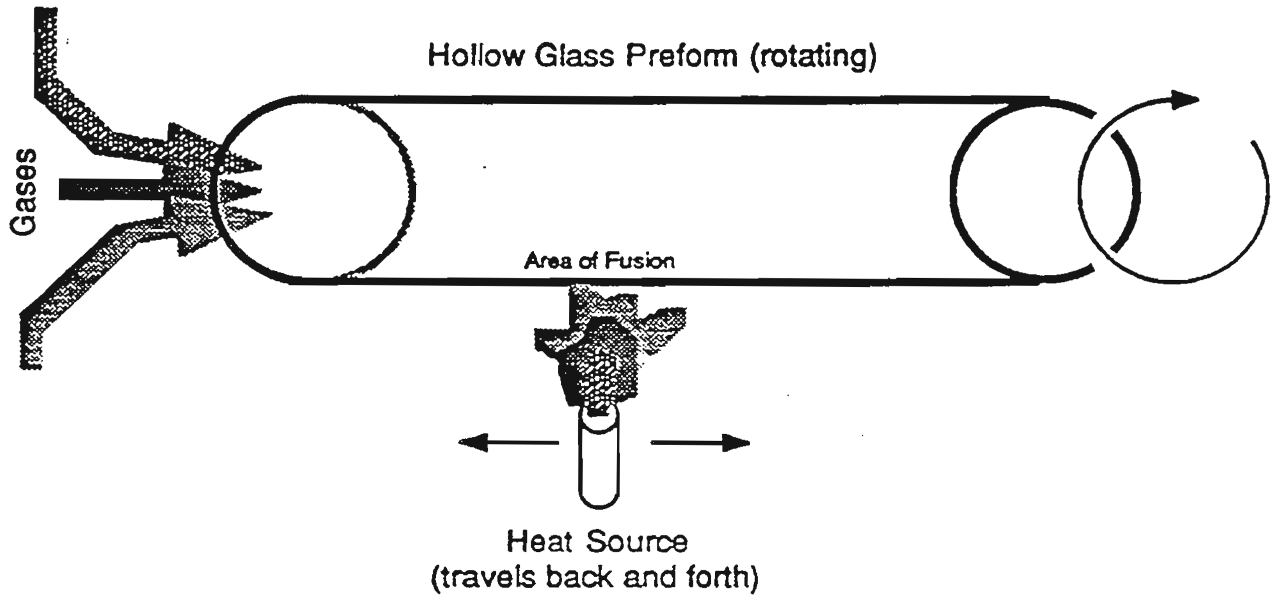

Hollow Glass Preform (rotating)
Gases
Area of Fusion
Heat Source
(travels back and forth)

Figure 9

MODIFIED CHEMICAL VAPOR DEPOSITION

Ref. Figure 9

In modified chemical vapor deposition (MCVD), several processes combine to create the preform (which is later pulled into fiber). A hollow preform, approximately 3 feet long and one inch in diameter, spins rapidly on a lathe. A computer-controlled mixture of gases is pumped into one end. Underneath, a heat source (such as an oxyacetylene torch) passes back and forth about once per minute.

Each passage of the heat source fuses a small amount of the gases to the surface. Most of the gas is vaporized silicon dioxide (glass), but there are carefully controlled amounts of impurities, or dopants. These cause changes in the index of refraction of the glass. As the torch moves and the preform spins, a layer of glass is laid down inside the hollow preform. The dopants (mixture of gases) can be changed with every layer, so the index may be varied across the diameter.

Eventually, enough layers are built up to fill the tube. It is now a scale model of the desired fiber - but much shorter and much thicker. It is now taken to the drawing tower to be pulled into fiber.

BASIC DIGITAL TRANSMISSION THEORY

PURPOSE

This section introduces the student to the concept of basic digital transmission theory.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. List and briefly describe the advantages of digital transmission
2. Briefly describe how the Nyquist Theorem applies to digital transmission
3. List the three parameters associated with Pulse Code Modulation (PCM)
4. Describe unipolar and bipolar signals
5. Identify and describe the North American Digital Hierarchy

BASIC DIGITAL TRANSMISSION THEORY

TABLE OF CONTENTS

DIGITAL TRANSMISSION

One of the strongest trends in the telecommunications industry in the 1970's and 1980's has been the conversion to digital technology. Transmission equipment, central office switches, PBX's, and even telephone handsets have benefitted from the digital revolution.

It is a revolution spurred by the semiconductor industry. Functions which formerly took bays of equipment and thousands of dollars may now be accomplished on a single chip, for pennies. As costs have dropped, performance capabilities have soared. Today, digital signal processing techniques that have always had theoretical advantages now have economic advantages as well.

NORTH AMERICAN STANDARDS

A set of standards for digital transmission have evolved in the United States and Canada. These specify certain parameters for signals of different bit rates (the DS, or Digital Signal, levels). Those most commonly used today include:

DS-1	1.544Mbps	24 voice channels
DS-1C	3.152Mbps	2 x DS-1
DS-2	6.312Mbps	4 x DS-1
DS-3	44.736Mbps	7 x DS-2

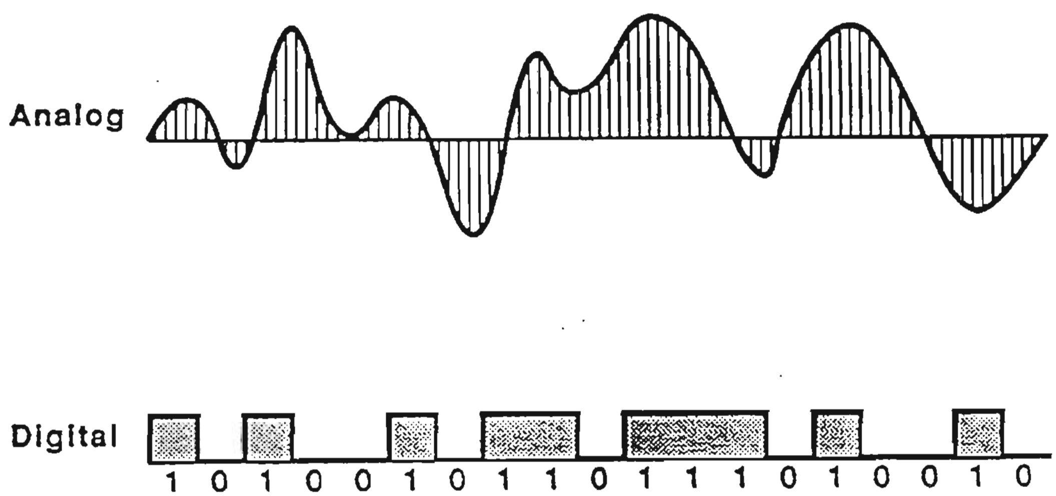


Figure 1

ANALOG TO DIGITAL CONVERSION

Ref. Figure 1

Advantages of Digital Conversion:

- Less susceptible to noise and interference
- Easier to regenerate signal if repeaters are needed
- Very accurate reproduction of original signal, although with the penalty of added bandwidth requirements
- Allows use of high-speed digital integrated circuits
- Provides built-in error detection
- Compatible with digital computer systems

SAMPLING (PULSE AMPLITUDE MODULATION)

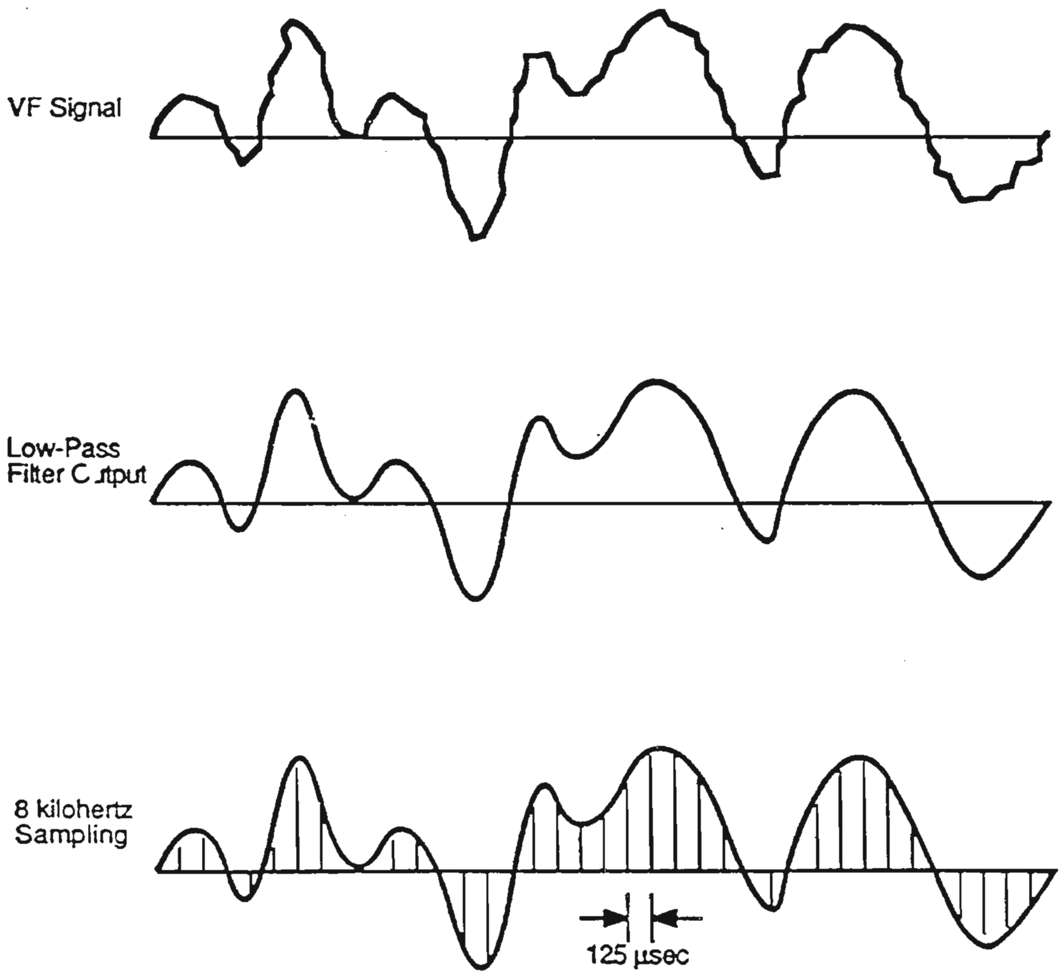


Figure 2

NYQUIST THEOREM

Ref. Figure 2

A basic rule of digital transmission is known as the Nyquist Theorem. It states that in order to reproduce a stream of analog data (such as voice), the digital sampling rate must be at least equal to twice the highest frequency in the analog stream.

The human ear is sensitive roughly from 20 Hz to 20 kHz. This would suggest that we needed a sampling rate of 2 x 20 kHz = 40 k Hz. This would have been prohibitively expensive until very recently. However, the human brain is an amazing signal processor. Empirical tests have shown that we can throw away all voice data from 4kHz to 20kHz with minimal effect. Although the sound channel is certainly not high-fidelity, it covers the two basic requirements of speech communication: intelligibility (understanding the words said), and recognizability (identifying the voice of the speaker). Therefore, the four kilohertz voice channel has become a standard.

Using the Nyquist Theorem, it is easy to see that to reproduce this 4kHz signal, our sampling rate must be at least 2 x 4000 = 8000 Hz. This would be a theoretically perfect system; however, in practice, transmission systems sample at 8000 Hz and allow the voice channel to be slightly less than 4000 Hz (3.2kHz is typical).

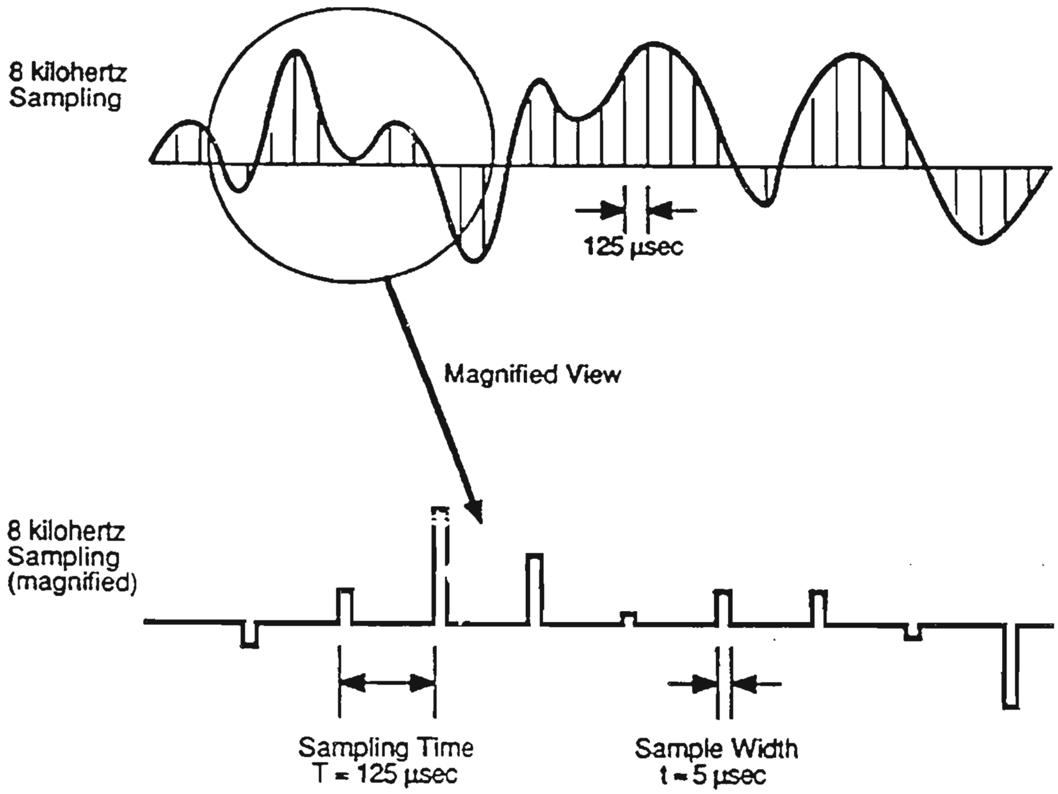
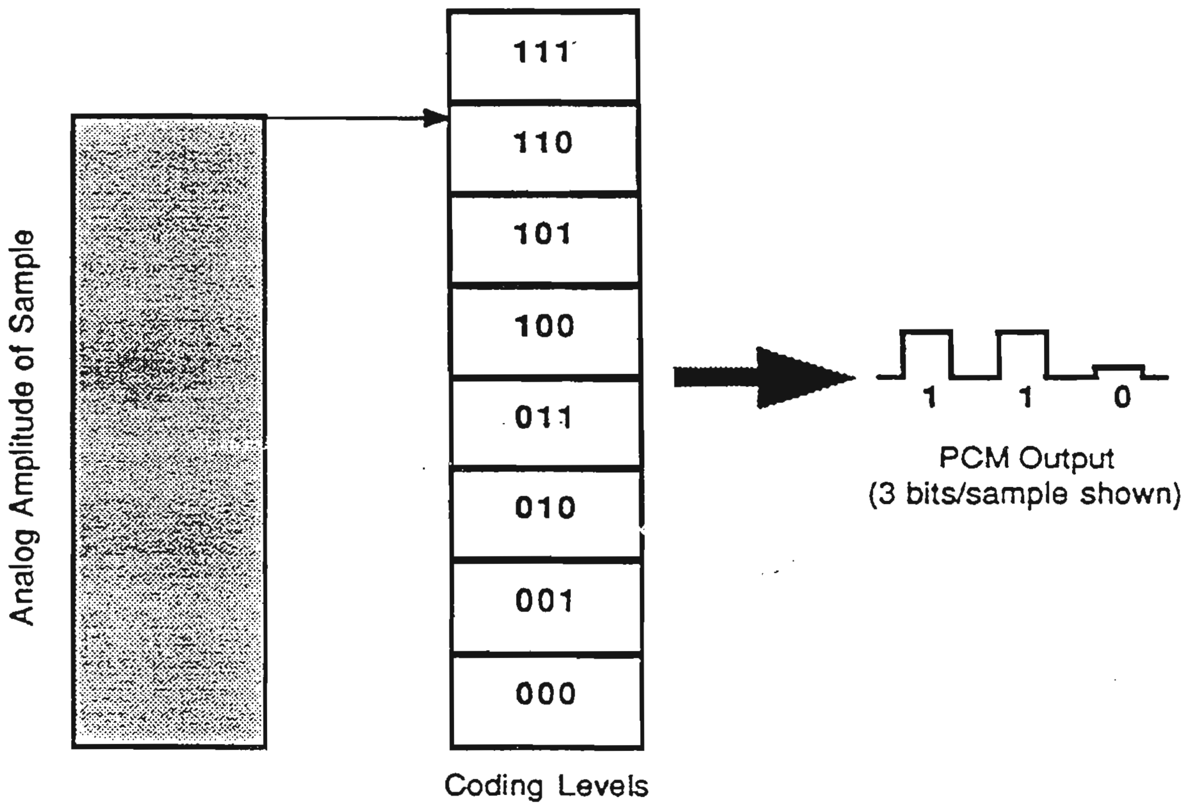

8 kilohertz
Sampling
125 µsec
Magnified View
8 kilohertz
Sampling
(magnified)
Sampling Time
T = 125 µsec
Sample Width
t = 5 µsec

Figure 3

COMPOSITE PULSE AMPLITUDE MODULATION

Ref. Figure 3

Since the width of an amplitude sample is significantly less than the sampling time, many signals may be interleaved without overlap. In the North American DS-1 signal, 24 sets of 8 kilohertz data are interleaved before digital conversion. The resultant signal is referred to as composite PAM.



Analog Amplitude of Sample
111
110
101
100
011
010
001
000
Coding Levels
1
1
0
PCM Output
(3 bits/sample shown)

Figure 4

PULSE CODE MODULATION

Ref. Figure 4

Note that, for clarity, the sample shown displays only three bits per sample, which produces $2^3 = 8$ coding levels. Voice-grade systems use eight bits per sample, producing $2^8 = 256$ coding levels. Digital music systems can use as many as 20 bits per sample, resulting in over a million coding levels.

SUMMARY OF VOICE ENCODING

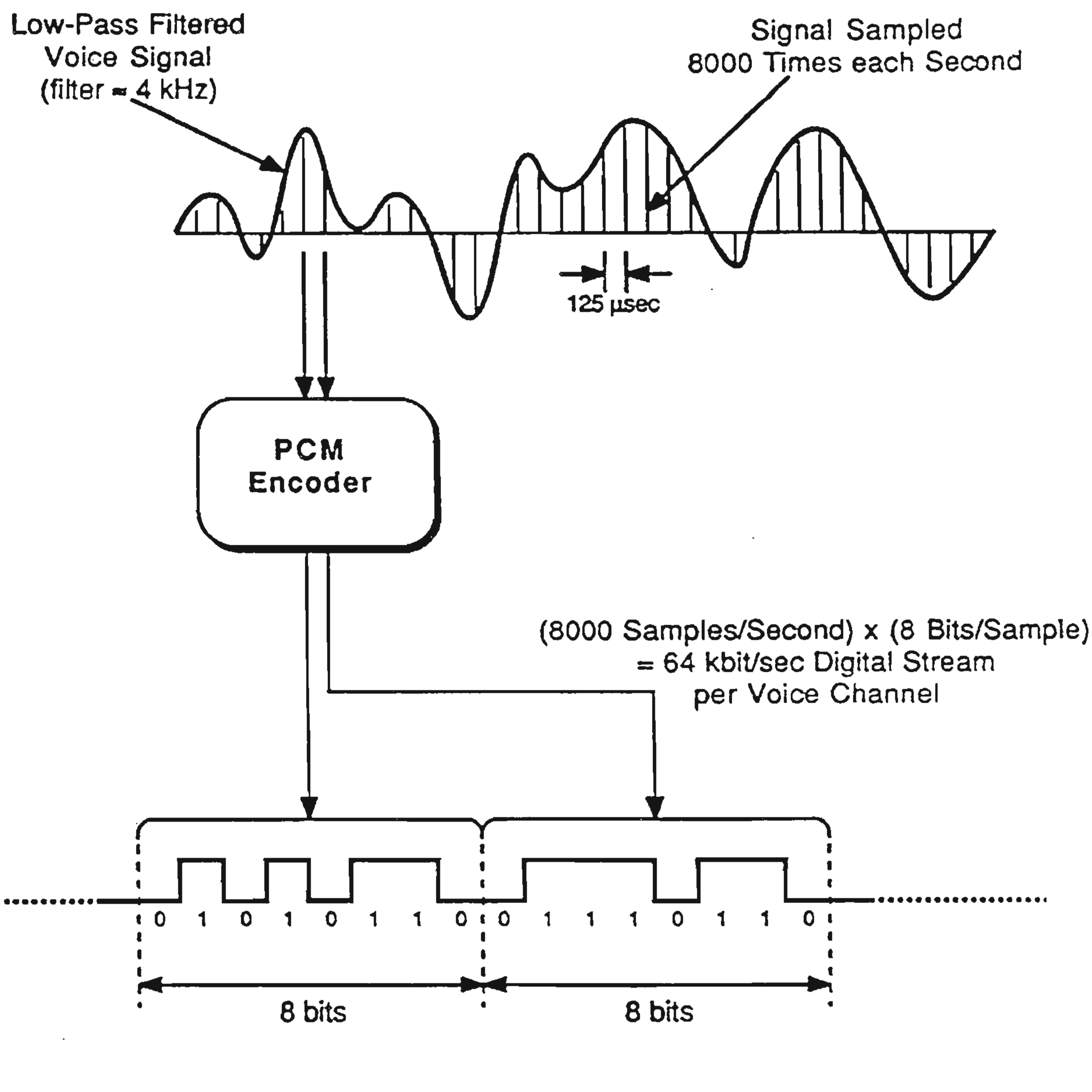


Figure 5

QUANTIZATION ERROR

The error in reconstructing a digitized signal is related to the number of bits used in coding the sample. There is a tradeoff between reproduction accuracy and system complexity.

A rate of 3 bits per sample, as shown on the previous page, would be quite simple to implement, but would not produce an understandable voice signal. On the other hand, a rate of 20 bits per sample would produce a signal nearly indistinguishable from the original, but would require very sophisticated electronics. Such coding schemes are only economical for high-performance digital audio systems such as compact discs. (Note: CD systems also sample far in excess of the 8kHz discussed here. Most systems currently available use a 44kHz sampling rate with 18 to 20 bits per second.)

For the public digital network, manufacturers have established a standard coding rate of 8 bits per sample as a reasonable compromise between cost and fidelity.

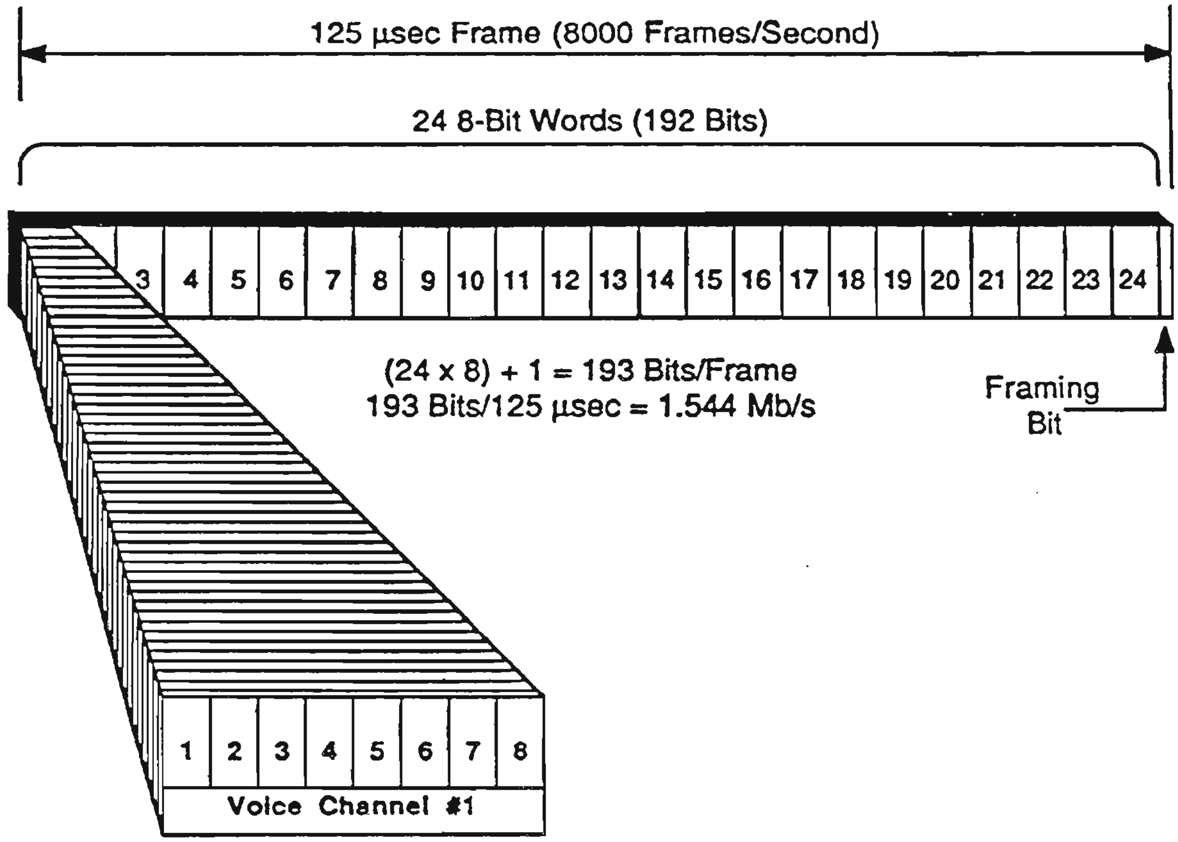

125 µsec Frame (8000 Frames/Second)
24 8-Bit Words (192 Bits)
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
(24 x 8) + 1 = 193 Bits/Frame
193 Bits/125 µsec = 1.544 Mb/s
Framing Bit
1 2 3 4 5 6 7 8
Voice Channel #1

Figure 6

DS-1 FRAME FORMAT

Ref. Figure 6

The above framing format is used by DS-1 equipment to properly identify each time slot and its place in the DS-1 link. A similar but more complex arrangement of framing bits is used to organize data bits in DS-3 transmission links.

Definition of Digital Multiplexer

CCITT Recommendation G.702: A *digital multiplexer* is equipment for combining by time-division-multiplexing two or more tributary digital signals into a single composite digital signal. A *digital demultiplexer* separates the composite signal into its component tributaries. The term *muldex* is a contraction of multiplexer-demultiplexer.

Please note that, although slightly inaccurate, the terms *multiplex* or *multiplexer* are often used to refer to equipment that performs both multiplexing and demultiplexing functions.

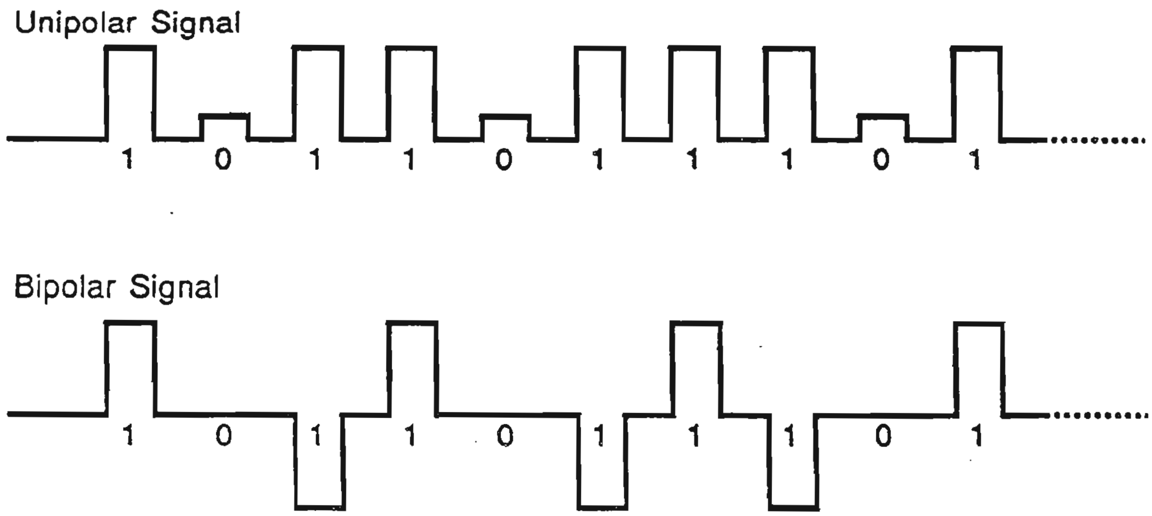


Figure 7

UNIPOLAR TO BIPOLAR

Ref. Figure 7

Unipolar signals are usually used within a piece of transmission equipment (intra-shelf signaling, etc.) However, for transmission between pieces of equipment (over twisted pair or coax), electrical signals are usually converted to bipolar form.

The bipolar conversion removes the low-frequency components of the signal, removing any average DC voltage. This provides several advantages: (1) line powering of downstream equipment (since the bipolar signal may be "piggybacked" on a DC bias voltage); (2) less power required to radio transmission; (3) easier to recover clock from incoming data.

Please note that all optical transmissions are unipolar - since we cannot transmit negative pulses of light.

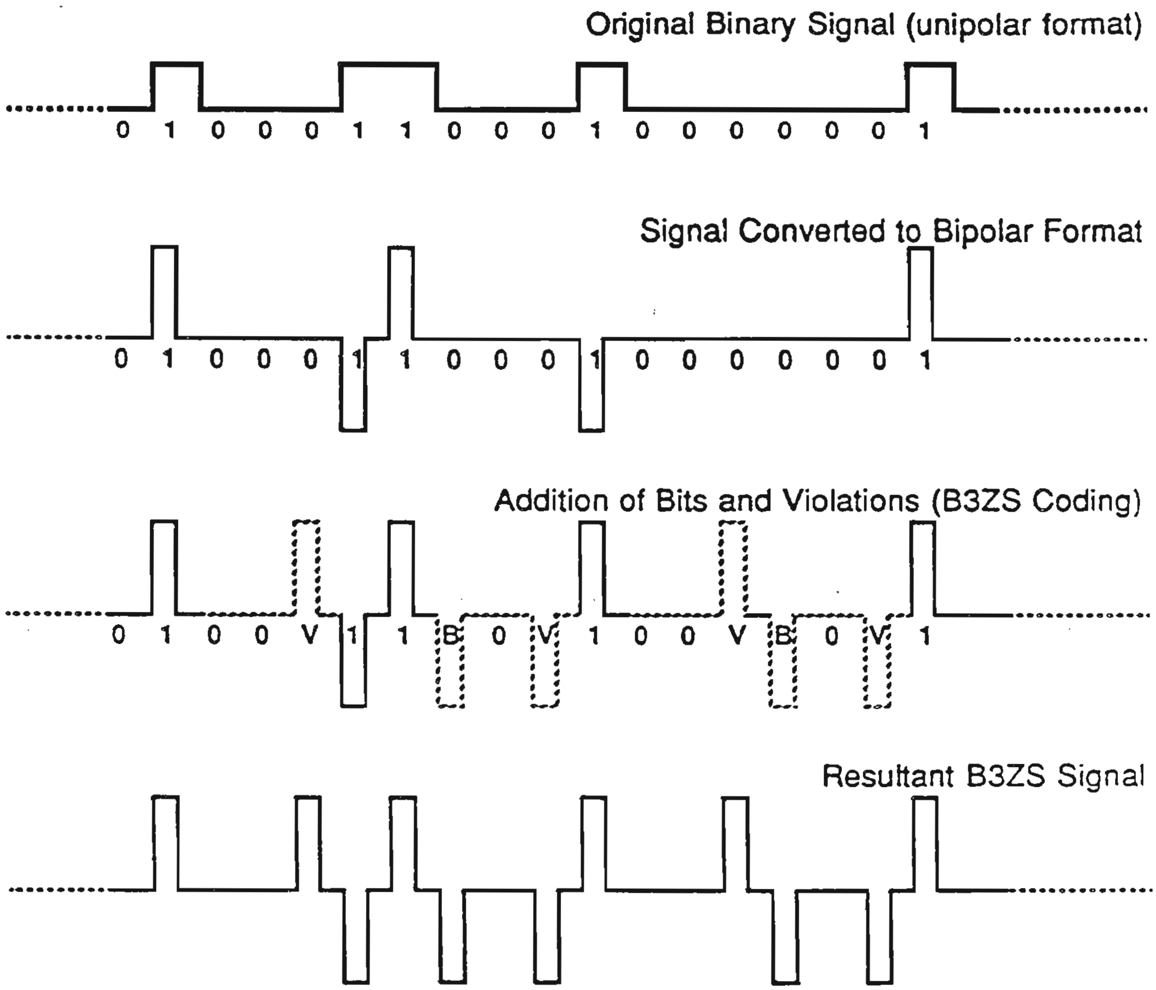

Original Binary Signal (unipolar format)
0 1 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 1
Signal Converted to Bipolar Format
0 1 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 1
Addition of Bits and Violations (B3ZS Coding)
0 1 0 0 V 1 1 B 0 V 1 0 0 V B 0 V 1
Resultant B3ZS Signal

Figure 8

BINARY THREE-ZERO SUBSTITUTION

Ref. Figure 8

"Straight" bipolar coding is not often used for transmission. When long sequences of zeros are transmitted, downstream equipment can have problems recovering the clock rate from the incoming data. Therefore, various schemes are employed to substitute sets of pulses for long streams of zeros. At the DS-3 rate, B3ZS is employed; at lower rates, less stringent methods are adequate (B6ZS for DS-2 and B8ZS for DS-1). Bipolar violations are used to flag the substitutions.

NORTH AMERICAN DIGITAL HIERARCHY

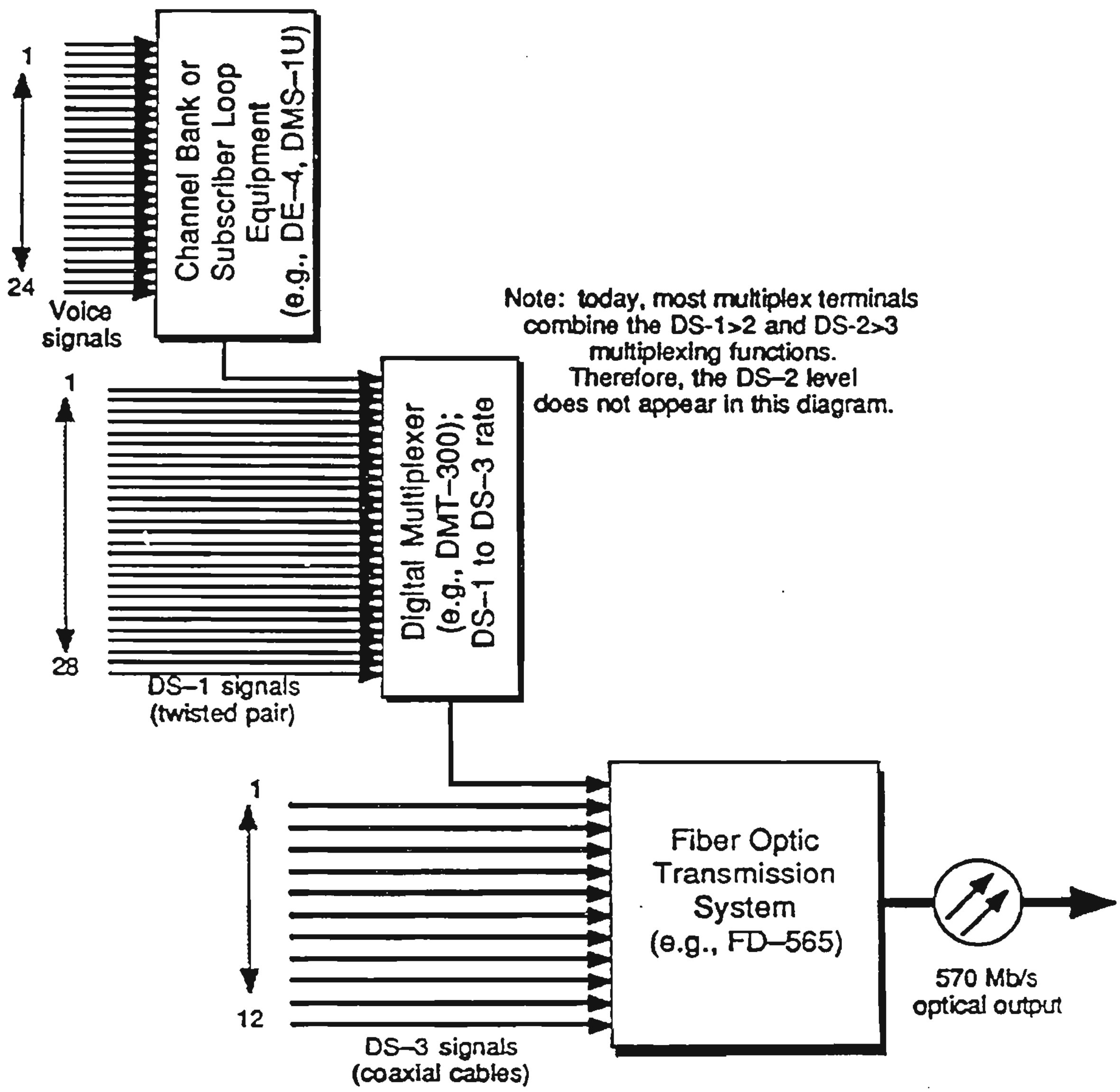


Figure 9

NORTH AMERICAN DIGITAL HIERARCHY

Ref. Figure 9

The following rates are those agreed on by major telecommunications manufacturers in the United States and Canada:

Carrier	**VF**	**DS-1**	**DS-2**	**DS-3**	**Bit Rate**
Voice Circuit	1	-	-	-	64 kbps
DS-1 Line	24	1	-	-	1.544 Mbps
DS-1C Line	48	2	-	-	3.512 Mbps
FD-2	96	4	1	-	6.312 Mbps
FD-3	672	28	7	1	44.736 Mbps
FD-135	2016	84	21	3	135.510 Mbps
FD-565	8064	336	84	12	570.480 Mbps

<u>Notes:</u>

The DS-1 format is sometimes referred to as the "T-1" format. Bit rates are not direct multiples of lower-level bit rates due to the increased overhead requirements of higher transmission levels.

There is a DS-4 format defined (274.176 Mbps), but this has met with little commercial acceptance. For reference, a DS-4 Signal would be the equivalent of two FD-135 channels or half an FD-565 channel.

INTRODUCTION TO THE FMT-150B/C/D SYSTEM

PURPOSE

This section introduces the student to the FMT-150B/C/D system, which includes transmission capacity, modes of operation, various FMT-150B/C/D features and protection switching.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. Describe the difference between the FMT-150 "B", "C", and "D."
2. Describe basic signal flow within the FMT-150B/C/D system
   - Explain how FMT-150B/C/D signal multiplexing between low speed signals and high speed signals is accomplished
3. Describe the various configurations of the FMT-150B/C/D
4. Explain protection switching within the FMT-150B/C/D system.
5. Describe the DM13 two Modes of Operations
6. Describe the differences between the four site configurations.

7. List and describe the four levels of alarm lamps for troubleshooting

8. Describe briefly the major diffeerences in the shelves of the FMT-150B/C/D

9. List specific environmental specifications for the FMT-150B/C/D

INTRODUCTION TO THE FMT-150B/C/D SYSTEM

TABLE OF CONTENTS

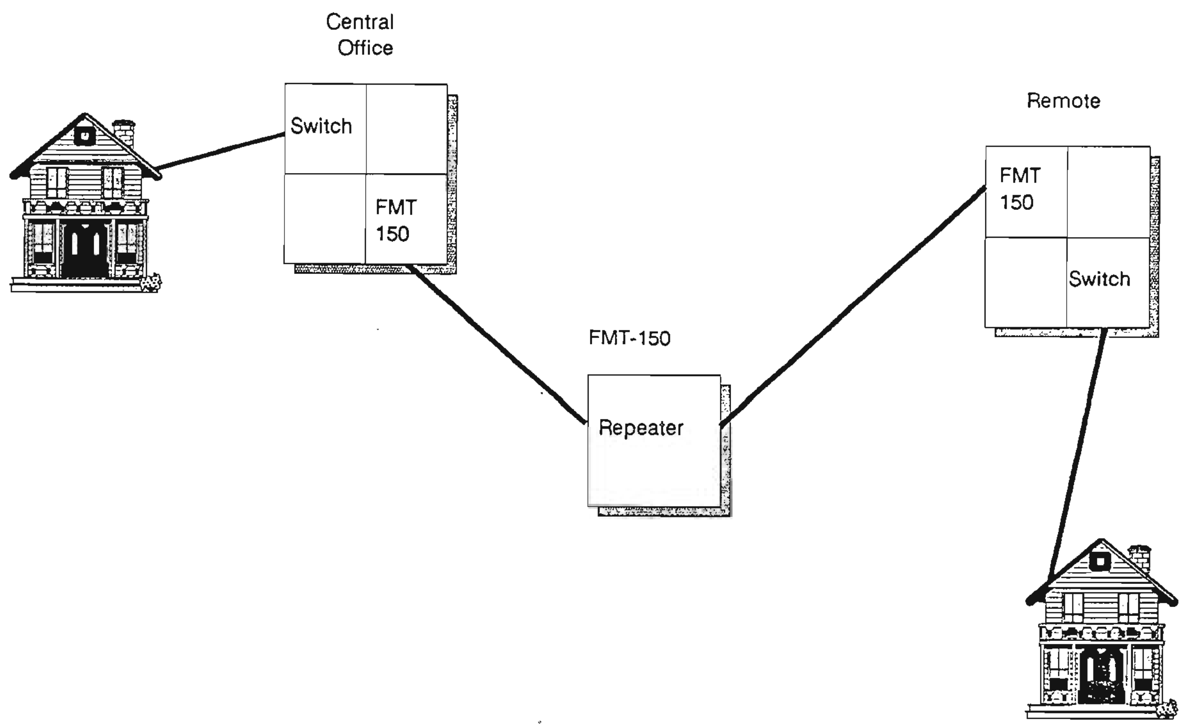

Central
Office
Switch
FMT
150
FMT-150
Repeater
Remote
FMT
150
Switch

Figure 1

FMT-150B/C/D INTRODUCTION

Ref. Figure 1

The FMT-150 system was designed as a small to medium capacity optical transmission media.

It incorporates the newest means of system maintenance and operational capabilities.

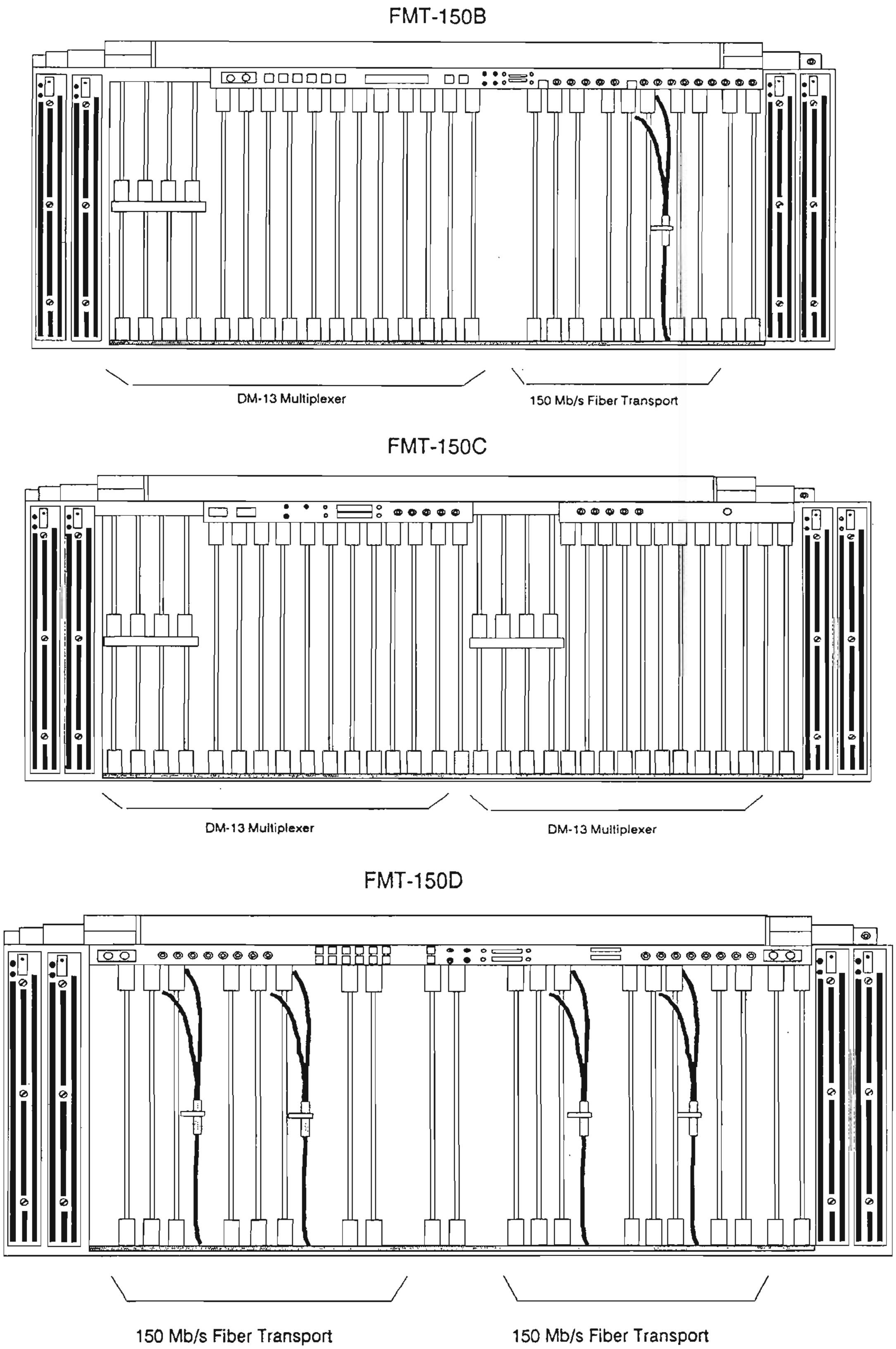

FMT-150B
DM-13 Multiplexer
150 Mb/s Fiber Transport
FMT-150C
DM-13 Multiplexer
DM-13 Multiplexer
FMT-150D
150 Mb/s Fiber Transport
150 Mb/s Fiber Transport

Figure 2

FMT-150B/C/D SYSTEM

Ref. Figure 2

The FMT-150B/C/D system is actually a combination of successful Northern Telecom products developed in response to the ever-changing requirements of the telecommunications industry. The product architecture supports such applications as subscriber loop, inter-office links, hub configurations, drop/insert, and features overhead transmission capacity for ease of operation and maintenance.

The Fiber Multiplex Terminal (FMT-150B/C/D) is capable of combining mixtures of DS-1, DS-1C, and DS-2 streams into an optical DS-3 output, while providing sophisticated surveillance and protection features.

The FMT-150 fiber optic transmission system combines DM-13 multiplexers and 150 Mbps Fiber Transports in compact transmission capacity for ease of operation and maintenance on a network oriented basis.

The Fiber Multiplex Terminal (FMT) 150B/C/D Family consists of three products:

- FMT-150B - a single shelf unit which consists of a digital multiplexer/demultiplexer and a 150 Mbps fiber optic interface module.
- FMT-150C - a single shelf unit which consists of two digital multiplexer/demultiplexers.
- FMT-150D - a single shelf unit used for regenerating fiber optic signals which consists of two 150 Mbps fiber optic interface sections.

Although FMT-150B, FMT-150C and FMT-150D are three different shelves, they are all composed of two basic building blocks:

- the DM-13 multiplexer
- the 150 Mbps fiber interface

Each FMT-150B/C/D system contains the following items:

FMT-150B Shelf:

- One DM-13 digital multiplexer/demultiplexer
- One 150 Mbps fiber optic interface module for unprotected configuration or two for optional 1 + 1 protection
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection
- Maintenance Control Unit for alarm and control processing
- Service Channel Unit providing voice communication between terminal sites (optional)

FMT-150C Shelf:

- Two DM-13 digital multiplexer/demultiplexers
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection

FMT-150D Shelf:

- Two 150 Mbps fiber optic interface modules for unprotected configuration or four for optional 1 + 1 protection
- Two power supply units for unprotected configuration, or four for optional 1 + 1 protection
- Two Maintenance Control Units for alarm and control processing
- Service Channel Units providing voice communication between terminal sites (optional)

Designed for Growth

All aspects of the FMT-150 system are designed to allow for easy growth as the user's circuit requirements change. For example, a customer could install a FMT-150 system carrying only a few DS-1 signals, with the rest of the interface board wired out to unused cross-connect panels. Later, the customer could add in more circuit packs (i.e., DS-1 circuits or, depending on need, add DS-1C or DS-2 circuits instead). Note that the configuration of the cable interface board is determined by the type of circuit being installed and must be wired accordingly.

DM-13 Signal Flow

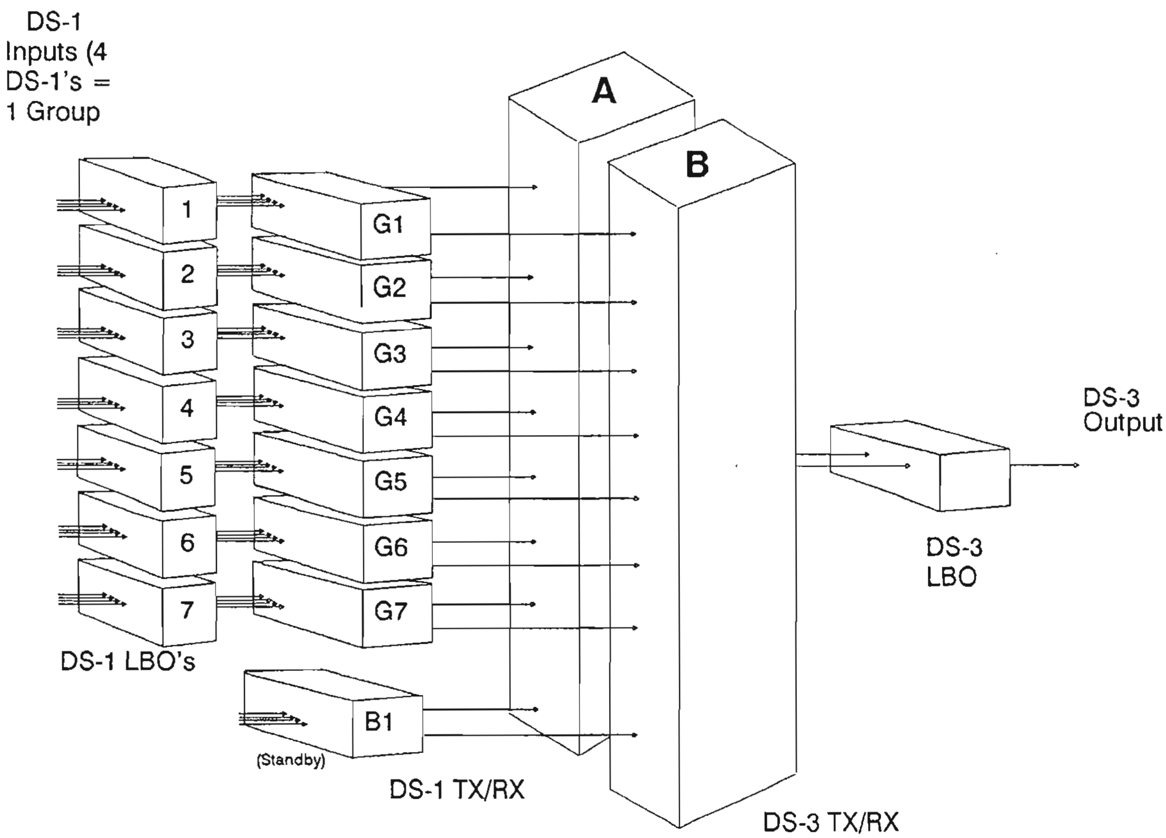


Figure 3

SIGNAL FLOW

Transmission Capacity

Ref. Figure 3

The groups of a DM-13 multiplexer may consist of any combination of four DS-1, two DS-1C, or one DS-2 line tributary that result in an aggregate bit rate of 44.736 Mbps (the DS-3 bit rate). This is then handled by one 150 Mbps fiber interface module. Maximum capacities are as follows:

- 28 DS-1 tributaries (24 voice channels)
- 14 DS-1C tributaries (48 voice channels)
- 7 DS-2 tributaries (96 voice channels)
- any combination of the above in which the bit rate is less than or equal to 44.736 Mbps.

A FMT-150C shelf can multiplex twice the maximum of an FMT-150B thus producing two DS-3 signals.

A FMT-150B used in conjunction with an FMT-150C can multiplex a total of three DS-3 signals.

Examples of other arrangements meeting the maximum capacity of the DM-13 are as follows:

- 24 DS-1 and 1 DS-2 tributaries
- 16 DS-1 and 3 DS-2 tributaries
- 16 DS-1, 2 DS-1C, and 2 DS-2 tributaries
- 4 DS-1C and 5 DS-2 tributaries

DM-13 Signal Flow

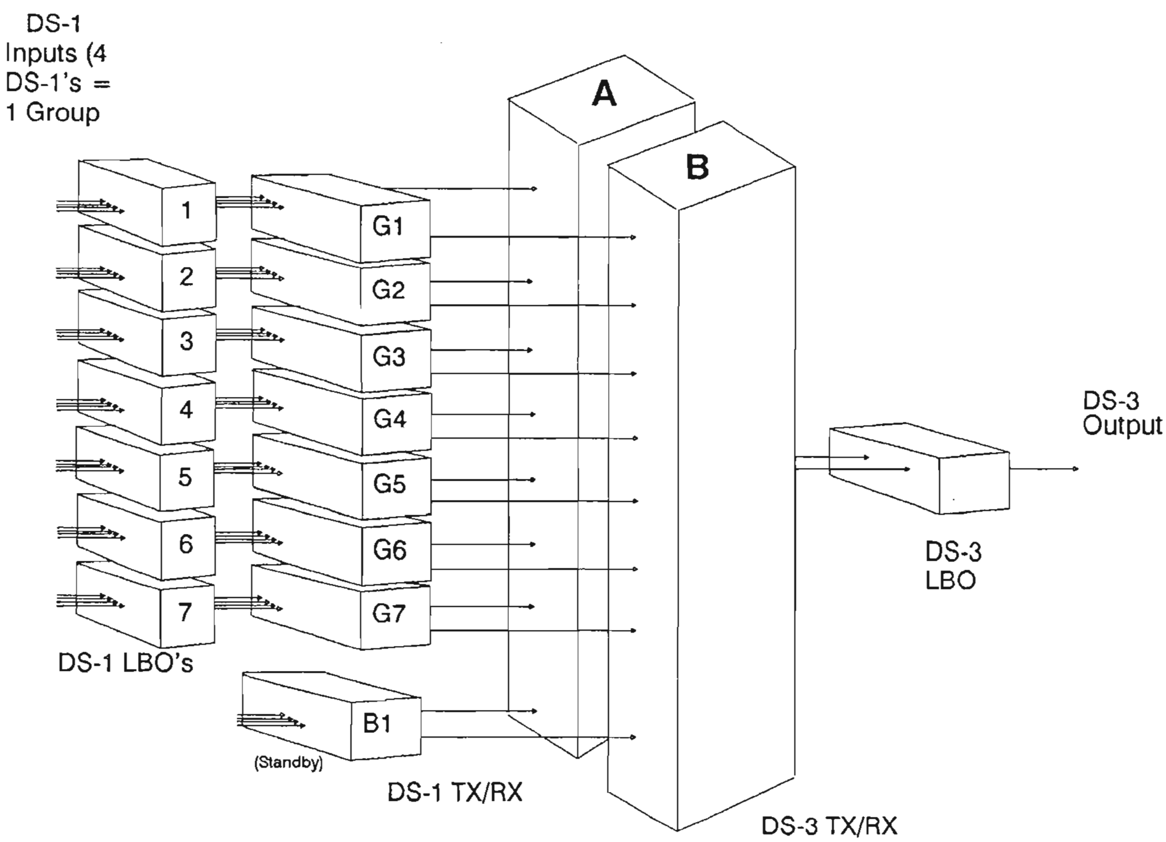


Figure 4

Signaling

Ref. Figure 4

The FMT-150B and C architecture distinguishes betweentypes of signaling:

- optical
- translator (STX)
- high-speed and low-speed

In this terminology, optical signaling refers to the 149.76 Mbps optical signal rate and the STX refers to the Northern Telecom defined electrical signal containing the DS-3 payload information and overhead bit structure within a 49.92 Mbps signal rate. High-speed refers to the DS-3 rate (44.736 Mbps) and is limited to the DM-13 groups and tributaries at the DS-1, DS-1C or DS-2 rate (1.544 Mbps, 3.152 Mbps and 6.312 Mbps respectively).

Multiplexing

Multiplexing between low speed signals (DS-1, DS-1C and DS-2) and the high speed signal is accomplished in two stages. In the first stage of multiplexing, the low speed signals are synchronized into seven groups at the DS-2 signal rate. This is performed by DS-1, DS-1C, and DS-2 Tx/Rx modules. Also, this stage converts the signals from bipolar to unipolar format. The second stage of multiplexing organizes the seven groups into a single DS-3 digital signal which is again bipolar. Each of the seven groups at the DS-2 rate may be composed of one DS-2, two DS-1C, or four DS-1 signals. Lastly, the electrical DS-3 signal is converted into an optical signal for transmission over optical fibers.

150 Mb/s Fiber Interface Signal Flow

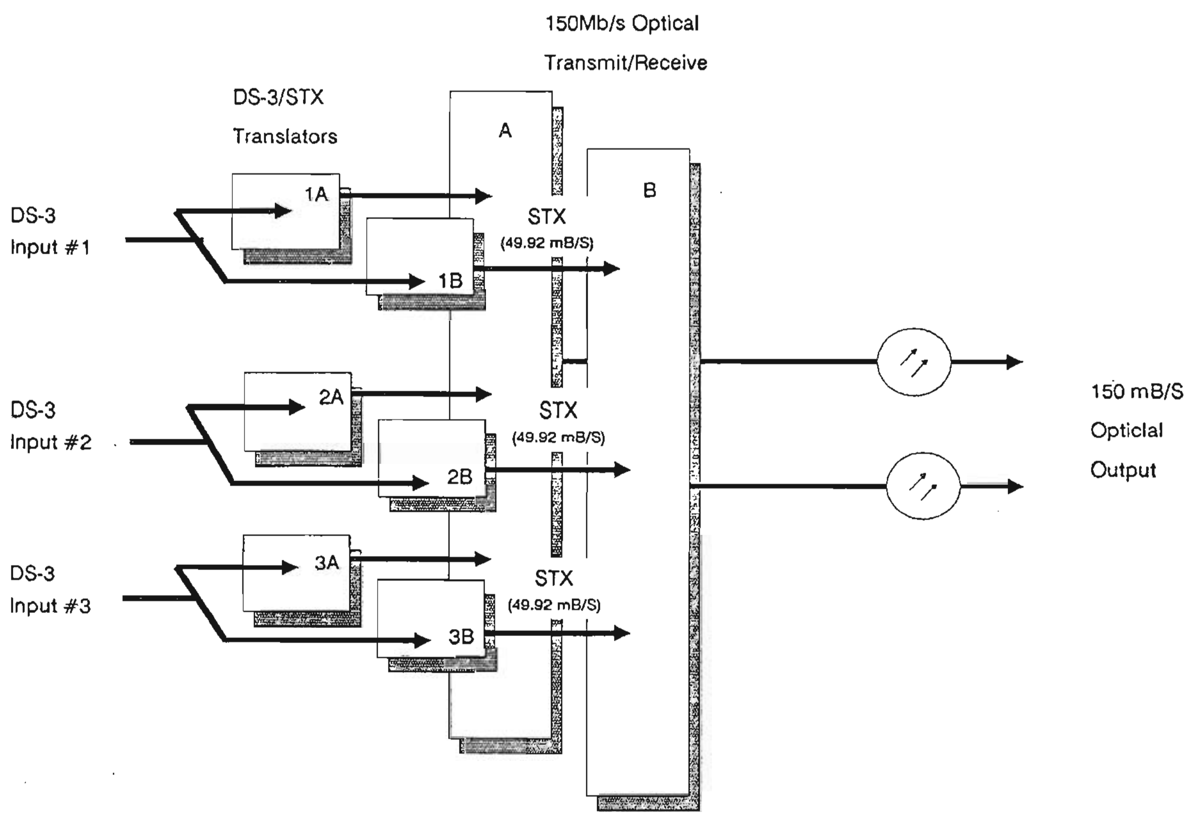


Figure 5

150 Mbps FIBER TRANSPORT

Ref. Figure 5

The 150 Mbps interface can receive up to 3 incoming DS-3 signals from the DM-13 multiplexers (or other DSX-3 sources). In the transmit direction, each DS-3 signal is translated to a STX signal (49.92 Mbps). The overhead bits in the STX signal carry alarm, maintenance, and service channel information for the network. The signal processing, (and that for the opposite direction) is performed within the DS-3 Translator module. There is one working Translator and one standby Translator per DS-3 signal. The three 49.92 Mbps signals are multiplexed together within the 150 Mbps Optical Tx/Rx module to generate a single electrical signal with a line rate of 149.76 Mbps. The electrical signal is then converted into an optical equivalent for transmission over fiber optic cables. In the receive direction, an incoming 149.76 Mbps optical signal is converted to its electrical form and then demultiplexed to 3 STX signals. The signals are then routed to the appropriate Translator module where each 49.92 Mbps signal is split into a DS-3 signal (44.736 Mbps) and corresponding overhead. The overhead containing the network information is fed to the Service Channel Unit (SCU) and Maintenance Control Unit (MCU) for processing.

CONFIGURATION

Maintenance Control Unit

Each FMT-150 node is equipped with one maintenance control unit (MCU). The maintenance control unit provides monitoring and control of the performance of the FMT-150 node. Monitoring and control is provided for the 150 Mbps fiber interface, up to three associated DM-13 multiplexers, one (optional) service channel unit (for voice data) and all associated power supply units. The MCU gathers and processes alarm information for transmission throughout the network. This gathered information is carried in the overhead of the 49.92 Mbps signal. Control commands sent to the node from the CRT interface are also carried in the 49.92 Mbps overhead and are processed by the MCU at the appropriate node

Note: A "Node" is defined as any place in the Fmt-150 network where a MCU is located. The maximum number of nodes allowed in a 150 network is sixteen..

Service Channel Unit

The FMT-150 B and D shelves can be fitted with a Service Channel Unit (SCU) which provides voice/data communication through the overhead. Two voice channels per DS-3 signal are provided: one local order wire channel, and one express order wire channel. Local order wire accesses all sites common to a DS-3 signal. Express order wire accesses only terminal sites common to a DS-3 signal. Express and local order wire are accessible via a jack at the front of the shelf.

Each site in an FMT-150 network may be individually addressed using DIP switches on the SCU. Sites are accessed by dialing a 4 digit number from a handset/headset.

The SCU also provides customer input and output points. These are used to retrieve status and alarm information not only from the FMT-150, but also from any other external equipment desired. The NT7H75BA version of the SCU supports 12 customer inputs and 4 customer outputs. The NT7H75BB version supports 8 inputs and 16 outputs.

Power Supply Unit

Each FMT-150 shelf is equipped with four power supply units which convert either -48V or -24V to +5/-5 volts which is used for the entire shelf. Power supply units are monitored by the maintenance control unit for proper operation. A failure with a power supply unit is displayed on the CRT interface unit for quick and simple detection.

CRT Interface

The Maintenance Control Unit supports control and monitoring of an FMT-150 network through a CRT interface. The CRT allows the user to display the network status, and any alarm that exist. Control over remote sites (e.g., force switch, loopback, etc.) can be implemented through commands entered at the CRT terminal. The software accepts commands entered by the user at the keyboard and responds by displaying information concerning alarms, status, control, and maintenance information on the CRT screen. The interface may operate at 300, 1200, 2400 or 9600 baud rates.

PROTECTION

The FMT-150B/C/D provides Low-Level and High-Level automatic switching. Low-Level includes low-speed (DS-1, DS-1C, and/or DS-2 rate) automatic protection switching, while the high-level includes both high-speed (DS-3 rate), and Translator (STX rate) automatic protection switching. The DS-1, DS-1C, DS-2, DS-3 and STX protection switches all operate independently.

DM-13 Multiplexer:

DS-1 Tx/Rx module:	1:N (where N = 1-7)
DS-1C Tx/Rx module:	1:N (where N = 1-7)
DS-2 Tx/Rx module:	1:N (where N = 1-7)
DS-3 Tx/Rx module:	1 + 1

150 Mbps Fiber Transport:

DS-3 Translator	1 + 1
Optical Tx/Rx Unit:	1 + 1

Common Equipment:

Power Supply Unit:	1 + 1

DM-13 Terminal Configuration

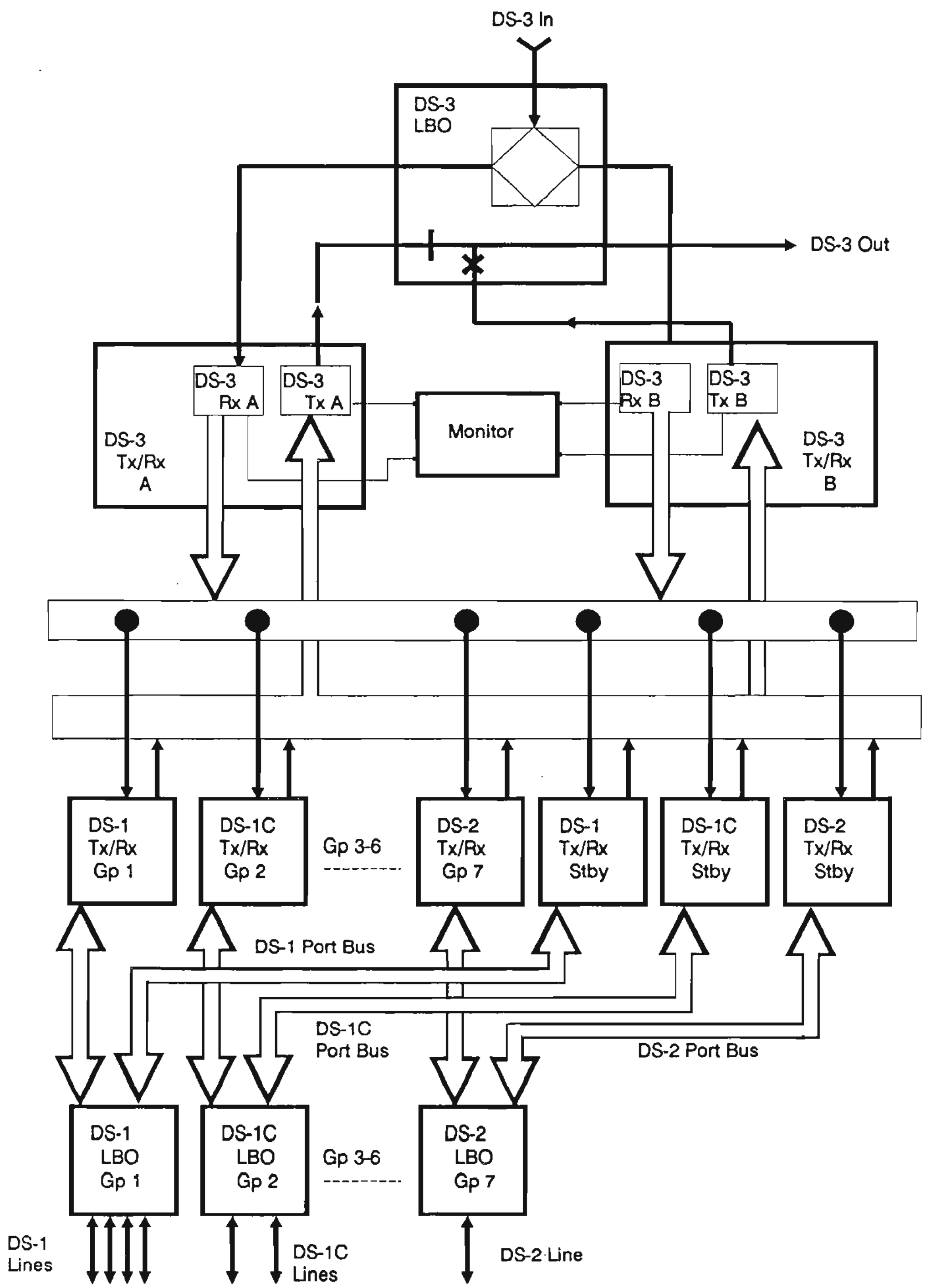


Figure 6

MODES OF OPERATION

Ref. Figure 6

The DM-13 can be configured for either:

- Terminal Operation
- Drop/Insert Operation.

The essential differences between the two modes of operation are in the low speed stage of multiplexing. In terminal mode, all DS-2 groups are demultiplexed to their composite low speed signals. In Drop and Insert operation the low speed signals do not have to be demultiplexed past the DS-2 rate..

Terminal operation is generally required at sites where the DS-3 signals are terminated. In this case, the equipment is configured for bi-directional signal processing. Drop and Insert is required at intermediate sites where DS-3 signals must be accessed for information (either in whole or at lower bit rates). In Drop/Insert configurations, typically twice as much transmission equipment is required due to the uni-directional configurations.

DM-1 Drop and Insert Configuration

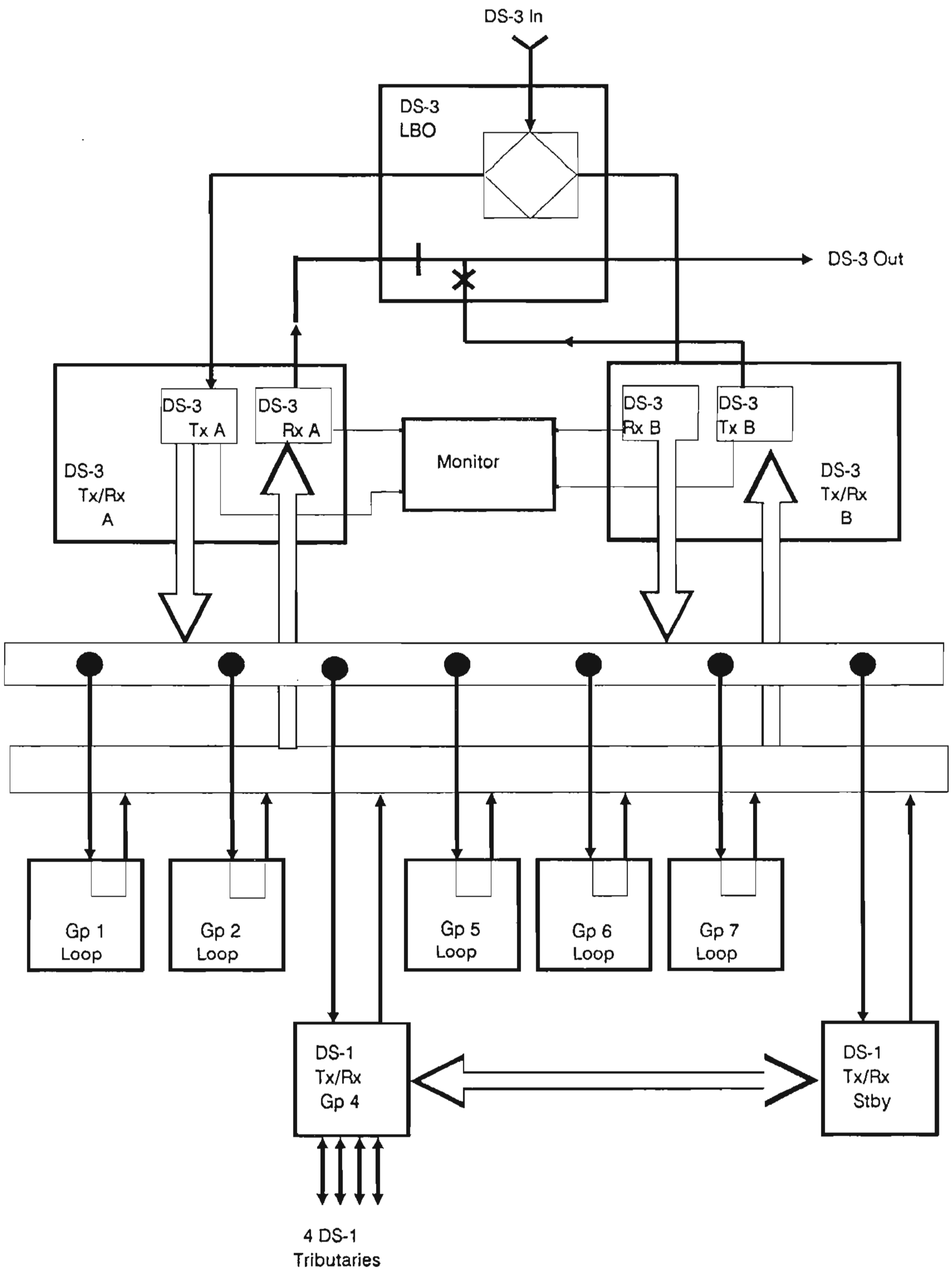


Figure 7

MODES OF OPERATION (Continued)

Ref. Figure 7

In terminal operation for the DM-13, all low-speed groups are demultiplexed from a DS-3 to their respective low-speed bit rates. The low-speed signals are then accessed for further processing. In Drop/Insert configurations, some of the low-speed tributaries within a DS-3 are not required at the location and must be "looped through" the site. This is accomplished by using a special "loop-thru" module which is available for this process. This eliminates hard patch requirements. The tributaries are looped through at the 6.312 Mbps unipolar line rate. Looped through groups have their signals looped directly back into the multiplexer process. Typically, DM-13 terminal configurations require one bi-directional DM-13,while Drop/Insert locations require one DM-13 per direction.

Typical FMT-150 Terminal Shelf

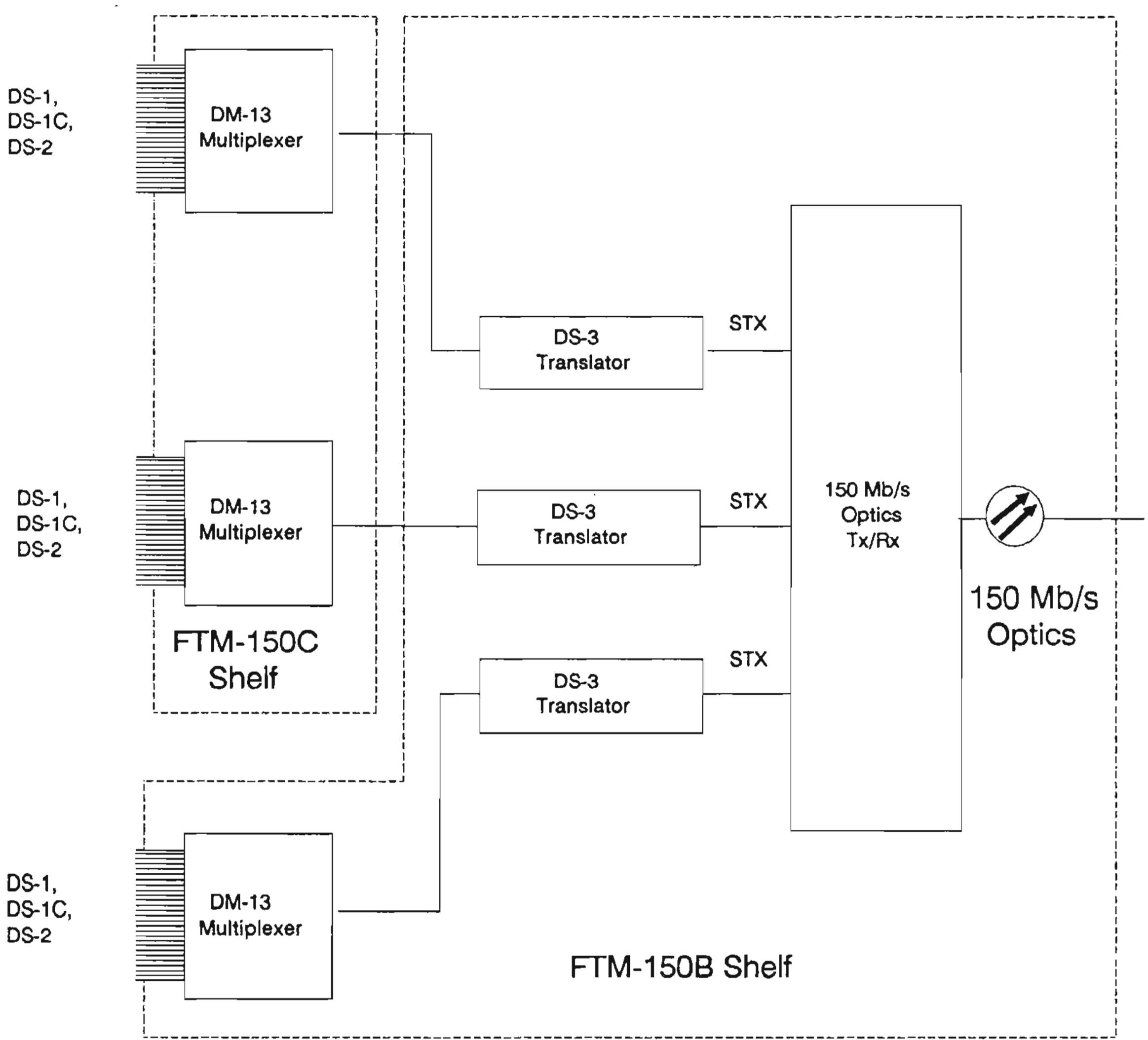


Figure 8

SITE CONFIGURATIONS

The FMT-150B/C/D shelves can be arranged together to form several types of site configurations:

- terminal
- drop/insert
- repeater
- hub

Terminal Site

Ref. Figure 8

A terminal site combines up to three DM-13 multiplexers with one 150 Mbps fiber interface. This could be formed with one FMT-150B shelf and one FMT-150C shelf, as shown in *Figure 8.*

Note: The FMT-150B has two independent signal processing units, the multiplexer and fiber interface units. Therefore, the FMT-150B shelf may be fed any mix of DS-3s from other external sources (i.e., radio products, existing DMT-300 sources, etc).

Typical FMT-150 Drop/Insert Site

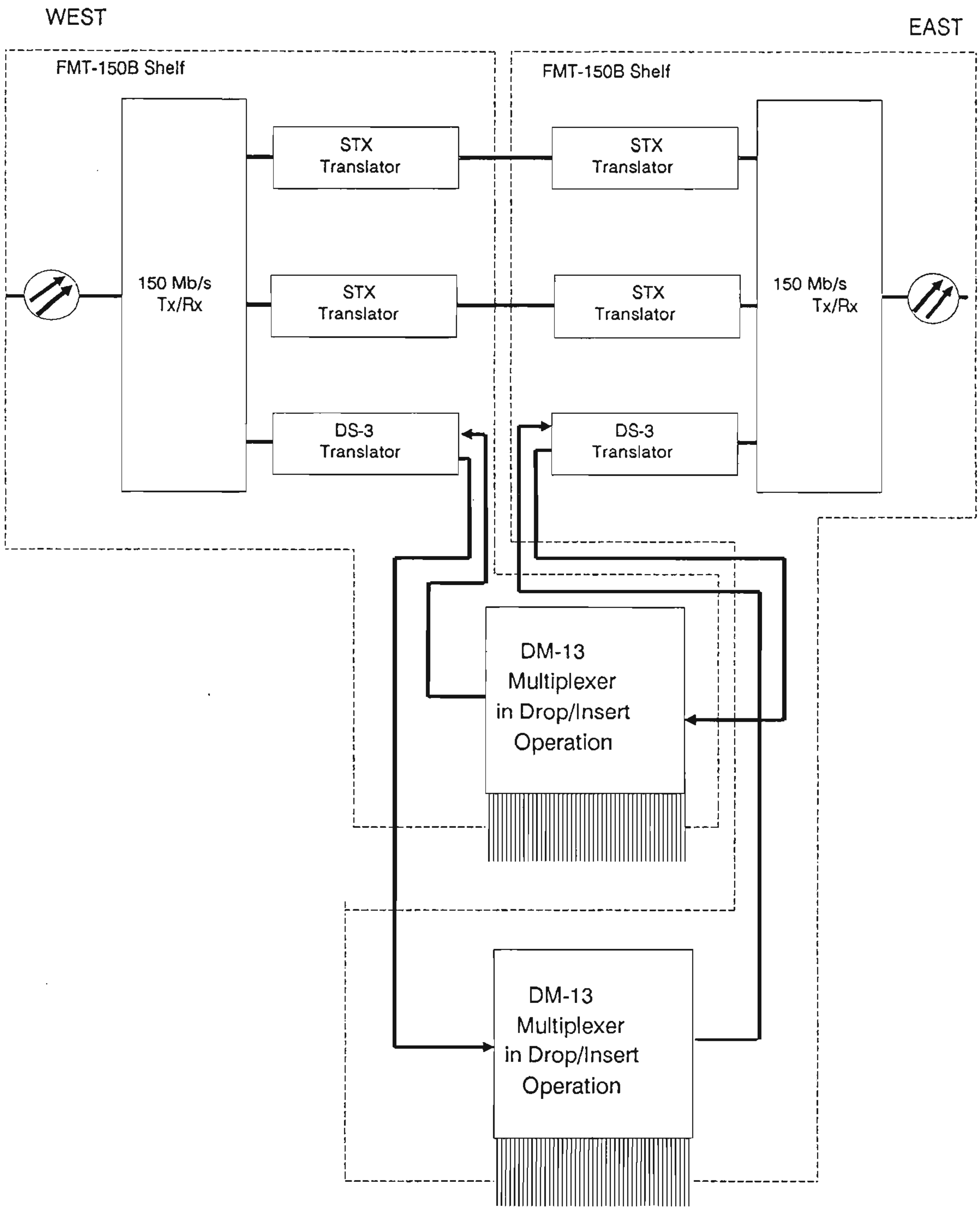


Figure 9

Drop/Insert

Ref. Figure 9

A drop/insert site combines two 150 Mbps interfaces with various combinatons of DM-13 multiplexers. Each 150 Mbps interface (and any associated multiplexer equipment) processes the signals for one direction. An example using two DM-13s can be derived from two FMT-150B shelves as shown in *Figure 9.* Note that this could also be done with one FMT-150C shelf and one FMT-150D shelf since the shelves in either configuration are functionally identical.

Typical FMT-150 Repeater Site

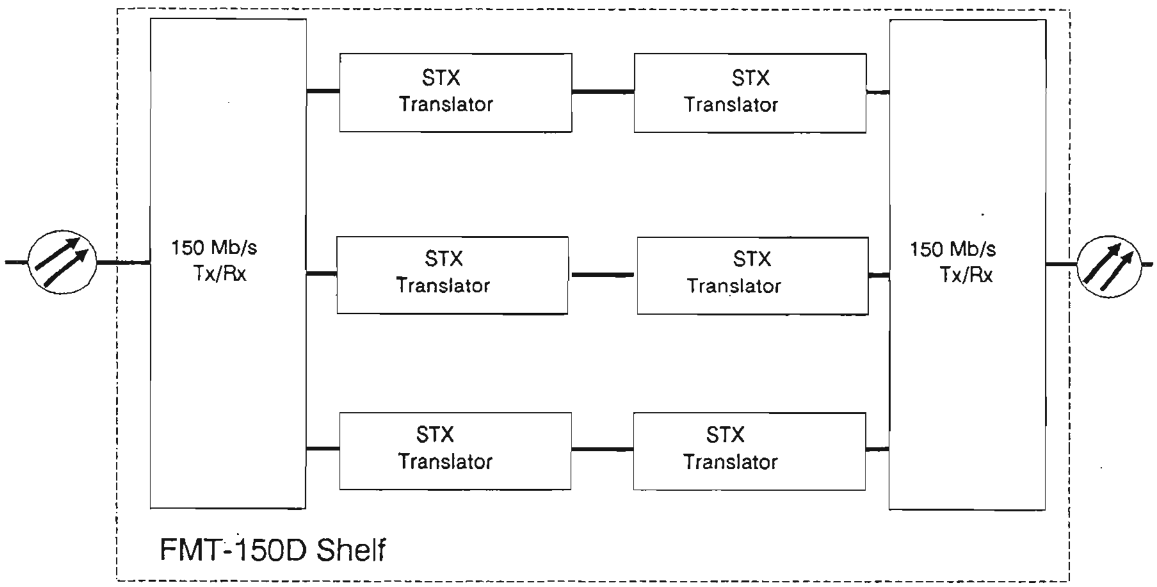


Figure 10

Repeater Site

Ref. Figure 10

A repeater site combines two 150 Mbps fiber interfaces that serve to regenerate the optical signal for further transmission. Such a site could be formed from a single FMT-150D shelf, as shown in *Figure 10.*

Typical FMT-150 Hub Site

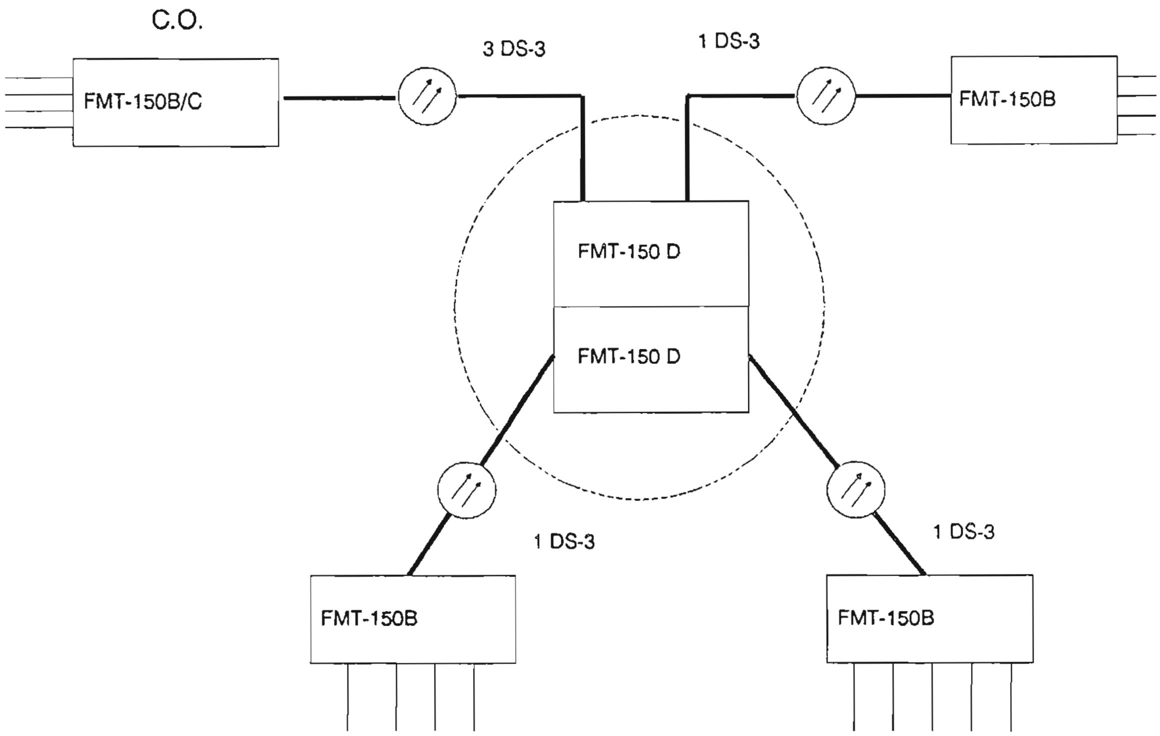


Figure 11

Hub Site

Ref. Figure 11

A hub site combines optical interfaces that enable us to route the DS-3 signals in different directions. This is done without the use of extra multiplexers. Therefore, the signal does not have to be broken down to the DS-1 level.

FMT-150B/C/D BAY AND SHELF DESCRIPTION

PURPOSE

This section describes in more detail Northern Telecom's equipment implementation in order to support DS-3 transmission.

OBJECTIVES

Using student guide, classoom notes, and NTP's, the student will be able to:

1. Describe the configuration of a typical fully equipped FMT-150B/C/D Bay
2. Describe the Central Access Maintenance and Monitoring System
3. Describe the FMT-150B/C/D shelf and circuit pack layout
4. List four equipment connections within the FMT-150B/C/D
5. Describe the Customer Access Interface Assembly and its location
6. Describe the following options:
   - Optical Termination Tray
   - Fuse and Alarm Panel

7. List and describe the four levels of alarm lamps for troubleshooting

8. Describe briefly the major differences in the shelves of the FMT-150B, FMT-150C, and FMT-150D

9. List specific environmental specifications for the FMT-150B/C/D

FMT-150B/C/D SYSTEM CONFIGURATION

TABLE OF CONTENTS

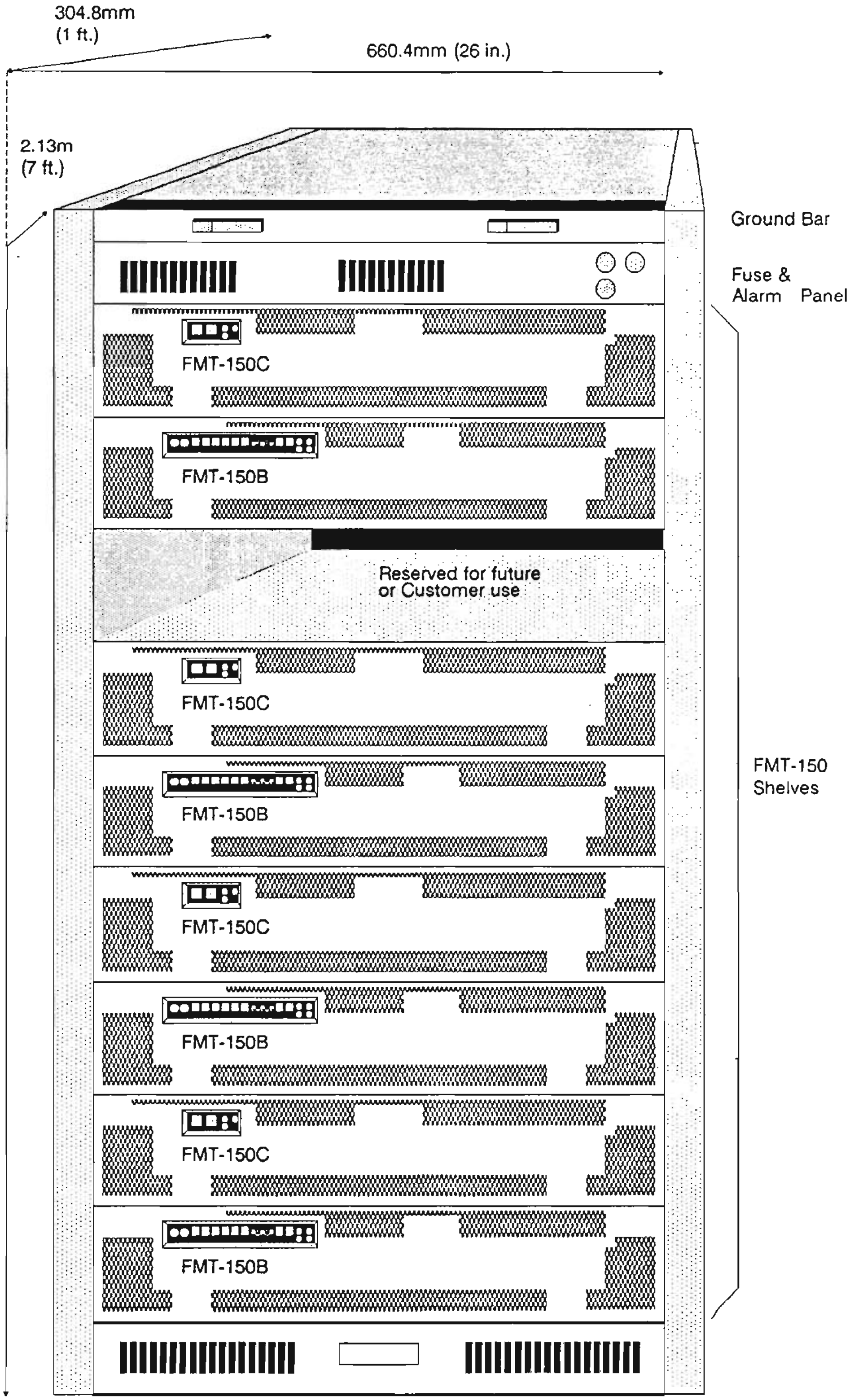

304.8mm
(1 ft.)
660.4mm (26 in.)
2.13m
(7 ft.)
Ground Bar
Fuse &
Alarm Panel
FMT-150C
FMT-150B
Reserved for future
or Customer use
FMT-150C
FMT-150B
FMT-150C
FMT-150B
FMT-150C
FMT-150B
FMT-150
Shelves

Figure 1

FMT-150 BAY AND SHELF DESCRIPTION

Ref. Figure 1

The FMT-150 fiber multiplex terminal equipment is designed for modular growth. Each module, or circuit pack, performs a specific function, and most may be equipped only to meet particular requirements. Since the system can be customized to fill individual needs, the customer need only pay for the options desired.

All FMT-150 shelves are equipped with a cover that allows ventilation of the circuit modules and monitoring of alarm indicators without removing the cover.

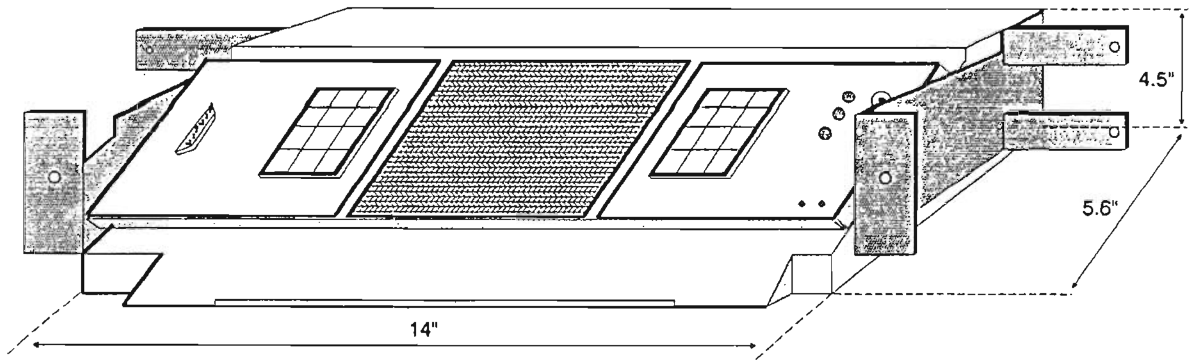
The FMT-150 is designed as a single shelf system that may be equipped in various configurations (e.g. FMT-150B, FMT-150C or FMT-150D). The shelves may be mounted on any 584 mm (23 inch) standard rack. Circuit modules plug into the shelf from the front to provide easy access for maintenance or other servicing. The FMT-150 shelf carries a DM-13 multiplexer and the associated electro-optic converter. A typical example of a 2.13 m (7 foot) bay configuration for eight bidirectional optical channels is shown in Figure 1. A fully loaded bay is equipped with eight FMT-150 shelves, a fuse and alarm panel, and an AC outlet.

STANDARD BAYS

A maximum of eight FMT-150 terminal shelves may be mounted in a 7 foot bay. There is also additional bay space reserved for a Fuse and Alarm panel, AC outlet, ground bar, optical splice/storage panel, and future enhancements such as a Centralized maintenance unit (i.e., CAMMS).

Northern Telecom does not recommend installing more than the maximum recommended systems in a bay. Therefore, although bays up to 11.5 feet high are available, the region above the 7 foot bay should be left empty.

CAMMS Shelf Assembly



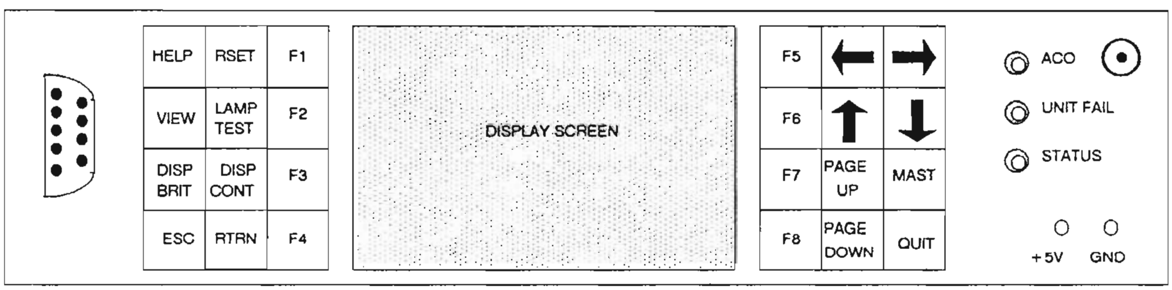


Figure 2

CENTRAL ACCESS MAINTENANCE AND MONITORING SYSTEM

Ref. Figure 2

The Central Access Maintenance and Monitoring System (CAMMS) device is an alarm surveillance and control system that will facilitate monitoring and maintenance of the FMT-150 transmission system. In its simplest form, the CAMMS consists of a maintenance display unit (MDU) that interfaces with a single FMT-150 system. A maintenance processor unit (MPU) is added to provide access to more than one FMT-150.

CAMMS is a single shelf unit measuring 14 inches wide, 5.6 inches in depth and 4.5 inches in height. It is built to mount in a standard nineteen inch rack, but for FMT-150 purposes, it may be equipped with twenty-three inch adapter brackets.

The unit occupies two and one half vertical mounting spaces of the bay layout.

As CAMMS contains a centralized display, it is recommended that the device be installed at a height allowing for a comfortable viewing level (i.e., below the first two FMT-150 shelves).

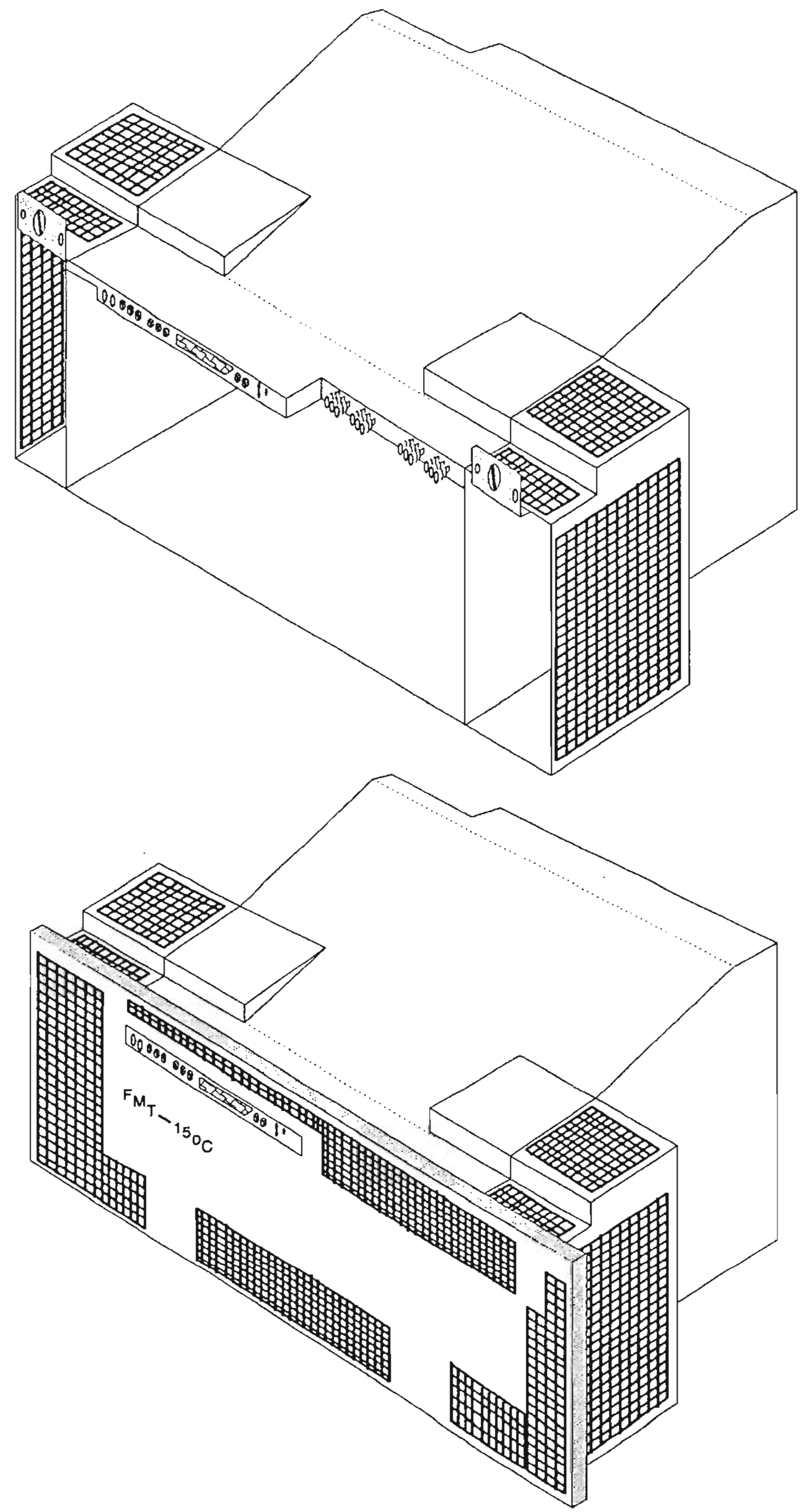


Figure 3

SYSTEM SHELVES

Ref. Figure 3

Circuit pack modules plug into the shelf from the front providing easy access for maintenance or other servicing. The shelves require 23 inch mounting centers and should be mounted in unequal flange type bays to accommodate the 25.9 inch shelf width. All FMT-150 shelves are equipped with snap-on covers that allow ventilation of the circuit modules, and monitoring of shelf alarm indicators with the covers installed. The cover may be easily removed to access the internal equipment.

FMT-150B Circuit Pack Layout

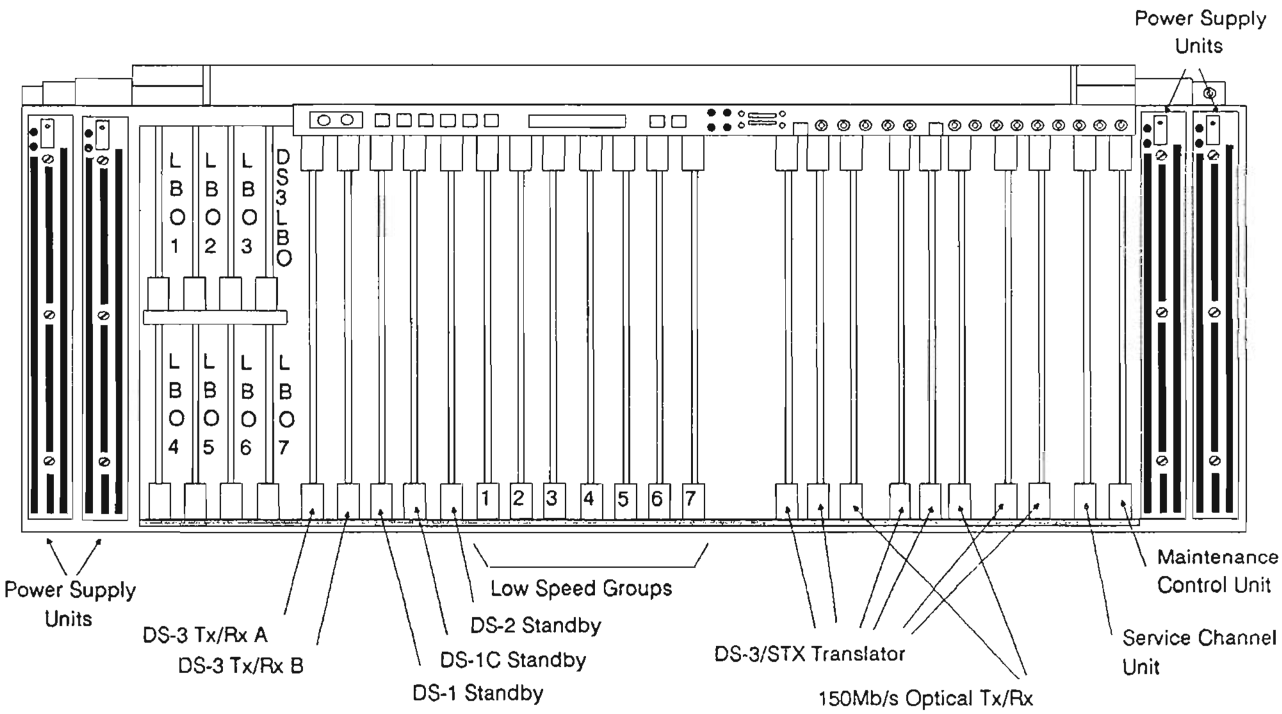


Figure 4

FMT-150C Circuit Pack Layout

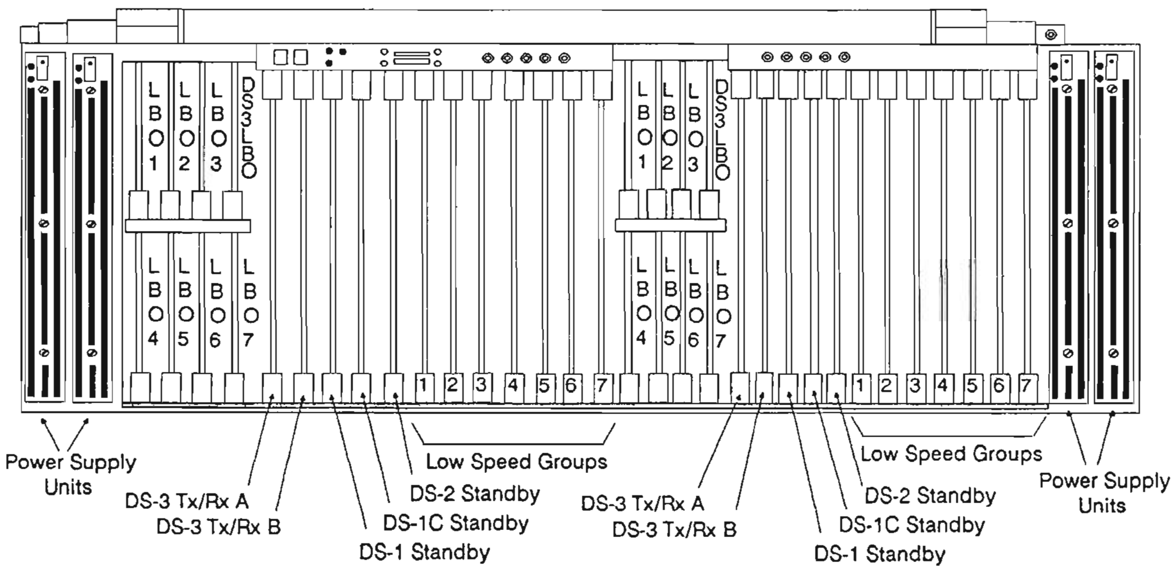


Figure 5

FMT-150D Circuit Pack Layout

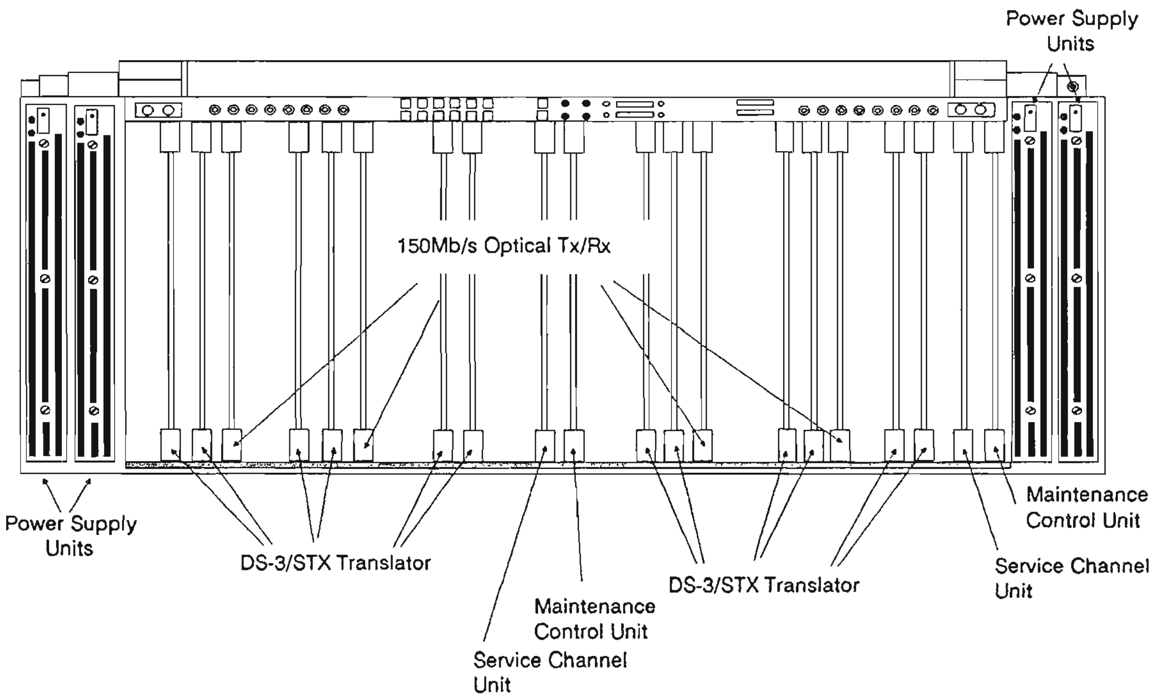


Figure 6

CIRCUIT PACK LAYOUT

Ref. Figure 4, 5 and 6

Shelf Layout

The three FMT-150 shelf layouts are shown in Figures 4, 5 and 6. Each shelf measures 25.9 inches wide, by 8.8 inches high by 12.0 deep. Each of the shelves provides space for four power supply units, two on each side of the shelf. All circuit modules are installed and accessed from the front of the shelf. The DM-13 multiplexer monitor and control module is mounted on hinges at the front of the shelf. All other modules slide into position in pre-assigned slots inside the shelf. On the backplane of each shelf, wire-wrap pins allow for connection of low-speed cabling, office alarms, E2A telemetry and customer defined input and output points. At the front of each shelf, subminax connectors for DS-3 signals are mounted, as well as alarm LED indications, order-wire operation buttons and jacks, and an electrostatic discharge jack.

STUDENT NOTES

EQUIPMENT CONNECTIONS

Each FMT-150B shelf (or FMT-150B/C/D shelves) requires connections for power, low-speed signals, high speed signals, and alarm telemetry, optical interfaces, and optional customer inputs/outputs.

Note: In addition to the above connections, there are six STX connectors located in the FMT-150B backplane. These STX connectors are used to patch the overhead at a Drop and Insert site to provide communication between the two Drop and Insert shelves.

The FMT-150D shelf requires connections for power, high-speed signals, alarm telemetry, optical interfaces, and optional customer inputs/outputs.

With the exception of the DS-3 and optical interfaces, all connections are terminated on the Customer Access Interface Assembly located on the rear of each shelf. The optical and DS-3 signals are terminated on the front of the shelf through subminax cabling for the DS-3 signals and optical patchcords or pigtails for the optical signals.

Communication between the DM-13 Monitor and Control module and the rest of the shelf is accomplished through a set of three internal ribbon connectors that connect the Monitor and Control module to the internal backplanes of the shelf. The three ribbon cables are connectorized on one end to allow removal from the Monitor and Control module if a changeout is required.

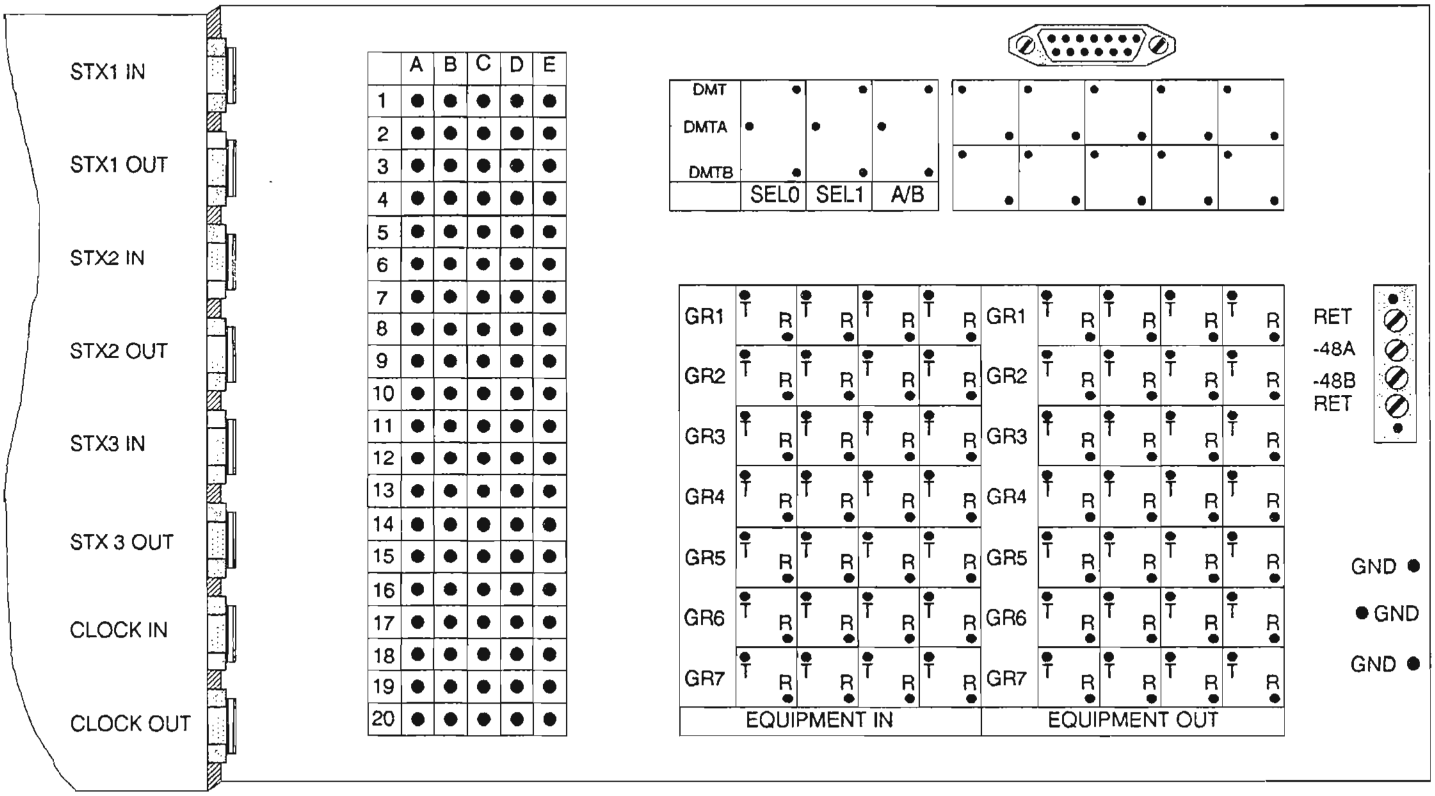
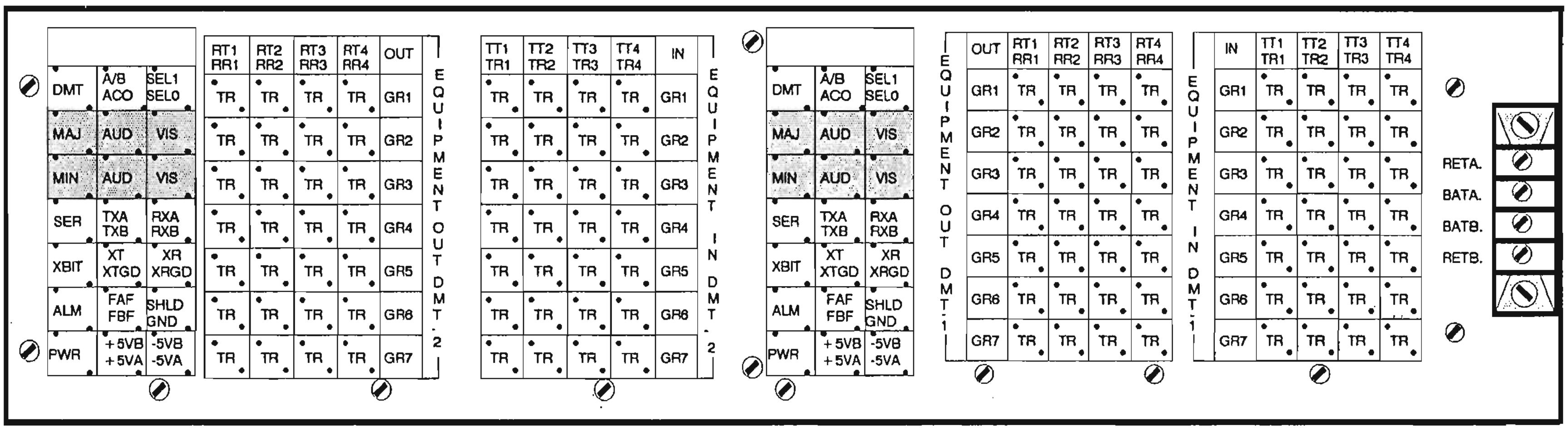

STX1 IN
STX1 OUT
STX2 IN
STX2 OUT
STX3 IN
STX 3 OUT
CLOCK IN
CLOCK OUT
A
B
C
D
E
DMT
DMTA
DMTB
SEL0
SEL1
A/B
GR1
GR2
GR3
GR4
GR5
GR6
GR7
EQUIPMENT IN
EQUIPMENT OUT
RET
-48A
-48B
RET
GND
GND
GND

Figure 7



−25 dBm [illegible]

Figure 8

FMT-150D Customer Access Interface Assembly

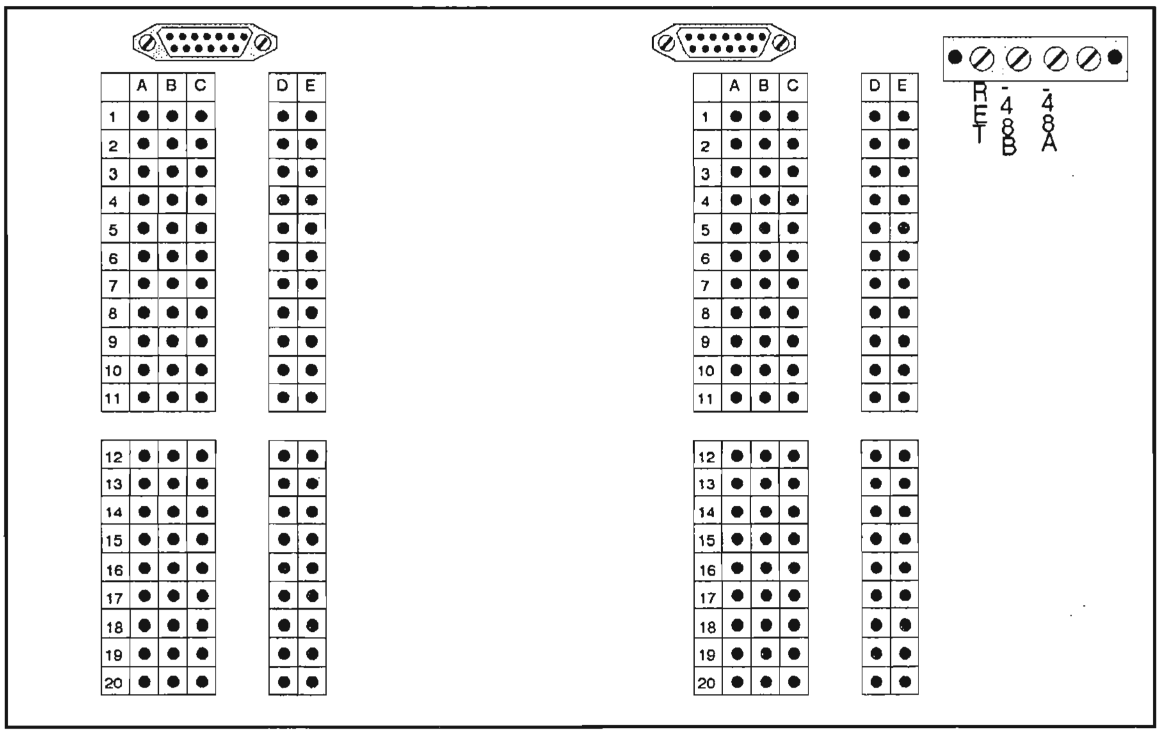


Figure 9

CUSTOMER ACCESS INTERFACE ASSEMBLY

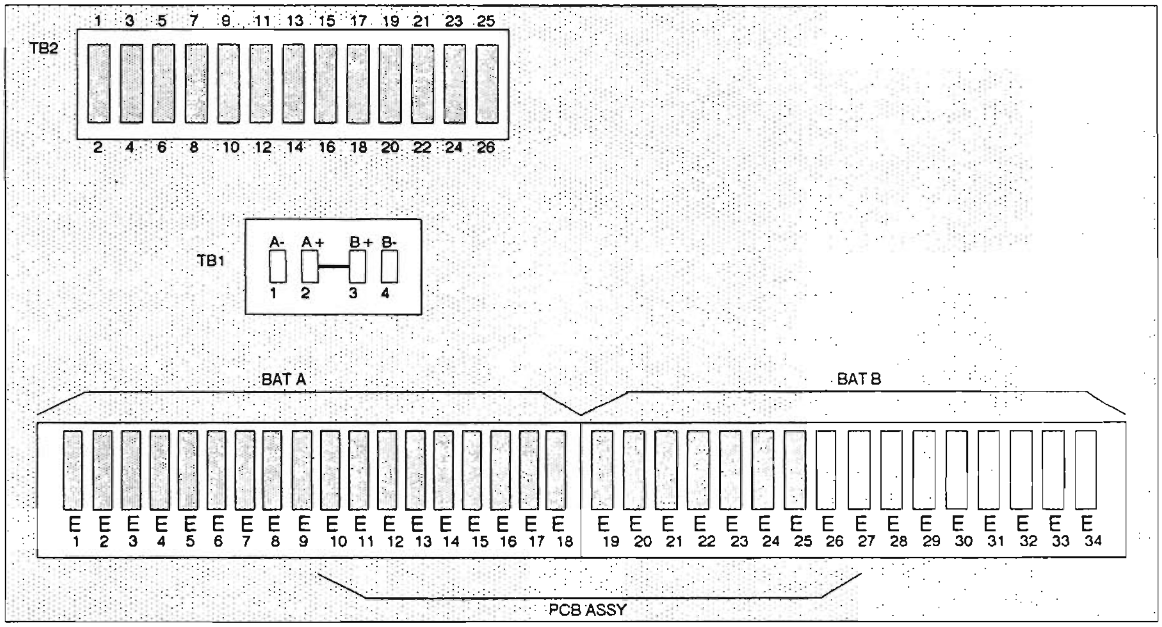
Ref. Figure 7, 8 and 9

There is one Customer Access Interface Assembly for each FMT-150 shelf. This assembly is located on the rear of the shelf and depending on the FMT-150 application terminates some or all of the following:

- DC power cables through a four terminal barrier strip
- DS-1/1C/2 cables via wire-wrap pins
- alarm and telemetry cabling via additional wire-wrap terminations
- STX connectors,
- optional customer inputs/outputs

Note: A front mounted Customer Access Interface Assembly is also an available option.

NT7H46AA/BA Fuse and Alarm Panel



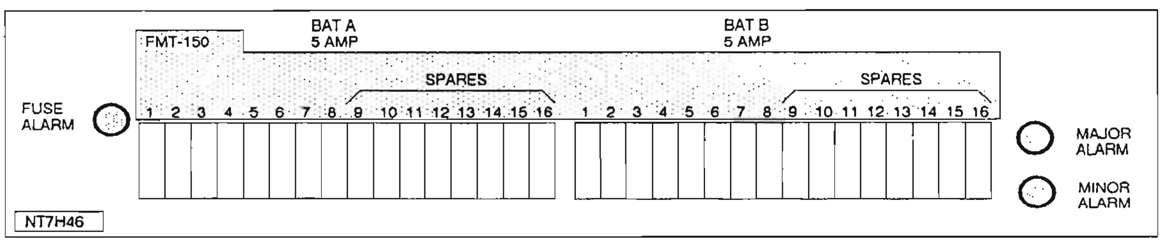


Figure 10

OPTICAL TERMINATION TRAY

If the optical patchcords are spliced to the outside plant cable, an optional termination tray may be ordered. This tray will provide the area needed for cable splicing. The typical location of this tray in a 7 foot bay is directly under the optional fuse and alarm panel.

The optical termination panel occupies one 1.75 inch vertical mounting space.

Note: An optical storage tray is also available providing for storage of excess fiber.

FUSE AND ALARM PANEL

Ref. Figure 10

An optional fuse and alarm panel may be installed at the top of a FMT-150 bay. This provides a common connection point for all power cabling and alarm telemetry. Two 5-amp fuses are equipped for each FMT-150 shelf. Connections inside the fuse and alarm panel provide access to relay closure alarms and the E2A serial telemetry interface.

There are three lamps on the fuse and alarm panel faceplate:

- Major
- Minor
- Fuse Alarm

The fuse and alarm panel occupies two 1.75 inch vertical mounting spaces.

ALARM LAMPS

The FMT-150 provides four levels of alarm lamps for troubleshooting:

- Bay Alarms
- Shelf Alarms
- Monitor and Control/CRT
- Individual Circuit Pack Alarms

Bay Alarms

The bay Major and Minor Alarms are provided as red and yellow lamps on the fuse and alarm panel. Major alarms (red) include those that involve a service failure at the DS-3 level or higher. Minor alarms (yellow) include any non-service affecting alarms at any level, or a service affecting DS-1/1C/2 line alarm.

Shelf Alarms

The shelf alarm indicators are located at the top of the shelf and remain visible with the shelf cover installed. The LED indicators are as follows:

- Major, Minor, Fuse and Remote LEDs on the B and D shelves.
- Major, Minor and Fuse LEDs on the C shelf.

Monitor and Control

In the FMT-150B/C, the monitor and control module only has one red LED for Mon Dis/Unit Fail

Circuit Pack Alarms

All FMT-150 circuit packs containing active components include one or more LEDs to provide alarm and/or status information about the unit. These LEDs can be hardware or software related (depending on the type of failure). A red LED indicates an alarm, green and yellow LEDs are used for status indications.

FMT-150B Shelf Features

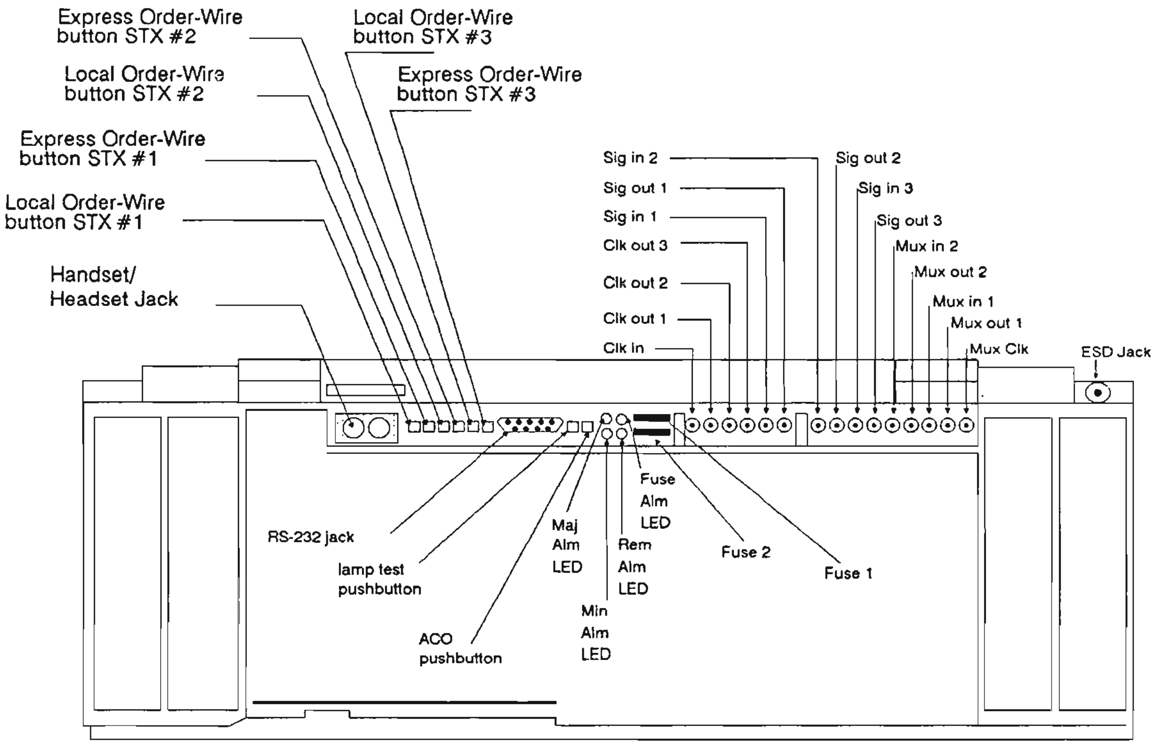


Figure 11

SHELF FEATURES

Features at the front of the FMT-150B shelf are shown in figure 11 and described below:

CONNECTORS	DESCRIPTION
SIG OUT 1,2,3	DS-3/STX output 1,2,and 3 form DS-3/STX translators respectively.
SIG IN 1,2,3	DS-3/STX input 1,2, and 3 to DS-3/STX translators respectively.
DS-3 IN 1	DS-3 input to DM-13.
DS-3 IN 2	Not used for this application.
DS-3 OUT 1	DS-3 output from DM-13.
DS-3 OUT 2	Not used for this application.
CLK OUT 1,2,3	DS-3, #1, #2, #3 clock.
CLK IN	External clock for the 150 Mb/s system.
MUX CLK	External clock input for the DM-13 multiplexer.
ESD	Used to ground personnel to prevent accidental discharge.
Handset/Headset Jack	Provides voice communication over orderwire facility.
RS-232 Jack	Provides interface for CRT/CAMMS cable.

LEDs	DESCRIPTION
MAJOR	RED - Service affecting failure.
MINOR	YELLOW - Non-service affecting failure.
FUSE ALM	RED - A shelf fuse has been blown.
REM	YELLOW - An alarm has occurred at a remote site.

BUTTONS	DESCRIPTION
LP TEST	Lights up all LEDs/
ACO	Turns off existing audible alarm indicators.
LOC 1,2,3	Rings every site common to STX signal #1, #2, #3.
EXP 1,2,3	Rings every site common to STX signal #1, #2, #3.

FUSES	DESCRIPTION
Fuse 1, Fuse 2	5A GMT type fuse on the BATA and BATB feeds respectively.

FMT-150C Shelf Features

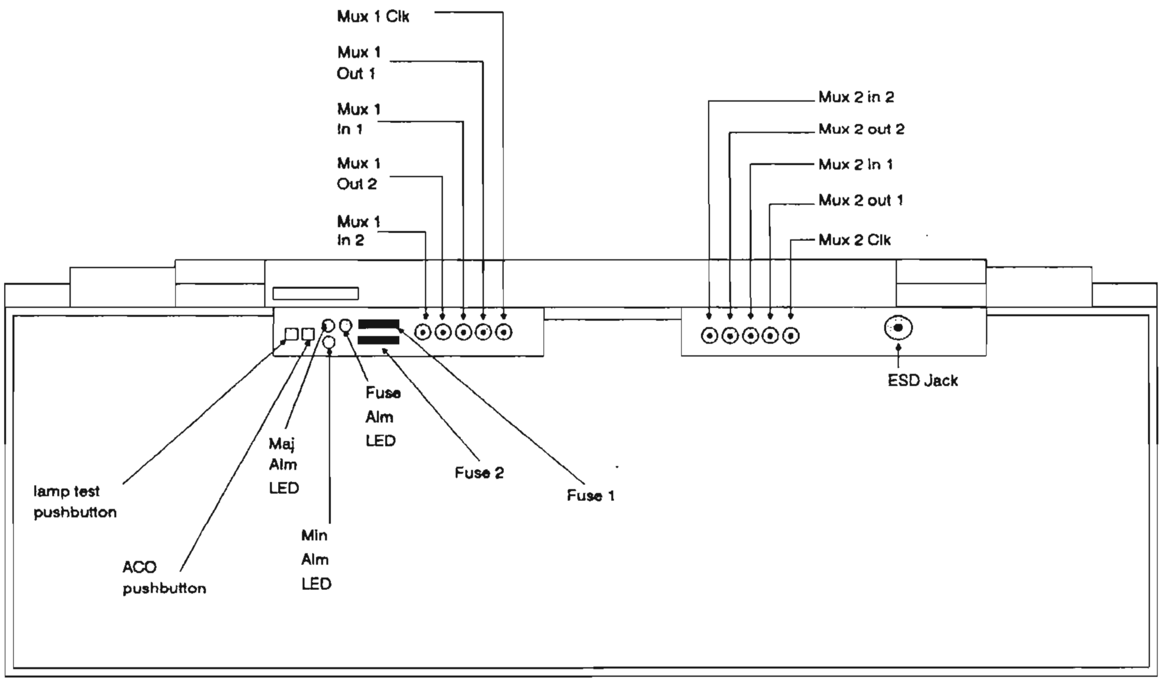


Figure 12

SHELF FEATURES

Features at the front of the FMT-150C shelf are shown in figure 12 and described below:

CONNECTORS	DESCRIPTION
MUX 1 IN	DS-3 input to DM-13.
MUX 2 IN	Not used for this application.
MUX 1 OUT	DS-3 output from DM-13.
MUX 2 OUT	Same as DS-3 OUT 1 but not used for this application.
MUX 1 ,2 CLK	External clock 1 and 2.
ESD	Used to ground personnel to prevent accidental discharge.

LEDs	DESCRIPTION
MAJOR	RED - Service affecting failure.
MINOR	YELLOW - Non-service affecting failure.
FUSE ALM	RED - A fuse has blown.

FUSES	DESCRIPTION
Fuse 1, Fuse 2	5A GMT type fuse on BATA and BATB feeds respectively.

FMT-150D Shelf Features

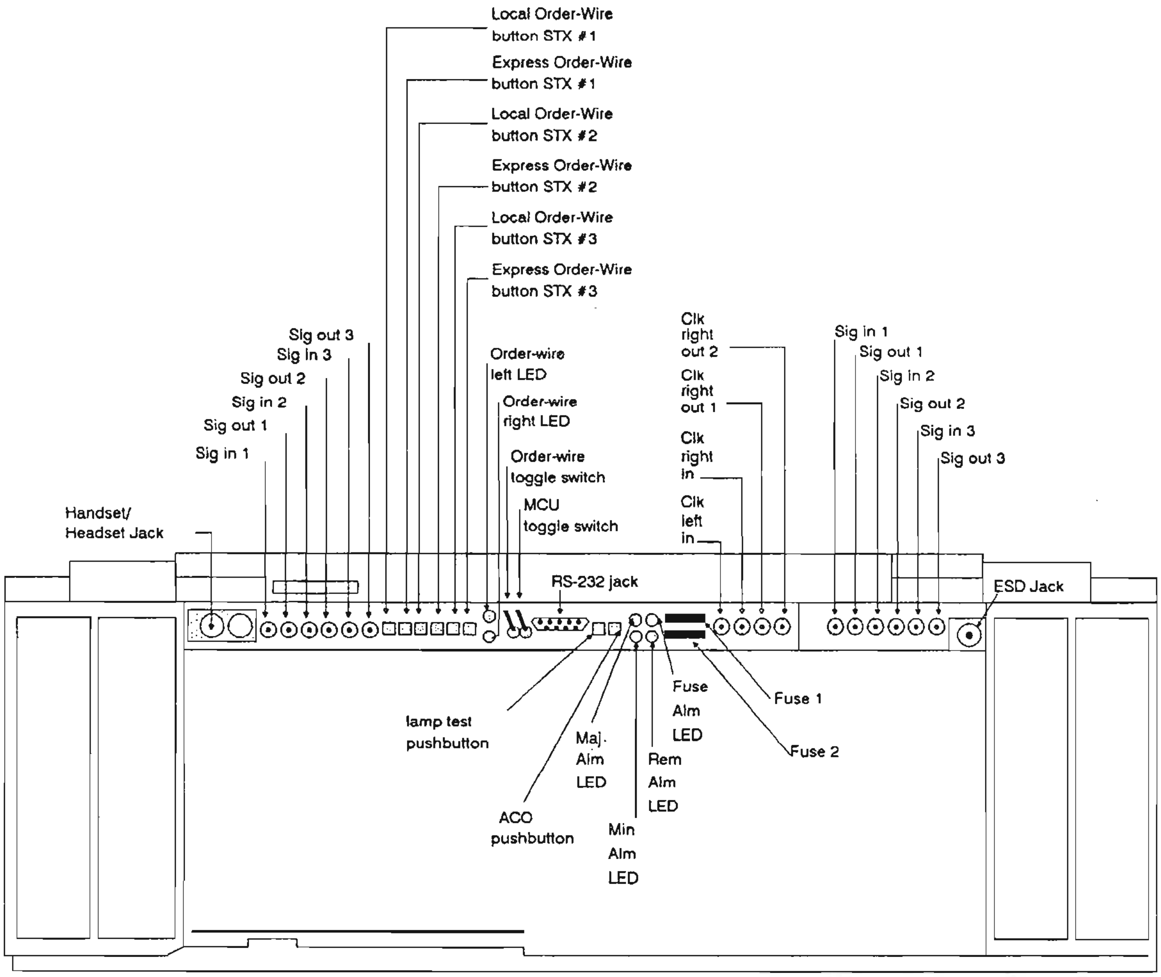


Figure 13

SHELF FEATURES

Features at the front of the FMT-150D shelf are shown in figure 13 and described below:

CONNECTORS	DESCRIPTION
MUX 1 IN	DS-3 input to DM-13.
MUX 2 IN	Not used for this application.
MUX 1 OUT	DS-3 output from DM-13.
MUX 2 OUT	Same as DS-3 OUT 1 but not used for this application.
MUX 1, 2 CLK	External clock 1 and 2.
ESD	Used to ground personnel to prevent accidental discharge.

LEDs	DESCRIPTION
MAJOR	RED - Service affecting failure.
MINOR	YELLOW - Non-service affecting failure.
FUSE ALM	RED - A fuse has blown.

FUSES	DESCRIPTION
Fuse 1, Fuse 2	5A GMT type fuse on BATA and BATB feeds respecively.

ENVIRONMENTAL SPECIFICATIONS

The specified temperature ranges for FMT-150 equipment are given below.

NOTE: Short term is defined to be no more than 72 consecutive hours, no more than a total of 15 days per year.

Temperature

Normal Operating:	0 to 40 C (32 to 104 F)
Short Term:	0 to 50 C (32 to 122 F)
Storage and Shipping	-50 to 70 C *(-58 to 158 F)*

Relative Humidity

Operating	20% to 95% at 4 kPa water vapor over operating temperature (no condensation).
Storage and Shipping:	0% to 95% maximum or 5.3 kPa (no condensation)

Note: An extended temperature model is available. See NTP 321-3211-180

FMT-150B/C/D CIRCUIT PACK DESCRIPTION

PURPOSE

This section provides a detailed description of the various circuit packs which could be configured in a FMT-150B/C.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. Explain the various functions of the Monitor and Control module
2. Briefly describe the DS-1/DS-1C/DS-2/DS-3 LBO/Switch Module
3. Briefly describe the DS-1/DS-1C/DS-2/DS-3 Transmit/Receive Module
4. Briefly describe the DS-2 loop-through module
5. Briefly describe the two types of Translator Units
6. Briefly describe the 150 Mbps Transmit/Receive module
7. Describe the Maintenance Control Unit
8. Describe the Service Channel Unit and the differences between the available versions
9. Describe the Power Supply Unit (PSU)

FMT-150B/C CIRCUIT PACK DESCRIPTION

TABLE OF CONTENTS

CIRCUIT PACK DESCRIPTIONS

The various plug-in modules that can be used in a FMT-150B/C are as follows:

• NT7H61	Monitor and Control Module
• NT7H63	DS-1 LBO/Switch Module
• NT7H64	DS-1C LBO/Switch Module
• NT7H65	DS-2 LBO/Switch Module
• NT6H71	DS-1 Transmit/Receive Module
• NT6H67	DS-1C Transmit/Receive Module
• NT6H68	DS-2 Transmit/Receive Module
• NT6H52	DS-2 Loop-Through Module
• NT6H62	DS-3 Transmit/Receive Module
• NT7H66	DS-3 LBO/Switch Module
• NT7H69	Power Supply Module
• NT7H75	Service Channel Unit (SCU)
• NT7H90	Maintenance Control Unit
• NT7H85	DS-3 Translator Unit
• NT7H85BA	STX Translator Unit
• NT7H80	150 MBPS TX/RX

The FMT-150B/C terminal shelf is sometimes referred to as a plug-in module as well. The product engineering code for this module is NT7H31.

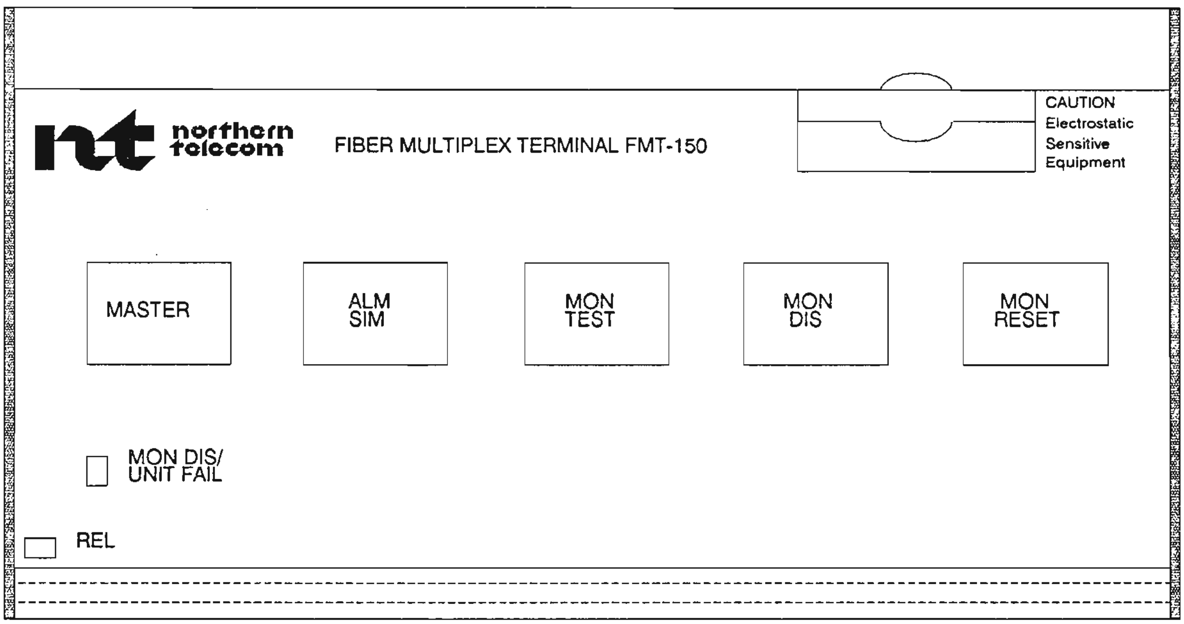

northern telecom
FIBER MULTIPLEX TERMINAL FMT-150
CAUTION
Electrostatic
Sensitive
Equipment
MASTER
ALM SIM
MON TEST
MON DIS
MON RESET
MON DIS/ UNIT FAIL
REL

Figure 1

NT7H61BA MONITOR AND CONTROL MODULE

Ref. Figure 1

The NT7H61BA Monitor and Control module along with the Maintenance and Control Unit (MCU), provides monitoring and controlling of the DM-13 multiplexer as follows:

- Controls DS-1/1C/2 and DS-3 protection switching based on error detection and alarm status interrupt information from the individual Tx/Rx modules, and on bit-by-bit monitoring of the DS-3 signals by the Monitor and Control module itself.
- Performs bit-by-bit monitoring for the DS-3 Tx/Rx modules.
- Provides DM-13 communication information routing to the maintenance control unit for remote alarm and status information.
- Scans the switches on the module faceplate for manual control and diagnostic inputs.
- Provides self-disconnect from the system in the event of failure of the monitor self-check (soft failure), or hard failure, to prevent interruptions of the Tx/Rx multiplexing operations.
- Provides a standby crystal clock for the DS-1 and DS-2 modules so that the receiver circuits continue to produce AIS outputs when "all-zero" output or DS-2 alarm conditions are detected.

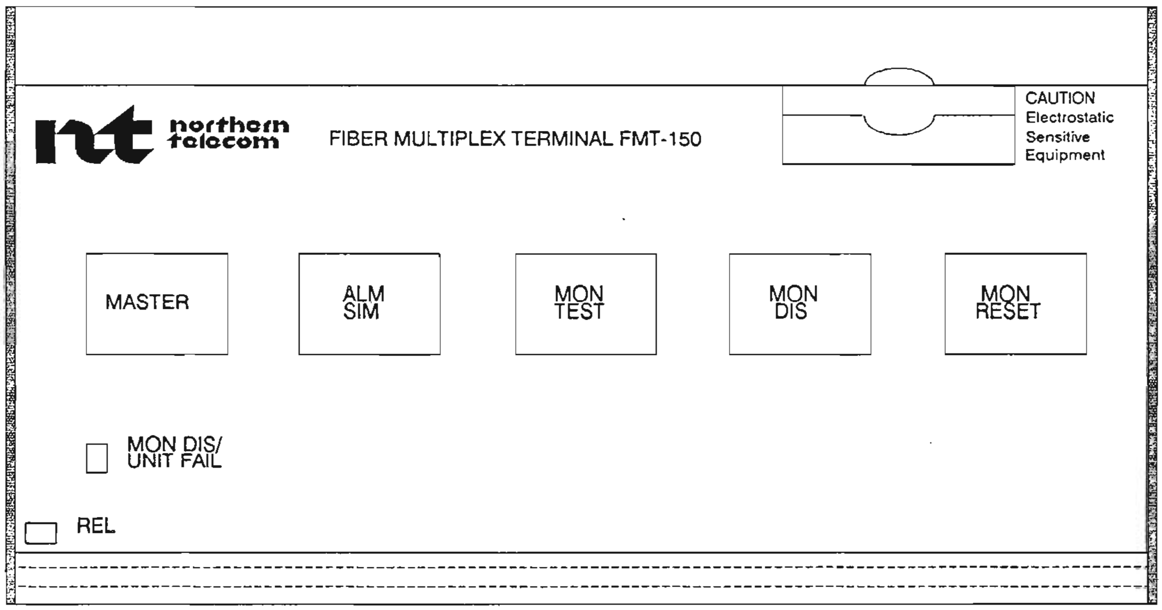

northern telecom
FIBER MULTIPLEX TERMINAL FMT-150
CAUTION
Electrostatic
Sensitive
Equipment
MASTER
ALM
SIM
MON
TEST
MON
DIS
MON
RESET
MON DIS/
UNIT FAIL
REL

Figure 2

NT7H61BA MONITOR AND CONTROL MODULE FACEPLATE

Ref. Figure 2

The NT7H61BA faceplate includes 5 buttons and one LED. The five buttons permit the following four operations:

- Monitor disable (e.g., used before replacing a circuit module).
- Monitor reset (e.g., used after replacing a circuit module).
- Alarm simulation (to test FMT-150 alarm indicators - LEDs, lamps, buzzers, etc.)
- Monitor test.

The faceplate also contains one red LED that lights up when the Monitor and Control module fails, or when it has been disabled manually.

STUDENT NOTES

LBO/SWITCH MODULES

NT7H63 DS-1 LBO/Switch Module

The low-speed LBO/switch modules (NT7H63) provide access to the low-speed protection bus.

Switches on the front edge of the module must be set for the correct distance to the DS-1 cross-connect.

Low-speed protection switches are performed automatically by the Monitor and Control module. A low speed protection switch command closes relays on the affected low-speed LBO/switch module to transfer all tributaries in that group to the appropriate standby module.

Functionally, the DS-1 LBO is divided into two transmission paths:

- In the transmit direction, the module accepts four DS-1 signals from the office DSX-1 cross-connect and splits them into two sets of four DS-1 signals each. One set feeds the DS-1 transmitter/receiver (Tx/Rx) group module with which the LBO is associated, and the other set connects on the protection relay to the DS-1 transmit protection bus.
- In the receive direction, the module accepts two sets of four DS-1 signals: one set from the Tx/Rx group module, and the other from the DS-1 receive protection bus. The two sets of inputs are connected through contacts on the protection relay that selects one set or the other for connection to the LBO networks. The selected signals then pass through the LBO networks for connection to the DSX-1 cross-connect. Each of the four LBO networks has three optional settings, depending on the distance to the cross-connect facility.

These are selected by means of three-position switches on the front edge of the module (the module does not have to be removed from the shelf). The three settings on each switch are:

- S (Short): 0 to 150 ft.
- M (Medium): 150 to 450 ft.
- L (Long): 450 to 750 ft.

Operation of the protection switch relay to switch the NT7H63 signals from the DS-1 Tx/Rx group module to the protection buses is in response to either:

- a protection switch signal from the software-controlled protection switch circuits in the monitor and control module when trouble is detected on one or more of the four DS-1 channels in the group;
- a manual force switch.

NT7H64 DS-1C LBO/Switch Module

Functionally, the DS-1C LBO is divided into two transmission paths:

In the transmit direction, the module accepts two DS-1C signals from the office DSX-1C cross-connect and splits them into two sets of two signals each. One set feeds the DS-1C transmitter/receiver (Tx/Rx) group module with which the LBO is associated, and the other set connects through normally open contacts on the protection relay to the DS-1C transmit protection bus.

In the receive direction, the module accepts two sets of DS-1C signals: one set from the DS-1C Tx/Rx group module, and the other set from the DS-1C receive protection bus. The two sets of inputs are connected through contacts on the protection relay that selects one set or the other for connection to the LBO networks. The selected signals then pass through the LBO networks for connection to the DSX-1C cross-connect.

Each of the LBO networks has five optional settings, depending on the distance to the cross-connect facility, which are selected by means of switches on the front edge of the module (the module does not have to be removed from the shelf). The settings on each switch are:

- A: 0 to 150 ft.
- B: 150 to 300 ft.
- C: 300 to 450 ft.
- D: 450 to 600 ft.
- E: 600 to 750 ft.

Operation of the protection switch relay, to switch the NT7H64 signals from the DS-1C Tx/Rx group module to the protection buses, is in response to either:

- a protection switch signal from the software controlled protection switch circuits in the monitor and control module when trouble is detected on one or both of the DS-1C tributaries; or
- a manual force switch

NT7H65 DS-2 LBO/Switching

Functionally, the DS-2 LBO is divided into two transmission paths:

In the transmit direction, one DS-2 signal from the office DSX-2 cross-connect first passes through an LBO network whose value is selectable, depending on the distance from the cross-connect. The input is then split into two paths: one path feeds the DS-2 Tx/Rx group module with which the LBO is associated, the other path connects through normally open contacts on the protection relay to the DS-2 transmit protection bus.

In the receive direction, the module accepts two DS-2 signals: one from the DS-2 Tx/Rx group module with which the LBO is associated, and the other from the DS-2 receive protection bus. The two inputs are connected through contacts on the protection relay that selects one or the other for connection to an LBO network. The selected signal then passes through the LBO network for connection to the DSX-2 cross-connect.

Each of the LBO networks has seven optional settings, depending on the distance to the cross-connect facility, which are selected by means of switches on the front edge of the module (the module does not have to be removed from the shelf). The settings on each switch are:

- A: 0 to 90 ft.
- B: 90 to 250 ft.
- C: 250 to 410 ft.
- D: 410 to 570 ft.
- E: 570 to 730 ft.
- F: 730 to 890 ft.
- G: 890 to 1000 ft.

Operation of the protection switch relay to switch the NT7H65 input and output from the DS-2 Tx/Rx group module to the protection buses is controlled in response to either:

- a protection switch signal from the software-controlled protection switch circuits in the monitor and control module when trouble is detected on the DS-2 channel; or
- a manual force switch.

NT7H66 DS-3 LBO/Switch Module

Functionally, the DS-3 LBO module is divided into two transmission paths:

In the transmit direction, DS-3 transmit signals from the DS-3 Tx/Rx modules A and B are connected to contacts on a protection relay that is software controlled. Switching of the relay happens in response to protection switching or manual force switching. The DS-3 signal which is selected by the relay is then passed through a 225 ft. LBO that is switched into the signal path when the distance to the DSX-3 cross-connect or to the 150 Mbps fiber interface is less than 225 ft. The 225 ft. LBO is bypassed (by means of a switch on the module) if the distance to the DSX-3 cross-connect or to the 150 Mbps fiber interface is from 225 ft. to 450 ft. From the LBO, the transmit signal is connected in two directions:

- to a subminax connector on the FMT-150 shelf (DS-3 OUT)
- through a 0 db gain buffer amplifier to an SMC coaxial monitor jack (DS-3 OUT MON) at the front edge of the LBO module. The Monitor and Control module must face downwards to access this jack. Switch S3 provides optional splitting of the DS-3 output, although this only used with non-FMT-150B/C/D products.

In the receive direction, the DS-3 signal from the DSX-3 cross-connect or 150 Mbps fiber interface is connected to a set of contacts on a manually operated input selector. With the selector in its normal position, the input signal is connected to two paths.

- One path is through a selectable, 225 ft LBO, similar to the LBO in the transmit path and a 900 ft. equalizer network to a hybrid circuit which splits the received signal to feed both DS-3 Tx/Rx modules A and B.
- The second path from the input selector is through a 0 db gain buffer, and another set of contacts on the same selector, to an SMC-type monitor jack (Rx A MON) at the front of the LBO module.

When the input selector is manually switched to its other position, the received DS-3 signal is connected to a termination resistance. The DS-3 Rx A MON jack is connected to the LBO circuit. This arrangement permits the DS-3 IN MON to be used as an emergency DS-3 signal input.

NOTE: The second DS-3 input (DS-3 IN2) to the DS-3 LBO can only be used with non-FMT-150B/C/D products.

TRANSMIT/RECEIVE MODULES

NT6H71 DS-1 Transmit/Receive Module

The NT6H71 contains all the necessary circuitry for multiplexing a group of four asynchronous DS-1 transmit signals into one DS-2 format signal, and demultiplexing a DS-2 received signal into its four DS-1 component signals. The module includes option selectors to provide interfaces for DS-1 signals encoded in either AMI (alternate mark inversion) or in B8ZS (bipolar 8-zero substitution) format. An option selector is also provided to select either priority (P) or normal protection switching operation on a group basis (available on AA version only).

The module includes monitoring and diagnostic circuitry to detect errors and malfunctions as they occur. The monitors send appropriate alarm signals to the monitor and control board for alarm processing and to light a FAIL indicator on the front edge of the unit.

The option selectors and the FAIL indicator (a Red LED) are mounted on the front edge of the module so that the options can be selected without removing the module from the shelf. The option selectors consist of:

- A five-section DIP switch; four selectors for the AMI/B8ZS options in the four DS-1 receive paths, and the fifth for either normal or priority (P) protection switching for the group.
- A four-section DIP switch for selecting AMI/B8ZS options in four DS-1 transmit paths.

Note: A four-section DIP switch is available on the BA version with the ability to select an *all-ones* or *all-zeros* output to the downstream equipment in the event of an incoming line failure.

NT6H67 DS-1C Transmit/Receive Module

The NT6H67 DS-1C Tx/Rx contains all the necessary circuitry for multiplexing a group of two asynchronous DS-1C signals into one DS-2 format signal in the transmit direction, and demultiplexing a DS-2 signal into its two DS-1C components in the receive direction. The module includes AMI decoding in the transmit direction, and AMI encoding in the receive direction. An option selector is also provided to select either priority or normal protection switching on a group basis.

The module includes monitoring and diagnostic circuitry to detect errors and malfunctions as they occur. The monitors send appropriate alarm signals to themonitor and control board for alarm processing and to light a fail indicator on the front edge of the unit.

The option selector and the FAIL indicator are mounted on the front edge of the module so that the option can be selected without removing the module from its position in the shelf.

NT6H68 DS-2 Transmit/Receive Module

This module handles a single DS-2 transmission rate using a standard B6ZS (Binary Six Zero Substitution) coding.

The internal 6.312 Mbps signal, although at a DS-2 rate, is a unipolar signal. The unipolar signal is converted to a bipolar B6ZS signal and connected to the receive side of the DS-2 tributary through a line driver.

In the receive direction, the module selects the DS-2 rate group signal from the output of the DS-3 receiver, and writes the data into an elastic store, using a gaped clock to remove the stuff bits.

In the transmit direction, the function of DS-2 Tx/Rx is to accept one DS-2 format signal from the DS-2 tributary and provide one synchronous DS-2 rate, unipolar group signal to the DS-3 transmitter.

NT6H62 DS-3 Transmit/Receive Module

The NT6H62 contains all the necessary circuitry for multiplexing seven DS-2 rate group signals into one DS-3 format signal in the transmit direction, and demultiplexing one DS-3 signal into its seven DS-2 rate components in the receive direction. It also controls the master high-speed clock for the shelf.

The unipolar 6.312 Mbps streams are multiplexed together along with standard DS-3 overhead bits in a B3ZS (Binary Three Zero Substitution) format. The resulting total bit rate is 44.736 Mbps.

The master clock can be drawn from one of two sources:

- From an internal oscillator on the high-speed transmit/receive module (terminal operation)
- From the incoming 44.736 Mbps DS-3 bit stream (when used in a drop/insert configuration)

One DS-3 transmit/receive module is required for the multiplexer to operate. A second may be added if high-speed protection is required.

NT6H52 DS-2 LOOP-THROUGH MODULE

The Loop-through module is used to replace low speed tributary Tx/Rx modules on loop-through groups when the DM-13 is operating in the drop/insert mode. By this the DS-2 signals are reinserted into the DS-3 signal.

In the loop-through, the group signal is selected from the DS-2 receive data bus from the DS-3 receiver, regenerated, and looped back, at the unipolar level, to the DS-2 transmit data bus for onward transmission.

The Loop-through is not protected in the protection switching. There is no LBO module associated with a loop through.

TRANSLATOR UNITS

NT7H85 DS-3 Translator Unit

The DS-3 Translator unit is a bi-directional module that converts a DS-3 signal (44.736 Mbps) to one synchronous transport signal (STX) at 49.92 Mbps and vice-versa. The overhead bit stream containing both orderwire and alarm information is inserted and extracted from the main bit stream in this module. There is one working DS-3 Translator module and one standby module per DS-3 signal.

There are two options on each DS-3 Translator unit. One option allows the operator to set the Translator unit in terminal or drop/insert mode. The other option will attenuate the signal based on the selected LBO distance: LBO IN (0 to 230 ft for NE728 cable and 0 to 164 ft for RG-59 cable) adds attenuation and LBO OUT (213 to 450 ft for NE728 cable and 164 to 250 ft for RG-59 cable) does not.

NT7H85BA STX Translator Unit

The STX Translator is a bi-directional unit that accepts an STX input instead of a DS-3 input and is used exclusively with a repeater or hubbing configuration. The overhead bit stream containing both orderwire and alarm information is inserted and extracted from the main bit stream in this module. There is one working STX Translator module and one standby module per STX signal.

There are two options on each STX Translator unit. One option allows the operator to set the Translator unit in repeater or hub mode. The other option will attenuate the signal based on the selected LBO distance; LBO IN (0 to 230 ft for NE728 cable and 0 to 164 ft for RG-59 cable) adds attenuation and LBO OUT (213 to 450 ft for NE728 cable and 164 to 250 ft for RG-59 cable) does not.

150 MBPS TX/RX (NT7H80) Module

The 150 Mbps Tx/Rx module provides multiplexing and demultiplexing for up to 3 STX signals for each 150 Mbps signal. Conversion of the 150 Mbps signal from electrical to optical form (and vice-versa) is also performed on the same module.

Transmit: the 150 Mbps Tx/Rx module is fed by the STX signals from respective translator modules, along with possible keep-alive signals. The 149.76 Mb/s output signal is then scrambled and converted to an optical signal by the laser driver. The laser power monitor provides an optical degrade alarm if the signal power decreases by 3 dB. The output optical signal is routed to the biconical connector on the edge of the printed circuit board for easy accessibility.

Receive: The optical 150 Mbps line is converted and amplified by the Pin-FET diode and amplifier circuit. The scrambled 150 Mbps signal is descrambled and the 149.76 MHz clock is recovered. The clock is divided by 3 to 49.92 MHz clock that is made available to the DS-3 translators and external output. The 149.76 Mb/s is demultiplexed to 3 STX signals and are also fed into the DS-3 translators.

The following are the most common versions of the NT7H80 TX/RX card:

- NT7H80AA (short range SM)
- NT7H80AE (standard range SM)
- NT7H80BA (standard range MM)

Note: Extended temperature range optics are also available.

NT7H90 MAINTENANCE CONTROL UNIT (MCU)

The MCU is required for the gathering of all Major and Minor alarm information within an FMT-150 network. Access to these alarms is accomplished through the customer access interface assembly located at the rear of each FMT-150B or D shelf.

NOTE: The FMT-150C shelf does not need an MCU. In this case, the gathering of all Major and Minor alarm information for both multiplexers is performed through the Monitor and Control module.

The MCU is the main interface to the customer, either through a CRT terminal or an alarm scanning device using E2A protocol.

The DIP switches on the Maintenance Control Unit set the node identification (addressing scheme) for each FMT-150B and D shelf. A line-learn button is provided on the card edge as a method to "learn-out" any unwanted alarms in the system. A unit fail LED is provided on the front edge of the card.

The following are available MCU cards and their application:

- NT7H90CA:
  - DS-3 performance monitoring
  - Tandy 200 and CAMMS interface
  - Used in point-to-point and multipoint configurations

- NT7H90DA:
  - No DS-3 performance monitoring
  - Cannot interface Tandy 200 and CAMMS interface
  - Used in point-to-point and multipoint configurations
- NT7H90GA:
  - No DS-3 performance monitoring
  - Cannot interface Tandy 200 and CAMMS interface
  - Used in point-to-point configurations

NT7H75 SERVICE CHANNEL UNIT (SCU)

The service channel unit provides voice communication between FMT-150 sites and supports a system of customer specified input and output telemetry.

Voice communication in FMT-150 systems makes use of the overhead data in an STX signal. In each STX overhead signal, two independent channels, local and express, are dedicated to the order-wire facility. Users can specify which STX signal and channel is used.

Customer specified inputs and outputs are accessible to the user through pins on the backplane of the FMT-150 shelves. The state of inputs and outputs (active or not) can be displayed on the CRT interface. Control over outputs is also possible through the CRT interface.

Two versions of the SCU are available:

- NT7H75BA contains 12 form-A inputs and 4 form-C outputs
- NT7H75BB contains 8 form-A inputs and 16 form-A outputs. The outputs are in parallel throughout the FMT-150 network so that alarms at remote sites can be monitored. (Must be used in conjunction with the NT7H90CA MCU).

NT7H69 POWER SUPPLY MODULE

Two power supply modules are required to supply regulated +5 volts and -5 volts to the FMT-150B/C. A second set of power supply modules may be equipped (and wired to a separate office battery feed) for protection. If both are equipped, either can handle the load for the entire drawer in the event of a failure of the other power feed. An ON/OFF switch, voltage test points, voltage adjustment screw and status LEDs are located on the front of the power supply module.

FMT-150B/C/D PROTECTION SWITCHING

PURPOSE

The purpose of this section is to introduce the student to the FMT-150B/C/D protection switching for a 1 + 1 system.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. Identify the two types of protection switching for the FMT-150B/C/D system.

2. Describe the following aspects of low-level protection switching:

   - Switching Action

   - Semi-revertive Switching

3. Describe the following aspects of high-level protection switching

   - Switching Action

   - Non-revertive switching

FMT-150B/C PROTECTION SWITCHING

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FMT-150B/C/D PROTECTION SWITCHING

The FMT-150B/C/D provides Low-Level and High-Level automatic switching. Low-Level includes low-speed (DS-1, DS-1C, and/or DS-2 rate) automatic protection switching, while the high-level includes both high-speed (DS-3 rate), and Translator (STX rate) automatic protection switching. The DS-1, DS-1C, DS-2, DS-3 and STX protection switches all operate independently.

Low-Speed and High-Speed protection switching within each multiplexer is controlled by the Monitor and Control module which reports information directly to the MCU and instructs the appropriate low-speed or high-speed LBO to perform the switch. STX protection switching within each Translator is both hardware (i.e., component failures) and software (i.e., line failures) controlled. Hardware switching is determined by the Translator's internal protection switching circuitry which is set to switch at 10^{-6} Bit Error Rate (BER); software switching is determined through CRT thresholds between 10^{-6} and 10^{-9}.

> **Caution:** If the Monitor and Control module fails, switching will occur only for the Translators and not for the multiplexer. If the MCU fails, switching will occur for the multiplexer and the Translators (for the hardware default of 10^{-6} only). In this case the CRT will not function, since the MCU drives the RS-232 interface.

DM-13 Signal Flow

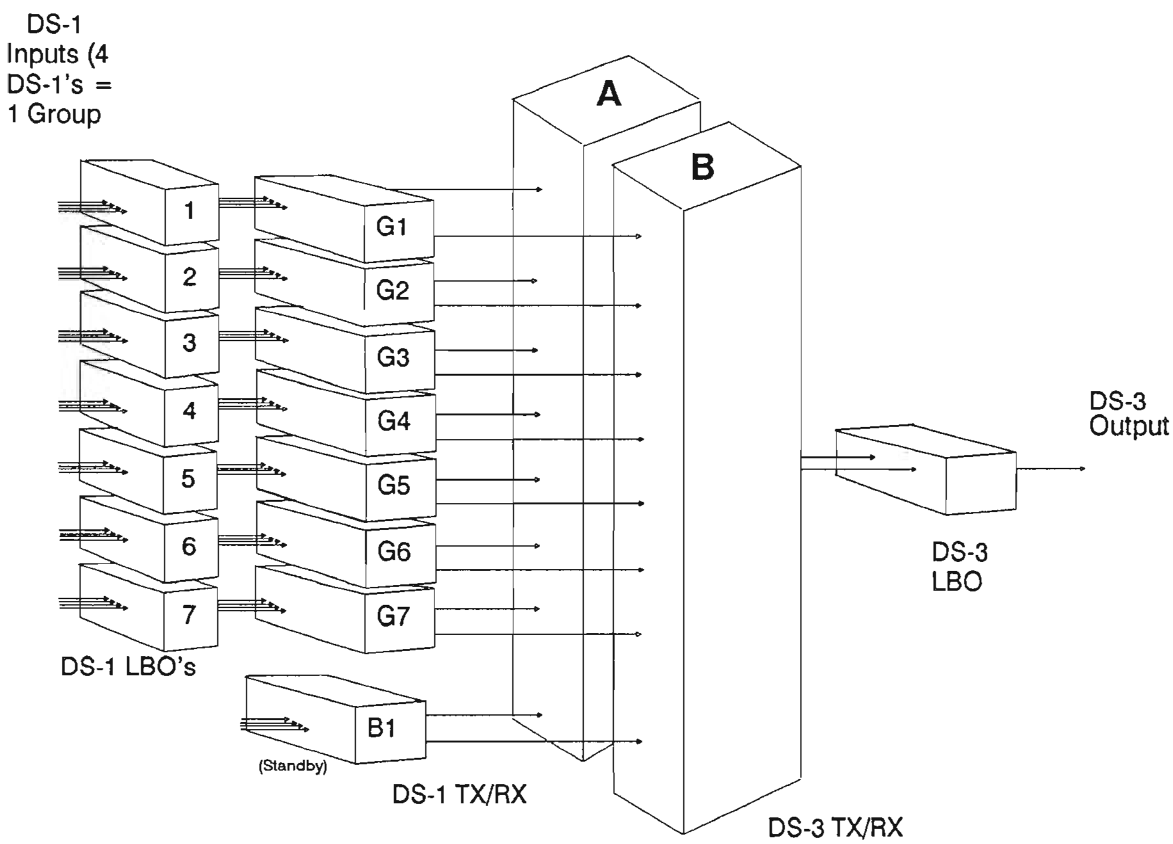

Figure 1

LOW-LEVEL PROTECTION SWITCHING

Ref. Figure 1

The low-level protection switch handles low-speed transmit/receive module failures. All switching is done by groups (where a group is made up of four DS-1 signals, two DS-1C's, or a single DS-2). Switching is also bi-directional. A group failure in one direction will cause both directions of transmission to be switched to the appropriate standby module.

The low-speed standby modules are identical to the working low-speed transmit/receive modules. However, each module is optioned differently to indicate whether it's in the standby or working mode. One standby module must be equipped for each type of tributary to be protected.

Therefore, if a multiplexer is carrying only DS-1 traffic, only a DS-1 standby module is required. If a multiplexer is carrying a mixture of DS-1, DS-1C, and DS-2 traffic, all three standby slots must be equipped if protection switching is desired

Low-Level Switching Action

Ref. Figure 1

Any low-speed group may be switched to protection automatically or manually. An automatic switch takes place whenever the monitor detects any low-speed transmit/receive module failures.

The Monitor and Control module will send a switch command to the appropriate low-speed LBO/switch unit. Relays will close on this unit to send the low-speed tributaries to the appropriate standby module.

Note that the DS-1, DS-1C, and DS-2 protection buses are independent. Therefore, if a multiplexer is carrying a mixture of tributaries, it can protect simultaneous failures on different types of tributaries.

Semi-Revertive Low-Level Switching

Low-level switching is semi-revertive. This means that the "STBY" module will release the switched traffic once the corresponding faulty module is cleared. If the operator replaces a faulty module, he/she will always perform a Monitor Reset to re-enable the Monitor and Control module. This action will clear any automatic low-speed protection switch (if the appropriate working module is now functioning properly).

At this point, the standby module is available to handle another low-speed protection switch, if required.

Low-Level Priority Switching

Since the low-speed protection switch may have a 1:N configuration (several working modules sharing a single standby module), there may, on occasion, be competition for a standby module. The low-speed modules have been designed to allow the operator to select priority for low-speed switching. Each group may have priority set either ON or OFF through switches on the low-speed transmit/receive module.

If a group with priority-OFF selected is being protected, and a priority-ON group of the same type fails, the priority group will "bump" the non-priority group from the standby module; the "bumped" group would then go into service failure.

In the event of competition between low-speed groups with equal priority (either on or off), the controlling rule is simply "*first come, first served*".

Note: The DS-1 TX/RX Card NT6H71AA contains this priority switch option. It is no longer available on the NT6H71BA versions.

HIGH-LEVEL PROTECTION SWITCHING

The high-level protection switch includes two distinct switching processes: high-speed protection switching (DS-3 level) *within the multiplexer* and the Translator protection switching (STX level). In both cases, switching is bi-directional. A card failure in one direction will cause both directions of transmission to be switched from the live module to the standby module.

A high-level protection switch may be performed either automatically or manually. At the multiplexer level, an automatic DS-3 switch takes place whenever the monitor circuitry detects a high-speed transmit/receive module failure. At the Translator level, an automatic STX switch takes place whenever the Translator circuitry or the MCU software detects a transmit/receive module failure.

High-Level Switching Action

DS-3 Level

Ref. Figure 1

There must be two high-speed Tx/Rx modules equipped if high-speed protection switching is required. The protected high-speed Tx/Rx modules are usually referred to as A and B. The module carrying traffic is referred to as "LIVE" and the other as "STBY", but these labels will be reversed by a Force Switch or an automatic protection switch.

The high-speed protection switching action occurs within the high-speed DS-3 LBO/switch module of the multiplexer. The Monitor and Control module will send a switch command to the high-speed LBO/switch unit. Relays will close on this unit to replace the existing DS-3 output (from the live DS-3 transmit/receive module) with the DS-3 output from the standby module.

150 Mb/s Fiber Interface

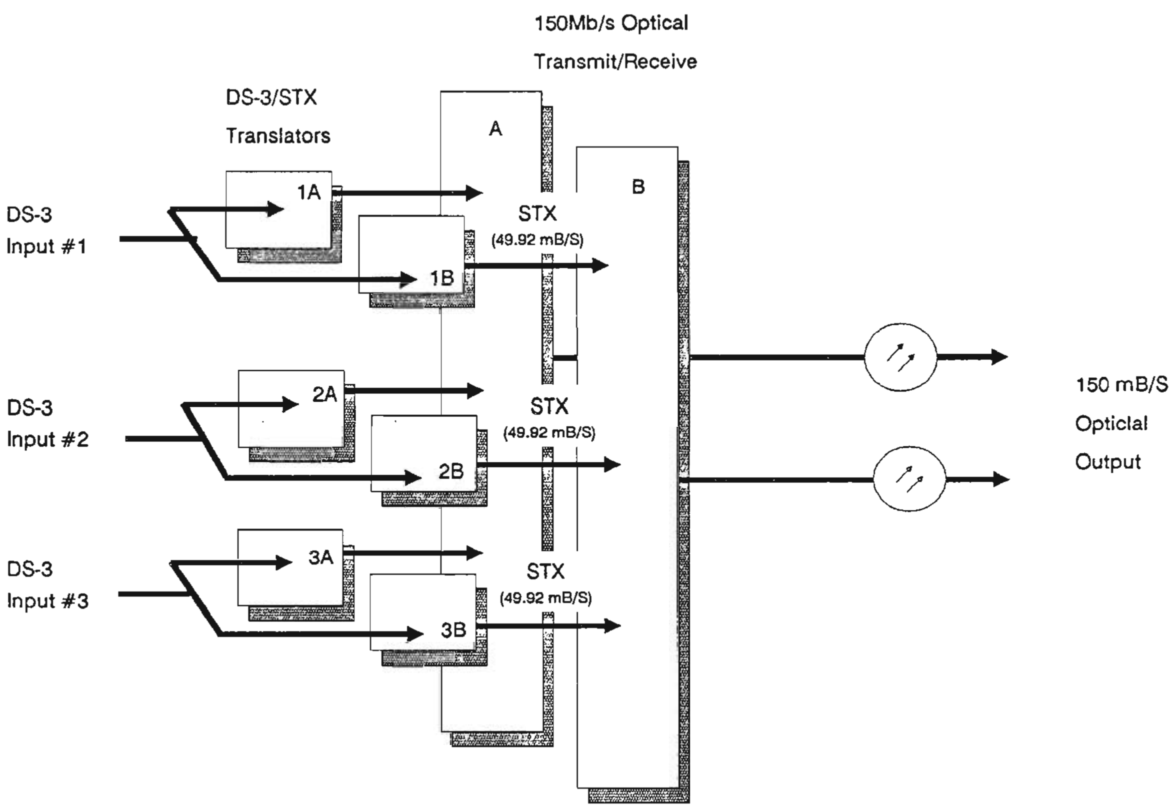

Figure 2

STX Level

Ref. Figure 2

There must be two Translator Tx/Rx modules equipped for each working DS-3 signal if high-speed protection switching is required. In each pair, the module carrying traffic is referred to as "LIVE" and the other module as "STBY", but these labels will be reversed by a Force Switch or an automatic protection switch.

The STX switching is accomplished by internal hardware circuitry or switch selection from the MCU. The hardware circuitry monitors the following conditions:

DS-3 Frame Loss

STX Frame Loss

DS-3 Signal Degrade

Unit Fail

When a failure is detected in the hardware circuitry, the switch control logic will release the active status of the affected Translator to the adjacent module. The former "standby" Translator will then declare an "active" status and assume signal processing. Once the fault has been resolved, the former module will assume a "standby" status and traffic *will not revert* to the original configuration.

STUDENTS NOTES

Non-Revertive Switching

DS-3 and STX Level

High-level switching is *non-revertive.* This means that there is no built-in preference between the active and standby module positions. A protection switch will reverse the "LIVE" and "STBY" labels for these positions. Traffic *will not revert* if the fault is cleared.

For example, if traffic is being carried on high-speed module A (Translator 1A) and a switch is requested, traffic will switch to module B (Translator 1B) and will remain there, even when the fault is later cleared on module A (Translator 1A). Module B (Translator 1B) is now identified as "LIVE" and module A (Translator 1A) as "STBY". This configuration will remain in effect until another high-level switch is requested.

ALARMS TELEMETRY AND ORDERWIRE

PURPOSE

This section outlines the number of local and remote alarms which are structured in order to effectively locate the problem source.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will, be able to:

1. List and briefly describe the five types of alarm telemetry
2. Describe the four relay output types
3. Briefly describe FMT-150B/C E2A Serial Telemetry
4. Briefly describe the functions of the RS-232 serial interface
5. Briefly describe the interface and functions of the Central Access Maintenance and Monitoring System (CAMMS)
6. Briefly describe the Operation of the Orderwire
7. Explain the purpose of customer inputs and outputs

ALARMS TELEMETRY AND ORDERWIRE

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ALARM TELEMETRY

Depending on the application, the FMT-150 provides five types of alarm telemetry:

Relay Contacts

Dry-contact relays drive the office major and minor alarms.

E2A Serial Telemetry (RS422)

More detailed information about the system is available through the serial interface. In addition to the local E2A, the FMT-150 has provisions for remote E2A capabilities. This allows all equipment locations to remote E2A information back to the terminal using the overhead bit stream. Once the information is at the terminals, the user can access the information in the same way as the local E2A information. For offices without E2A capability, outboard alarm systems are available to translate E2A protocol into individual relay contacts.

CRT (RS-232)

Use of the CRT connected to one node of an FMT-150 network allows the customer to isolate and identify various alarm conditions at any site within an FMT-150 system.

Central Access Maintenance and Monitoring System (CAMMS)

The CAMMS device communicates with FMT-150 systems as an RS-232 device replicating the displays of a CRT directly connected to the FMT-150. Although the CAMMS primary function is to provide the user with a CRT type interface, an advanced version of the CAMMS is available for the FMT-150 that will serve as an RS-232 port switching unit, permitting the user to select from one of sixteen independent FMT-150 systems (one per RS-232 port).

STUDENT NOTES

Customer Inputs/Outputs

Customer inputs are ground seeking contact points, likely fed from a customer's "Form A" relay or similar device (such as open door sensor or fire detector), that allow for the remoting of customer information via the overhead bit stream. Customer outputs are selectable Form C relay closures that are provided for customer use. Status of any input or output can be detected by way of the CRT interface.

Relay Contacts

From	To
To FMT-150B backplane	NT6H4601/03 PCB
E3	MAJ AUD 1
A4	MAJ AUD 2
D2	MAJ VIS 1
E2	MAJ VIS 2
C4	MIN AUD 1
D4	MIN AUD 2
B3	MIN VIS 1
C3	MIN VIS 2

Note: For additional FMT-150B shelves, the above should be connected in parallel.

For example:

Connect MAJ AUD 1 (shelf #1) to MAJ AUD 1 (shelf #2).
Connect MAJ AUD 2 (shelf #1) to MAJ AUD 2 (shelf #2).

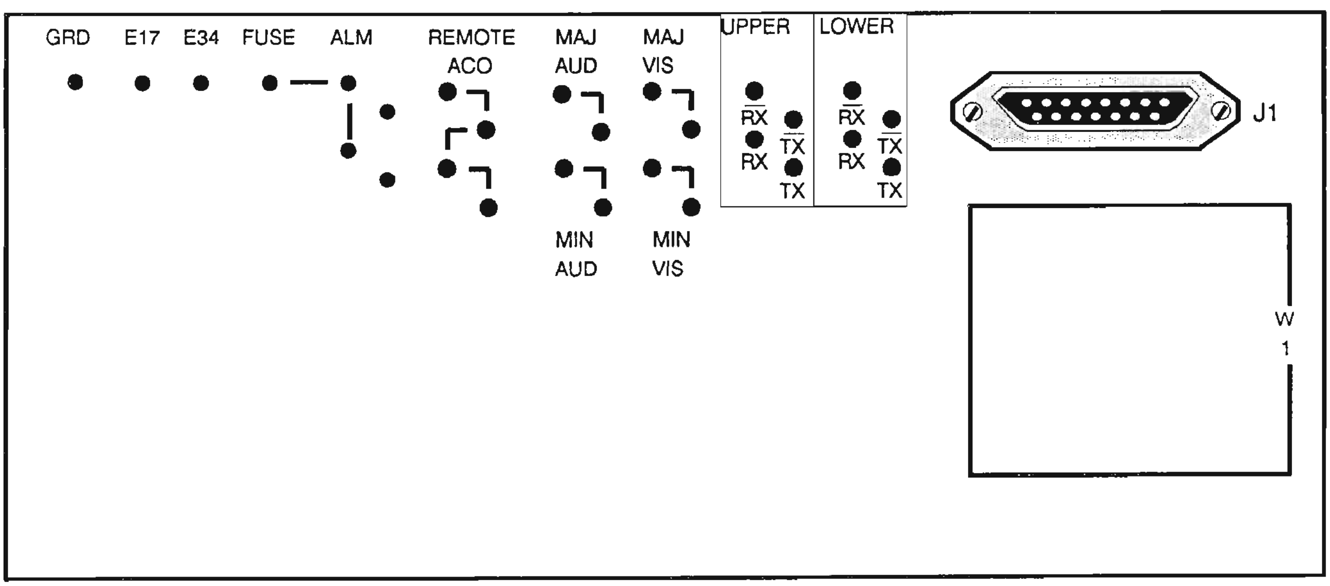


Figure 1

RELAY CONTACTS

Ref. Figure 1

Each FMT-150 provides four relay outputs:

- Major Audible
- Major Visual
- Minor Audible
- Minor Visual

Major alarms indicate a service failure on the DS-3 or optical line which results in the loss of traffic. Minor alarms indicate a non-service failure (except for low-speed faults) in which traffic has not been lost because of standby modules.

The audible alarms (both Major and Minor) may be silenced by pressing the ACO (Alarm Cut-Off) key on the shelf itself.

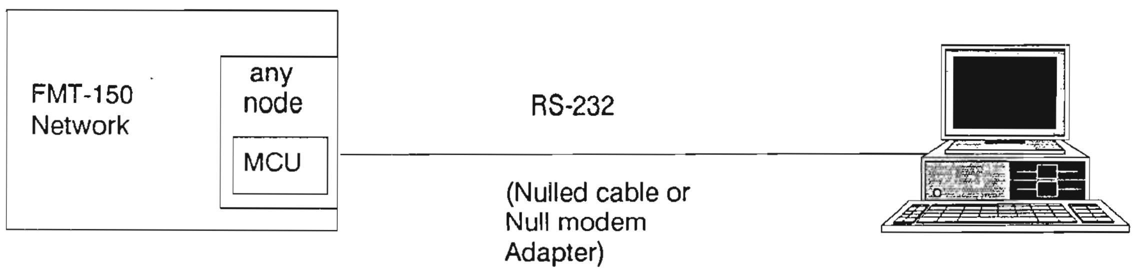
The visual alarms (both Major and Minor) may be connected to the local office alarm lights, as well as to a centralized alarm display.

The above relay contacts can be wired as normally open or normally closed depending on the existing alarm system where the FMT-150 is to be installed.

RELAY CONNECTIONS

After the equipment has been installed, relay outputs from each system are combined in the optional fuse and alarm panel located at the top of the bay. This allows a single set of connections to monitor a fully equipped FMT-150 bay.

CRT Access via Shelf Connection (local)



CRT Access via Modem Connection (Remote)

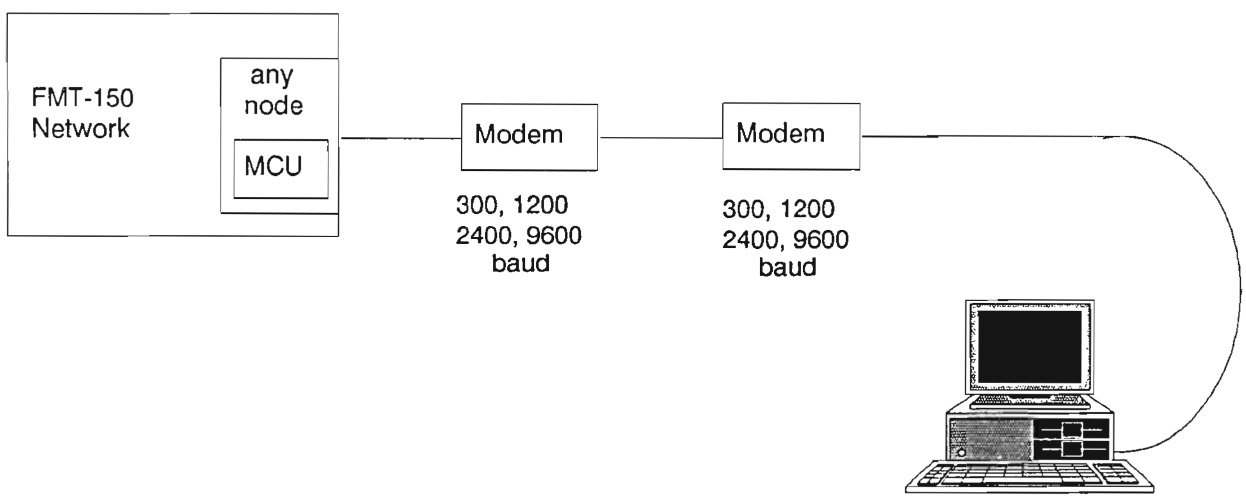


Figure 2

E2A SERIAL TELEMETRY

Ref. Figure 1

An E2A serial telemetry interface is available for system-wide alarm access and remoting. Information in a serial E2A system is organized into displays. Each display contains up to 64 alarm, status, and control points. The E2A telemetry interface is controlled by the customer's alarm monitoring equipment. This equipment will send bit sequences to the FMT-150 shelf requesting certain alarm and status points; the FMT-150 will then respond with a bit sequence.

RS-232 SERIAL INTERFACE (CRT)

Ref. Figure 2

In the operation of the FMT-150B and D, a serial RS-232 port accessible through a 25 pin connector located in the front and rear of the shelf (only one of the connectors can be accessed at a time). The port can accommodate a CRT, CAMMS, and a modem, and perform the following functions:

- display menus
- accept commands from the operator and route them to the system for execution
- display all alarm information either on request or via the alarm logger

The information available from this interface is used for alarms, protection switching, configuration and maintenance. Some of the operational features which may be accessed using a CRT terminal are as follows: Force switch, Lockout, Loopback, Password assignment, Site name assignment, System date and time settings.

CAMMS Shelf Assembly

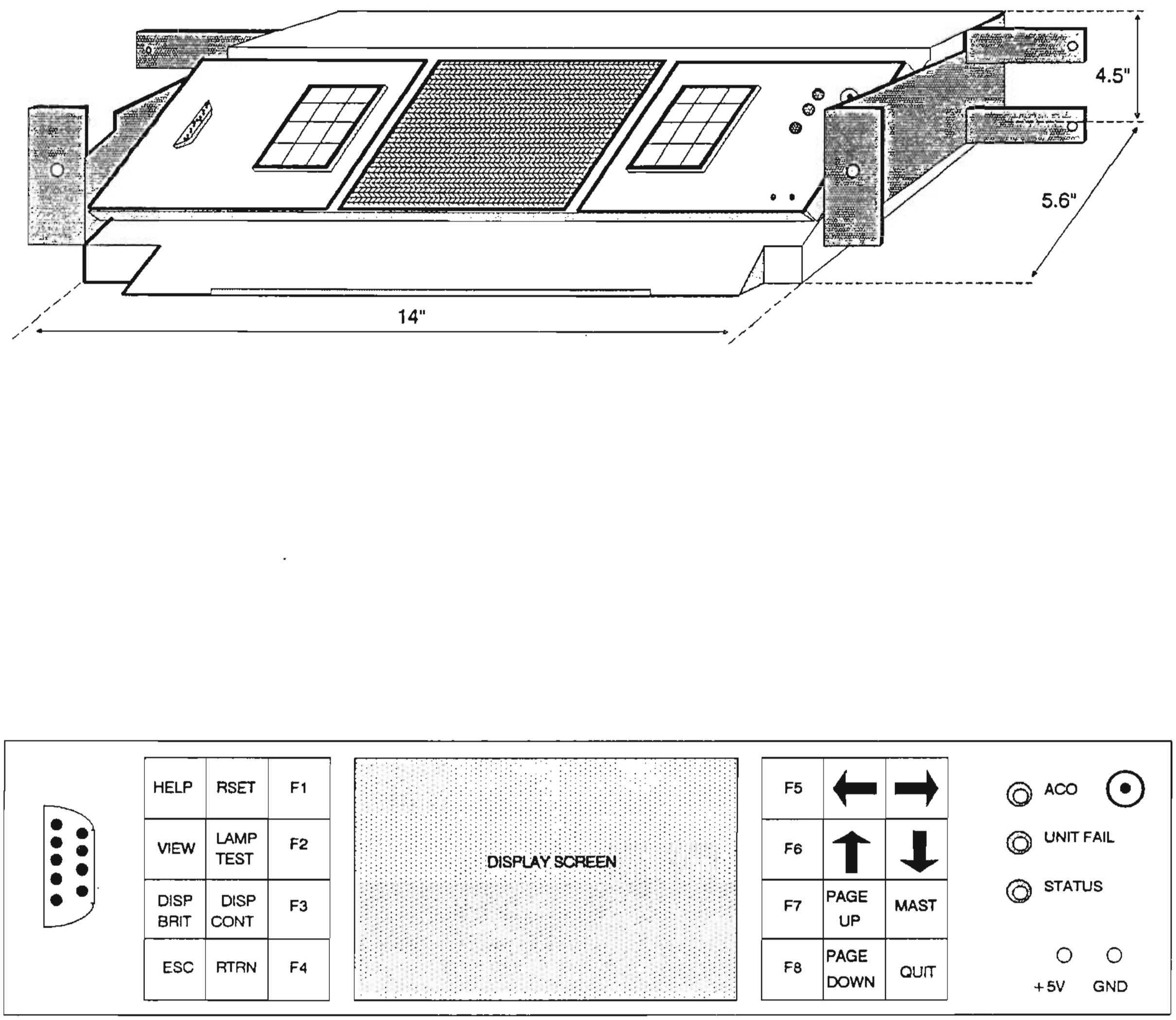


Figure 3

CAMMS

Ref. Figure 3

Communication between the CAMMS and FMT-150 equipment is accomplished through the RS-232 CRT port. The FMT-150 must be equipped with the required software to support the CAMMS interface. This software is contained in an EPROM located on the NT7H90CA MCU only.

It is important to note that the use of the CAMMS interface may eliminate the requirement for an external CRT interface. Therefore, when integrating the CAMMS with an FMT-150 network, all monitoring and interrogation can be performed without the use of outside equipment manufacturing.

Information is displayed through an integrated display on the front of the CAMMS unit. The displayed information is gathered, stored and formatted by the FMT-150's MCU with the CAMMS serving simply as an extension of the RS-232 interface.

The display unit is the integral user interface of the CAMMS. The 12 button keypad allows the user to process commands through CAMMS to the FMT-150 equipment. The display is an LCD type screen consisting of 20 lines by 40 characters.

CUSTOMER INPUT/OUTPUT TELEMETRY AND ORDER-WIRE

Order-wire within an FMT-150 system is handled by the Service Channel Unit. The SCU allows the user to access two independent channels in each STX overhead bit stream. This permits voice communication between sites in an FMT-150 system. Two conversations may take place simultaneously through the local express voice channels.

Each Service Channel Unit on the FMT-150 is equipped with relays for customer specified applications. These relays are accessible through pins on the backplanes of the FMT-150B and D shelves. Both inputs and outputs can be accessed and operated through the CRT interface.

The relays driving the customer I/O are mounted on the Service Channel Unit which comes in two versions:

- NT7H75BA: 12 inputs/4 outputs (Form A/Form C)
- NT7H75BB: 8 inputs/16 outputs (Form A/Form A)

A customer input is activated by placing a battery return condition on the appropriate pin of the FMT-150B or D backplane.

SUPPLEMENTAL REMOTE SERIAL INTERFACE INFORMATION

Information in an E2A system is organized into displays. Each display contains 64 alarm and/or status points. In the FMT-150, the display is evenly divided between 32 alarm points and 32 status points.

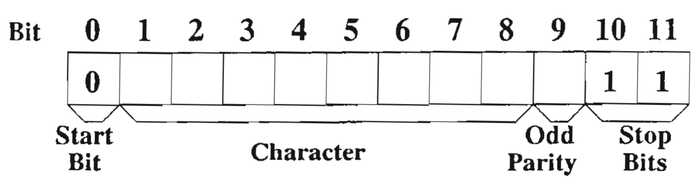
A display is not an actual physical display screen. It is simply a convenient way of referring to a large number of alarm and status points in a matrix format.

The maintenance control unit of FMT-150B and D shelves supports a serial interface that complies with the Bell System Technical Reference PUB49001, Sections 3.0 and 4.0.

The FMT-150 RS-422 serial interface is designed to provide information to all nodes in an FMT-150 system through the maintenance control unit at any one node. The node which is used to access the system presents a single E2A Alarm Processing Remote (APR) interface.

General Interface

Interface: EIA standard RS-422



Character Scan Request

This is an 8-bit, 1-character sequence that is transmitted to the maintenance control unit. The figure below shows the format of the scan request.

Bit	8	7	6	5	4	3	2	1
	0	0	MSB		LSB	MSB		LSB

Character Scan Reply

Four characters (32 points) are allocated for alarms; and four characters (32 points) for status; hence the assignment is L128 per Pub. 49001.

Scan Point	1	2	3	4	5	6	7	8

DM-13 MONITOR OPERATIONAL PROCEDURES

PURPOSE

This section describes the three control functions which provide maintenance testing on the FMT-150B/C.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. List the operations available on the FMT-150B/C MCU with the 5-key faceplate
2. Describe each of the four operations available on the FMT-150B/C MCU with the 5-key faceplate
3. List the functions available on the FMT-150B/C Monitor and Control Module with the 16-key faceplate
4. Describe each function of the Monitor and Control Module with the 16-key faceplate

DM-13 MONITOR OPERATIONAL PROCEDURES

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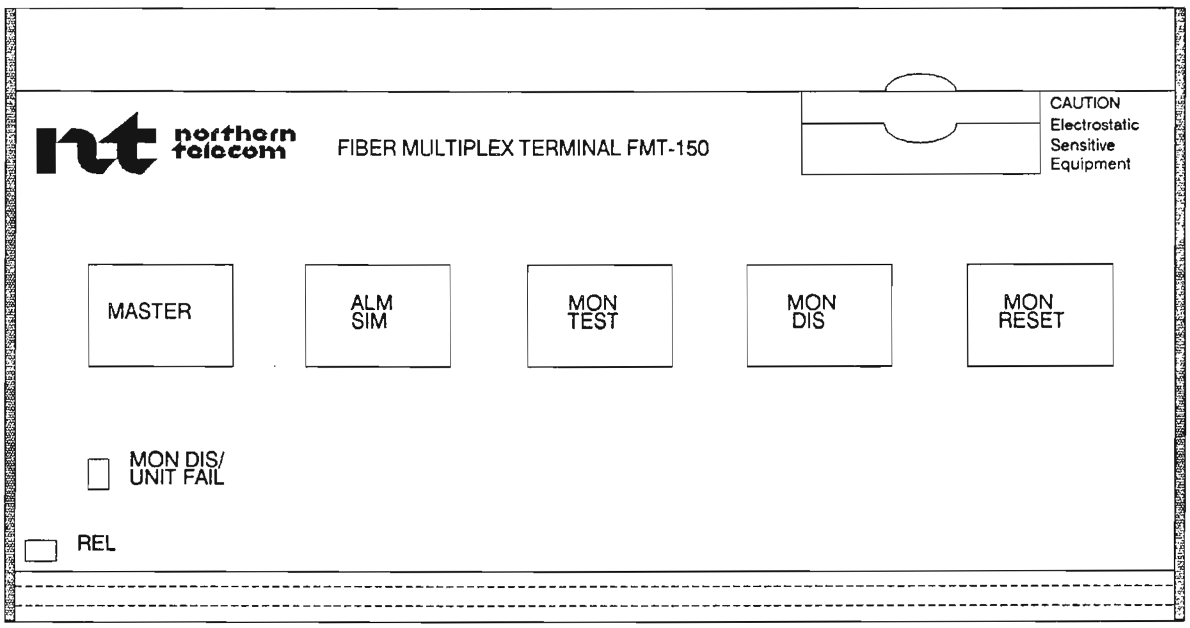

northern telecom
FIBER MULTIPLEX TERMINAL FMT-150
CAUTION
Electrostatic
Sensitive
Equipment
MASTER
ALM SIM
MON TEST
MON DIS
MON RESET
MON DIS/ UNIT FAIL
REL

Figure 1

5 KEY MONITOR AND CONTROL FACEPLATE

Ref. Figure 1

The 5 key Monitor and Control feature is located within each DM-13 of the FMT-150B and C. The Monitor and Control module directs all low-speed and high-speed protection switching in a DM-13 multiplexer, whether manually entered from the CRT or resulting from error detection in the individual Tx/Rx modules, or from DS-3 bit-by-bit error checks in the Monitor and Control module itself.

The 5 keys permit the following four operations:

- Monitor Test
- Monitor Disable
- Monitor Reset
- Alarm Simulation

The faceplate also contains one red LED that lights when the Monitor and Control module fails, or when it has been disabled manually.

Implementing Monitor Control Functions

Monitor Self-Test

mon test

Perform monitor self-test.

Monitor Disable

master   mon dis

(press simultaneously)

Disable Monitor and Control faceplate. Raises Minor Alarm.

Always perform this function prior to removing circuit packs from the system.

Monitor Reset

master   mon reset

(press simultaneously)

Resets faceplate.

Always perform this function after inserting modules, changing any system configuration or to clear a Monitor Disable.

Alarm Simulation

alm sim   mon test

(hold for 2 seconds)

Activates alarm relays for 5 seconds. Checks the office alarms.

Press the Alarm Simulation button then press and hold the Monitor Test button for 2 seconds.

Figure 2

MONITOR TEST

Ref. Figure 2

The Monitor Test key instructs the Monitor and Control module to perform a thorough self-test of all operations.

A self-test is automatically executed on power-up and during a Monitor Reset. The operator may perform a self-test at any time by simply pressing the Monitor Test key.

The Mon Dis/Unit Fail LED will light if the monitor fails the self-test.

Implementing Monitor Control Functions

Monitor Self-Test

mon
test

Perform monitor self-test.

Monitor Disable

master

mon
dis

(press simultaneously)

Disable Monitor and Control faceplate. Raises Minor Alarm.

Always perform this function prior to removing circuit packs from the system.

Monitor Reset

master

mon
reset

(press simultaneously)

Resets faceplate.

Always perform this function after inserting modules, changing any system configuration or to clear a Monitor Disable.

Alarm Simulation

alm
sim

mon
test

(hold for 2 seconds)

Activates alarm relays for 5 seconds. Checks the office alarms.

Press the Alarm Simulation button then press and hold the Monitor Test button for 2 seconds.

Figure 2

MONITOR DISABLE

Ref. Figure 2

The Monitor Disable function disables the Monitor and Control module from control of the system. This must be executed whenever modules are to be replaced or system configurations are to be changed. To prevent accidental disabling, the Monitor Master Control key must be held down when this key is pressed.

Certain key software routines are continually self-checked by the Monitor and Control module. If one of these appears to be in error, the faceplate will automatically disable itself. Therefore, a Monitor Disable, whether manual or automatic, will raise a Minor alarm. A red LED, Mon Dis/Unit Fail, will also light when the faceplate has been disabled.

Always disable the monitor before inserting and/or removing modules.

Implementing Monitor Control Functions

Monitor Self-Test

mon
test

Perform monitor self-test.

Monitor Disable

master   mon
dis

(press simultaneously)

Disable Monitor and Control faceplate. Raises Minor Alarm.

Always perform this function prior to removing circuit packs from the system.

Monitor Reset

master   mon
reset

(press simultaneously)

Resets faceplate.

Always perform this function after inserting modules, changing any system configuration or to clear a Monitor Disable.

Alarm Simulation

alm
sim   mon
test

(hold for 2 seconds)

Activates alarm relays for 5 seconds. Checks the office alarms.

Press the Alarm Simulation button then press and hold the Monitor Test button for 2 seconds.

Figure 2

MONITOR RESET

Ref. Figure 2

The Monitor Reset will re-initialize all software, learn the configuration of the system, take inventory of active modules, and perform the power-up diagnostics. To avoid accidental resets, the Monitor Master Control key must be held down when this key is pressed.

A Reset should be executed whenever modules have been replaced or system configurations have been changed.

Implementing Monitor Control Functions

Monitor Self-Test

mon
test

Perform monitor self-test.

Monitor Disable

master

mon
dis

(press simultaneously)

Disable Monitor and Control faceplate. Raises Minor Alarm.

Always perform this function prior to removing circuit packs from the system.

Monitor Reset

master

mon
reset

(press simultaneously)

Resets faceplate.

Always perform this function after inserting modules, changing any system configuration or to clear a Monitor Disable.

Alarm Simulation

alm
sim

mon
test

(hold for 2 seconds)

Activates alarm relays for 5 seconds. Checks the office alarms.

Press the Alarm Simulation button then press and hold the Monitor Test button for 2 seconds.

Figure 2

ALARM SIMULATION

Ref. Figure 2

The ALM SIM and MON TEST buttons must be pressed consecutively to perform an alarm simulation. An alarm simulation is that all minor and major alarms (audible & visible) are activated and all serial port alarm staus bits are set high for a period of five seconds.

Quiz - Module 8

1. What are the four operations which can be executed on the Monitor and Control Card?

2. How many LEDs are there on the faceplate, and what are their names?

3. How can a thorough self-test of all operations be executed?

4. A monitor disable function will be used for what purpose and what, if any, alarms are raised?

5. Whenever modules or system configurations are changed, what step or steps should be executed?

6. During an alarm simulation test, all alarm points are set high for how long?

EXPLANATION OF THE FMT-150B/D CRT FUNCTIONS

PURPOSE

The purpose of this section is to introduce the student to the FMT-150B/D CRT Functions.

OBJECTIVES

Using the student guide, classroom notes, and NTP's, the student will be able to:

1. Describe the main functions of the CRT.

2. Perform various CRT commands.

EXPLANATION OF THE FMT-150B/D CRT FUNCTIONS

Table of Contents

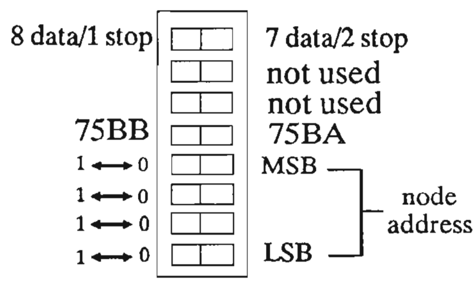
SET UP PROCEDURE FOR CRT INTERFACE

The FMT-150 CRT interface is the most powerful method of monitoring, controlling, and troubleshooting an FMT-150 system. It is typically accessed through a standard CRT terminal (VT-100 compatible), either locally or through a dial-up modem. Many terminals and most personal computers can emulate this standard. The addition of an optional Centralized Access Maintenance and Monitoring System (CAMMS) will also provide for a centralized monitoring interface for up to 16 FMT-150 systems. Alarms and status points of up to 16 nodes in the system can be accessed from any site equipped with an NT7H90xx Maintenance Control Unit.

Maintenance Control Unit Installation

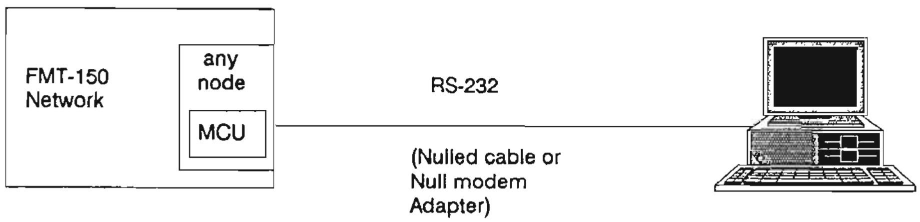
The FMT-150B has a single slot for the Maintenance Control Unit located on the right hand side of the shelf, whereas, the FMT-150D has two MCU slots (one for each optical section). They are located in the middle and right hand side of the shelf. Both of the MCUs on the 150D operate independently of each other and interface with its corresponding fiber transport section.

The MCU has DIP switches to determine the node's address (1-16). They are set as follows:



The baud rate must also be determined. For local access, it would be 9600 baud (the fastest). For remote access, the rate would be dependent on the modem being used.

CRT Access via Shelf Connection (local)



CRT Access via Modem Connection (Remote)

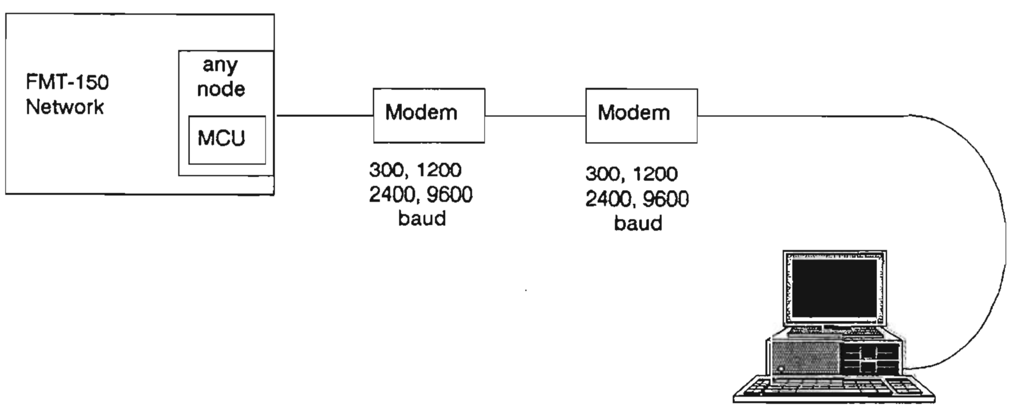


Figure 1

Connection to the Maintenance Control Unit is made using RS-232. The port on the back of the MCU takes a standard male DB-25 connector. The other end will be determined by the connection port on the particular piece of equipment.

Note: The pin-outs for the RS-232 connector and other information concerning the operations of the Hayes Smartmodem 1200 can be found in the FMT-150 Quick Reference under CRT Operations.

Some of the indications that should be seen on the front of the modem are:

HS	High Speed (1200 baud)
AA	Auto-Answer
TR	Terminal Ready (recognizes DTR)
MR	Modem Ready

If the TR signal is not there, the modem is not recognizing the Maintenance Control Unit. Check the cable connections and cable type; ensure the telephone line is properly connected; make note of the assigned phone number.

For more information see NTP 321-3211-202 DP 2012.

Smartmodem 1200 and SmartcomII are trademarks of Hayes Microcomputer Products, Inc.

CRT Configuring

Before an operator can log on the CRT terminal must be configured for proper communication. The basic settings required are as follows:

Terminal Communication Parameters

VT-100 emulation (VT-102 and VT-220 also accepted)
7 or 8 data bits (See Note below)
1 or 2 stop bits See Note below)
No parity
No local echo (full duplex)
Baud rate (1200 for most modems, 9600 for direct connect)

Note: The CRT interface will support both 7 and 8 data bit transmission selectable by the user via switch 8 of the MCU DIP switch.

DIP #8 = '0' --> 7 data bits selected/2 stop bits
DIP #8 = '1' --> 8 data bits selected/1 stop bit

Printer Connection

If a printer is going to be used for logging of alarms, certain protocol settings might have to be changed so that XON/XOFF from the terminal to the FMT-150 might be passed. The printer will only record the alarm/status messages, and not the full-screen displays from the FMT-150. Also, the alarm logger feature must be enabled for the printer to operate.

VT-100, VT-102, and VT220 are trademarks of Digital Equipment Corporation.

Logging On

The way in which the connection is made to the FMT-150 will determine what will be seen on the screen of the CRT.

If there is a direct connection to the FMT-150 the terminal should be in the "on-line" mode. If the connection is made through a modem, after normal dial-up procedures, there should be a CONNECT prompt. For both ways of connection, the next procedure is the same. The carriage return key <CR> is pressed three times until a "Enter Terminal Type" prompt appears on the screen. After the terminal type is selected (#1 for DEC VT100), a message "Waiting for initialization ..." will be displayed. Next will come the "login" prompt. The operator input would be the password, if it has been set. If there is no password then the <CR> is pressed, and the operator is logged on.

Log in Procedure (MCU NT7H90CA)

Steps	Dialogue	Comments
1.	<CR> <CR> <CR> 1- DEC VT100 2- NT Meridian 6000 (Procom or crosstalk with VT100 Emulation) 3- Tandy 200 (running Telcom) F4- NT CAMMS MDU Enter Terminal Type	Enter carriage returns until the message querying terminal type appears
2.	# <CR>	Type number (1, 2, 3, or F4) corresponding to terminal type
3.	Login: password <CR>	Enter user password. Note: If a password has not been previously selected, or if this is an initial logon into a new system, the password is defaulted to a <CR>.

ALARM COMMANDS

Entering Commands

The commands that can be entered cover a wide variety of areas as detailed on the following pages: alarm, switching, configuration, and maintenance.

The Tables are read from left to right. Entries are made from each column until a <CR> is reached. Whenever a letter is bold-faced, it means type that letter on the keyboard. A pound sign (#) refers to a number that must be entered. After entering a full command string (terminated by a <CR>), the requested information will be displayed on the CRTs screen. All numerical entries must be terminated by a "space" character. All commands are terminated with a carriage return <CR>.

Help Screens

There are hundreds of possible command strings available. Whenever there is doubt about what character(s) may be entered next, simply press the space bar. A list of legal entries will be displayed at the bottom of the screen (for example, "TRY: a c m l s ?"). To request additional information about these entries, type a question mark. A brief help screen will be displayed explaining the available options at that point in the command string.

Keyboard Shortcuts

If you wish to repeat a string of commands, or enter commands very similar to it, you may use the right-arrow key. This will repeat your previous command line, piece by piece. Individual elements may be replaced as it goes.

Command elements may be deleted with either the left-arrow or backspace keys.

For a detailed explanation of commands and parameters see NTP 321-3211-301.

Alarm Commands

Alarm Commands (MCU NT7H90CA)

Key inputs from left to right				Comments
a			<CR>	System-level alarm screen
a	#<sp> (# is the node number, from 1 to 16)	o	<CR>	Optical Tx/Rx unit-level alarm screen.
a	#<sp> (# is the node number, from 1 to 16)	t	<CR>	Translator module-level alarm screen.
a	#<sp> (# is the node number, from 1 to 16)	m	<CR>	DM-13 multiplexer-level alarm screen.
a	#<sp> (# is the node number, from 1 to 16)	c	<CR>	Common equipment-level and customer input/output points alarm screen.

SWITCHING COMMANDS

Switching Commands (MCU NT7H90CA)

Key inputs from left to right →

									Comments
s	<CR>								Display Translator's switch status for local node or node last displayed.
s	#<sp> (# is the node number, from 1 to 16)	<CR>							Display Translator's switch status for node #.
s	#<sp>	t	#<sp> (# is the translator number, from 1 to 3)	a or b	f	o	<CR>		Operate force switch on translator unit.
s	#<sp>	t	#<sp>	a or b	f	r	<CR>		Release force switch on translator unit.
s	#<sp>	t	#<sp>	a or b	b	o	<CR>		Operate loopback on translator unit.
s	#<sp>	t	#<sp>	a or b	b	r	<CR>		Release loopback on translator unit.
s	#<sp>	t	#<sp>	l	o	<CR>			Operate lockout on translator unit.
s	#<sp>	t	#<sp>	l	r	<CR>			Release lockout on translator unit.
s	#<sp>	m	#<sp> (# is the DM-13 number, from 1 to 3)	<CR>					Display switch status of DM-13.
s	#<sp>	m	#<sp>	f	g	#<sp> (# is the group number, from 1 to 7)	o	<CR>	Operate force switch on DM-13 LS Tx/Rx module.
s	#<sp>	m	#<sp>	f	g	#<sp>	r	<CR>	Release force switch on DM-13 LS Tx/Rx module
s	#<sp>	m	#<sp>	f	h	a or b	<CR>		Force switch on DM-13 HS Tx/Rx module from A to B or B to A.

Continued on next page

SWITCHING COMMANDS

Switching Commands (MCU NT7H90CA)

Key inputs from left to right →									Comments
s	# <sp> (# is the node number, from 1 to 16)	m	# <sp> (# is the DM-13 number, from 1-3)	l	g	# <sp> (# is the group number, from 1-7)	o	<CR>	Operate lockout on DM-13 LS Tx/Rx module.
							r	<CR>	Releases lockout on DM-13 LS Tx/Rx module.
					h	a or b	o	<CR>	Operate lockout on DM-13 HS Tx/Rx module.
							r	<CR>	Releases lockout on DM-13 HS Tx/Rx module.
					1	o		<CR>	Operate lockout on DS-1 Tx/Rx standby module.
						r		<CR>	Release lockout on DS-1 Tx/Rx standby module.
					c	o		<CR>	Operate lockout on DS-1C Tx/Rx standby module.
						r		<CR>	Release lockout on DS-1C Tx/Rx standby module.
					2	o		<CR>	Operate lockout on DS-2 Tx/Rx standby module.
						r		<CR>	Release lockout on DS-2 Tx/Rx standby module.
				b	# <sp> (# is the group number from 1 to 7)	# <sp> (# is the group number from 1 to 7)	o	<CR>	Operate loopback on DS-1C Tributary.
							r	<CR>	Release loopback on DS-1C Tributary.
				d	o			<CR>	Disable remote DS-1/C tributary.
					r			<CR>	Enable remote DS-1/C tributary.
		i	# <sp> (# is the customer input point, form 1 -2)					<CR>	Clear customer input (1 or 2) at node #.
		o	# <sp> (# is the customer output point, from 1 to 16)		s			<CR>	Set customer output (manual/latched at node #.
					c			<CR>	Clear customer output (manual/latched at node #.
* (* is all nodes)		o	# <sp> (# is the customer output point, from 1 to 16)		s			<CR>	Set customer output (manual/latched at all nodes.
					c			<CR>	Clear customer output (manual/latched at all nodes.

CONFIGURATION COMMANDS

<table>
<tr><th colspan="6">Configuration Commands</th><th>(MCU NT7H90CA)</th></tr>
<tr><th colspan="6">Key inputs from left to right →</th><th>Comments</th></tr>
<tr><td rowspan="6">c</td><td colspan="5"><CR></td><td>Display all nodes, customer input/output point names and status of alarm logger.</td></tr>
<tr><td rowspan="2">a</td><td>e</td><td colspan="3"><CR></td><td>Enable alarm logger.</td></tr>
<tr><td>d</td><td colspan="3"><CR></td><td>Disable alarm logger.</td></tr>
<tr><td>d</td><td>#<sp>
1</td><td>#<sp>
2</td><td>#<sp>
3</td><td><CR></td><td>Set date (YY/MM/DD): #1 is last 2 digits of year, #2 is month, #3 is day.</td></tr>
<tr><td>t</td><td>#<sp>
1</td><td>#<sp>
2</td><td colspan="2"><CR></td><td>Set time (HH/MM): #1 is hour, #2 is minute.</td></tr>
<tr><td>p</td><td colspan="2">"oldpass"</td><td>"newpass"</td><td><CR></td><td>Change password from "oldpass" to "newpass".
Note: To change the default password of <CR>, double quotes " " must be entered for "oldpass".</td></tr>
</table>

Continued on next page

CONFIGURATION COMMANDS (cont'd)

Configuration Commands (MCU NT7H90CA)

Key inputs from left to right								Comments
c	n	* (* is all nodes)	<CR>					Display all nodes, customer input/output point names and status of alarm logger.
c	n	#<sp> (# is the node number, from 1 to 16)	<CR>					Display translator, customer status, and output MNET bridging.
c	n	#<sp>	n	"name"	<CR>			Name node #.
c	n	#<sp>	t	#<sp> (# is the translator number, from 1 to 3)	r	e	<CR>	Enable received status/alarm overhead.
c	n	#<sp>	t	#<sp>	r	d	<CR>	Disable received status/alarm overhead.
c	n	#<sp>	t	#<sp>	t	e	<CR>	Enable transmitted status/alarm overhead.
c	n	#<sp>	t	#<sp>	t	d	<CR>	Disable transmitted status/alarm overhead.
c	n	#<sp>	t	#<sp>	b	e	<CR>	Enable blue signal insertion.
c	n	#<sp>	t	#<sp>	b	d	<CR>	Disable blue signal insertion.
c	n	#<sp>	t	#<sp>	p	e	<CR>	Enable parity correction.
c	n	#<sp>	t	#<sp>	p	d	<CR>	Disable parity correction.
c	n	#<sp>	t	#<sp>	s	#<sp> (# is the signal degrade threshold, from 6 to 10)	<CR>	Set translator signal degrade threshold (1E-6 to 1E-10).
c	n	#<sp>	b	*	e	<CR>		Enable M-Net bridging at head hub.
c	n	#<sp>	b	*	d	<CR>		Disable M-Net bridging at head hub.
c	n	#<sp>	b	$\#_x$ <sp> x= 1-3	$\#_x$ <sp> x= 1-3	e	<CR>	Bridge STX $\#_x$ to STX $\#_y$
c	n	#<sp>	b	$\#_x$ <sp> x= 1-3	$\#_x$ <sp> x= 1-3	d	<CR>	Bridge STX $\#_x$ from STX $\#_y$
c	n	#<sp>	m	#<sp> (# is the DM-13 number, from 1-3)	m	<CR>		Reset monitor and control unit.
c	n	#<sp>	m	#<sp>	l	<CR>		Clear line failure minor alarm caused by incoming DS-2 frame loss.
c	n	#<sp>	l	<CR>				Learns out any removed module position.

Continued on next page

CONFIGURATION COMMANDS (cont'd)

Configuration Commands (MCU NT7H90CA)

Key inputs from left to right →											Comments
c	g	o	# <sp> (# is the customer output point, from, 1 to 16)	i # <sp> (# is the condition to be inserted, , 1 to 7) or a	r or l or n # <sp> or s # <sp> (# is the node or site number, from 1 to 16)	c	a	<CR>			Add/Insert MCU type condition for remote/ local sites or node/ site #.
							c, e, g, h, s	$\#_1$ <sp> (See note below)	<CR>		
						g	# <sp> (# is general point, from 100-128)	<CR>			Add/Insert general point condition for remote/local sites or node/site #.
						m	# <SP> (# is the DM-13 number, from 1 -3)	1, 2 or c	a	<CR>	Add/Insert DS-1/2/1C standby type condition for remote/local sites or node/site #.
									c, e, g, h, s	$\#_1$ <sp> (see note below) <CR>	
								g	# <SP> (# is group number from 1 to 7)	a <CR>	Add/Insert group # type condition for remote/local sites or node/site #.
										c, e, g, h, s $\#_1$ <sp> (see note below) <CR>	
								m	a	<CR>	Add/Insert DM-13 type condition for remote/local sites or node/site #.
									c, e, g, h, s	$\#_1$ <sp> (see note below) <CR>	
						s	a	<CR>			Add/Insert SCU type condition for remote/ local sites or node/ site #.
							e, h, s	$\#_1$ <sp> (See note below)	<CR>		

Continued on next page

NOTE: $\#_1$ is the point selected from Table 10-A to 10-F in the FMT-150B/C/D NTP, section 321-3211-104.

CONFIGURATION COMMANDS (cont'd)

Configuration Commands (MCU NT7H90CA)

<table>
<tr><th colspan="12">Key inputs from left to right →</th><th>Comments</th></tr>
<tr><td rowspan="6">c</td><td rowspan="6">g</td><td rowspan="6">o</td><td rowspan="6"># <sp>
(# is the customer output point, from, 1 to 16)</td><td rowspan="6"># <sp>
(# is the condition to be inserted, , 1 to 7)
or
a</td><td rowspan="6">r
or
l
or
n # <sp>
or
s # <sp>
(# is the node or site number, from 1 to 16)</td><td rowspan="2">o</td><td rowspan="2" colspan="2">a
or
b</td><td>a</td><td colspan="2"><CR></td><td rowspan="2">Add/Insert optical type condition for remote/local sites or node/site #.</td></tr>
<tr><td>c
e
g
h
s</td><td># <sp>
2
(see note below)</td><td><CR></td></tr>
<tr><td rowspan="2">t</td><td rowspan="2">#
<SP>
(# is the translator number from 1 to 3)</td><td rowspan="2">a
or
b</td><td>a</td><td colspan="2"><CR></td><td rowspan="2">Add/Insert translator type condition for remote/local sites or node/site #.</td></tr>
<tr><td>c
e
g
h
s</td><td># <sp>
2
(see note below)</td><td><CR></td></tr>
<tr><td rowspan="2">p</td><td rowspan="2" colspan="2">#
<SP>
(# is the PSU number, from 1 -4)</td><td>a</td><td colspan="2"><CR></td><td rowspan="2">Add/Insert FSU type condition for remote/local sites or node/site #.</td></tr>
<tr><td>c
e
g
h
s</td><td># <sp>
2
(see note below)</td><td><CR></td></tr>
</table>

Continued on next page

NOTE: $\#_2$ is the point selected from Table 10-A to 10-F in the FMT-150B/C/D NTP, section 321-3211-104.

CONFIGURATION COMMANDS (cont'd)

Configuration Commands (MCU NT7H90CA)

Key inputs from left to right →									Comments
c	g	p						<CR>	Display configuration global performance event alarms.
c	g	p	b	#<sp> (# is the B/C threshold, between 2 and 9999)				<CR>	Set type B/type C threshold.
c	g	p	e	#<sp> (# is the performance event number, from 1 to 4)	p	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as parity errors, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	a	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as type A seconds, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	b	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as type B seconds, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	c	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as type C seconds, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	f	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as frame losses, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	l	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as frame losses seconds, including a threshold value, for current hour/day/untimed interval.
c	g	p	e	#<sp>	e	h / d / u	$\#_3$<sp> (see note below)	<CR>	Define event # as parity error seconds, including a threshold value, for current hour/day/untimed interval.
c	g	p	u					<CR>	Start untimed interval.

Note: $\#_3$ is the threshold value between 0 and 65534.

PERFORMANCE COMMANDS

Performance Commands (MCU NT7H90CA)

<table>
<tr><th colspan="6">Key inputs from left to right</th><th>Comments</th></tr>
<tr><td rowspan="6">p</td><td rowspan="6">#<sp>
(# is the node number, from 1 to 16)</td><td rowspan="2">i</td><td>c</td><td>h
d
u</td><td><CR></td><td>Performance at node # for current hour/day/untimed interval.</td></tr>
<tr><td>l</td><td>m
h
d
u</td><td><CR></td><td>Performance at node # for last minute/hour/day/untimed interval.</td></tr>
<tr><td rowspan="2">t</td><td rowspan="2">#<sp>
(# is the translator number, from 1 to 3)</td><td>a</td><td><CR></td><td>Display translator A performance screen at node #.</td></tr>
<tr><td>b</td><td><CR></td><td>Display translator B performance screen at node #.</td></tr>
<tr><td rowspan="2">o</td><td colspan="2">a</td><td><CR></td><td>Display optics A performance screen at node #.</td></tr>
<tr><td colspan="2">b</td><td><CR></td><td>Display optics B performance screen at node #.</td></tr>
</table>

MAINTENANCE COMMANDS

Maintenance Commands (MCU NT7H90CA)

Key inputs from left to right					Comments
m	r (see note)	* (* is all nodes)	<CR>		Reset all nodes (Global reset).
		# <sp> (# is the node number, from 1 to 16)	<CR>		Reset node # (display does not change).
	t	# <sp> (# is the node number, from 1 to 16)	o	<CR>	Operate test of customer input/output points.
			r	<CR>	Release test of customer input/output points.

Note: After executing a local or global MCU reset, the message "PROCESSOR CRASH" will appear on the bottom of the CRT's screen. As a result, the user will have to log back into the system. In addition, a global MCU reset will clear all "names" and "settings" previously defined (i.e.: Node, System ID, custormer inputs/outputs, time and date).

Logout Procedure (MCU NT7H90CA)

Steps	Dialogue	Comments
1.	l	
2.	<CR>	The user is now logged out of the system.

DISPLAY NETWORK STATUS

Display Network Status (MCU NT7H90CA)

Steps	Dialogue	Comments
1.	n	Network status screen.
2.	<CR>	

NT7H90DA/GA MCU PROCEDURES

The preceding pages of commands where used with the NT7H90CA Maintenance Control Unit; in the following pages the commands for the NT7H90DA/GA MCU will be covered.

The first of these commands is the Log In Command, which must be done before any other commands can be entered.

Log in Procedure (MCU NT7H90DA/GA)

Steps	Dialogue	Comments
1.	<CR> <CR> <CR>	Enter carriage returns until the message querying terminal type appears
	1- DEC VT100 2- NT Meridian 6000 (Procom or crosstalk with VT100 Emulation) 3- NT MDU	
	Enter Terminal Type	
2.	# <CR>	Type number (1) corresponding to terminal type
3.	Login: password <CR>	Enter user password. Note: If a password has not been previously selected, or if this is an initial logon into a new system, the password is defaulted to a <CR>.

Alarm Commands

Alarm Commands (MCU NT7H90DA/GA)

Key inputs from left to right					Comments
a			<CR>		System-level alarm screen
	#<sp>	o	<CR>		Optical Tx/Rx unit-level alarm screen.
		t	<CR>		Translator module-level alarm screen.
		m	<CR>		DM-13 multiplexer-level alarm screen.
		c	<CR>		Common equipment-level and customer input/output points alarm screen.
			c	<CR>	Clear customer input

Configuration Commands

Configuration Commands (MCU NT7H90DA/GA)

Key inputs from left to right						Comments
c		<CR>				Display nodes, customer input/output point names.
c	a	e	<CR>			Enable alarm logger.
c	a	d	<CR>			Disable alarm logger.
c	i	#<sp>	"name"	<CR>		Name a customer input point
c	o	#<sp>	"name"	<CR>		Name a customer output point
c	d	#<sp> 1	#<sp> 2	#<sp> 3	<CR>	Set date (YY/MM/DD): #1 is last 2 digits of year, #2 is month, #3 is day.
c	t	#<sp> 1	#<sp> 2	<CR>		Set time (HH/MM): #1 is hour, #2 is minute.
c	p	"oldpass"	"newpass"	<CR>		Change password from "oldpass" to "newpass".
c	s	"system ID name"	<CR>			Name system ID.

Configuration Commands

Configuration Commands (MCU NT7H90DA/GA)

Key inputs from left to right								Comments
c	n	#<sp>	<CR>					Display translator enable/disable status.
c	n	#<sp>	n	"name"	<CR>			Name node #.
c	n	#<sp>	t	#<sp>	r	e	<CR>	Enable received status/alarm overhead.
c	n	#<sp>	t	#<sp>	r	d	<CR>	Disable received status/alarm overhead.
c	n	#<sp>	t	#<sp>	t	e	<CR>	Enable transmitted status/alarm overhead.
c	n	#<sp>	t	#<sp>	t	d	<CR>	Disable transmitted status/alarm overhead.
c	n	#<sp>	t	#<sp>	b	e	<CR>	Enable blue signal insertion.
c	n	#<sp>	t	#<sp>	b	d	<CR>	Disable blue signal insertion.
c	n	#<sp>	t	#<sp>	p	e	<CR>	Enable parity correction.
c	n	#<sp>	t	#<sp>	p	d	<CR>	Disable parity correction.
c	n	#<sp>	c	#<sp>	e	<CR>		Enable M-Net bridging at head hub.
c	n	#<sp>	c	#<sp>	d	<CR>		Disable M-Net bridging at head hub.
c	n	#<sp>	x	$\#_1$ <sp>	$\#_2$ <sp>	e	<CR>	Connect STX$_1$# to STX$_2$#
c	n	#<sp>	x	$\#_1$ <sp>	$\#_2$ <sp>	d	<CR>	Disconnect STX$_1$# from STX$_2$#
c	n	#<sp>	m	#<sp>	m	<CR>		Reset monitor and control unit.
c	n	#<sp>	m	#<sp>	l	<CR>		Clear line failure minor alarm caused by incoming DS-2 frame loss.

Remote Loopback

There are two different types of loopbacks available with the FMT-150:

Low-Speed Loopback

A low speed loopback (DS-1 or DS-1C), must be initiated at the near-end location. In this case, "near-end" is defined as the location where the signal is to be received for testing. The low-speed loopback process will internally loop individual tributaries back to the user for signal testing.

Note: During a loopback condition, any traffic associated with the tributary is interrupted; therefore, a caution should be used when performing low-speed remote loopbacks.

Translator Loopback

A translator loopback (DS-3 or STX), must be initiated at the far-end location via the CRT which can be accessed from any location in the system. In this case, " far-end" is defined as the location opposite from which the signal is to be received for testing.

To perform a Translator Loopback, the standby Translator of the DS-3 stream to be tested must be looped back. At the opposite location, the corresponding Translator must be in the active position (a Translator Force Switch operation may be required) for the loopback process to occur.

Note: Although only one of the Translators (the standby Translator) in a pair will display the actual loopback condition, both Translators (that is, the actual DS-3 signals) are looped back. This means that during a Translator loopback condition, any traffic associated with the Translator (or DS-3) is interrupted. As a result, caution should be used when performing remote loopbacks at the translator level.

Switching Commands (MCU NT7H90DA/GA)

Key inputs from left to right →									Comments
s	<CR>								Display switch status for local node.
s	# <sp>	<CR>							Display switch status for node #.
s	# <sp>	t	# <sp>	a or b	f	o	<CR>		Operate force switch on translator unit. (see note)
s	# <sp>	t	# <sp>	a or b	f	r	<CR>		Release force switch on translator unit. (see note)
s	# <sp>	t	# <sp>	a or b	b	o	<CR>		Operate loopback on translator unit.
s	# <sp>	t	# <sp>	a or b	b	r	<CR>		Release loopback on translator unit.
s	# <sp>	t	# <sp>	l	o	<CR>			Operate lockout on translator unit.
s	# <sp>	t	# <sp>	l	r	<CR>			Release lockout on translator unit.
s	# <sp>	m	# <sp>	<CR>					Display switch status of DM-13.
s	# <sp>	m	# <sp>	f	g	# <sp>	o	<CR>	Operate force switch on DM-13 LS Tx/Rx module.
s	# <sp>	m	# <sp>	f	g	# <sp>	r	<CR>	Release force switch on DM-13 LS Tx/Rx module
s	# <sp>	m	# <sp>	f	h	a or b	o	<CR>	Operate force switch on DM-13 HS Tx/Rx module.
s	# <sp>	m	# <sp>	f	h	a or b	r	<CR>	Release force switch on DM-13 HS Tx/Rx module

Continued on next page

Note: Force switch on translator must be released for normal protection switching.

Switching Commands (cont'd)

Switching Commands (MCU NT7H90DA/GA)

Key inputs from left to right									Comments
s	#<sp>	m	#<sp>	l	g	#<sp>	o	<CR>	Operate lockout on DM-13 LS Tx/Rx module.
							r	<CR>	Releases lockout on DM-13 LS Tx/Rx module.
					h	a or b	o	<CR>	Operate lockout on DM-13 HS Tx/Rx module.
							r	<CR>	Releases lockout on DM-13 HS Tx/Rx module.
					1	o	<CR>		Operate lockout on DS-1 Tx/Rx standby module.
						r	<CR>		Release lockout on DS-1 Tx/Rx standby module.
					c	o	<CR>		Operate lockout on DS-1C Tx/Rx standby module.
						r	<CR>		Release lockout on DS-1C Tx/Rx standby module.
					2	o	<CR>		Operate lockout on DS-2 Tx/Rx standby module.
						r	<CR>		Release lockout on DS-2 Tx/Rx standby module.
				b	#<sp>	#<sp>	o	<CR>	Operate loopback on DS-1C Tributary.
							r	<CR>	Release loopback on DS-1C Tributary.
				d	o	<CR>			Disable remote DS-1/C tributary loopbacks.
					r	<CR>			Enable remote DS-1/C tributary loopbacks.

Maintenance Commands

Maintenance Commands (MCU NT7H90DA/GA)

Key inputs from left to right					Comments
m	r	*	<CR>		Reset all nodes (display does not change).
		#<sp>	<CR>		Reset node # (display does not change).
	t	#<sp>	o	<CR>	Operate test of customer input/output points.
			r	<CR>	Release test of customer input/output points.

Logout Procedure (MCU NT7H90DA/GA)

Steps	Dialogue	Comments
1.	l	
2.	<CR>	The user is now logged out of the system.

OPTION SETTINGS

PURPOSE

This section introduces the student to the FMT-150B/C/D circuit pack option (DIP switches, slide switches) located on the majority of the modules.

OBJECTIVES

Using student guide, classroom notes, and NTP's, the student will be able to:

1. Set options on and install all circuit packs in a 1 + 1 system.

OPTION SETTINGS

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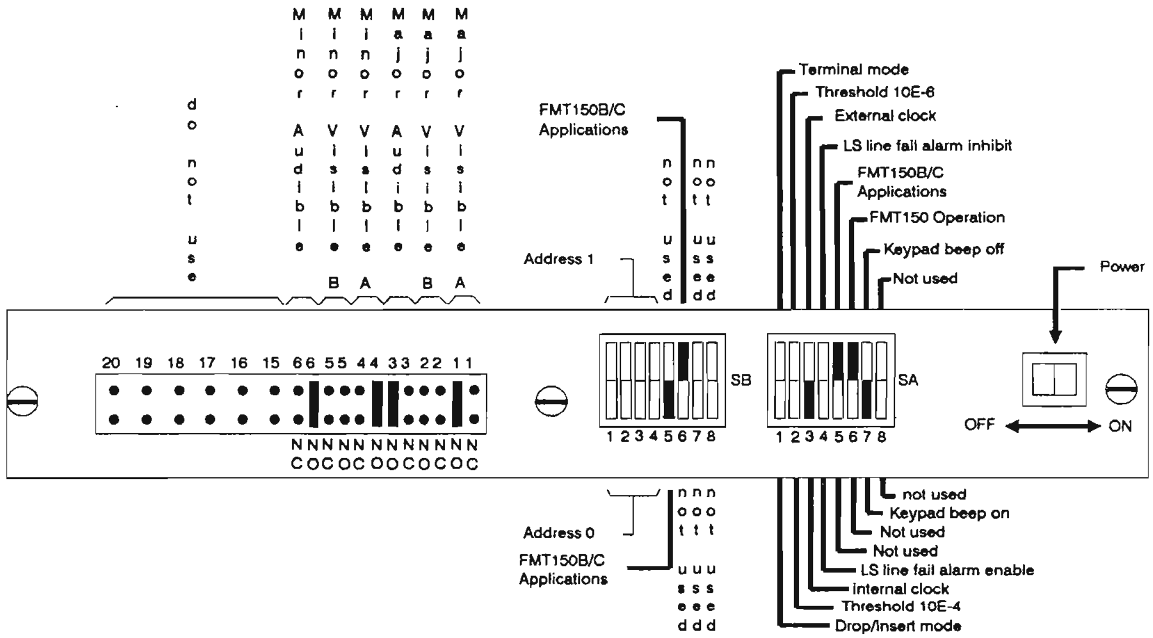
OPTION SETTINGS

Before testing the FMT-150B/C systems, all options must be set correctly. This refers to the circuit pack options (DIP switches, slide switches and "suitcase" straps) located on the majority of the modules.

Because the FMT-150B/C is designed to be such a flexible system, there are numerous options that need to be set. Extreme care should be taken when setting these options, or acceptance can be significantly delayed.

Monitor and Control Module (NT7H61BA)



Shorting Plug Notes

1. Place shorting plugs in positions1, 3, 4 and 6 NO to provide the interface between the Monitor & Control Unit and the Maintenance Control Unit
2. On FMT-150 C shelves, shorting plug 2 must be selected as NO, and shorting plug 5 must be selected as NC.
3. Do not place any plugs in positions 15 thorugh 20.

Table 1
FMT-150B/C system

Typical Monitor and Control Position	DM-13 Address	Switch SB setting			
		1	2	3	4
FMT-150B DM-13	0	0	0	0	1
FMT-150C Left Hand Side DM-13	1	0	0	1	1
FMT-150C Right Hand Side DM-13	2	0	1	0	1

Figure 1

Monitor and Control Module (NT7H61BA) Switch Settings

Ref. Fig. 1

Switch	Options
SA-1	Drop-Insert Mode/Terminal Mode: If the DM-13 multiplexer is in a Drop-Insert configuration, set SA-1 accordingly; otherwise set switch to terminal mode.
SA-2	Parity Threshold 10^{-4} /**Parity Threshold 10^{-6}:** Parity error thresholds of 10^{-4} or 10^{-6} parity errors per second for the received DS-3 is selected using switch SA-2
SA-3	**Internal Clock/External Clock:** Set switch SA-3 to Internal Clock for all installations.
SA-4	**LS Alarm Enable/LS Alarm Inhibit:** Low speed (LS) line fail alarms are either enabled or inhibited using switch SA-4.
SA-5	**Not used**
SA-6	**Not used**
SA-7	**BeepOn/Beep Off:** This switch enables or disables an audible beep in response to manual pushbutton operation.
SA-8	**Not used**

Student Notes

Monitor and Control Module Switch Settings (Cont'd)

Switch	Options
SB-1	**Address 0/Address 1:** This switch selects the most significant bit (MSB) of the E2A telemetry address. Addresses are set in binary from 0 to 7 (000 to 111) or 0 to 15 (0000 to 1111) for eight and sixteen DM-13 addresses, respectively. Refer to Tables DP 2000-B and C for conversion of addresses to binary. Refer to Table 1 for an explanation of address setting.
SB-2	**Address0/Address 1:** This switch selects the second most significant bit of the E2A telemetry address. Refer to Table 1 for an explanation of address setting.
SB-3	**Address 0/Address 1:** This switch selects the third most significant bit (MSB) of the E2A telemetry address. This bit becomes the least significant bit (LSB) if eight DM-13 addresses are used. Refer to Table 1 for an explanation of address setting.
SB-4	**Address 0/Address 1:** This switch selects the least significant bit (LSB) of the E2A telemetry address if sixeen DM-13 addressing is used. If eight DM-13 addressing is used, set switch SB-4 to "1". Refer to Table 1 for an explanation of address setting.
SB-5	**Not used/FMT-150:** Set to FMT-150 operation.
SB-6	**Not used**
SB-7	**Not used**
SB-8	**Not used**

DS-1 Tx/Rx Module (NT6H71AA/BA/XA)

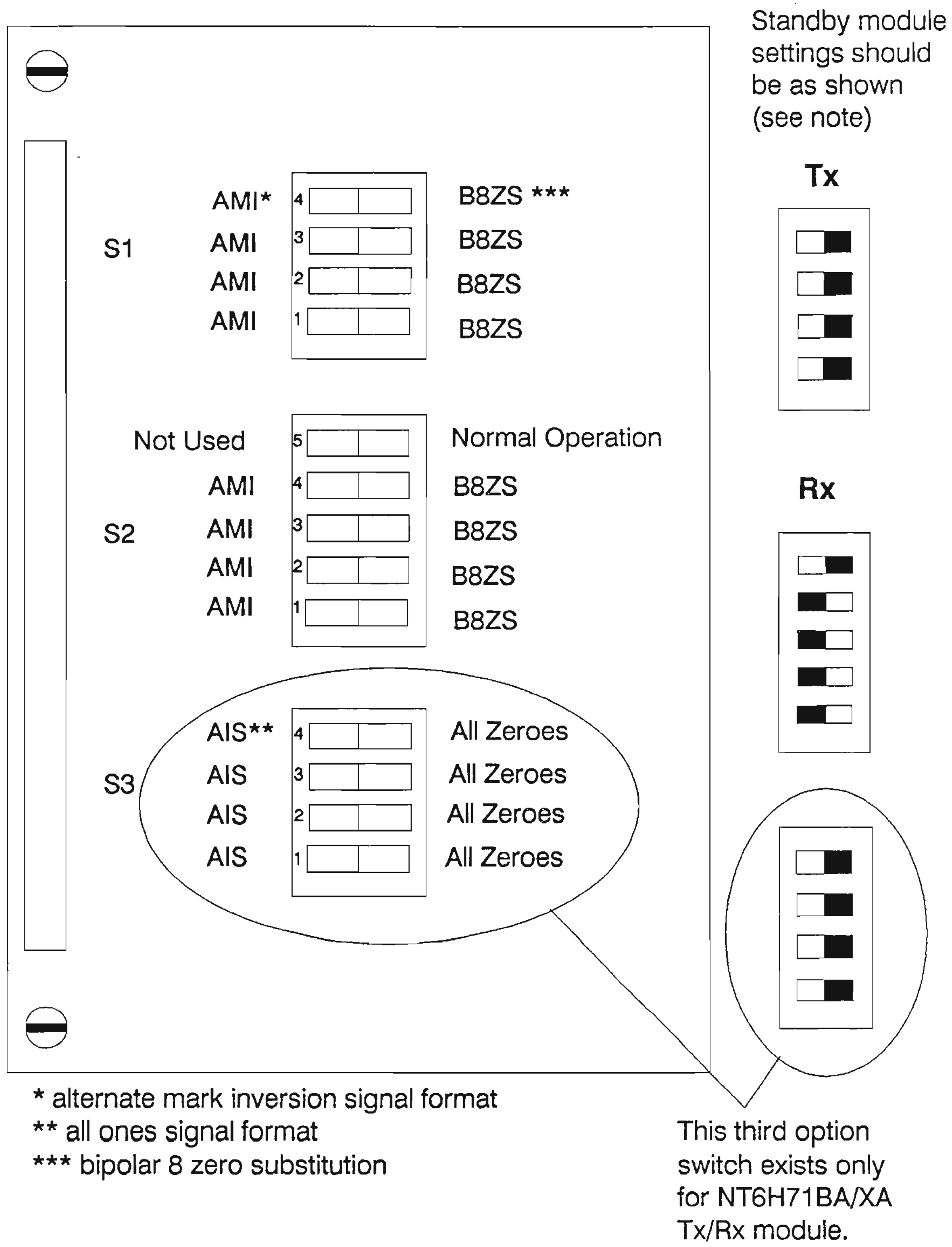


Figure 2

DS-1 Tx/Rx Module (NT6H71AA/BA/XA) Switch Settings

Ref. Fig. 2

DS-1 Tx/Rx (NT6H71AA)

Switch	Options
S1-1 to S1-4	**AMI/B8ZS Rx Tr 1 to 4:** Set to either Alternate Mark Inversion (AMI) or Binary Eight Zero Substitution (B8ZS), depending on the required signal format for each tributary in the transmit direction. For operation with ZBTSI format, set to AMI. The standby module switches should all be set to B8ZS.
S2-1 to S2-4	**AMI/B8ZS Rx Tr 1 to 4:** Set to either AMI or B8ZS depending on the required signal format for each tributary in the receive direction. For operation with ZBTSI format, set to AMI. The standby module switches should all be set to AMI.
S2-5	**Not used/Normal Operation:** Set this switch to Normal Operation for both working and standby modules.

Note: Standby module switches are set according to the above rules so that the standby module may replace any working module, and still accomodate the replaced module's line code selection.

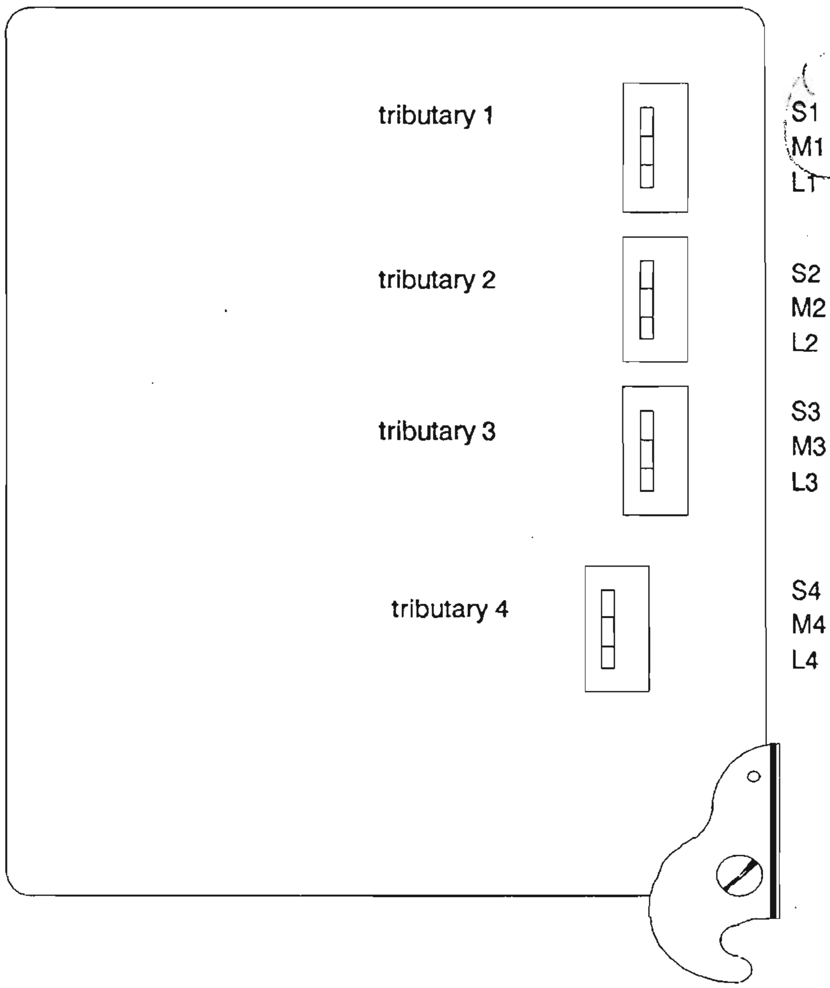
DS-1 Tx/Rx Module Switch Settings (Cont'd)

DS-1 Tx/Rx (NT6H71BA and NT7H71XA)

Switch	Options
S2-1 to S2-4	AMI/B8ZS Rx/Tr 1 to 4: Set to either Alternate Mark Inversion (AMI) or Binary Eight Zero Substitution (B8ZS), depending on the required signal format for each tributary in the transmit direction. For operation with ZBTSI format,set to AMI. The standby module switches should all be set to B8ZS.
S2-5	Not Used/Normal Operation: Set this switch to Normal Operation for both the working and stand-by modules.
S3-1 to S3-4	All1's/All 0's: Set to either all 1's or all 0's output, depending on the desired emergency output code (AIS). Both the local and remote switch (near-end and far-end) must be set in the same way for the same for the same tributary (that is, both to all 1's, or both to all 0's, but not mixed). The standby module must have all switches set to all 0's.

Note: Standby module switches are set according to the above rules so that the standby module may replace any working module, and still accomodate the replaced module's line code selection.

DS-1 LBO Module (NT7H63AA)



dist. initially short (from FMT to DSX)

Figure 3

DS-1 LBO Module (NT7H63AA) Switch Setting

Ref. Fig. 3

Switch	Options
Tributaries 1 to 4	S/M/L: Set each 3-position switch to either Short (S), Medium (M), or Long(L) according to the distance to the cross-connect for each tributary, using the following information:

S = short	0 - 45.7m (0-150 ft.)
M = medium	45.7 - 137.0m (150 - 450 ft.)
L = long	137.0 - 199.6m (450 - 655 ft.)

DS-1C Tx/Rx Module (NT6H67AA/XA)

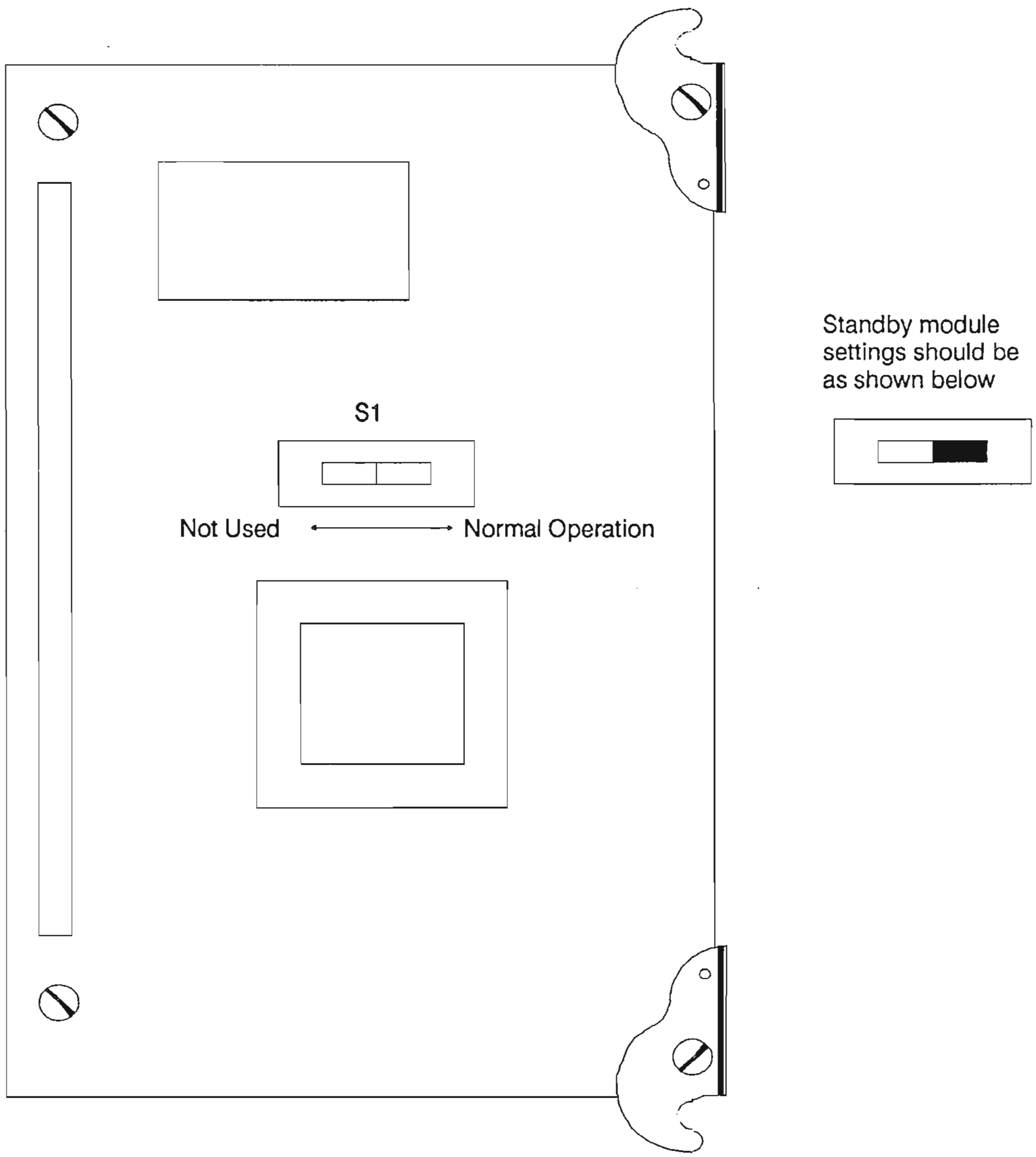


Figure 4

DS-1C Tx/Rx Module (NT7H67AA and NT7H67XA)

Ref. Fig. 4

Switch	Options
S1	**Not Used/Normal Operation:** Set this switch to Normal Operation.

DS-1C LBO Module (NT7H64AA)

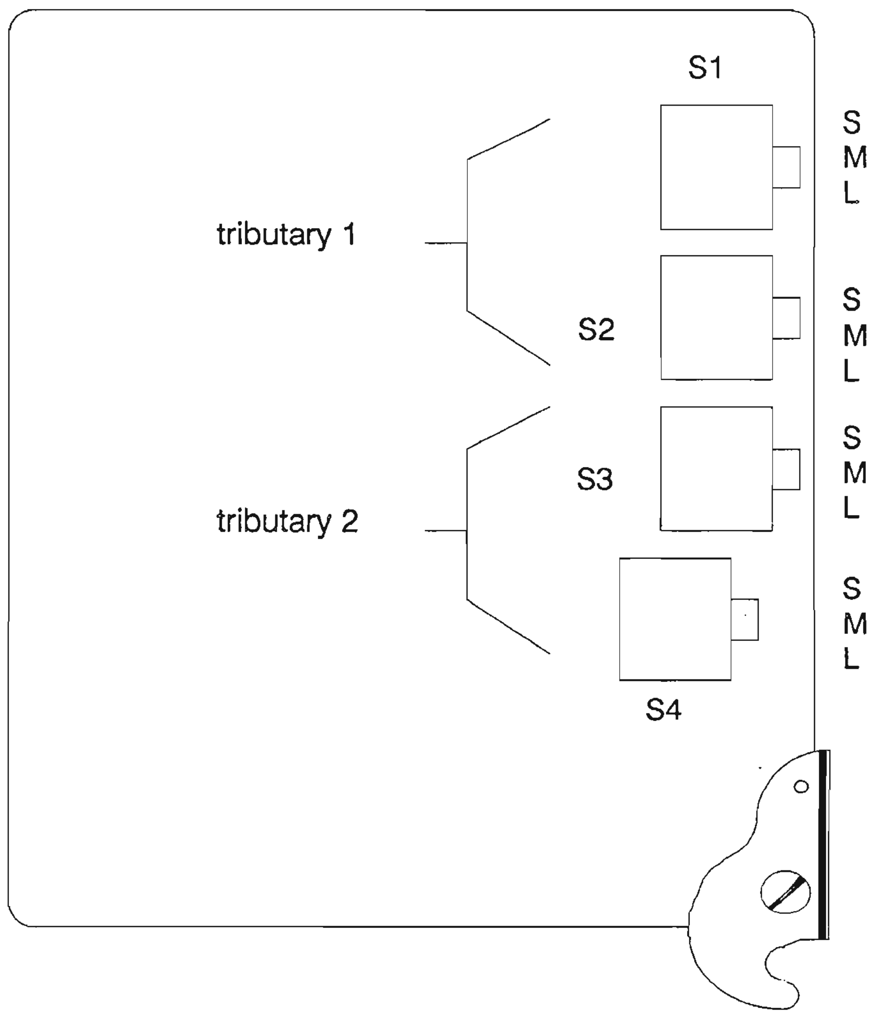


Figure 5

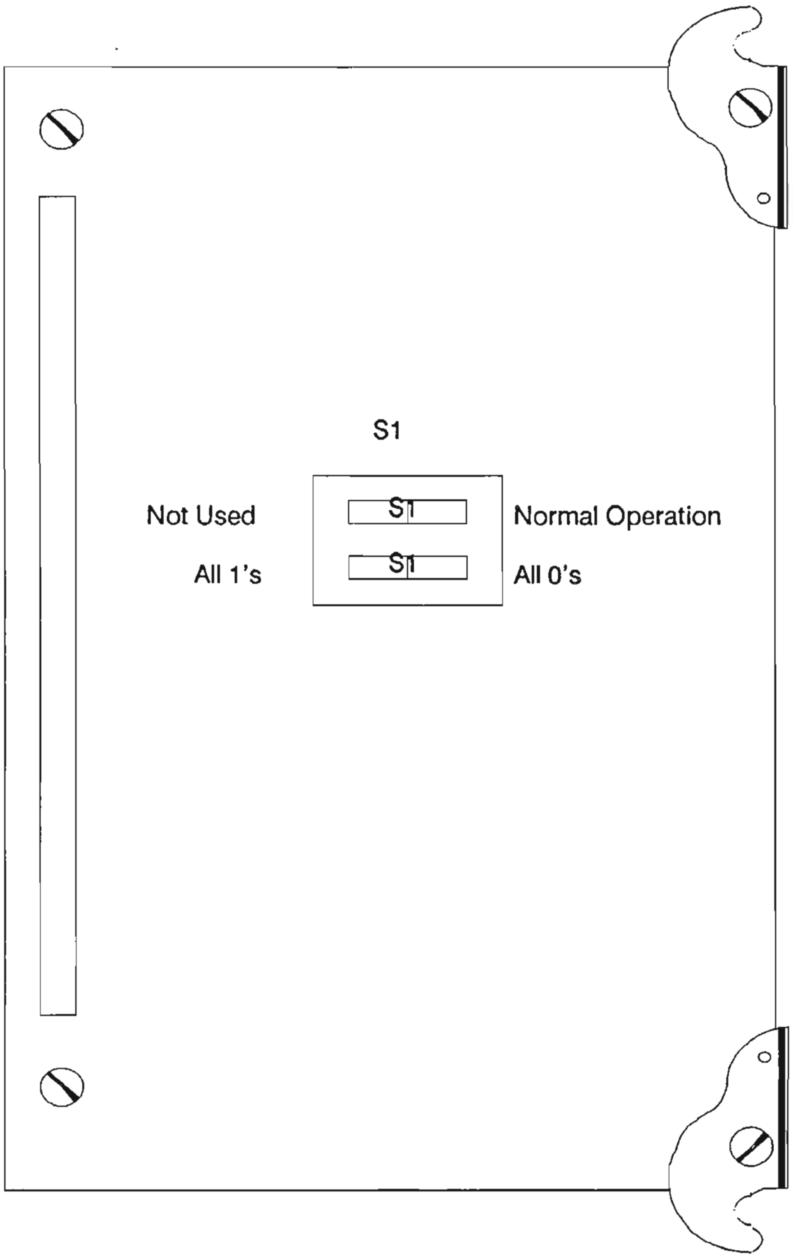
Ds-1C LBO Module (NT7H64AA) Switch Settings

Ref. Fig. 5

Switch	Options
S1, S2, S3, and S4	Set S1, S2, S3, and S4 according to the distance to the DS-1C cross-connect:

Distance to the DS-1C Cross-Connect	Tributary 1 S1	S2	Tributary 2 S3	S4
0 -30 m (0-100 ft)	S	S	S	S
30-76 m (100-250 ft)	M	S	M	S
76-122 m (250-400 ft)	L	S	L	S
122-162 m (400-533 ft)	L	M	L	M
162-200 m (533-655 ft)	L	L	L	L

DS-2 Tx/Rx Module (NT6H68AA/XA)



Standby module settings should be as shown below

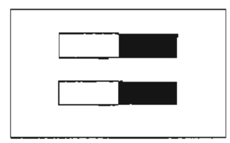


Figure 6

DS-2 Tx/Rx Module (NT6H68AA and NT6H68XA)

Ref. Fig. 6

Switch	Options
S1-PRIO	Not Used/Normal Operation: Set this switch to Normal Operation.
S1-A1S	All 1's/All 0's: If a DS-2 signal is not detected in the receive direction, either an All 1's or an All 0's signal will be inserted, selectable by this switch.

DS-2 LBO Module (NT7H65AA)

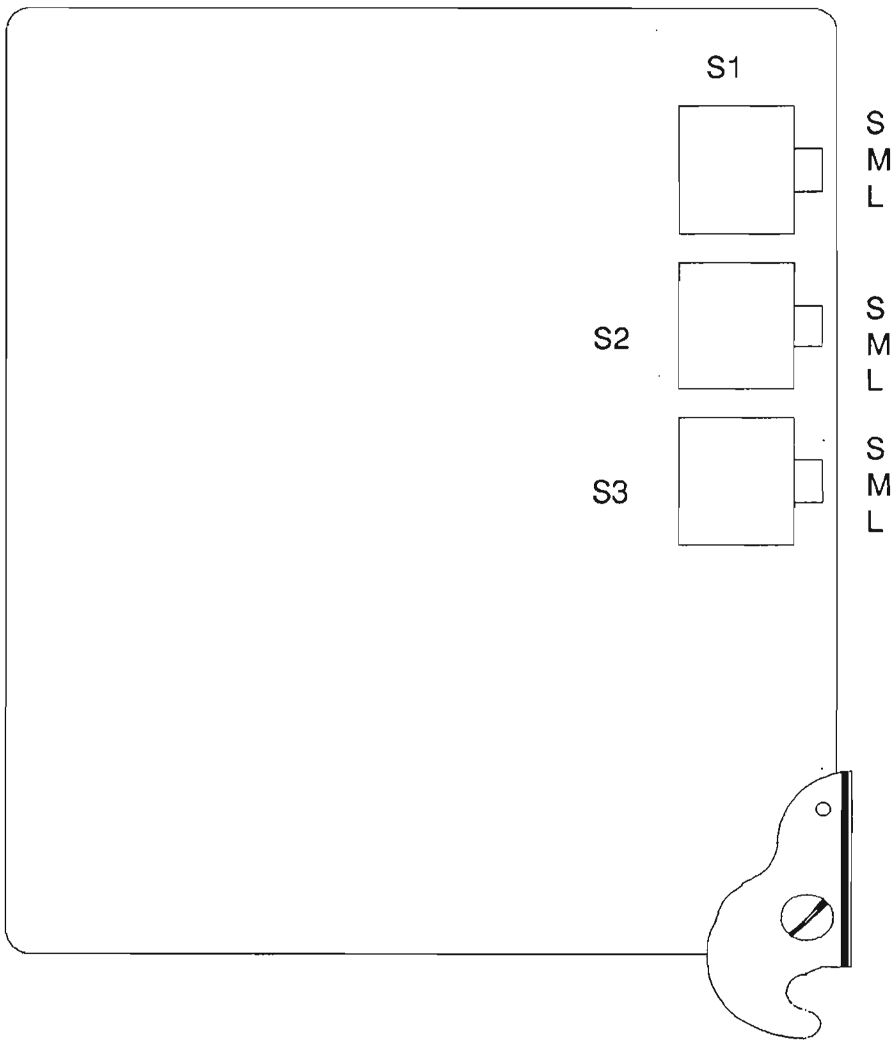


Figure 7

DS-2 LBO Module (NT7H65AA)

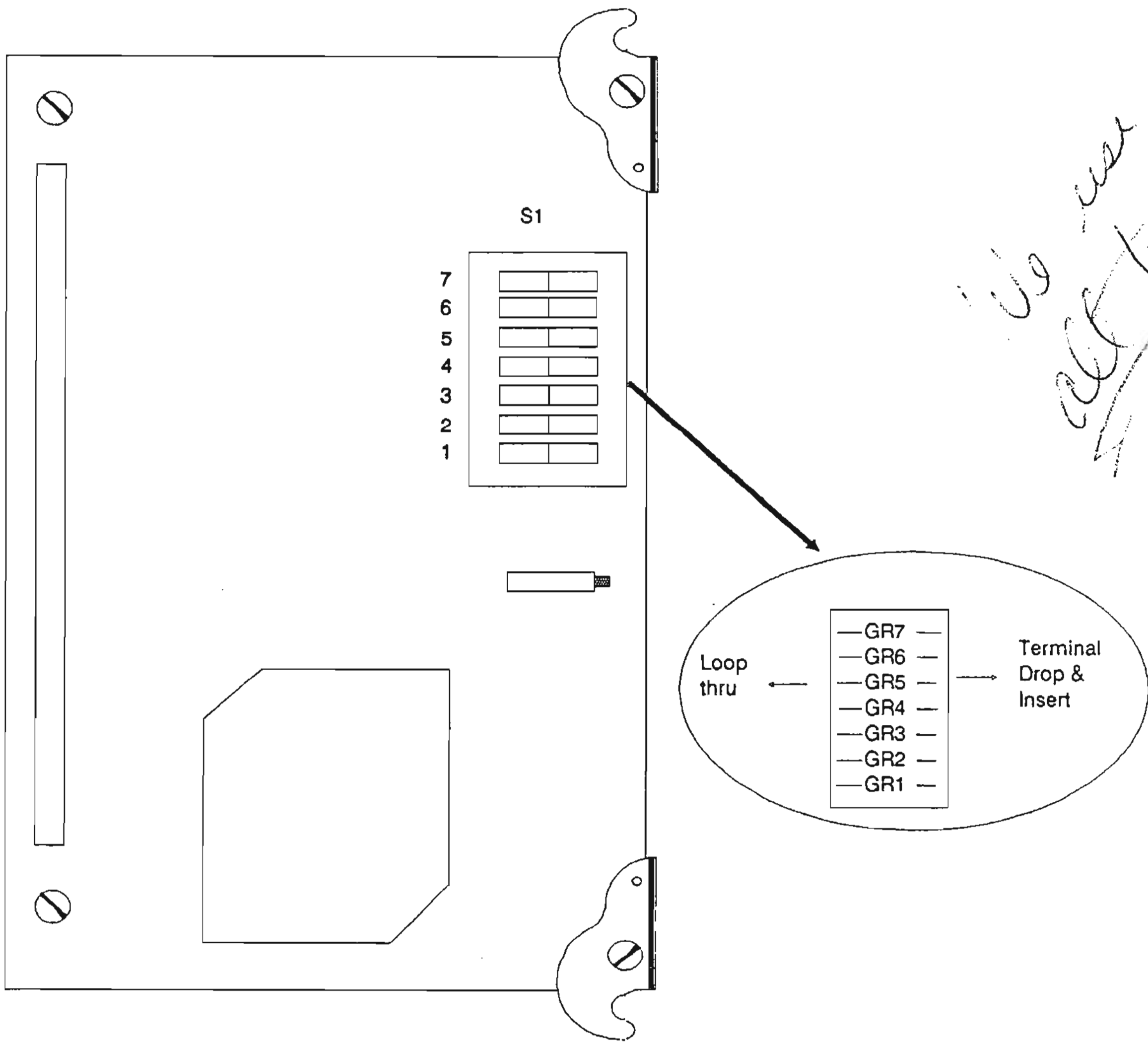
Ref. Fig. 7

Switch	Options
S1, S2, and S3	Set S1, S2, and S3 according to the distance to the DS-2 cross-connect:

Distance to the DS-2 Cross-Connect	S1	S2	S3
0-30 m (1-100 ft)	S	X	X
30-91 m (100-300 ft)	M	X	X
91-122 m (300-400 ft)	L	S	X
122 - 152 m (400-500 ft)	L	M	X
152 - 183 m (500-600 ft)	L	L	S
183 - 244 m (600-800 ft)	L	L	M
244 - 305 m (800-1000 ft)	L	L	L

where X = (may be set to any position)

DS-3 Tx/Rx Module(NT6H62AA/AC/XA)



to use - all terminal

Figure 8

DS-3 Tx/Rx Module (NT6H62AA/AC/XA)

Ref. Fig. 8

Switch	Options
GR1 to GR7	Loop Thru/Terminal or Drop-Insert: For each group (1 through 7) set each switch according to system configuration.

> Caution: Precautions must be taken when handling or replacing circuit modules.

DS-3 LBO Module (NT7H66AA)

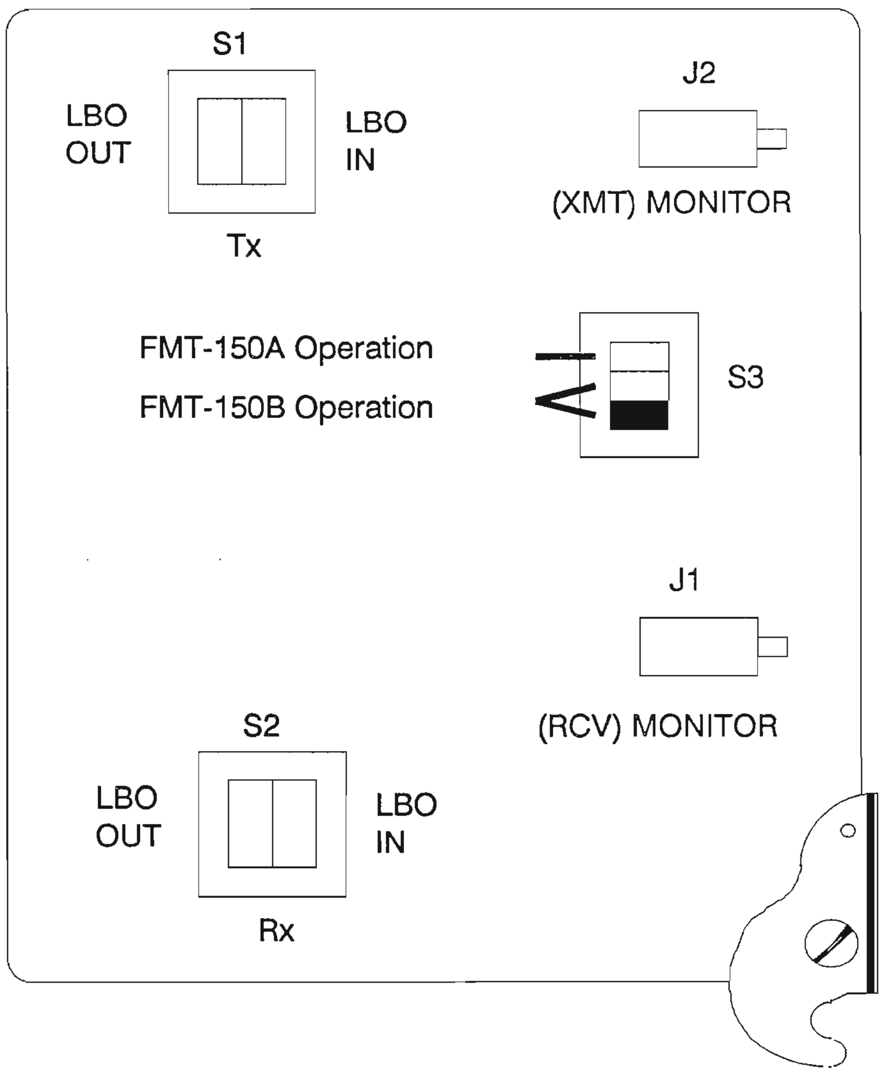


Figure 9

DS-3 LBO Module (NT7H66AA) Switch Settings

Ref. Fig. 9

Switch	Options
S1, S2	LBO In/Out: Set switch S1 and S2 according to the distance to the DSX-3 cross-connect:

Distance to the DSX-3 Cross-Connect or DM-13 Multiplexer Using NE728 Cable Type	Distance to the DSX-3 Cross-Connect or DM-13 Multiplexer Using RG-59 B/U Cable Type	LBO
0 -68 m (0-225 ft)	0 -50 m (0-164 ft)	LBO In
68 - 137 m (225-450 ft)	50 - 76 m (164-250 ft)	LBO Out

S3	**FMT-150A/FMT-150B:** Set the switch according to the shelf being configured.

DS Translator Module (NT7H85AA/CA/XA)

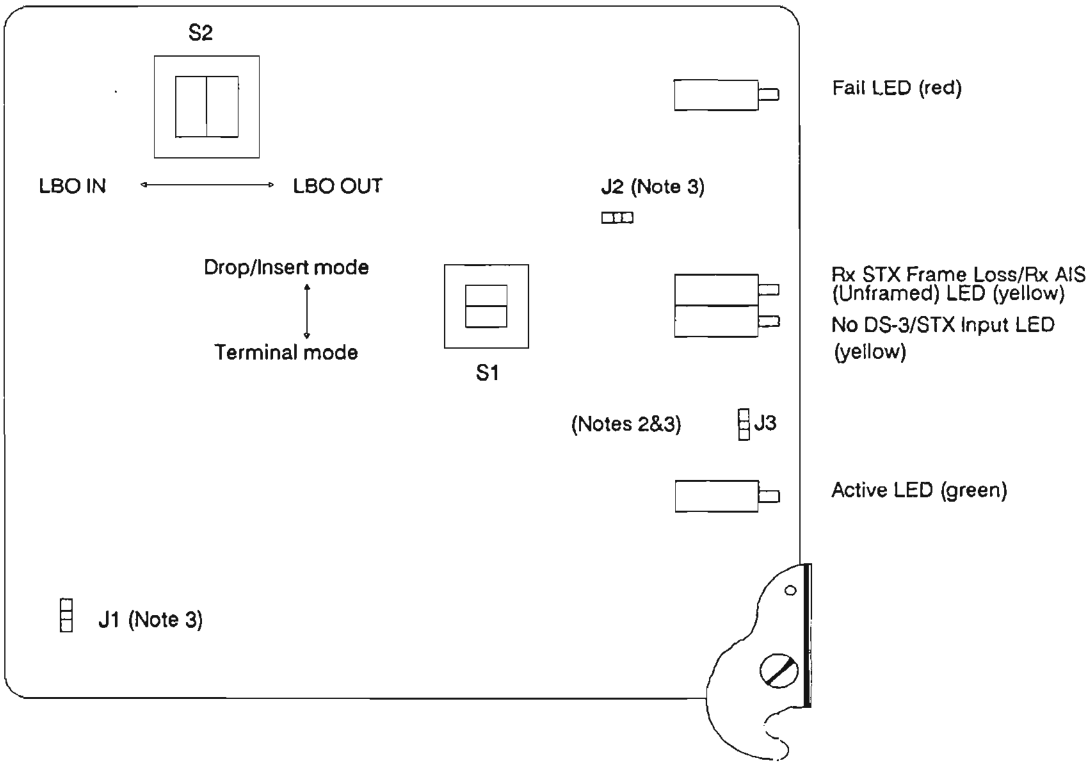


Figure 10

Note 1:	This DS-3 Translator is used in terminal and drop-in sert configurations.	
Note 2:	J3	Found only in the NT7H85CA Translator module.
Note 3:	J1	Install for unprotected operation Remove for protected operation.
	J2	Always installed.
	J3	Install for DS-3 cable lengths 0-225 feet Remove for DS-3 cable lengths 226-450 feet

DS-3 Translator Module (NT7H85AA/CA/XA) Switch and Jumper Settings

Ref. Fig. 10

Switch/Jumper	Options
S2	**LBO IN/LBO Out:** Set Switch LBO to either the IN or OUT position according to the distance to the DSX-3 cross-connect and type of cable used:

Distance to the DSX-3 Cross-Connect or DM-13 Multiplexer Using NE728 Cable Type	Distance to the DSX-3 Cross-Connect or DM-13 Multiplexer Using RG-59 B/U Cable Type	LBO
0 -68 m (0-225 ft)	0 - 50 m (0-164 ft)	LBO In
68 - 137 m (225-450 ft)	50 - 76 m (164-250 ft)	LBO Out

S1	**Drop-Insert/Terminal Mode:** Set this switch to Terminal Mode for all applications where a DS-3 is terminated. Set the switch to Drop-Insert at intermediate sites requiring a DS-1, DS-1C, DS-2 or DS-3 drop/insert.

STX Translator Module (NT7H85BA/XB)

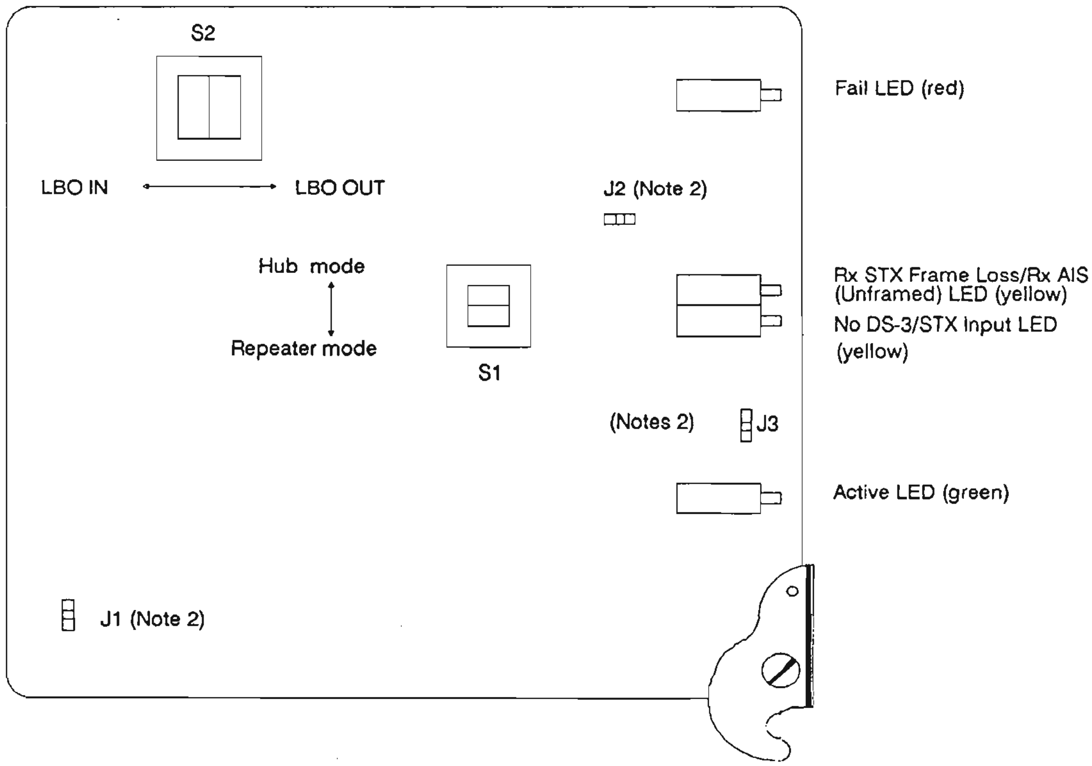


Figure 11

Note 1: This STX Translator is used in repeater and hub configurations

Note 2: J1 Install for unprotected operation
Remove for DS-3 unprotected operation

J2 Always installed

J3 Install for DS-3 cable lengths 0-225 feet
Remove for DS-3 cable lengths 226-450 feet

STX Translator Module (NT7H85BA/X)
Switch and Jumper Settings

Ref. Fig. 11

Switch/Jumper	Options
S2	**LBO In/LBO Out:** Set Switch LBO to either the IN or OUT position according to the distance to the DSX-3 cross-connect for the received DS-3 (STX) only and type of cable used:

Distance to the DSX-3 Cross-Connect Using NE728 Cable Type	Distance to the DSX-3 Cross-Connect Using RG-59 Cable Type	LBO
0 - 68 m (0-225 ft)	0 - 50 m (0-164 ft)	LBO In
68 - 137 m (225-450 ft)	50 - 76 m (164-250 ft)	LBO Out

Switch/Jumper	Options
S1	**Hub/Repeater Mode:** Set this switch to Hub if the STX Translator is used at a hub site. Set the switch to Repeater if the STX Translator is used at a repeater site.

Caution: Precautions must be taken when handling or replacing circuit modules

150 Mb/s Optical Tx/Rx Module (NT7H80)

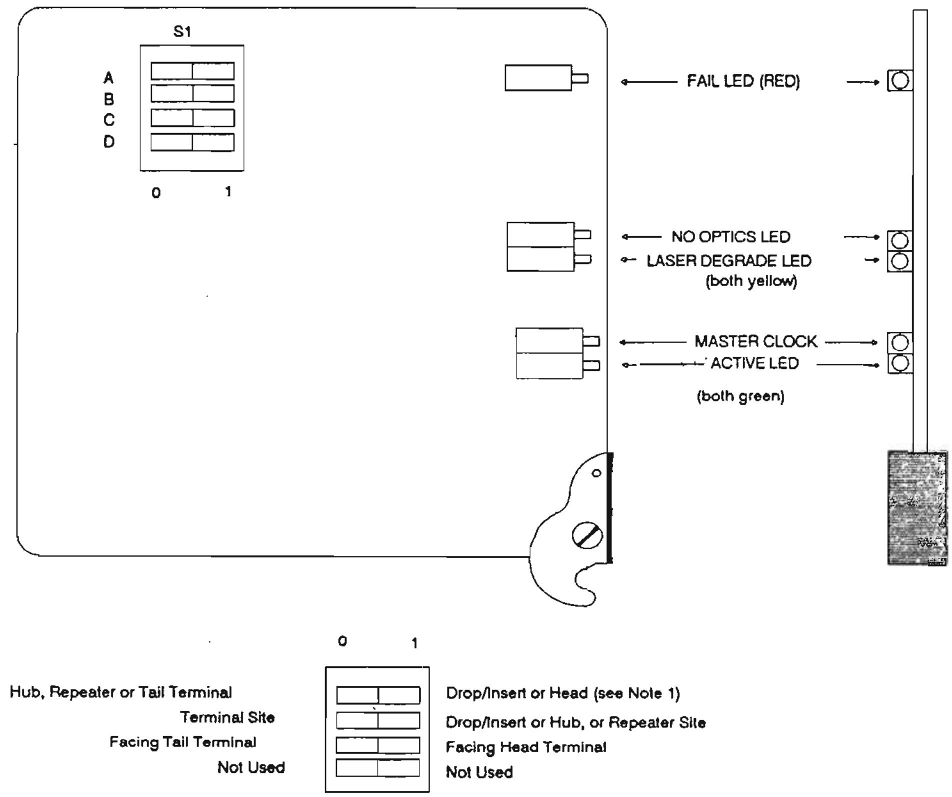


Figure 12

Note 1: "Head"indicates the FMT-150 system clock source terminal, while "Tail" indicates any other terminal site in the FMT-150 network.

Note 2: This switch is not used at terminal nodes.

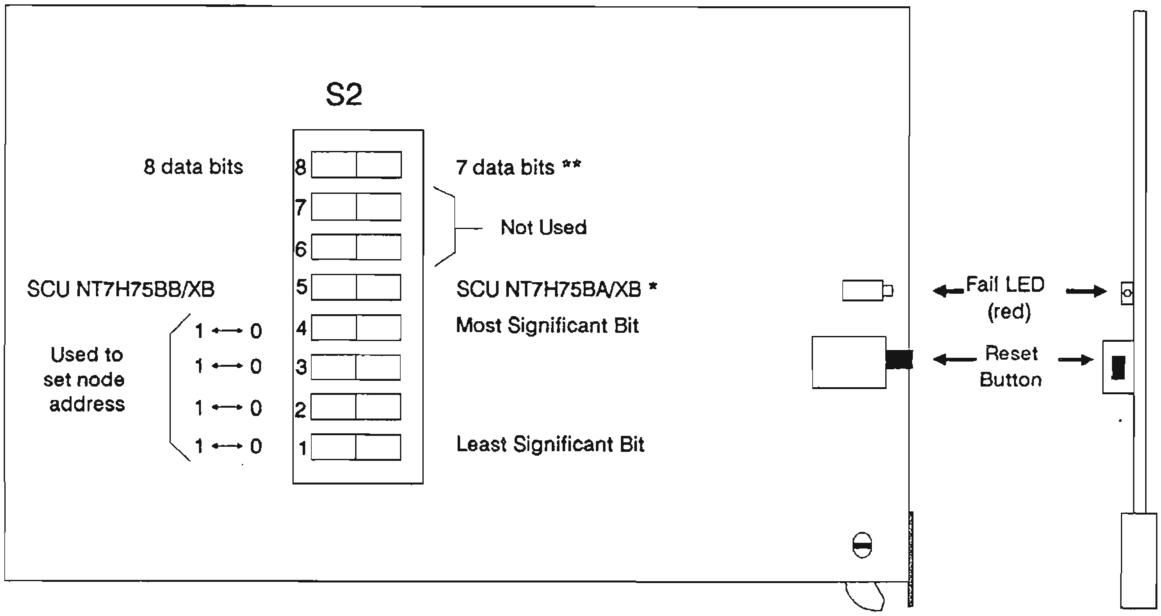
150 Mb/sOptical Tx/Rx Module(NT7H80) Switch Settings

Ref. Fig. 12

Switch	Options
S1-A	Tall Terminal or Drop-Insert/Head Terminal, Hub or Repeater: If this node is at a tail terminal site (clock receiving or east terminal), or at a deop/insert sit, set switch S1-A to "0". If this node is at a head terminal site (clock generating or west terminal), or at a hub or repeater site, set switch S1-A to "1".
S1-B	Terminal/Drop-Insert, Hub, or Repeater: At terminal sites, set Switch S1-B to "0". At drop/insert, hub, or repeater sites, set Switch S1-B to "1".
S1-C	Facing Tail (east)/Facing Head (west): If the node is facing a tail terminal (clock receiving or east terminal) set switch S1-C to "0". If the node is facing a head terminal (clock generating or west terminal) set switch S1-C to "1". If the node is at a terminal site itself.
S1-D	This switch is not used.

Caution: Precautions must be taken when handling or replacing circuit modules.

Maintenance Control Unit (NT7H90CA/DA/GA)



* This switch is used on the NT7H90CA only.
** This switch is used on the NT7H90CA/DA/GA only.

Figure 13

Maintenance Control Unit (NT7H90) Switch Settings

Ref. Fig. 13

Switch	Options
S1	**Reset Button:** This button must be pressed upon initialization of the FMT-150 system.
S2-1 to S2-4	**Address Switches (1/0):** Use the bottom four switches of S2 to set the address of the node. The bottom switch sets the Least Significant bit in the address, the fourth switch from the bottom sets the Most Significant Bit in the address.

Note: There is a difference of one between the switch selected address of an MCU and the displayed address on the CRT interface.

Binary Switch Selected Address	Displayed Node Address on CRT Interface
0000	1
0001	2
0010	3
0011	4
0100	5
0101	6
0110	7
0111	8
1000	9
1001	10
1010	11
1011	12
1100	13
1101	14
1110	15
1111	16

STUDENT NOTES

Switch	Options
S2-5	**SCU NT7H75BB/SCU NT7H75BA:** Set the switch according to the type of service channel unit installed (if any). Applies only to the NT7H90CA only.
S2-8	**7-bit Communiction/8-bit Communication:** Set this switch according to the desired communicaion format with the CRT interface (applies to NT7H90CA/DA/GA only).

Service Channel Unit (NT7H75BA/XA)

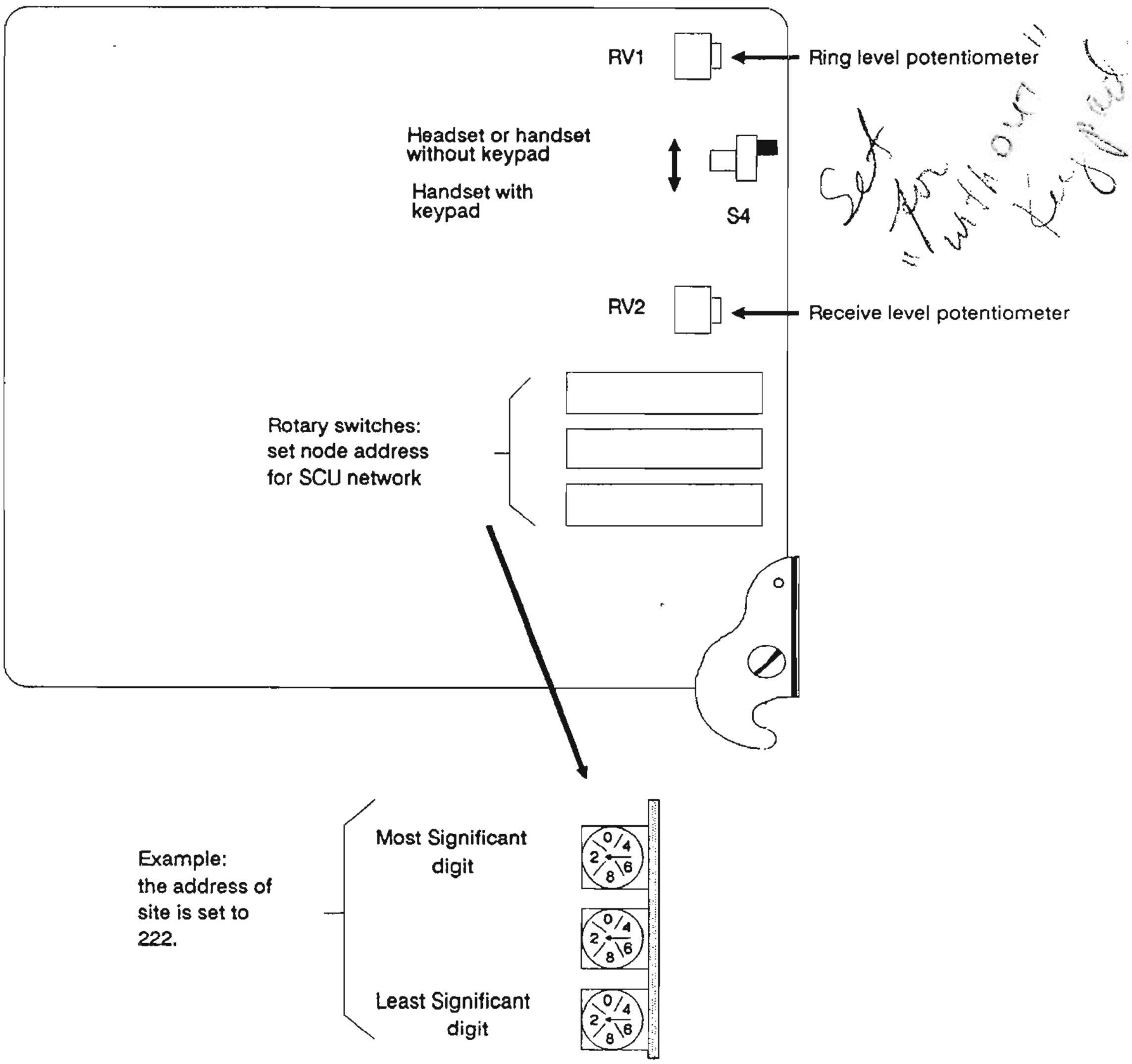


Figure 14

Note: Address 000 is not allowed.

Service Channel Unit (NT7H75BA/XA) Switch Settings

Ref. Fig. 14

Switch	Options
Ring Level Potentiometer	**Clockwise/Counterclockwise:** Turn this potentiometer clockwise to increase the ring volume, and turn counterclockwise to reduce the ring volume.
DTMF Enable/ Disable	**Enable/Disable:** Set according to the type of headset/handset in use. If the headset or handset is equipped for DTMF (dual tone multi-frequency) (that is, it has pushbuttons), set switch to ENABLE.
Receive Level Potentiometer	**Clockwise/Counterclockwise:** Turning this potentiometer clockwise increases the volume at the headset or handset earpiece. Turning counterclockwise reduces the volume.
Rotary Address	**0 to9:** Set each rotary switch to a digit of the node address that the SCU occupies. The top switch sets the most significant digit, and the bottom switch sets the least significant digit. Note that no address shall be set to "000" in an FMT-150 system.

Service Channel Unit (NT7H75BB/XB)

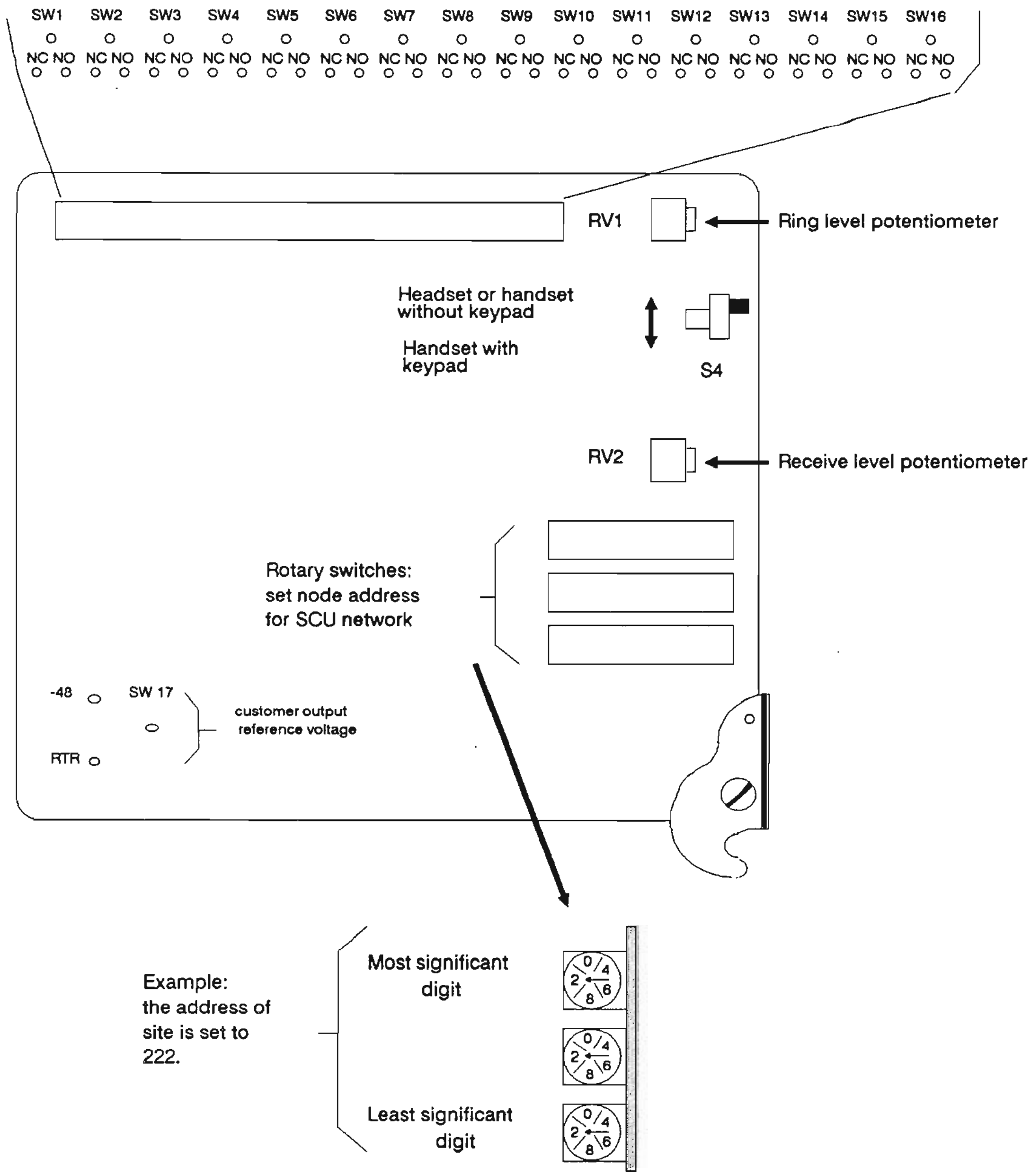


Figure 15

Note: Address 000 is not allowed.

Service Channel Unit (NT7H75BB/XB) Switch Settings

Ref. Fig. 15

Switch	Options
Ring Level Potentiometer	**Clockwise/Counterclockwise:** Turn this poten tiometer clockwise to increase the ring volume, and turn counterclockwise to reduce the ring volume.
DTMF Enable/ Disable	**Enable/Disable:** Set according to the type of headset/handset in use. If the headset or hand-set is equipped for DTMF (dual tone multi-frequency) (that is, it has pushbuttons), set switch to ENABLE.
Receive Level Potentiometer	**Clockwise/Counterclockwise:** Turning this potentiometer clockwise increases the volume at the headset or handset earpiece. Turning counterclockwise reduces the volume.
Rotary Address	**0 to 9:** Set each rotary switch to a digit of the node address that the SCU occupies. The top switch sets the most significant digit, and the bottom switch sets the least significant digit. Note that no address shall be set to "000" in an FMT-150 system.
SW1 to SW1-16	**Normally Open/Normally Closed:** For each customer output, select each as either normally open or normally closed. Place the jumper across the selected pin and the top pin for each output.
SW1-17	**-48 V/RTR:** For each customer output, select the output voltage to be either the battery voltage (-48 or -24 V) or the battery return. Place the jumper across the seleced pin and the right most pin.

Power Supply Unit (NT7H69AA/BA/BB/BC)

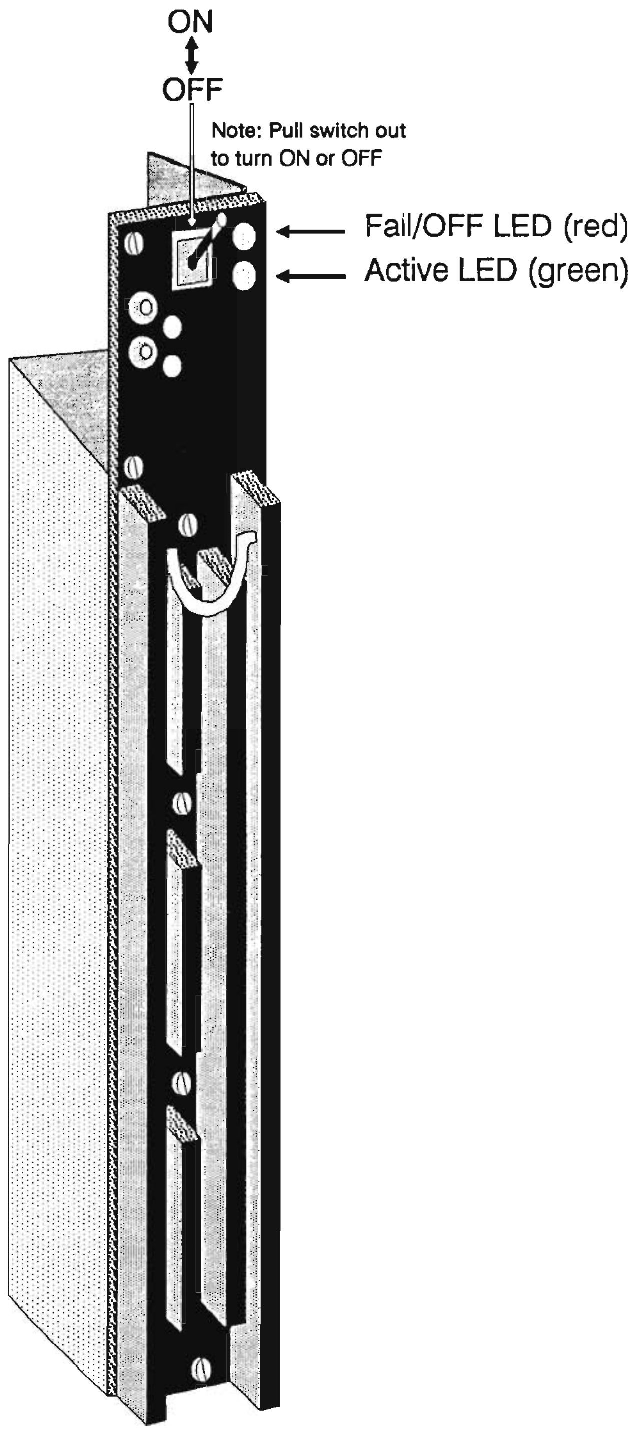


Figure 16

Power Supply Unit (NT7H69AA/BA/BB/BC) Switch Settings

Ref. Fig. 16

Switch	Options
On/Off Switch	**On/Off:** Set this switch to the ON position to initialize a FMT-150 system.
Level Potentiometer	**Clockwise/Counterclockwise:** Turn this potentiometer clockwise to increase the Output Voltage Level; turn counterclockwise to reduce the Output Voltage Level.

Shelf	PSU Position	Volts dc
FMT-150B	A1/B1	5.4 ± 0.04
	A2/B2	5.2 ± 0.02
FMT-150C	A1/B1	5.2 ± 0.02
	A2/B2	5.2 ± 0.02
FMT-150D	A1/B1	5.4 ± 0.04
	A2/B2	5.2 ± 0.02

> Caution: Precautions must be taken when handling or replacing circuit modules.

APPENDIX A

FMT-150B/D CRT FUNCTIONS LABORATORY

Purpose

This laboratory exercise is designed to familiarize the student with the operation of the CRT and its interface with the FMT-150B/D.

Objectives

Using the student guide, NTPs, and Quick Reference Guide-CRT Functions, the student will be able to:

1. Use the CRT to monitor the present status of the FMT-150 system

2. Perform, through the CRT, such tasks as force switches and loopbacks which may be necessary in maintaining the FMT-150 system

FMT-150B/D CRT FUNCTIONS LABORATORY

TABLE OF CONTENTS

Description **Page**

FMT-150B/D CRT Interface

As has been stated the FMT-150 CRT interface is the most powerful method of monitoring, controlling, and troubleshooting an FMT-150 system. This lab will give you an introduction to the CRT and its functions.

Detailed procedures of all of these functions may be found in NTP section 321-3211-301.

Equipment

CRT VT100 (or equivalent)
Null Modem Cable

Conventions

The CRT interface uses several conventions on screen which the user should be aware of. They are as follows:

a = minor alarm
A = major alarm
* = active point in the system
e = enabled point in the system
d = disabled point in the system
. = units equipped
D = Drop/Insert node
H = Hub node
R = Repeater node
T = Terminal node
m = masked point in system

References

NTP section 321-3211-301
Quick Reference Guide-CRT Functions
Student Guide

Procedures

Procedure 1: Set Up and Login

1. **Press the Set Up function key**. You will see a function key in the top left corner of your keyboard. After you press this key you will see the **Set up** directory. We must set up the General and Communication directories.

   Use your cursor to move to the **General directory**.

   Press Enter. This will give you the **General Set Up.** For our purposes, along the first row you must see VT 100 Mode and VT 100 ID. If these do not appear move your cursor to the one you wish to change and **press enter** until the proper term appears. When these are correct move your cursor to "To next set up ".

   Press Enter. You are now in the **Communications Set Up.** The process is the same here as above. You want to see the following information:

   TRANSMIT = 9600
   7 data bits,No parity
   2 stop bits
   (verify the two above with your instructor as they depend on specific option settings)
   No local echo

   Press Set Up. You are now ready to login.

2. **Press <CR>** until you get a prompt which says "Enter terminal type".

Your options will be

1 - DEC VT100, or
2 - NT Meridian 6000

Press # (1 or 2) **<CR>**

Your cursor will now follow the word login.
Press <CR>, unless your instructor gives you a password
Then enter it here.

You are now logged on to the system and are prepared to enter a wide variety of commands which are necessary to monitor and maintain the FMT-150B/D. These commands are given in detail in your NTP and in your student guide. We will look at a few of the different commands here.

3. Look in your NTP at Section 321-3211-301. Operator Task Lists OT 0002 and OT 0003 will give you a list of detailed procedures (DPs) which are applicable to Maintenance Control Units NT7H90DA/GA/XD and NT7H90CA/XC respectively.

   In each of the following procedures perform the operations which are applicable to your system.

Procedure 2: Configuration Commands

1. **Press c <CR>**. This gives us the global configuration of our system. There can be up to 16 nodes in the system. Each active node will have the name of its software indicated beside its number, under Rel.

   How many nodes are there in your system?________

   What is the software release at node 1?_________

2. Customer input and output names may be entered and changed. To change the customer input name at node 1, enter the following string of commands:

For NT7H90DA/GA/XD:

Enter	System Response
c	Configure
i	Name for customer input point
##<sp>	## as: (## is the point to be named)
"door open"	"door open" (this is used as an example only)
<CR>	*Displays Current Screen*

What do you see?______________________

For NT7H90CA/XC:

Enter	System Response
c	Configure
g	global
n	Name for
i	customer input number
## <sp>	## as: (## is the input number)
"door open"	"door open" (this is an example only)
<CR>	*Displays current screen*

What do you see? ____________________

Note: Your customer name must be in quotation marks " ". Also, you must **always** press the space bar after entering a number.

Move your cursor one space to the right then back to the left.

What appears at the bottom left hand corner of your screen?
RUB:______________

This is a reminder of your last command. To change it simply move your cursor to the right. This will repeat your command. When you reach the part you wish to change simply input the new information at that point and continue moving your cursor. For example **press** → → **2** → (until the end of your name) **<CR>**.

What happens?________________________

Customer output names are changed in the same way.

3. Change the date. For NT7H90DA/GA/XD and NT7H90CA/XC this procedure is the same.

Enter	System Response
c	Configure
d	date(yy/mm/dd)
##<sp>	##/ (the last two of the current year)
##<sp>	##/ (the month 1 to 12)
##<sp>	##/ (the day of the month)
<CR>	*Displays current screen*

Where does this change appear on the screen?

____

4. To see the configuration of a particular node:

Enter	System Response
c	Configure
n	node number
##<sp>	##
<CR>	*Displays current screen*

How many DS-3 signals are being received and transmitted from node 1?__________________
(for NT7H90DA/GA/XD only).

Is customer output 4 enabled or disabled?__________
(for NT7H90DA/GA/XD only)

Is blue insertion enabled or disabled at translator 2?

____

Is parity correction enabled or disabled at translator 3?

____

5. Enable blue insertion at translator 2 as follows (for either MCU):

Enter	System Response
c	Configure
n	node number
## <sp>	## (node number)
t	translator
## <sp>	## (translator number, 2 here)
b	blue insert
e	enable
<CR>	*Displays current screen*

6. Check the status of the same things at node number 2.

   What is your sequence of entries?____________________

   Enable blue insert for all translators if they are disabled.

   What are your entries? ____________________

   See your NTP for additional commands.

Procedure 3: Alarm Commands

1. **Press a <CR>.** This gives us the network alarm status

   How many minor alarms appear? ____________

   How many major alarms appear?____________

   Are the nodes Drop/Insert, Hub, Repeater, or Terminal nodes? ____________

2. We can also display an alarm screen at each of the following levels with the given commands:

Enter	System Response
a	Alarms at node
## <sp>	## (node number from 1-16)
o	optics
or	
t	translators
or	
m	M13
or	
c	common equipment
<CR>	*Displays current screen*

Using the commands above, look at each of these screens.

Procedure 4: Switching Commands

1. **Press s <CR>.** This will display the switch status for the local node.

   To display the switch status of the 150 Mb/s Fiber Interface enter the following commands:

Enter	System Response
s	Switch at node
## <sp>	## for (## is the node number)
t	translator
<CR>	*Displays current screen*

   Examine the switch status for the translator at node 1.

   Is there a loopback in operation?_____

   On what translator? _________

Release the loopback:

Enter	System Response
s	Switch at node
## <sp>	## for (##is node number)
t	translator
## <sp>	## (##is STX number 1-3)
a/b	A/B (A or B not both)
b	loopback
r	release
<CR>	*Displays current screen*

Operate a loopback on node 1 translator 3A. Use the same commands as listed above changing the translator number and replacing r with o for operate.

What changes do you see on the screen? __________

____

2. Display the switch status of the multiplexers as follows:

Enter	System Response
s	Switch at node
##<sp>	##for (##is node number)
m	M13 number
##<sp>	## (##is the DM-13 number)
<CR>	*Displays current screen*

How many group cards are active? ________

Which high speed card is live? ____________

Which type of standby cards are available (ie. DS1, DS1C, DS2) ? ____________

3. Force switch group 1 to its standby card. To do this turn to the switching commands in NTP Section 321-3211-301, DP 3034 (NT7H90DA/GA/XD) or DP 3134 (NT7H90CA/XC). Follow the list of commands for "low speed operate" in Table DP 3034-A (DP 3134-A)

4. Using the proper OT at the beginning of the NTP section find the DP necessary to operate a lockout on DM-13 LS Tx/Rx module G3. Do this now.

   What is your list of commands?__________________

   ____

Note: Procedures 5 and 6 are only applicable to systems equipped with NT7H90CA/XC.

Procedure 5: Assign a PSU Failed Condition

This procedure assigns a PSU #1 Failed condition to output ## (any number from 1-16) in node n.

1. Display customer output condition

Enter	System Response
c	Configure
g	global
o	customer output
## <sp>	## (## is the customer output)
<CR>	Display current screen

2. Add PSU#1 Failed condition as follows:

Enter	System Response
c	Configure
g	global
o	customer output
## <sp>	## (##is the customer output)
a	add condition
n	node number
p	PSU
## <sp>	## (##is power supply number)
h	alarm pt h
o	## (##of point selected from Table 10-A to 10-F)
<CR>	*Display current screen*

3. Turn off PSU.

4. What do you see in your screen under local value?

    ____

5. Display common equipment alarm. What do you see in output ##? ______________________________

6. Turn PSU#1 to go back to normal conditions.

Procedure 6: Set signal degrade threshold

Set the signal degrade threshold to 10^{-7} in translator #2 at node ## by entering the following commands:

Enter	System Response
c	Configure
n	node number
## <sp>	## (node number)
t	translator
## <sp>	##A&B (##is translator 1,2 or3)
s	Signal degrade threshold as 1E-
## <sp>	(Select exponent from 6 to 10)
<CR>	*Display current screen*

Procedure 7: Logout

1. Many other procedures can be done by following these guidelines in the NTP. Take time now to look over these procedures.

   Choose several procedures such as these to implement yourself.

   Which ones did you choose? ____________________

   ____

   What were your entries for each one?________________

   ____

   ____

2. If at any time you don't know what your options are press "?". This gives you a menu of your options at that time.

   Do this now.

   What does l represent? ____________

   Press l <CR>.

   You are now logged off of this system.

   Remember that detailed procedures of all of these commands scan be found in the NTP section 321-3211-301.

APPENDIX B

OPTION SETTINGS LABORATORY

PURPOSE

This laboratory exercise is designed to familiarize the student with the circuit packs of the FMT-150B/C/D system and their option settings.

OBJECTIVES

Using the student guide, NTPs, and classroom notes, the student will be able to:

- Set options on and install all circuit packs in a 1 + 1 system

OPTION SETTINGS LABORATORY

TABLE OF CONTENTS

OPTION SETTINGS

As stated in you student guide, before testing, options must be set correctly on the FMT-150B/C/D systems. Because of the flexibility of the system there are numerous options which must be set. Extreme care should be taken when setting these options or acceptance can be significantly delayed.

Safety Precautions

In addition to the standard equipment safety precautions, the following special precautions should be observed:

- Never look into an optical connector or fiber. Laser radiation, although invisible and painless, may cause permanent damage to your eyesight.
- Handle fiber patchcords gently. Although much more resilient than earlier optical patchcords, these used on the FMT-150 system should still be treated with care. Never put excess strain on them, and always clean optical connectors before using.
- Always wear a static strap. Static straps (or other approved methods of grounding) are necessary to prevent damage to the voltage-sensitive integrated circuits in the FMT-150 system.

Equipment

Antistatic Wrist-strap

References

Student Guide
NTP section 321-3211-202

Procedures

Procedure 1: Introduction

There are two task lists given in NTP section 321-3211-202 for option settings. The first list ST 0002-1 applies to all FMT-150 systems except the FMT-150C Stand-alone. The second, ST 0003-1, applies to the Stand-alone. This list will give you all the detailed procedures which must be followed for your system.

1. Locate in the NTP the appropriate task list for your system.

   How many detailed procedures (DPs) are given?_____

   What DP gives the option settings for the Maintenance Control Unit? ________

   Turn to this DP.

   How many switches must be set on this card?_____

   Note that the location of the switches is given by a drawing on the next page. When in doubt about any of these procedures refer to the NTP.

2. When setting options care must be taken to properly handle the circuit packs so as not to damage them. Follow these steps when removing or replacing circuit packs.

   - Attach an antistatic wrist-strap to the electrostatic discharge (ESD) jack on the shelf. Wear the antistatic wrist-strap.

   - Disable the monitor and control module.

   - Turn the monitor and control module downward to access the module to be set. Remove the module.

   - Set the option switches and carefully replace the module.

Your instructor has discussed each of the options you must set. As you perform the following procedures refer to your classroom notes or the NTP as needed.

Procedure 2: Set Options

Go to your Student Guide section on Option Settings. Follow the guidelines given and set options on each of the following circuit packs.

-Monitor and Control Module
-DS-1 Tx/Rx Module
-DS-1 LBO Module
-DS-1C Tx/Rx Module
-DS-1C LBO Module
-DS-2 Tx/Rx Module
-DS-2 LBO Module
-DS-3 Tx/Rx Module
-DS-3 LBO Module
-DS-3 Translator Module
-STX Translator Module
-150 Mb/s Optical Tx/Rx Unit
-Maintenance Control Unit
-Service Channel Unit (NT7H75BA/XA) or
-Service Channel Unit (NT7H75BB/XB)
(which ever is applicable to your system)
-Power Supply Unit

Remember to refer to your NTP or ask your instructor if there is any doubt as to what is applicable to your system.

APPENDIX C

ACCEPTANCE TESTS LABORATORY

Purpose

This laboratory exercise is designed to familiarize the student with the acceptance testing that must be completed before a working system is considered for live traffic.

Objectives

Using student guide, classroom notes, NTPs, and a live FMT-150 system, the student will be able to:

1. Determine what acceptance tests must be performed on a given FMT-150 system

2. Follow detailed procedures in order to perform specific acceptance tests to verify proper circuit operation

ACCEPTANCE TESTS LABORATORY

TABLE OF CONTENTS

ACCEPTANCE TESTING

Once the FMT-150B/C/D is installed it must pass a number of tests before being ready for service. The specific tests required vary with the system being installed. These requirements as well as the detailed procedures involved can be found in section 321-3211-203 of the NTP.

The following procedures will take you step by step through the testing process for the system in your classroom. Answer each of the questions asked by performing the indicated operation and recording your observations. Refer to the NTP section above when necessary.

Recommended Test Equipment

Test Apparatus

Tau-Tron S5104 Digital Transmission Test Set

Tau-Tron S5250 Digital Transmission Test Set

12XE Photodyne Optical Power Meter equipped with 2017 Adaptor (Biconical), 2021 (PC) Adaptor, and 2005 Blank Adaptor

NT6F24AA Variable Optical Attenuator e/w Biconical Connectors

8000A Fluke Digital Multimeter

VT-100 CRT or equivalent

Test Cables

Code	Description
NT3E15AA	A 5 m (16 ft) length of strengthened single-fiber cable
NT3E42AA	A 5 m (16 ft) length of strengthened single-fiber cable with biconical connectors at each end.
NE-P2BJ	2 m (6 ft) coaxial cable with an NT-358A-type plug at each end
NT1E41AA	3 m (10 ft) 75-ohm coaxial cable with a 51-111-3059-99 plug at one end and a NT-358-type plug at the other end
NE3P6E	3 m (10 ft) 310-to-alligator clips test cord
NE3E02AA	WECO to Subminax adaptor (or a short cable).

Note: Equivalent Equipment to those items listed above is acceptable.

Safety Precautions

In addition to the standard equipment safety precautions, the following special precautions should be observed:

> Caution: Never look into an optical connector or fiber. Laser radiation, although invisible and painless, may cause permanent damage to your eyesight.

- Handle fiber patchcords gently. Although much more resilient than earlier optical patchcords, these used on the FMT-150 system should still be treated with care. Never put excess strain on them, and always clean optical connectors before using in accordance with DP 1034 Section 321-3211-201.
- Always wear a static strap. Static straps (or other approved methods of grounding) are necessary to prevent damage to the voltage-sensitive integrated circuits in the FMT-150 system.

> Caution: The use of controls or adjustments or the performance of procedures, other than those specified herein, may result in hazardous radiation exposure.

- To perform these tests for an unprotected system, the system must be out-of-service.

References

Student Guide
NTP section 321-3211-203

Procedures

Procedure 1: Required Tests

NTP section 321-3211-203 contains a set of detailed procedures (DPs) which explain how to test FMT-150 shelves. Not all DPs are required at a given site. We must first determine which DPs are applicable to our specific system.

1. Locate the Test Task (TT) list on page 1 of the NTP section listed above. This list will give us the Test Procedure (TP) needed for our particular system.

   What system are you testing?____________________

Note: Answers given for the FMT-150B/C

   What TP is listed for your system?__________

2. Turn to the indicated TP. These are given immediately following the task list. This gives you a list of the detailed procedures (DPs) which need to be performed on your system.

   How many DPs are listed for your test procedure?____

   Each of these must be performed to ensure acceptance of the system.

   The following procedures are some of the DPs for the FMT-150B/C and FMT-150D systems.

Note to Instructor: Many answers will vary as they are dependent on the system being used or actual measurements being taken by the students.

Input Power

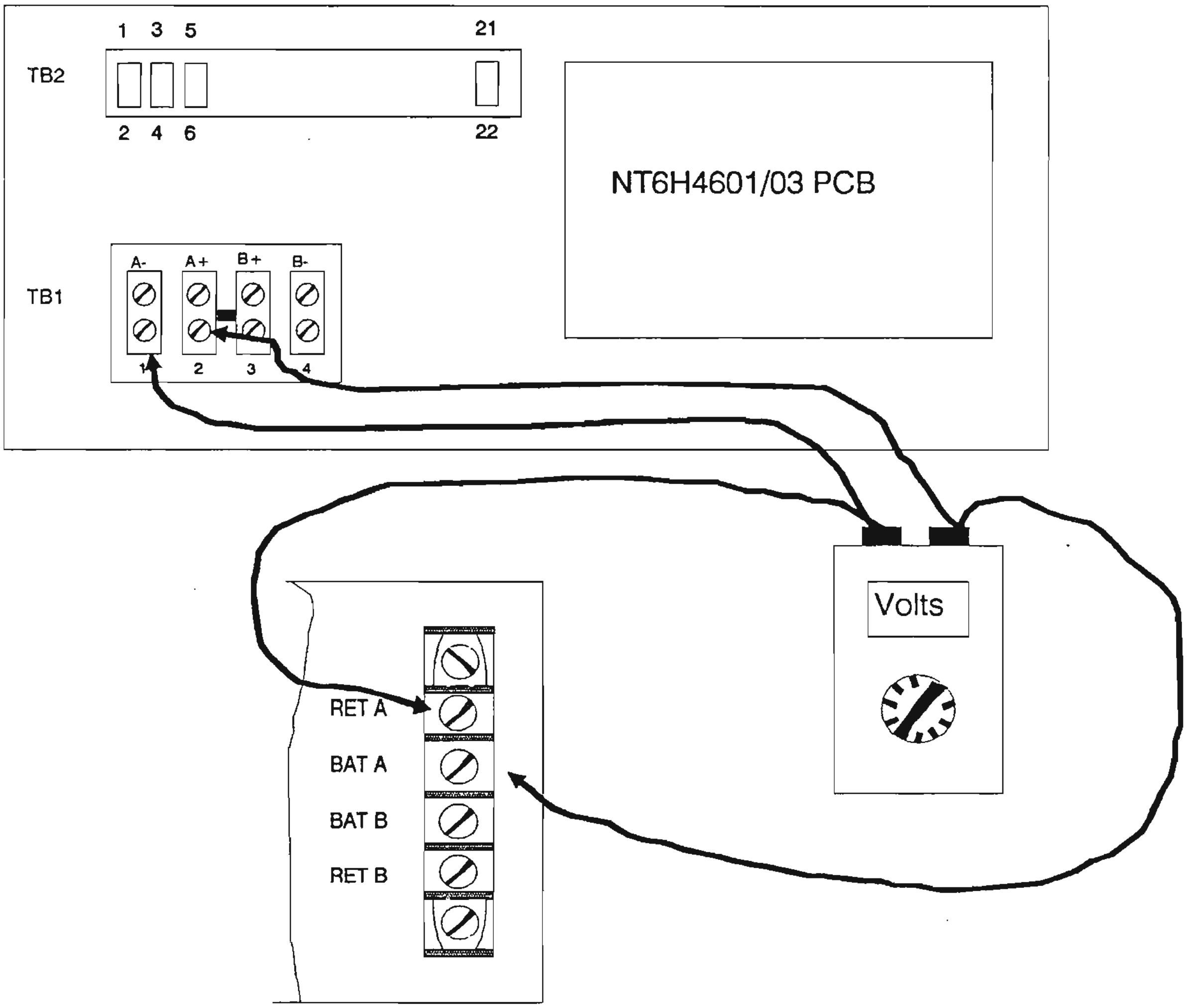


Figure 1

Procedure 2: Input Power Distribution Tests

Ref. Fig. 1

All FMT-150 plug-in modules should be removed prior to beginning this procedure.

Note: Antistatic precautions should be observed when handling modules.

1. Install the fuse (or reset breaker) on the battery distribution fuse board feeding the bay containing the FMT-150 shelf.

2. At the fuse and alarm panel, loosen the screw on the faceplate to access the terminal blocks. Measure the voltage at the terminal blocks.

Record input voltage A__________

Record input voltage B__________

Do these voltages meet the requirements listed in Figure 1?

(If not adjust them to within the required range.)

3. Install the required fuses in fuse holders at the front of the fuse and alarm panel.

4. Measure the voltage at the backplane of the FMT-150 shelf and verify polarity. Verify that the voltages measured are as indicated in step 2.

PSU Voltage Adjustment

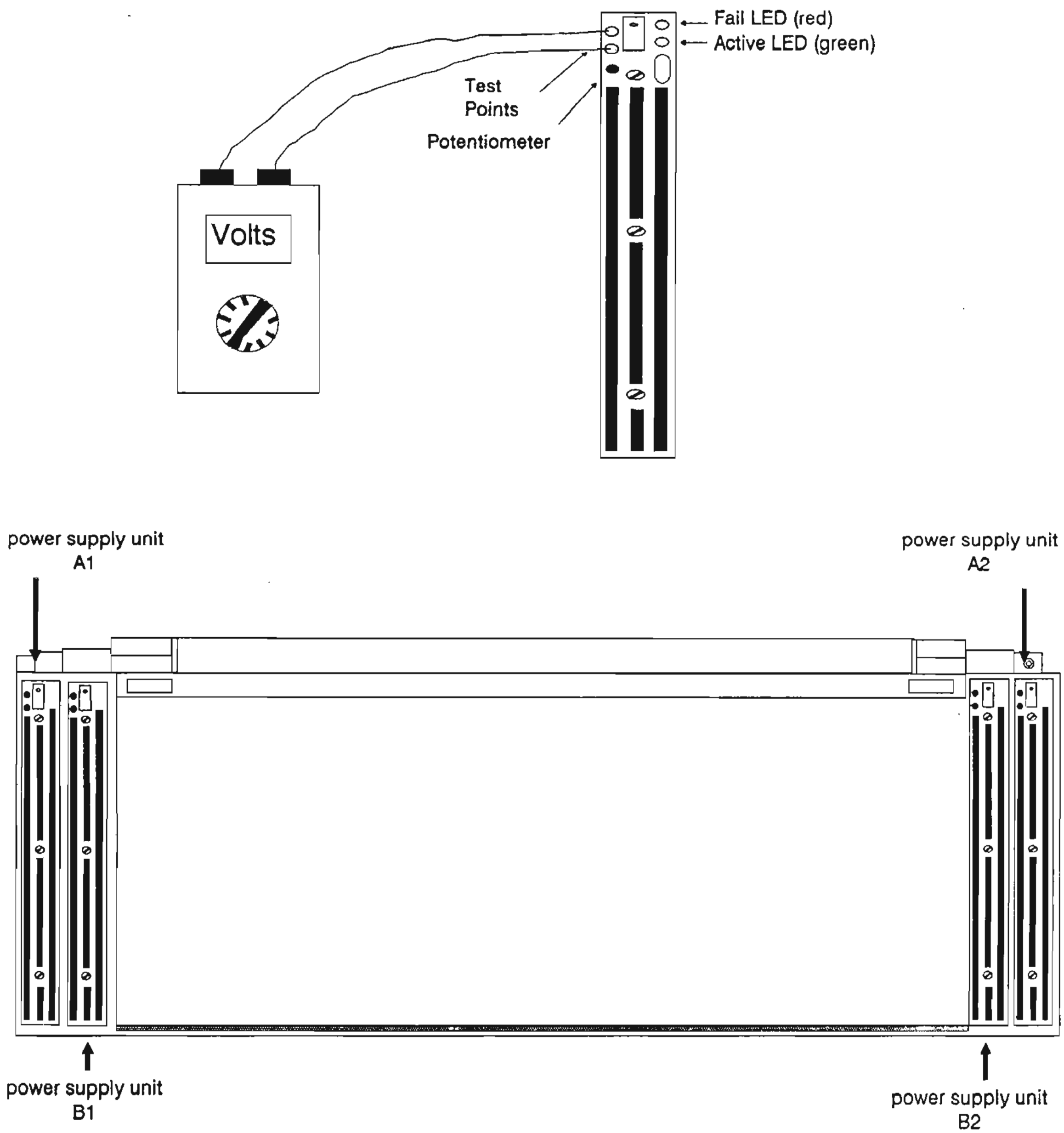


Figure 2

Ref. Fig. 2

5.Switch all four Power Supply Units ON.

Protected Configuration

6. Switch PSU A1 OFF.

7. At PSU B1, measure the voltage across the two test points.

   Does the voltage meet the specifications given in Table 1 (see the following page)?

   Using the potentiometer, adjust the voltage to within the required range.

8. Switch PSU A1 ON.

9. Repeat step 6 for PSU B1, step 7 for PSU A1, and step 8 for PSU B1.

10. Repeat step 6 for PSU A2, step 7 for PSU B2, and step 8 for PSU A2.

11. Repeat step 6 for PSU B2, step 7 for PSU A2, and step 8 for PSU B2.

Unprotected configuration

12. Switch both Power Supply Units ON.

13. At PSU A1, measure the voltage across the two test points. Using the potentiometer, adjust the voltage to specifications listed in Table 1.

14. Repeat step 13 for PSU A2.

Power Supply Unit Adjustment Levels

Power Supply Unit	FMT-150B	FMT-150C	FMT-150D
A1,B1	5.4 ± 0.04V	5.2 ± 0.02V	5.4 ± 0.04V
A2,B2	5.2 ± 0.02V	5.2 ± 0.02V	5.2 ± 0.02V

Table 1

Optical Output Power

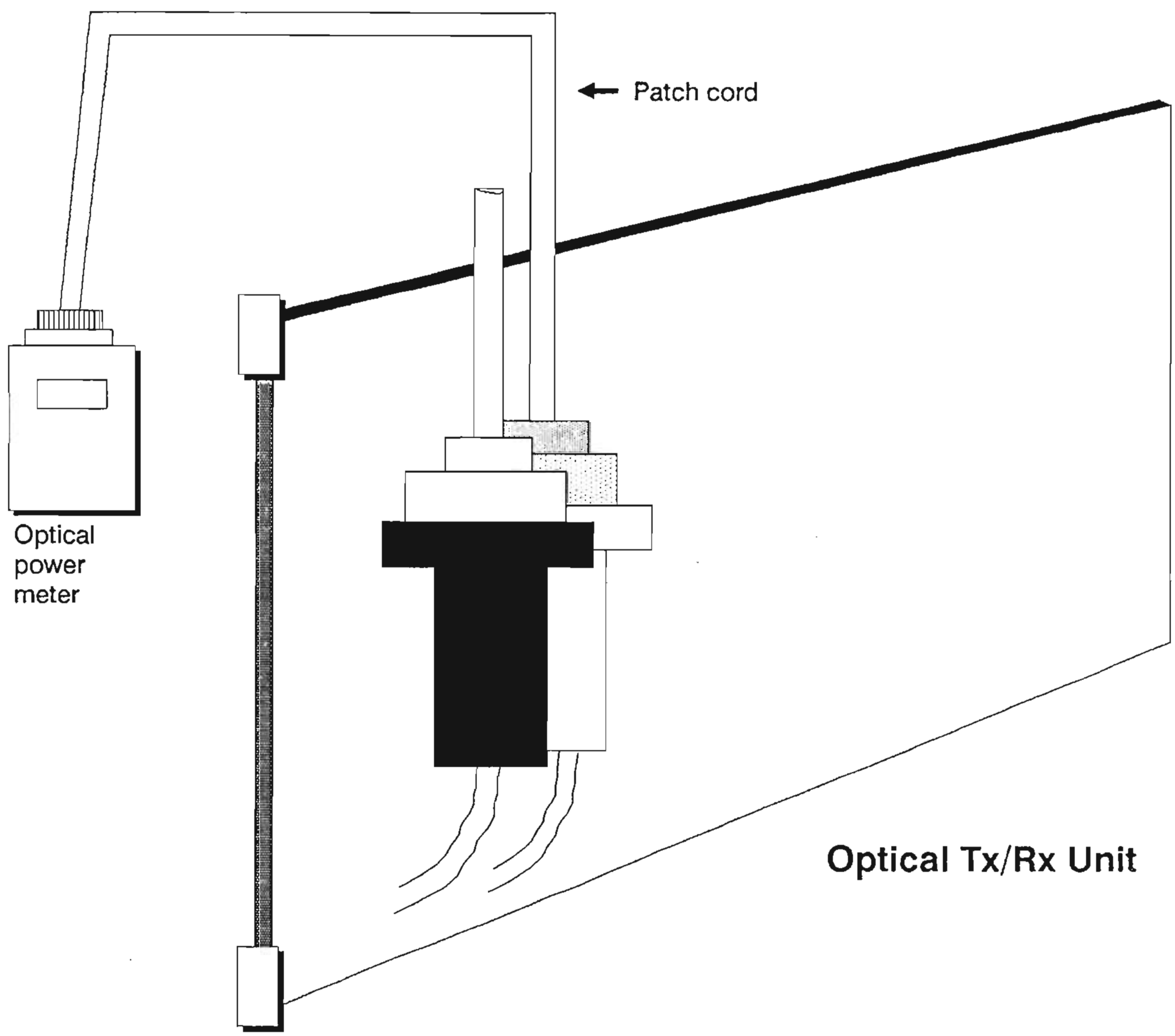


Figure 3

Procedure 3: Measure Transmitted Optical Output Power

Ref. Fig. 3

1. Disconnect the fiber cable (Tx OUT) from the Optical Tx/Rx Unit.

2. Connect one end of a patch cord to an optical power meter and the other end to the Optical power.

3. Measure the optical power. Record your results.

   NT7H80 ___ = or > ___

   Do they meet the minimum requirements listed below?

Optical Tx/Rx UnitPower level greater than

NT7H80AA	-11.5 dBm (i.e. -11)
NT7H80AE	-4.5 dBm (i.e. -4)
NT7H80BA	-0.3 dBm (i.e. +0.2)

If the requirements are not met, refer to Chart DP 2101-1 in the NTP.

Note: The reading in step 3 should be performed three times, and an average value should be taken as the final measurement.

4. Disconnect the optical test cord from the optical connector.

5. Reconnect the single-fiber cable to the optical connector.

6. Repeat steps 1 through 5 for each 150 Mb/s Tx/Rx module in the FMT-150 shelf.

Receiver Sensitivity

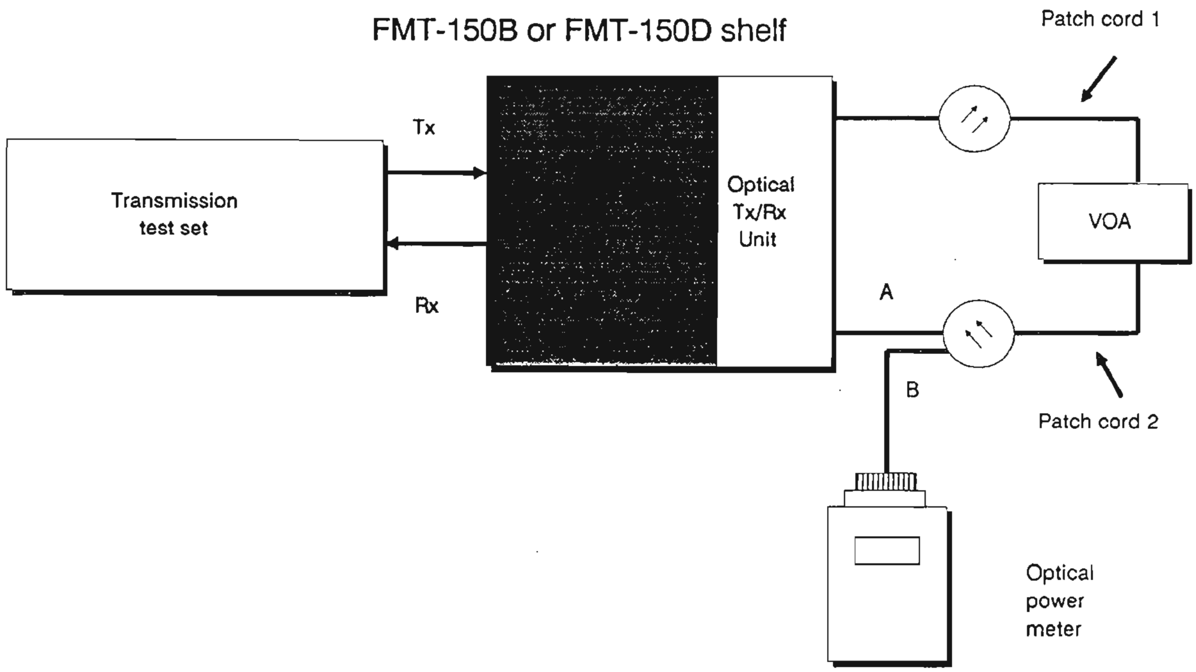


Figure 4

Procedure 4: Measure Receiver Sensitivity

Ref. Fig. 4

1. Loopback Optical Tx/Rx Unit A, through a VOA, using patch cords (configuration A in Figure 4).

Note 1:For NT7H80AB Optical Tx/Rx Unit, set VOA at 20 dB.

Note 2:For the duration of this test, switch A of the Optical Tx/Rx Unit should be set to Head Terminal (to provide clock source).

2. Adjust the VOA until the Optical Input Fail LED on the Optical Tx/Rx Unit A is ON.

3. Disconnect the patch cord from the Optical TX/Rx Unit and connect it to the optical power meter (configuration B in Figure 3).

   NT7H80 ___ = or < ____dbm

   Does this fall under the maximum allowable values listed below?

Optical Tx/Rx Unit	Power level less than
NT7H80AA	-29.6 dBm (for example, -30)
NT7H80AE	-35.0 dBm (for example, -36)
NT7H80BA	-23.0 dBm (for example, -24)

4.Repeat steps 1 to 3 for Optical Tx/Rx Unit B.

Received Optical Power

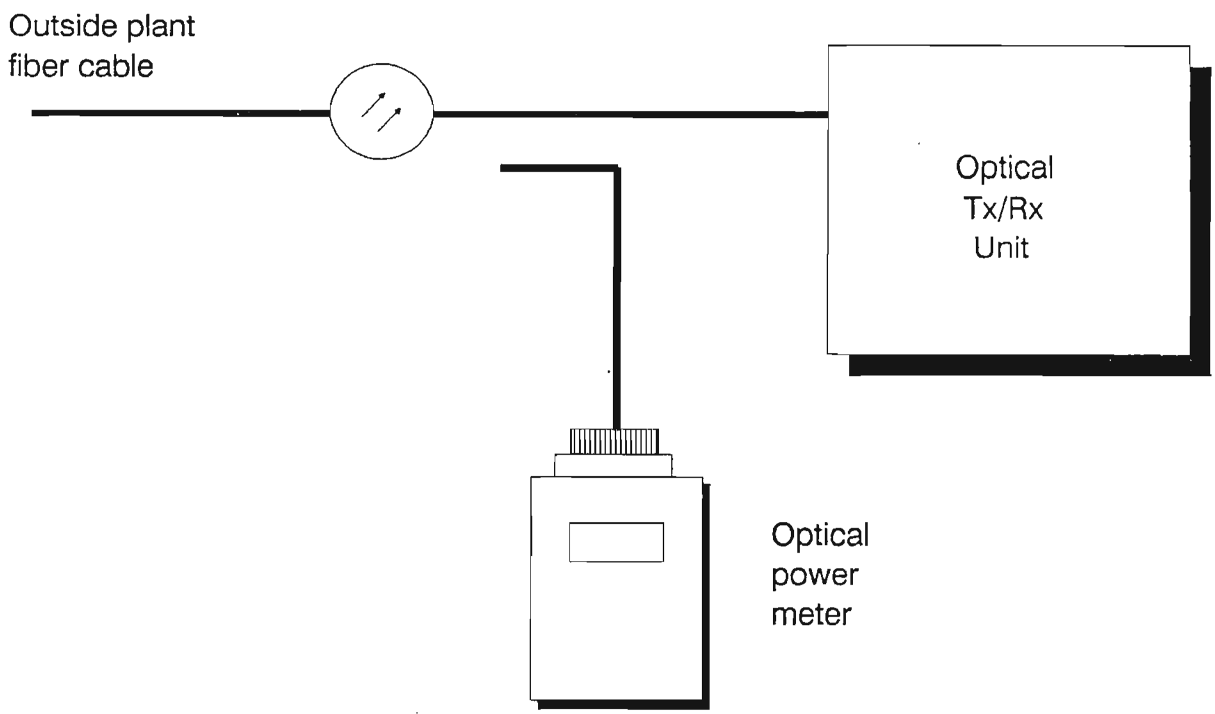


Figure 5

Procedure 5: Measure Received Optical Power

Ref. Fig. 5

1. Disconnect the fiber cable (Rx IN) from the Optical Tx/Rx Unit, and connect the fiber cable to the optical power meter.

2. Measure the optical power. Record your results.

   NT7H80____ = or < _____ dbm

Does this meet the minimum requirements?

Module	Power level greater than
NT7H80AA/PA	-29.6 dBm (BER < 10^{-9}) or -28.1 dBm (BER < 10^{-12})
NT7H80AB/AE/PB	-35.0 dBm (BER < 10^{-9}) or -33.5 dBm (BER < 10^{-12})
NT7H80BA/PC	-23.0 dBm (BER < 10^{-9}) or -21.5 dBm (BER < 10^{-12})

3. Verify that measured received optical power corresponds with calculated received power.

> **Caution:** Receiver optical input power must not exceed -13.0 dBm (NT7H80AB/AE/PB) and -9.0 dBm (NT7H80AA/PA), or damage to the module may result.

Local BER Test

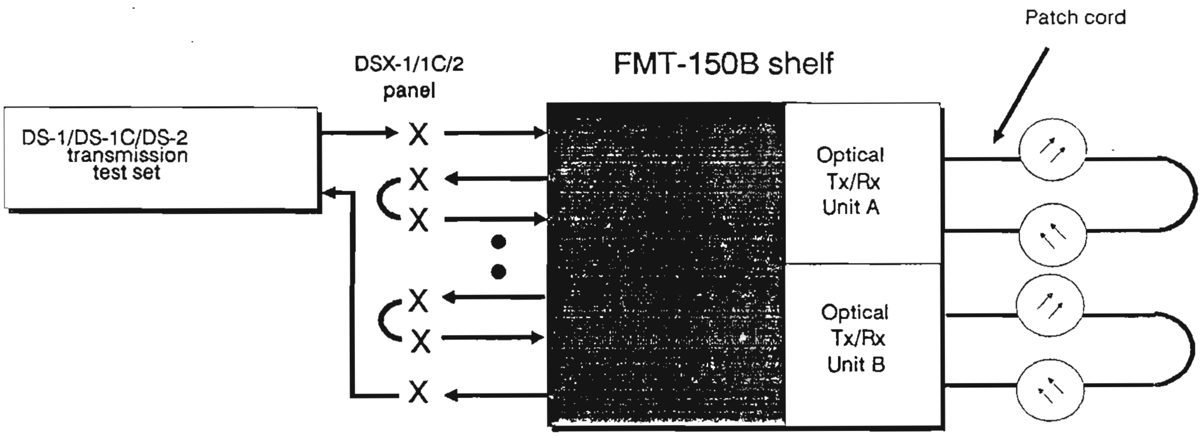


Figure 6

DSX-1/1C/2

From	To
Tributary 1 OUT	Tributary 2 IN
Tributary 2 OUT	Tributary 3 IN
Tributary 3 OUT	Tributary 4 IN
.	.
.	.
.	.
Tributary 27 OUT	Tributary 28 IN

Table 2

Procedure 6: FMT-150B/C Local BER Test

Ref. Fig. 6

1. Using a patch cord with the VOA set at 20 dB, loopback 150 Mb/s Tx/Rx modules A and B by connecting TX OUT to RX IN for each unit.

Note: For the duration of this test, Switch A of the 150 Mb/s Tx/Rx modules must be set to Head Terminal (to provide clock source).

2.At the DSX-1/1C/2 cross-connect panel, loopback tributaries in accordance with Table 2 using patch cords.

3. At the DSX-1/1C/2 cross-connect panel, connect the transmission test set output to tributary 1 IN, and the transmission test set input to tributary 28 OUT.

4. Force switch traffic to DS-3 translator module 1A (refer to NTP 321-3211-301,DP 3030).

5. Operate the BIT-ERROR-INJECT pushbutton on the transmission test set three times.

Requirement: Transmission test set displays 3-bit errors.

6. Reset the error count to zero, then allow the system to run for a 5-minute test interval.

   Record the actual test results.__________

Requirement: Transmission test set displays 0-bit errors.

FMT-150B/C Local BER Test (Cont'd)

7. Force switch traffic to DS-3 translator module 1B (refer to NTP 321-3211-301,DP 3030).

8. Repeat steps 5 and 6.

9. Reset switch A on the 150 Mb/s fiber interface to its original setting.

10. Force switch traffic back to the DS-3 translator 1A module (refer to NTP 321-3211-301, DP 3030).

End-to-End BER Test

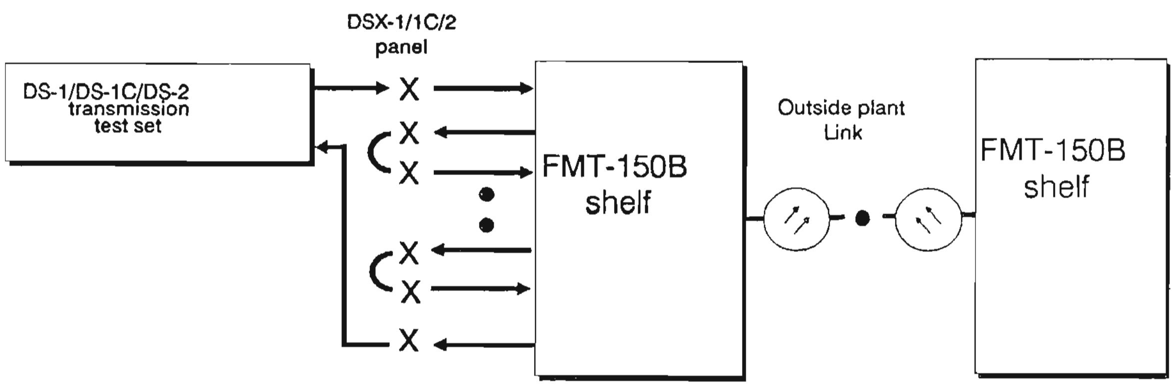


Figure 7

DSX-1/1C/2 Panel Connections

From	To
Tributary 1 OUT	Tributary 2 IN
Tributary 2 OUT	Tributary 3 IN
Tributary 3 OUT	Tributary 4 IN
.	.
.	.
.	.
Tributary 27 OUT	Tributary 28 IN

Table 3

Procedure 7: FMT-150B/C End-to-End BER Test

Ref. Fig. 7

1. At the DSX1/1C/2 cross-connect panel, loopback tributaries in accordance with Table 3 using patch cords.

2. At the DSX-1/1C/2 cross-connect panel, connect the transmission test set output to tributary 1 IN, and the trans mission test set input to tributary 28 OUT.

3. Force switch traffic to DS-3 translator module 1A at both terminal sites (refer to NTP 321-3211-301, DP 3030).

4. Using the CRT interface, operate loopback on all tributaries (refer to NTP 321-3211-301, DP 3036).

5. Operate the BIT-ERROR-INJECT pushbutton on the transmission test set three times.

Requirement: Transmission test set displays 3-bit errors.

6. Reset the error count to zero, then allow the system to run for a 5-minute test interval.

   Record the actual test results.__________

Requirements: Transmission test set display 0-bit errors.

7. Force switch traffic to DS-3 translator module 1B at both terminal sites (refer to NTP 321-3211-301, DP 3030).

8. Repeat steps 5 and 6.

9. Release loopback on all tributaries (refer to NTP 321-3211-301, DP 3036).

10. Force switch traffic back to DS-3 translators 1A module at both terminal sites (refer to NTP 321-3211-301, DP 3030).

Test Customer Input

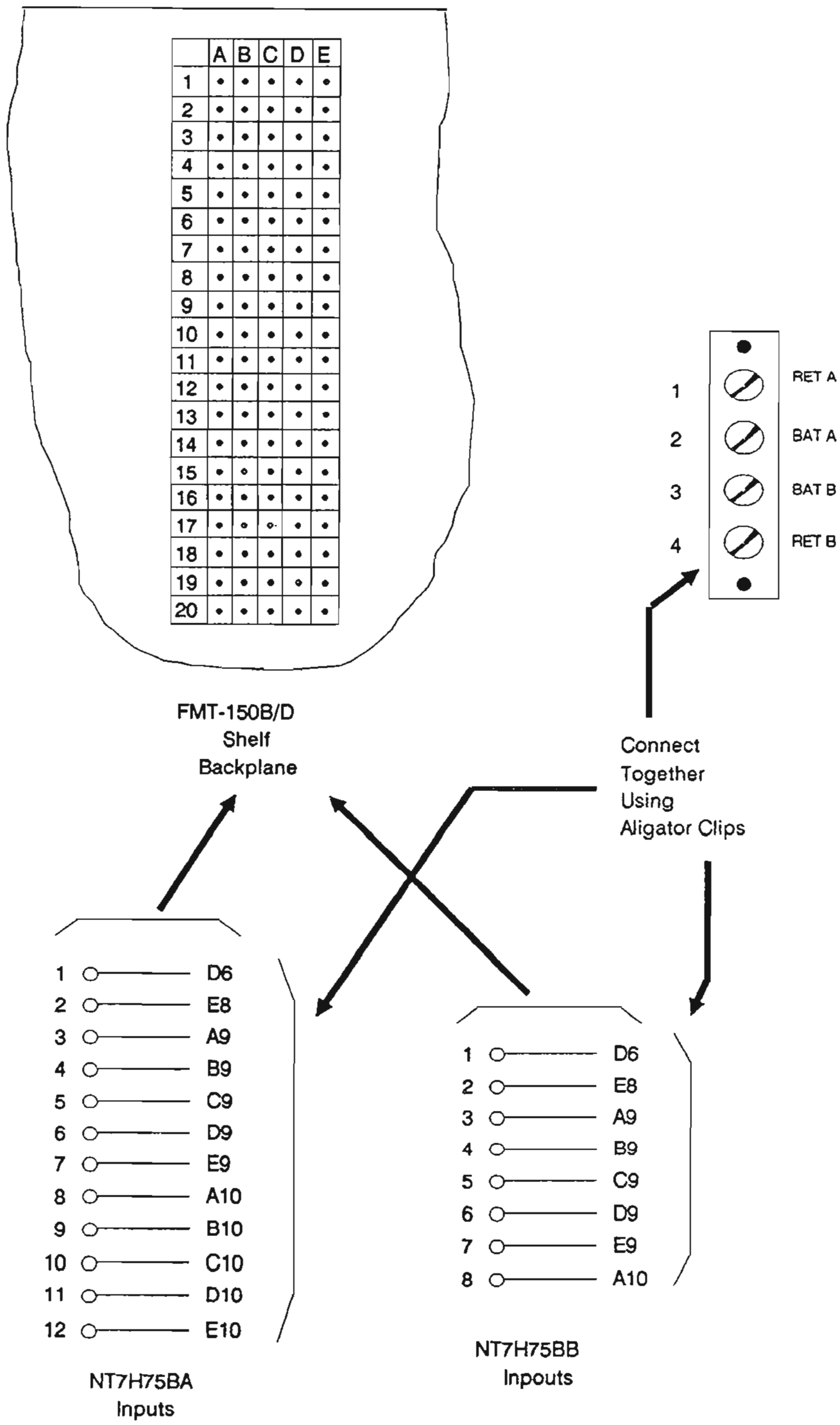


Figure 8

Procedure 8: Test Customer Inputs and Outputs

Customer Input

Ref. Fig. 8

To be used if SCU NT7H75BA or BB is equipped.

The following procedure must be performed individually for both Fiber Transports #1 and #2:

1. Connect the customer input under test to battery return using a mini-alligator clip, as shown in Fig. 8.

2. Using a VT100 emulating CRT terminal, display the common equipment-level alarm screen, and verify that the customer input is active. To display the common equipment-level alarm screen enter the following commands:

   "Alarms at node # for Common equipment"

Note: If using a Tandy 200, to display the customer input and verify that it is active enter the following commands:

   "Alarms at node # for customer inputs and outputs"

3. Remove the mini-alligator clip from the customer input.

4. For customer input #1 and customer input #2 only, clear the customer input using the VT100 emulating CRT or a Tandy 200 terminal by entering the following commands:

"Switch at node # for Customer input #" if NT7H90CA is equipped OR "Alarms at node # for Common equipment Customer input #" if NT7H90DA/GA is equipped.

5. Repeat steps 1 to 4 for all customer inputs (Note: NT7H75BA will support 12 customer inputs, while NT7H75BB will support only 8 customer inputs).

Record the results:

Customer Input #1	____
Customer Input #2	____
Customer Input #3	____
Customer Input #4	____
Customer Input #5	____
Customer Input #6	____
Customer Input #7	____
Customer Input #8	____
Customer Input #9	____
Customer Input #10	____
Customer Input #11	____
Customer Input #12	____

(√ indicates requirement is met)

Test Customer Output

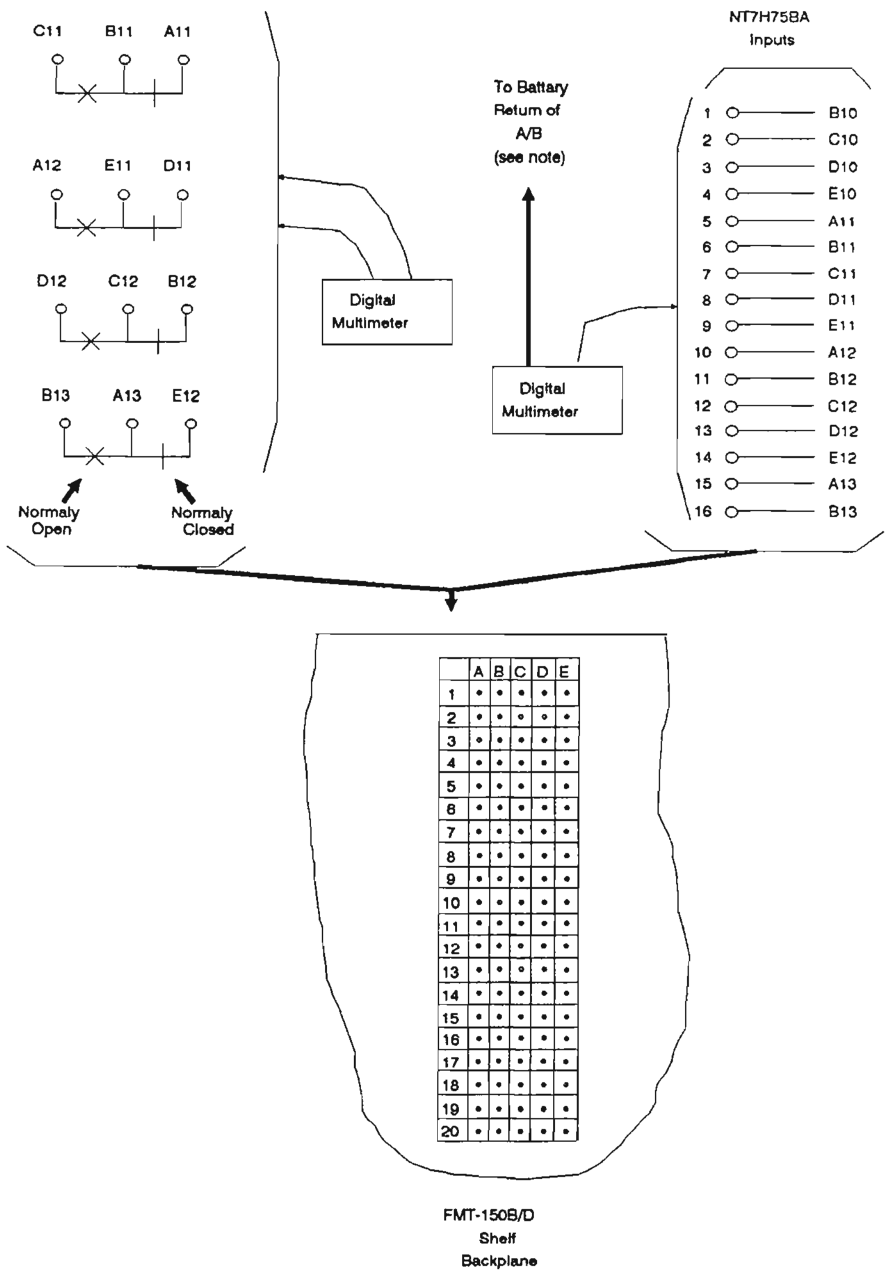


Figure 9

Note: Outputs for the NT7H75BB module will be relative to either the battery (-48/-24 V) or the battery return, depending on the position of the jumper SW17 on the NT7H75BB module.

Customer Output

Ref. Fig. 9

To be used if SCU NT7H75BA or BB is equipped.

Perform Procedure A if NT7H75BA and NT7H90DA/GA is equipped and Procedure B if NT7H75BB and NT7H90CA is equipped.

Note: NT7H75BA supports 4 customer outputs, while NT7H75BB supports up to 16 customer outputs.

Procedure A: Perform the following procedure individually for both Fiber Transports #1 and #2. Record your results on the chart following Procedure A.

1. For the customer output under test, measure the resistance across the normally closed contact and the common contact.

Requirement: zero ohms ($0\,\Omega$)

2. Using a VT100 emulating CRT or a Tandy 200 terminal, enable the customer output by entering the following commands:

"Configure Node # for Customer output # Enable"

Requirement: infinite resistance ($\infty\,\Omega$)

3. Using a VT100 emulating CRT or a Tandy 200 terminal, disable the customer output by entering the following commands:

"Configure Node # for Customer output # Disable"

4. Measure the resistance across the normally open contact and the common contact.

Requirement: infinite resistance ($\infty \, \Omega$)

5. Using a VT100 emulating CRT or a Tandy 200 terminal, enable the customer output by entering the following commands:

"Configure Node # for Customer output # Enable"

Requirement: zero ohms ($0 \, \Omega$)

6. Using a VT100 emulating CRT or a Tandy 200 terminal, disable the customer output by entering the following commands:

"Configure Node # for Customer output # Disable"

7. Repeat steps 1 to 6 for all customer outputs.

Note: Verify normally Open (NO) and Normally Closed (NC) conditions for customer output contacts.

Record your results here:

	Normally Closed (0 Ω)	Enable Customer Output (∞ Ω)
A-11 and B-11	_____	_____
D-11 and E-11	_____	_____
B-12 and C-12	_____	_____
E-12 and A-13	_____	_____

	Normally Open (∞ Ω)	Enable Customer Output (0 Ω)
C-11 and B-11	_____	_____
A-12 and E-11	_____	_____
D-12 and C-12	_____	_____
B-13 and A-13	_____	_____

(√ indicates requirement is met)

Procedure B:

Perform the following procedure individually for both Fiber Transports #1 and #2. Record your results on the table provided.

1. Display the Common equipment or Customer inputs and outputs alarm screen and verify that the customer output under test is cleared (i.e. the customer output doesn't display an asterisk):

   If using a VT100 emulating CRT→"Alarms at node #(# is the local node) for Common equipment"

   If using a Tandy 200→"Alarms at node # (# is the local node) for customer inputs and outputs"

   To clear a customer output that displays an asterisk, enter the following commands:

   "Configure Global customer output # (# is the customer output under test) Control Manual"

   "Switch at node # (# is the customer output under test) Clear"

2. For the customer output under test, measure the voltage across the output pin and either the BAT RET or the -48V depending on the selection of jumper SW17 located on the NT7H75BB module (See Note below).

Note: If BAT RET was selected, then to measure the customer output under test, you must measure the voltage across the output pin and BAT A/BAT B located on the backplane.
On the other hand if BAT A/BAT B was selected, then to measure the customer output under test, you must measure the voltage across the output pin and BAT RET located on the backplane.

Requirement: Continually varying voltage (floating voltage) if the output for the NT7H75BB was selected as normally open and +/- 48 Volts if the output was selected as normally closed.

3. To manually activate the customer output under test, enter the following commands using the VT100 emulating CRT or a Tandy 200:

   "Switch at node # (# is the customer output under test) Set"

4. Repeat Step 2.

   Requirement: +/-48 Volts if the output for the NT7H75BB was selected as normally open and continually varying voltage (floating voltage) if the output was selected as normally closed.

5. Clear the customer output under test by entering the following commands:

   "Switch at node # (# is the local node) for customer output # (# is the customer output under test) Clear"

6. Repeat steps 1 to 5 for all customer outputs.

   All Customer outputs operate as detailed above.

   Record your results on the following table:

Customer Output #1	______
Customer Output #2	______
Customer Output #3	______
Customer Output #4	______
Customer Output #5	______
Customer Output #6	______
Customer Output #7	______
Customer Output #8	______
Customer Output #9	______
Customer Output #10	______
Customer Output #11	______
Customer Output #12	______
Customer Output #13	______
Customer Output #14	______
Customer Output #15	______
Customer Output #16	______

(√ indicates requirement is met)

Procedure 9: Test Order Wire Continuity

1. At the originating test site, press the order-wire pushbutton (from LOCAL 1, EXPRESS 1, LOCAL 2, EXPRESS 2, LOCAL 3,and EXPRESS 3) which will ring at the answering test site (the sites must be on a common DS-3 signal, either 1, 2, or 3 in order to ring each other).

2. At the receive site, adjust the Ring-Level potentiometer to a satisfactory volume.

3. At the receive site, answer the call by inserting the handset or headset plug into the order-wire jack and pressing the flashing pushbutton at the shelf.

4. Adjust the Receive-Level potentiometer at both sites to a comfortable volume.

5. Verify proper voice transmission by talking.

6. Release the call by pressing the "#" key on the handset or headset.

7. Repeat steps 1, 3, 5, and 6 for each DS-3 signal that links the two sites under test.

8. Use selective dialing (use hand/headset pushbuttons) to ring the answering site from the originating site. Do this on both the local and express channels for each STX which links the sites under test, as well as with the local and express broadcast calls (which both ring all sites). Repeat steps 3, 5, and 6 for each case.

Note: The SCU must be set for DTMF operation for selective site dialing.

9. Let the originating site become the answering site, and vice-versa, then repeat steps 1 through 8 (except for step 4).

10. Perform steps 1 through 9 for every combination of two sites in the FMT-150 network.

Test Order Wire Performance

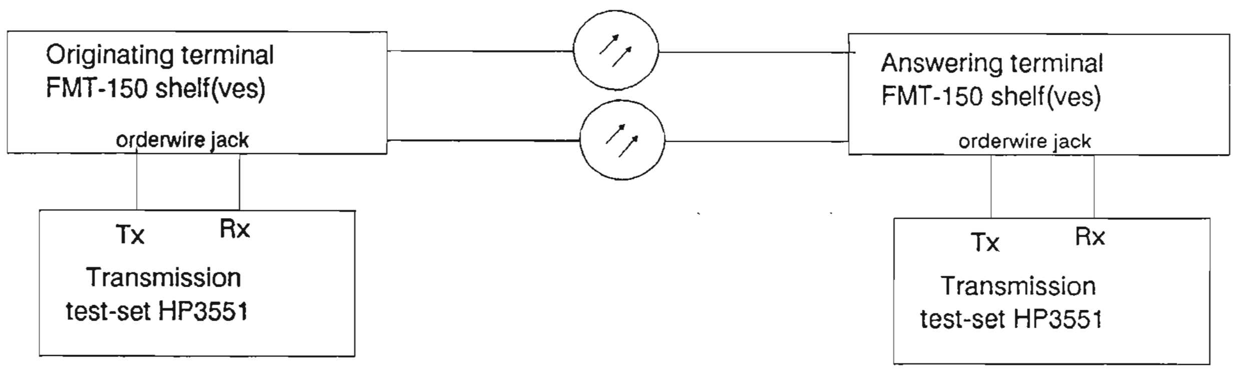


Figure 10

Test Order Wire Specifications

Ref. Fig. 10

1. At both terminal sites, connect voice-frequency trans mission test sets, as shown in Fig. 10.

2. Set the controls on the transmission test set as follows:

Power:	AC
Hold:	OFF
Function:	SEND at East end RECEIVE at West end
Impedance:	600 W
Frequency:	1 kHz
Level:	-16 dBm

3. Send one 1 -kHz tone from the originating terminal. Measure the received level at the west terminal.

   Record received level ________ dBm.

   Requirement: -1 to +1 dBm

4. Repeat steps 1 through 3 for the other direction of transmission.

5. Repeat steps 1 through 4 for another combination of two sites in the network until all combinations of two sites are exhausted.

APPENDIX D

FMT-150B/C/D TROUBLESHOOTING GUIDE

PURPOSE

The purpose of this section is to introduce the student to the FMT-150B/C/D Troubleshooting Guide.

OBJECTIVES

Using the student guide, classroom notes, and NTPs, the student will be able to:

1. Identify the four levels of alarm indications in order to localize problems

2. List all equipment which use LED indicators

FMT-150B/C/D TROUBLESHOOTING GUIDE

TABLE OF CONTENTS

Description **Page**

TROUBLESHOOTING

Every FMT-150 provides adequate system alarms to effectively troubleshoot all failures. The optional external interface (E2A) is useful in pinpointing failures to a specific site (especially valuable with unmanned offices), but is not required for essential operation.

As signal processing faults tend to propagate in the direction of transmission, follow all alarms to the upstream site (especially when troubleshooting optical alarms). Concentrate the initial search at this site and then work to the downstream site, eliminating alarms and problems on one site at a time.

Four levels of alarms are implemented on the FMT-150:

- Bay
- Shelf
- Monitor and Control faceplate or the CRT
- Circuit pack

By following these alarm indications, a troubleshooter can generally localize any problems.

Bay and shelf lamps are defined as Major and Minor. Circuit pack alarms are defined as Unit Fail alarms.

LED INDICATORS

All active FMT-150 circuit packs provide one or more types of LED indicators (red, yellow, and green) which greatly aid in the troubleshooting process. Unit Fail LEDs (red) usually indicate that the circuit pack itself has a problem. These red fail LEDs are provided for the following circuit modules:

- DS-1 Tx/Rx
- DS-1C Tx/Rx
- DS-2 Tx/Rx
- DS-3 Translator
- 150 Mbps Tx/Rx module
- Monitor and Control module
- Maintenance Control Unit
- Service Channel Unit

In addition to the red fail LED, the DS-3 Translator module is equipped with the following LEDs:

- **No DS-3 input** (yellow): Indicates that the presence of a DS-3 signal source cannot be detected.
- **Frame loss** (yellow): Indicates that the incoming DS-3 frame cannot be detected.
- **Active** (green): Indicates that the module is in the working mode.

In addition to the red fail LED, the 150 Mbps Tx/Rx module is equipped with the following:

- **Optical input fail** (yellow): Indicates that the incoming light level has degraded past the receiver's sensitivity threshold (i.e., broken fiber)
- **Laser degrade** (yellow): Indicates that the optical laser source has exceeded the internal degrade threshold.
- **Master clock** (green): Indicates that the module is currently supplying the internal clock source.
- **Active** (green): Indicates that a minimum of one DS-3 Translator corresponding to this optic module is active.

The Power Supply Unit is also equipped with one green LED indicating the module is active, and one red LED to indicate that the module has failed or has been turned off.

REPLACEMENT METHOD

Due to the modular nature of the FMT-150 system, all failures can be corrected by circuit pack replacement; no circuit packs are field-repairable. Whenever replacing a circuit pack, ensure all option settings are accurate. (Do not simply copy the switch settings from the module you are replacing - they may have been set wrong).

If replacing a particular circuit pack does not clear the problem, re-insert the original circuit pack before replacing something else. Otherwise, it becomes impossible to determine, once the system is cleared, just what action was responsible for repairing the fault and which pack to return for repair.

Always wear a static strap whenever replacing any FMT-150 circuit pack.

FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS

This procedure allows the user to interpret local indications, such as LEDs and lamps on FMT-150 equipment. The possible causes of the alarm conditions are given, and appropriate maintenance action is suggested.

Procedure:

1. Remove the cover (if used) from the FMT-150 shelf in alarm

2. For FMT-150B and C shelves, unlock the monitor and control faceplate(s), and tilt downwards to view the circuit modules located behind.

3. Observe all modules in the shelf, and the PEC code (NT...) of the module(s) showing an alarm indication, which is signified by either a red or yellow LED.

4. Refer to the appropriate figure(s) (Figure 1 to 10) for the module(s) in alarm

5. Refer to Table 1 to find possible causes of the indication, and take the maintenance actions indicated.

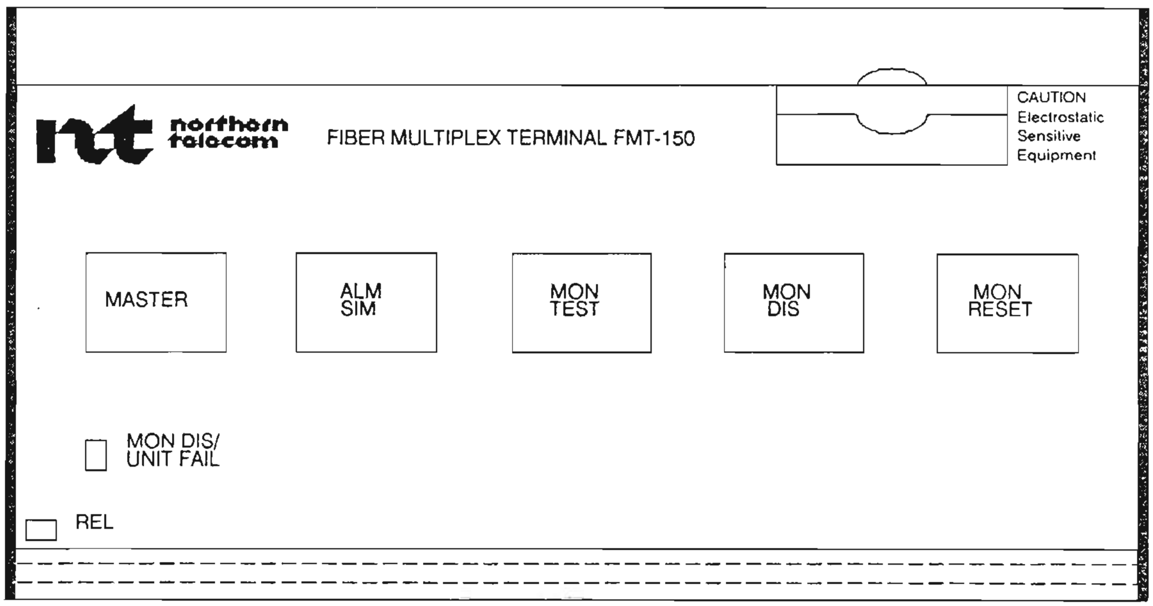
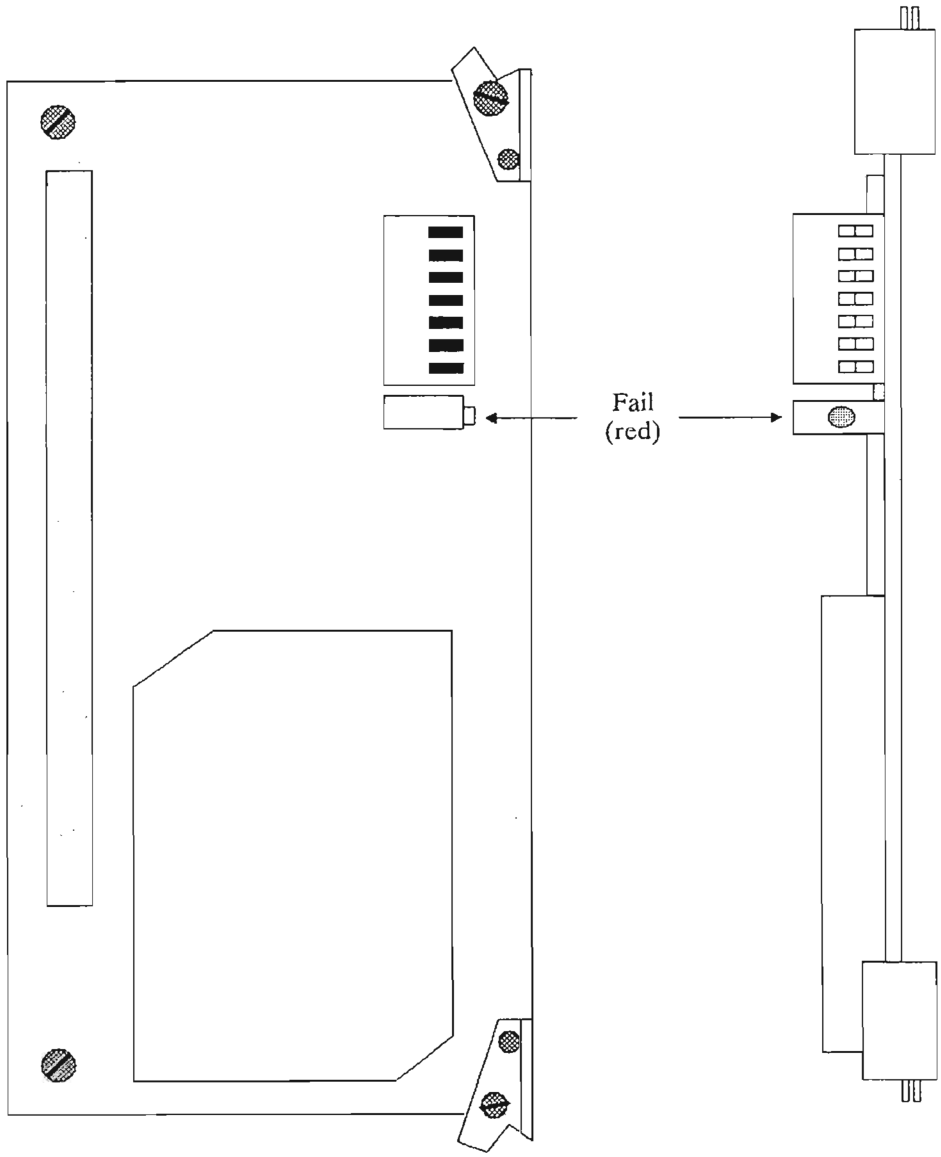
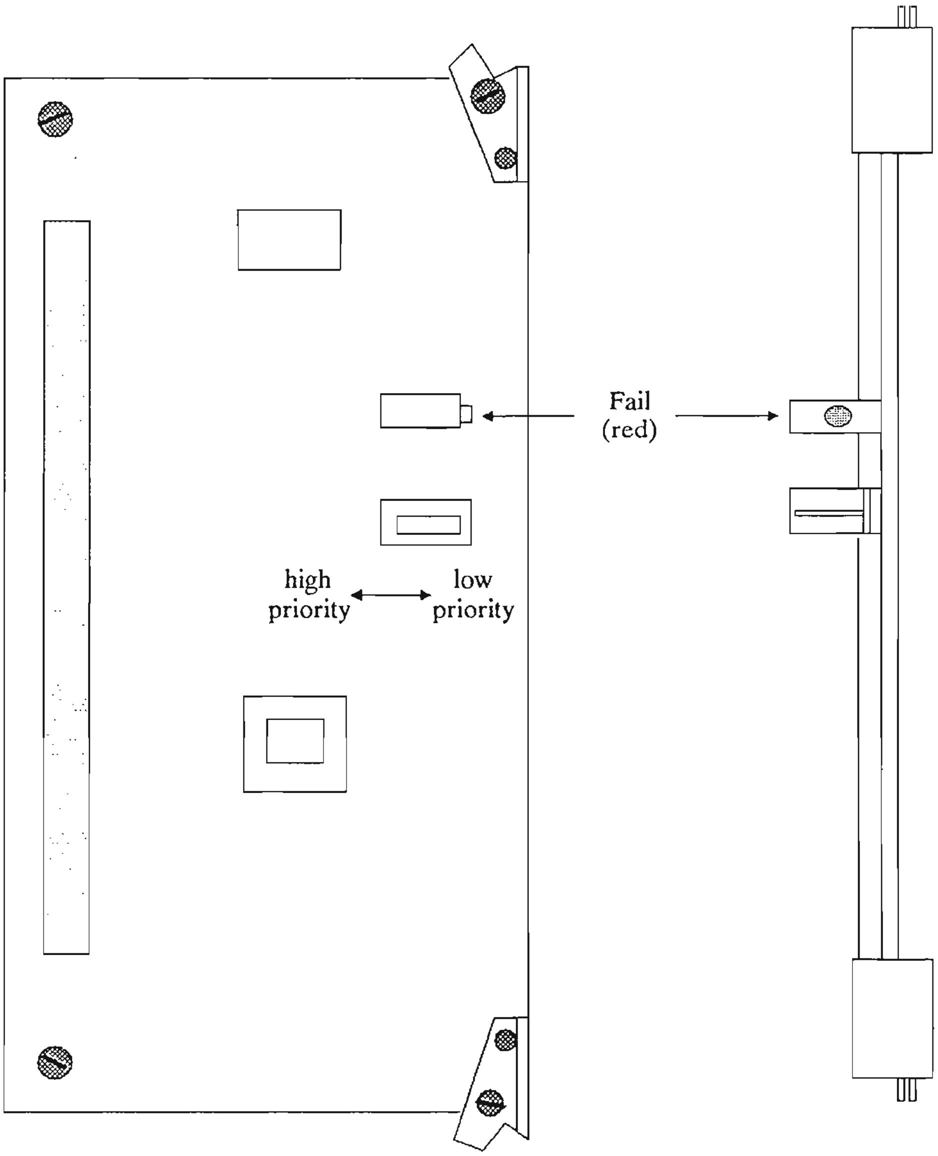

northern telecom
FIBER MULTIPLEX TERMINAL FMT-150
CAUTION
Electrostatic
Sensitive
Equipment
MASTER
ALM
SIM
MON
TEST
MON
DIS
MON
RESET
MON DIS/
UNIT FAIL
REL

Figure 1



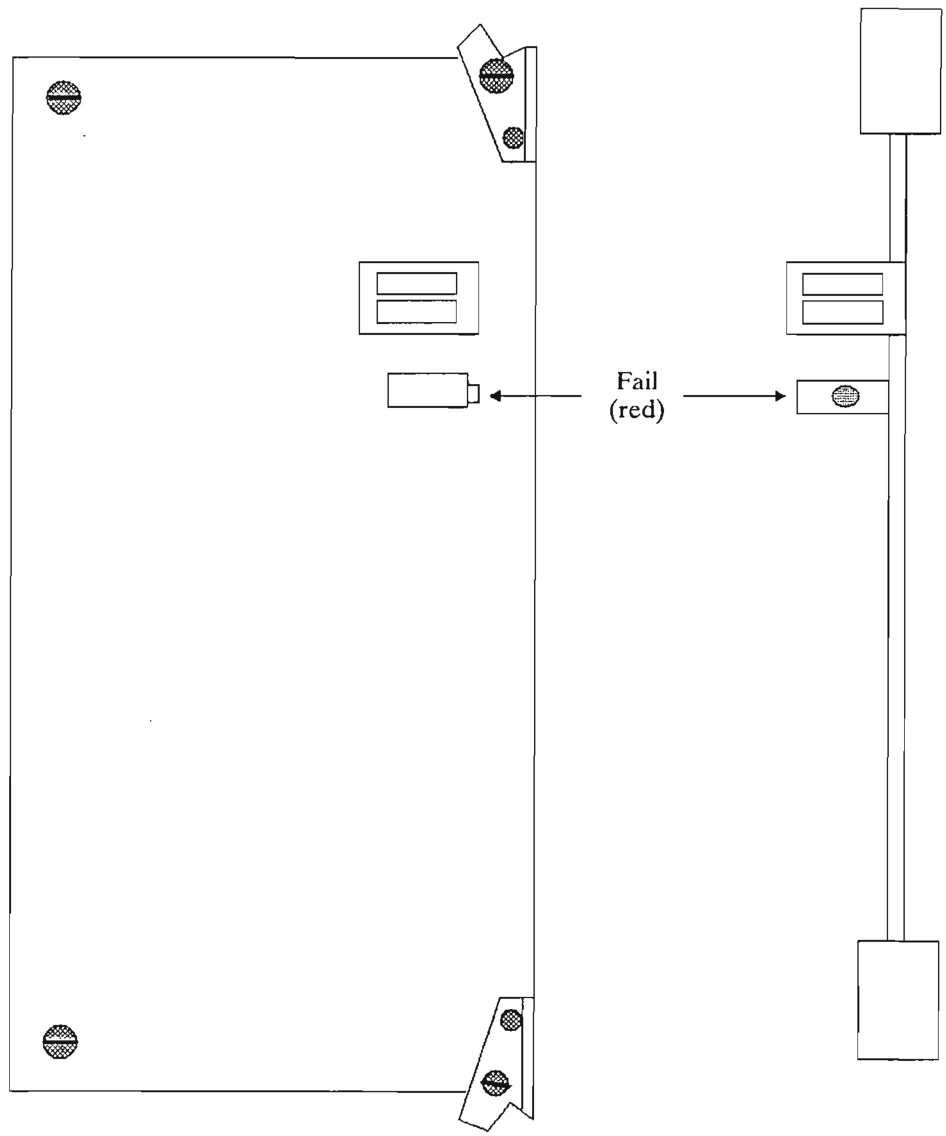
FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT6H62 and NT7H62 DS-3 Tx/Rx LED INDICATIONS

Figure 2



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT6H67 and NT7H67 DS-1 Tx/Rx LED INDICATIONS

Figure 3



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT6H67 and NT7H67 DS-1 Tx/Rx LED INDICATIONS

Figure 4

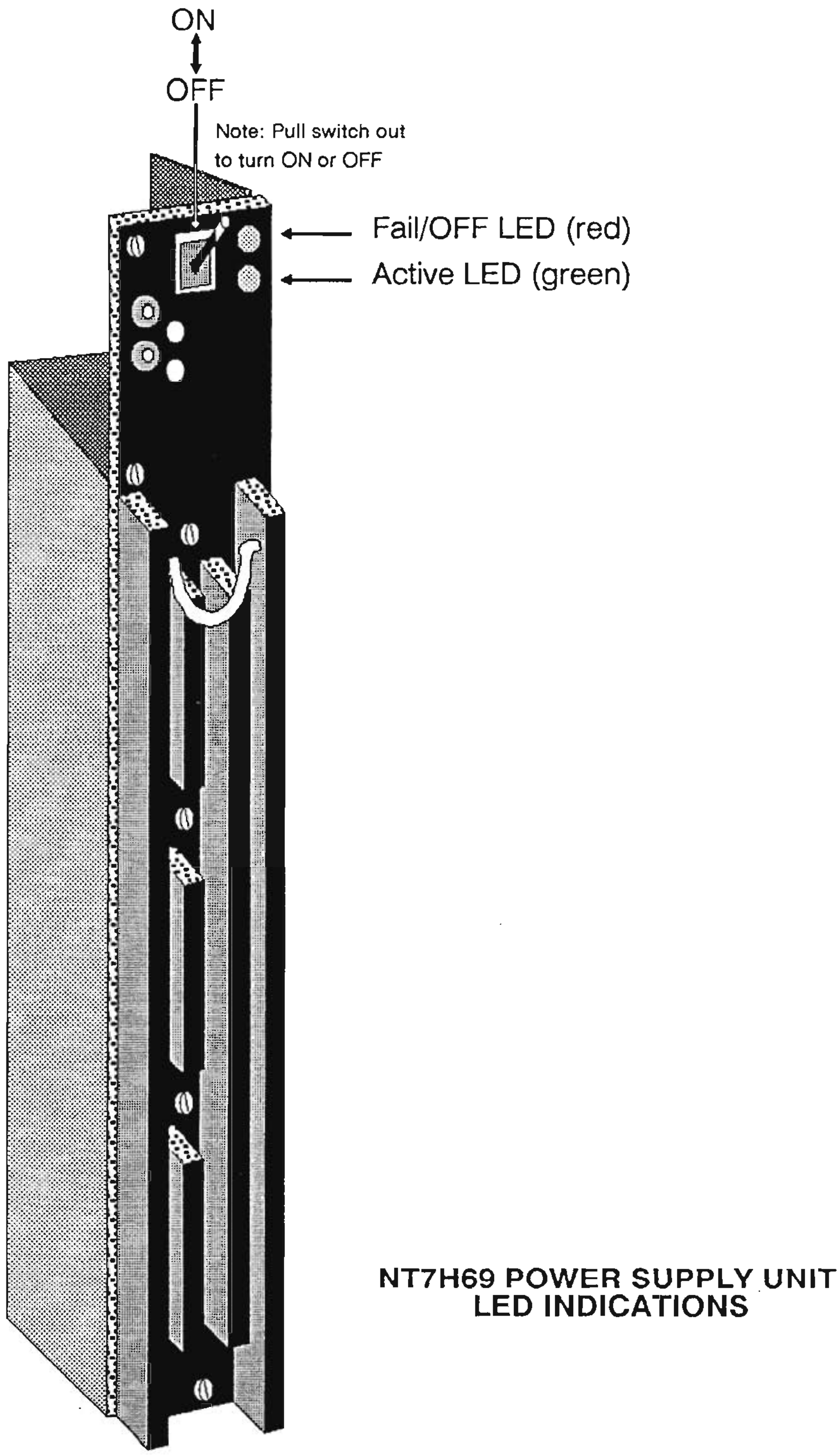
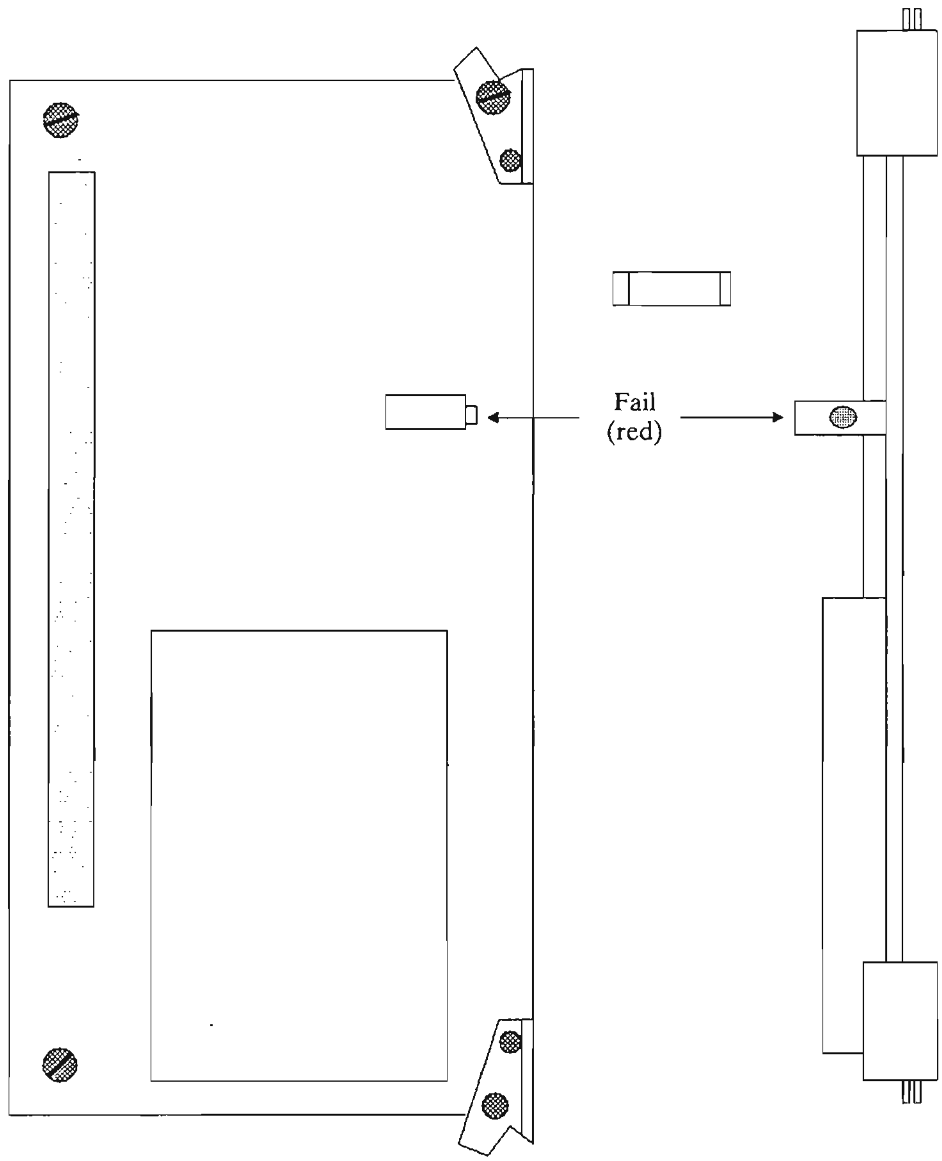
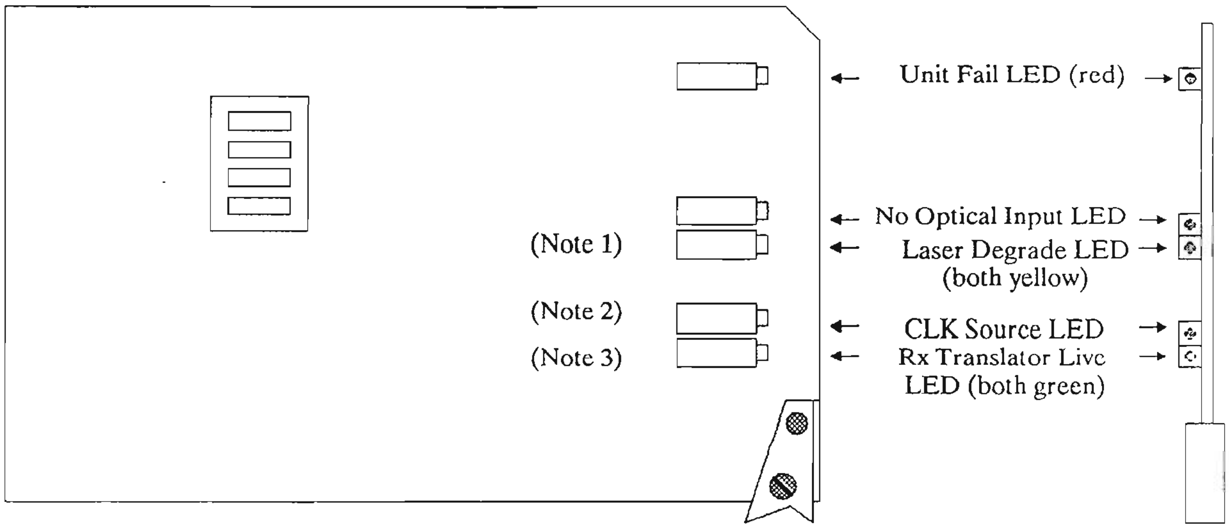

ON
OFF
Note: Pull switch out
to turn ON or OFF
Fail/OFF LED (red)
Active LED (green)
NT7H69 POWER SUPPLY UNIT
LED INDICATIONS

Figure 5



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT6H71 and NT7H71 DS-1 Tx/Rx LED INDICATIONS

Figure 6



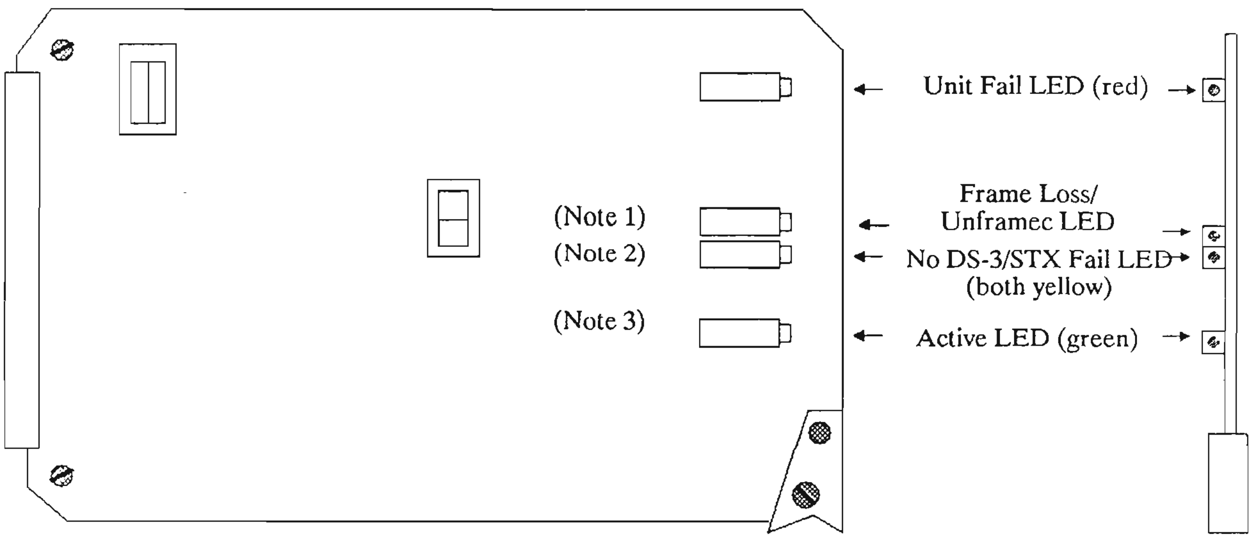
FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT7H80 150 Mb/s Tx/Rx LED INDICATIONS

Figure 7

Note 1: The Laser Degrade LED (yellow) is used to denote laser degrade in point-to-point systems but for multi-point networks it is the ORing of the following alarms: laser degrade or loss of clock input at an inter-mediate site.

Note 2: The Clock Source LED (green) is illuminated when it is the clock master with the shelf.

Note 3: The Rx Translator Live LED (green) is illuminated if any one of its corresponding translators is live in the RECEIVE direction.



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT7H85AA DS-3 Translator LED INDICATIONS

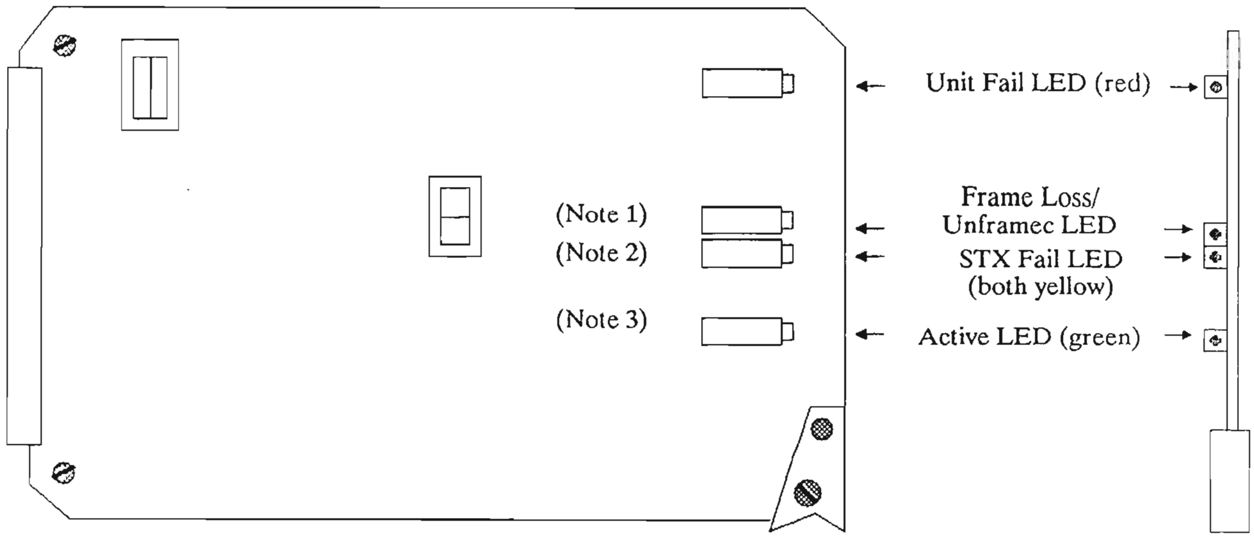
Figure 8

Note 1: The Frame Loss/Unframed LED is illuminated when the receive STX framing is lost (that is, fiber cut) or when all ones (A1S) unframed DS-3 is detected.

Note 2: The No DS-3/STX Fail is illuminated when:

- DS-3 input is lost *or*
- STX input signal is corrupted or lost (D/1 applications only), *or*
- STX clock loss from corresponding 150 Mb/s Electro-optics unit (D/1 aplications only).

Note 3: The Active LED is illuminated when the translator is LIVE in the RECEIVE direction.



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT7H85 STX Translator LED INDICATIONS

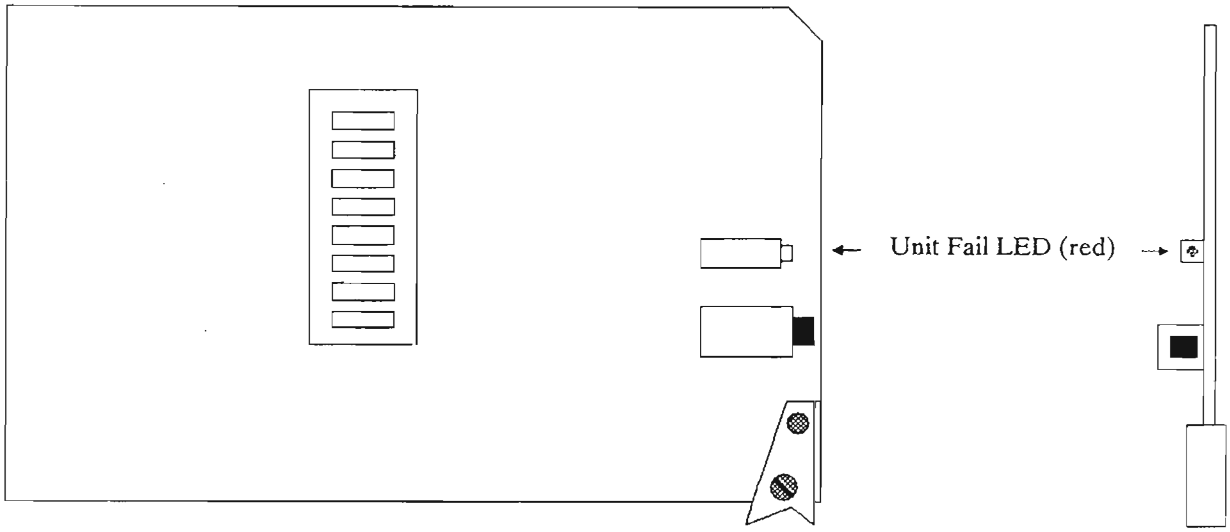
Figure 9

Note 1: The Frame Loss/Unframed LED is illuminated when the receive STX framing is lost (that is, fiber cut) or when the ones (A1S) unframed DS-3 is detected.

Note 2: The STX Fail is illuminated when:

- STX input signal is corrupted or lost, *or*
- STX clock loss from corresponding 150 Mb/s Electro-optics unit.

Note 3: The Active LED is illuminated when the translator is LIVE in the RECEIVE direction.



FAULT-LOCATE PROCEDURE USING LOCAL INDICATORS
NT7H90 MAINTENANCE CONTROL UNIT LED INDICATIONS

Figure 10

FMT-150 CIRCUIT MODULE LED INDICATIONS INTERPRETATION

TABLE 1

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT7H61BB/BD/ BE/XA/XB MON DIS/UNIT FAIL (*red*)	**1.** The monitor and control module has either been disabled or has failed.	**1.** Reset the monitor, *or* **2.** Switch the monitor power switch OFF then ON, *or* **3.** Replace the module per RP 6000
NT6H62AC and NT7H62XA FAIL (*red*)	**1.** The module has failed or the monitor and control module has been switched off.	**1.** Switch on the monitor and control module, *or*
	2. Incompatible releases of monitor and control module and DS-2 Tx/Rx have been mixed. Release 501, 502, and 503 of the NT7H61AA module cannot be used with the NT6H68AA module. Releases 600 and lower of NT7H61AABA cannot be used with the NT6H68AA module.	**2.** Reset the monitor and control module, *or* **3.** Replace The NT6H62AA module per RP 6000 *or* **4.** If DS-2 modules are used and there is a mismatch of modules (as indicated under probable cause) replace the monitor and control module with an updated version.

TABLE 1 (continued)

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT6H7AA and **NT7H67XA** FAIL (*red*)	**1.** The module has failed or the monitor and control module is switched off.	**1.** Switch on the monitor and control module, *or*
		2. Reset the monitor and control module, *or*
		3. Replace the NT6H67AA module per RP 6000.
NT6H68AA and NT7H68XA FAIL (*red*)	**1.** The module has failed or the monitor and control module is switched off.	**1.** Switch on the monitor and control module, *or*
		2. Reset the monitor and control module, *or*
		3. Replace the NT6H68AA module RP 6000.
NT7H69	**1.** The power supply unit is switched off.	**1.** Turn on the PSU, *or*
	2. The power supply unit has failed.	**2.** Replace the PSU.

TABLE 1 (continued)

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT6H71AA/BA and **NT7H1XA** FAIL (*red*)	**1.** The module has failed or the monitor and control module is switched off.	**1.** Switch on the monitor and control module, *or*
		2. Reset the monitor and control module, *or*
		3. Replace the NT6H71AA module per RP 6000.
NT7H80 FAIL (*red*)	**1.** The module has failed.	**1.** Ensure that the translator and optics modules are firmly inserted into the FMT-150 shelves, local, and remote, *or*
	2. The translator or optics modules, or both are not firmly inserted.	**2.** Reset the maintenance control unit (NT7H90) at the local and remote sites, *or*
	3. The associated translator module has failed.	**3.** Replace the NT7H80 module.

TABLE 1 (continued)

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT7H80 (cont'd) Optical Input FAIL (*yellow*)	**1.** A fiber cut has occurred.	**1.** Verify fiber span continuity.
	2. The fiber patch-cords/pigtails are incorrectly connected.	**2.** Verify proper patch-chord/pigtail connections.
	3. The power of the received optical signal is too low.	**3.** Verify sufficient received optical power, using DP 2103 in section 321-3211-203. Set attenuation of VOA accordingly.
	4. The remote NT7H80 module laser has degraded.	**4.** Replace the remote NT7H80 module.
Laser Degrade (*yellow*)	**1.** The laser located on the NT7H80 module has failed.	**1.** Replace the NT7H80 module.
NT7H85 FAIL (*red*)	**1.** The module has failed.	**1.** Ensure that the translator and optics modules are firmly inserted into their respective slots.
	2. The translator, or optics modules, or both are not firmly inserted.	**2.** Reset the maintenance control unit (NT7H90).

TABLE 1 (continued)

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT7H85 (cont'd)	**3.** The associated NT7H80 module has failed.	**3.** Replace the NT7H85 module.
		4. Replace the associated NT7H80 module.
Frame Loss/Unframed *(yellow)*	**1.** The received STX framing signal is not detected due to a failure anywhere in the transmission path of the DS-3 signal. The associated 150 Mb/s Tx/Rx modules (local and remote) may be in alarm, the fiber may be cut, the remote translator(s) may be faulty or removed, or the remote DS-3 inputs may be faulty.	**1.** Look for the other indications of failure on the FMT-150 equipment, at the local and remote sites, to try to isolate the cause of the problem.
	2. An all ones unframed DS-3 is detected.	**2.** Verify all associated modules, local and remote.
		3. Verify sufficient optical input power at the Rx connector (using DP 2103 in Section 321-3211-203).

TABLE 1 (concluded)

MODULE LED	PROBABLE CAUSE	ACTION TO TAKE
NT7H85 (cont'd) No DS-3 Input/STX FAIL (*yellow*)	**1.** The DS-3/STX signal from the shelf connector is absent or degraded.	**1.** Verify proper operation of the equipment generating DS-3 signal. If alarm indications still exist, correct as necessary.
	2. The coaxial cabling may be incorrect, damaged, or loose.	**2.** Check for correct coaxial cabling on the FMT-150 shelf. Ensure all cables are secured properly and in good condition.
	3. The equipment generating the DS-3/STX signal is in alarm, or has been turned off.	
NT7H90 **FAIL** (*red*)	**1.** The module itself has failed or the operating system has crashed.	**1.** Clear the alarm by resetting the maintenance control unit using the push button on the module.
		2. Reseat the MCU in its slot.
		3. Replace the software on the module with a new EEPROM, *or*
		4. Replace the whole maintenance control unit.

FAULT LOCATING USING THE CRT INTERFACE

Procedure

1. Display the global alarm conditions for the FMT-150 system (referring to DP 3004 of Section 321-3211-301). Examine the display screen for major alarms (A) and minor alarms to determine at which node(s) they occur. Classify each alarm as:

- Common Equipment Alarm, or
- 150 Mb/s Tx/Rx Module Alarm, or
- Common Equipment/Customer defined input alarm

2. Display the detailed alarm screen for the alarm condition, specifying the node, and the type of alarm, as found in step 1. Refer to DP 3005, 3006, and 3007 of Section 321-3211-301 and display these screens.

3. Locate and classify the alarm from the more detailed display screens, using step 2.

4. Refer to alarm screens as shown below:

Description	**Figure**	**Table**
Network alarm screen	11,12	2
Translator-level alarm screen	13,14	3
DM-13 multiplexer-level alarm screen	15	4
Common equipment-level alarm screen	16,17	5

Network Alarm Screen (NT7H90DA/GA/XD)

```
Alarm at All Nodes                                                              FMT-150

Node        1   2   3   4   5   6   7   8   9   10  11  12  13  14  15  16

COM        [1]..............................................................[1]

TRN        123 123 123 123 123 123 123 123 123 123 123 123 123 123 123 123
Type       TTT DRR DRR HHH TTT RRR RRR T   TRR TRR DDD DDD     TTT TTT TTT
TX         [2]..............................................................[2]
RX         [3]..............................................................[3]


OPTICS     AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB
           [4]..............................................................[4]


M13        [5]..............................................................[5]

- - Node Id.: 123456789012345  - - - - - - - - - Last Update: 87/03/06 11:07 - -


- - Syst Id.: 123456789012345 - - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 2

Figure 11

Network Alarm Screen (NT7H90CA/XC)

```
Alarm at All Nodes                                                                    FMT-150

Node            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16

Common         [1]                                                              [1]
Cust Input     [5]                                                              [6]

               AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB  AB
Optics         [4]                                                              [4]

               123 123 123 123 123 123 123 123 123 123 123 123 123 123 123 123
Translator
  Type         TTT DRR DRR HHH TTT RRR RRR T   TRR TRR DDD DDD     TTT TTT TTT
  TX           [2]                                                              [2]
  RX           [3]                                                              [3]

M13            [5]                                                              [5]

- - Node Id.: 123456789012345  - - - - - - - - - - Last Update: 87/03/06 11:07 - -


- - Syst Id.: 123456789012345  - - - - - - - - - - Time: 87/03/06 11:07 - - - - -
```

Note: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 2

Figure 12

NETWORK ALARM SCREEN INTERPRETATION

TABLE 2

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 An alarm concerning common equipment or customer inputs has occurred at the specified node.	**1.** A customer input has gone active.	**1.** Display the common equipment and customer input/output screen (DP 3007 and DP 3107 in Section 412-3211-301) to obtain more detail about the alarm. Then refer to the appropriate table in this FP to respond to the specific alarm condition.
	2. A common equipment module (MCU, SCU, or PSU) is in alarm.	
	3. A fuse has blown.	
	4. Communication with the DM-13 multiplexer(s) has been interrupted.	

Table 2 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
2 An alarm concerning a translator module in the transmit direction (towards the fiber) has occurred at the specified node(s) and DS-3 signal(s).	**1.** A line failure into the translator has caused the incoming DS-3 STX signal not to be detected, or to be detected as degraded.	**1.** Display the translator/optics alarm (DP 3105 in Section 312-3211-301) to obtain more detail about the alarm. Then refer to the appropriate table in this FP to respond to the specific alarm condition.
	2. The translator module itself has failed in the Tx direction.	
	3. The translator has been removed or is not communicating properly with the MCU.	
3 An alarm concerning a translator module in the receive direction (from the fiber) has occurred at the specified node(s) and DS-3 signal(s).	**1.** The received STX signal into the translator is not detected or has degraded because the associated optical Tx/Rx module has failed or a fiber breakage has occurred.	**1.** Display the translator/optics alarm (DP 3105 in Section 312-3211-301) to obtain more detail about the alarm. Then refer to the appropriate table in this FP to respond to the specific alarm condition.
	2. The translator itself has failed in the receive direction.	
	3. The translator has been removed or is not communicating property with the MCU.	

TABLE 2 (continued)

	ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
4	An alarm concerning the Optical Tx/Rx module has occurred at the specified node.	1. The optical input to the module has failed due to fiber breakage, disconnection, or far-end laser fail.	1. Display the translators/optics alarm screen (DP 3005 and DP 3105 in Section 312-3211-301) to obtain more detail about the alarm. Then refer to the appropriate table in this FP to respond to the specific alarm condition.
		2. The laser on the Optical Tx/Rx module itself has failed.	
		3. The Optica Tx/Rx module(s) has (have) failed.	
		4. The Optical Tx/Rx module has been removed or is not comunicating properly with the MCU.	

TABLE 2 (concluded)

	ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5	An alarm concerning a DM-13 multiplexer has occurred at the specified node and DS-3 stream.	**1.** A low- or high-speed line failure has occurred.	**1.** Display the DM-13 alarm screen (DP 3006 and DP 3106 in Section 312-3211-301) to obtain more detail about the alarm. Then refer to the appropriate table in this FP to respond to the specific alarm condition.
		2. A module of the DMS-13 multiplexer has failed.	
		3. The monitor and control module has been disabled.	
		4. Communication with the MCU has been disrupted.	
6	Customer Input	**1.** A customer input has gone active.	**1.** Display the common equipment alarm screen (DP 3107 in Section 312-3211-301) to which customer input has become active. Display the Node name/customer I/O names screen to identify the customer input (DP3110 in Section 321-3211-301).

Translator/Optics Alarm Screen (NT7H90DA/GA/XD)

```
Alarm at Node 3 Name 3-789012345 for Optics                              FMT-150
                                   A     B                                A     B
TRN                              1 2 3 1 2 3                            1 2 3 1 2 3

No DS3 Input                     1 ..........1      STX Frame Loss      6 ........ 6
TX Fail                          2 ..........2      Maint Bus Error     7 ........ 7
DS3 Frame Loss                   3 ..........3      Service Fail        8 ..........8
DS3 Signal Degrade               4 ..........4      Unit Removed        9 ..........9
RX Fail                          5 ..........5      Perf Event Alarm 1  18..........18
                                                    Perf Event Alarm 2  18..........18
                                                    Perf Event Alarm 3  18.....  ...18
                                                    Perf Event Alarm 4  18..........18
OPTICS                             A     B                                A      B

RX Optics Fail                     10    10         Maint Bus Error       15     15
TX Optics Fail                     11    11         Service Fail          16     16
Laser Fail                         12    12         Unit Removed          17     17
Laser Degrade                      13    13
Optical Input Fail                 14    14
- - Node Id.: 123456789012345  - - - - - - - - - - Last Update: 87/03/06 11:07 - -



- - Syst Id.: 123456789012345 - - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note: For the interpretation of the numbers inside the small boxes (1), refer to Table 3

Figure 13

TRANSLATOR/OPTICS ALARM SCREEN INTERPRETATIONALARM

TABLE 3

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 No DS-3 input is detected by the DS-3 translator.	**1.** A line failure to the FMT-150 shelf connector may have occurred, or DS-3 cabling is loose or incorrect.	**1.** Examine all DS-3 cabling to see that all connections are correct and secure.
	2. The device generating the DS-3 signal may have failed (possibly a DM-12 multiplexer, or other DS-3 source).	**2.** Determine any alarm conditions in the upstream equipment, such as a DMS-13 multipexer or radio link. Treat alarms for this equipment.
2 Tx fail. The VLSI chip on the translator for the transmit direction has failed.	**1.** The translator module has failed.	**1.** Replace the translator module (RP 6000 in this section).

TABLE 3 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
3 DS-3 frame loss. In the receive direction, framing of the DS-3 signal has been lost.	1. At the remote site, the opposing translator has failed or has been removed.	1. If not all three A or all three B translator modules indicate a DS-3 frame loss, then replace the translator opposite (far end) to the translator(s) indicating frame loss. Make sure modules are properly installed.
	2. If all three A or all three B translator modules indicate a DS-3 frame loss, then Optical Tx/Rx modules (local or remote) may have failed or have been removed. Also, a fiber cut or disconnection may have the same effect	2. If all three A or all three B translator modules indicate frame loss, then verify proper operation of both local and remote Optical Tx/Rx modules, taking appropriate action. Verify proper optical continuity and correct any problems.
4 DS-3 signal degrade. In the receive direction, the quality of the DS-3 signal has degraded.	1. The FMT-150 fiber link may be introducing errors due to incorrect link budget calculations or a failing laser at the far end Optical Tx/Rx module.	1. Verify optical link by checking optical output power, received optical power and receiver sensitivity. Look for any alarms concerning associated Optical Tx/Rx modules. Replace failed modules as necessary.
	2. The far end or the near end Optical Tx/Rx modules may have failed.	

TABLE 3 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5 Rx fail. The VLSI chip on the translator of the receive direction has failed.	**1.** The translator module has failed.	**1.** Replace the translator module (RP 6000 in this section).
6 STX frame loss. In the receive direction, the framing of the specified STX signal has been lost.	**1.** The DS-3 input to the far end FMT-150 shelf may have been removed or may have become loose.	**1.** At the far end, verify all DS-3 connections (inputs) to the FMT-150 shelf.
	2. The device generating the DS-3 signal at the far end has failed or has been disabled.	**2.** Verify operation of the DM-13 multiplexer (or other source) at the far end to the STX frame loss.
	3. If DS-3 frame loss is detected for the same translator, then possible causes include those listed for item 3.	**3.** If DS-3 frame loss is also detected, perform the recommended action of item 3.
7 Maintenance bus errors. Communication error between MCU and translator.	**1.** The translator bus is defective.	**1.** If communication has been lost (Maint. Bus Errors) with several modules, the MCU is probably faulty. If communications with only one module have failed, that module is probably faulty. Replace modules as necessary.
	2. The maintenance control unit (MCU) is faulty.	

TABLE 3 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
8 Service fail	1. Loss of traffic (indicated by "A").	1. Use other indications and this table to pinpoint problem.
9 Unit removed. A translator module has been removed from its slot.	1. A module has been removed from its slot.	1. Insert the module into its correct shelf position. If it is desired to "learn out" a new configuration, perform the learn out node command (DP 3044 in Section 321-3211-301).
10 Rx Optics Fail	1. Rx VLSI fail on Optical Tx/Rx module.	1. Replace Optical Tx/Rx module (RP 6000 in this section).
11 Tx Optics Fail	1. Tx VLSI fail on Optical Tx/Rx module.	1. Replace Optical Tx/Rx module (RP 6000 in this section)
12 Laser Fail	1. Laser fail on Optical Tx/Rx module.	1. Replace Optical Tx/Rx module (RP 6000 in this section)
13 Laser Degrade	1. Laser degrade on Optical Tx/Rx module.	1. Replace Optical Tx/Rx module (RP 6000 in this section)

TABLE 3 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
14 Optical Input Fail. No optical input.	1. Optical fiber cut.	1. Verify optical fiber continuity.
	2. Patch cord/pigtail not connected to Optical Tx/Rx module.	2. Verify patchcord/ pigtail connections.
	3. Remote Optical Tx/Rx module fail.	3. Verify operation of remote Optical Tx/Rx module.
	4. Received optical power less than minimum requirement.	4. Verify optical link budget.
15 Maint Bus Error. Communication error between MCU and Optical Tx/Rx module.	1. Optical Tx/Rx module fail.	1. Replace Optical Tx/Rx module (RP 6000 in this section).
	2. MCU fail.	2. Replace MCU (RP 6000 in this section).
16 Service Fail	1. Loss of traffic (indicated by "A").	1. Use other indications and this table to pinpoint problem.
17 Unit Removed	1. Optical Tx/Rx module removed.	1. Insert Optical Tx/Rx module.
18 Perf Event Alarm	1. One of the customer defined performance thresholds has been exceeded for a received DS-3 signal.	1. Display the performance event alarm definition screen (DP 3154 in Section 321-3211-301) to identify the type of performance alarm.
		2. Verify the complete optical path.

Translator/Optics Alarm Screen (NT7H90DA/XC)

```
Alarm at Node 3 Name 3-789012345 for Optics                                      FMT-150
                             A     B                                        A     B
Translator                 1 2 3  1 2 3                                   1 2 3  1 2 3
No DS3 Input               [1] ........ [1]      Loopback              [20] ....... [20]
TX Fail                    [2] ........ [2]      Maint Bus Error       [7] ........ [7]
DS3 Frame Loss             [3] ........ [3]      Service Fail          [8] ........ [8]
DS3 Signal Degrade         [4] ........ [4]      Unit Removed          [9] ........ [9]
RX Fail                    [5] ........ [5]      Perf Event Alarm 1    [18] ....... [18]
STX Frame Loss             [6] ........ [6]      Perf Event Alarm 2    [18] ....... [18]
No STX Input               [19] ....... [19]     Perf Event Alarm 3    [18] ....... [18]
Incorrect Config                                 Perf Event Alarm 4    [18] ....... [18]

OPTICS                         A      B                                    A      B
RX Optics Fail               [10]   [10]         Input Clock Loss        [21]   [21]
TX Optics Fail               [11]   [11]         Maint Bus Error         [15]   [15]
Laser Fail                   [12]   [12]         Service Fail            [16]   [16]
Laser Degrade                [13]   [13]         Unit Removed            [17]   [17]
Optical Input Fail           [14]   [14]

- - Node Id.: 123456789012345  - - - - - - - - - Last Update: 87/03/06 11:07 - -


- - Syst Id.: 123456789012345 - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 3

Figure 14

TABLE 3 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
19 No STX Input	**1.** The STX input to the rear of the FMT-150B shelf (drop/insert applications only) is not detected.	**1.** Verify rear connections to FMT-150B shelf (DP 1026 in Section 321-3211-201).
	2. The associated FMT-150B shelf at the drop/insert site has failed.	**2.** Verify operation of the other FMT-150B shelf at the drop/insert site.
20 Loopback	**1.** A loopback condition exists on the indicated translator.	**1.** Clear the loopback condition (DP 3132 in Section 321-3211-301).
21 Input Clock Loss	**1.** Clock signal is not detected.	**1.** Verify all clock cabling at the hub or drop/insert site (DP 1026 and DP 1029 in Section 321-3211-201).
	2. The associated FMT-150B or D shelf at the intermediate site has failed.	**2.** Verify operation of associated FMT-150B and D shelves at the intermediate site.

DM-13 Alarm Screen (NT7H90CA/GA/XC/XD)

```
Alarm at Node 3 Name 3-789012345 for M13                                   FMT-150
        Equpt        Trip     1234   1234   1234
M13    1   2   3     TX GP1   [9]..................[9]                        1    2    3
M/C   [1] [1] [1]    TX GP2   [9]..................[9]   DS3 Line Fail        [11] [11] [11]
HSA   [2] [2] [2]    TX GP3   [9]..................[9]   Monitor Disable      [12] [12] [12]
HSB   [3] [3] [3]    TX GP4   [9]..................[9]   External CLOCK Fail  [13] [13] [13]
DS1   [4] [4] [4]    TX GP5   [9]..................[9]   M13 Communication    [14] [14] [14]
DS1C  [5] [5] [5]    TX GP6   [9]..................[9]
DS2   [6] [6] [6]    TX GP7   [9]..................[9]   HS/LS Major          [15] [15] [15]
GP1   [7] [7] [7]                                        HS/LS Minor          [16] [16] [16]
GP2   [7] [7] [7]    RX GP1   [10].................[10]
GP3   [7] [7] [7]    RX GP2   [10].................[10]
GP4   [7] [7] [7]    RX GP3   [10].................[10]
GP5   [7] [7] [7]    RX GP4   [10].................[10]
GP6   [7] [7] [7]    RX GP5   [10].................[10]
GP7   [7] [7] [7]    RX GP6   [10].................[10]
PSU   [8] [8] [8]    RX GP7   [10].................[10]

- - Node Id.: 123456789012345 - - - - - - - - - - Last Update: 87/03/06 11:07 - -

- - Syst Id.: 123456789012345 - - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 4

Figure 15

DM-13 ALARM SCREEN INTERPRETATION

TABLE 4

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 M/C	1. Monitor and control module power is off.	1. Turn monitor and control module power on (DP 3107 in Section 321-3211-302).
	2. Monitor and control module fail.	2. Reset monitor and control module.
		3. Replace monitor and control module (RP 6000 in this section).
2 HSA	1. DS-3 Tx/Rx module fail.	1. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
	2. Incompatible releases of monitor and control module and DS-2 Tx/Rx have been mixed. The NT7H61BA monitor and control module, Releases 600 and lower, cannot be used with the NT6H68AA DS-2 Tx/Rx module.	2. Replace DS-3 Tx/Rx module. (RP 6000 in this section).
		3. Replace monitor and control module with higher release version.

TABLE 4 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
3 HSB	1. DS-3 Tx/Rx module fail.	1. Replace DS-3 Tx/Rx module.
4 DS-1	1. Standby DS-1 Tx/Rx module fail.	1. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
		2. Replace DS-1 Tx/Rx module. (RP 6000 in this section).
5 DS-1C	1. Standby DS-1C Tx/Rx module fail.	1. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
		2. Replace DS-1C Tx/Rx module. (RP 6000 in this section).
6 DS-2	1. Standby DS-2 Tx/Rx module fail.	1. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
		2. Replace DS-2 Tx/Rx module. (RP 6000 in this section).

TABLE 4 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
7 GP1-GP7	1. DS-1/DS-1C/DS-2 Tx/Rx module fail.	1. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
		2. Replace DS-1/DS-1C/DS-2 Tx/Rx module. (RP 6000 in this section).
8 Power Supply Unit	1. PSU is off, removed, or has failed.	1. Turn on, reinsert, or replace PSU. (RP 6000 in this section).
9 Tx GP1 - Tx GP7 DS-1/DS-1C/DS-2 line fail.	1. Loss of DS-1/DS-1C/DS-2 input to FMT-150 shelf back-plane.	1. Verify DS-1/DS-1C/DS-2 input to FMT-150 shelf backplane.
		2. Reset the monitor and control module. (DP 3107 in Section 321-3211-302).
10 Rx GP1 - Tx GP7 DS-1/DS-1C/DS-2 frame loss.	1. Any upstream equipment has failed.	1. Verify entire optical path, optics modules, translators, and DS-3 Tx/Rx modules and DS-3 cabling.
	2. Remote DM-13 has fewer low speed group cards than local DM-13.	2. Reset monitor and control module.
		3. Perform the "line learn"command for the DM-13 (DP 3018 in Section 321-3211-301).

TABLE 4 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
11 DS-Line Fail	1. No DS-3 input to DS-3 translator module.	1. Verify DS-3 input to DS-3 translator module
12 Monitor Disable	1. Monitor and control module disabled using faceplate push button.	1. Reset monitor and control module.
13 External Clock Fail	1. External clock source fail.	1. Verify external clock source.
14 M13 Communication. No communication between DM-13 and MCU.	1. Monitor and Control module is off.	1. Turn monitor and control module on (DP 2000 in Section 321-3211-202).
	2. Monitor and Control module disabled.	2. Verify monitor and control module enabled.
	3. DM-13 communication wiring is wrong.	3. Check DM-13 communication wiring (DP 1013 and DP 1023 in Section 321-3211-201).
	4. Monitor and Control module optioning is incorrect.	4. Verify monitor and control module optioning (DP 2000 in Section 321-3211-202).
15 HS/LS Major	1. DM-13 major alarm (service affecting failure.	1. Observe other displayed alarm conditions, and use this table to pinpoint problem.
16 HS/LS Minor	1. DM-13 minor alarm (non-service affecting failure).	1. Observe other displayed alarm conditions, and use this table to pinpoint problem.

Common Equipment and Customer Inputs/Outputs Alarm Screen (NT7H90DA/GA/XD)

```
Alarm at Node 3 Names 3-789012345 for Common Equipment                  FMT-150

Network Status
 Node number
 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16

 [1]...............................................[1]
Customer Inputs                                                         1  2  3  4
 1  2  3  4  5  6  7  8  9  10  11  12        Maintenance Control Unit  [4]
 [2].............................[2]          M13 Communication         [5] [5] [5]
                                              Power Supply Unit         [6] [6] [6] [6]
Customer Outputs                              Service Channel Unit      [7]
 1  2  3  4                                   Fuse Alarm                [8]
 [3]......[3]                                 Network Not Operational   [9]
                                              Network Controller Fail   [10]


- - Node Id.: 123456789012345 - - - - - - - - - - Last Update: 87/03/06 11:07 - -


- - Syst Id.: 123456789012345 - - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 5

Figure 16

Common Equipment and Customer Inputs/Outputs Alarm Screen (NT7H90CA/XC)

```
Alarm at Node 3 Names 3-789012345 for Common Equipment                    FMT-150

Network Status
 Node number
 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16

 [1]..........................................................[1]
Customer Inputs                                                     1  2  3  4
 1  2  3  4  5  6  7  8  9  10  11  12        MCU Not Responding    [4]
 [2]......................................[2]  M13 Communication     [5][5][5]
                                              Power Supply Unit     [6][6][6][6]
Customer Outputs                              Service Channel Unit  [7]
 1  2  3  4  5  6  7  8                       Fuse Alarm            [8]
 [3]......................[3]                 Network Not Operational [9]
                                              Network Controller Fail [10]
 9  10 11 12 13 14 15 16

- - Node Id.: 123456789012345  - - - - - - - - - Last Update: 87/03/06 11:07 - -


- - Syst Id.: 123456789012345 - - - - - - -  Time: 87/03/06 11:07 - - - - - - -
```

Note 1: For the interpretation of the numbers inside the small boxes ([1]), refer to Table 5

Note 2: The NT7H75BA/XA has 12 inputs and 4 outputs.
The NT7H75BB/XB has 8 inputs and 16 outputs.

Figure 17

COMMON EQUIPMENT AND CUSTOMER ALARM SCREEN INTERPRETATION

TABLE 5

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Node number	**1.** Alarm at specified node.	**1.** Use other indications and this table to pinpoint problem.
2 Customer Inputs	**1.** Customer input point enabled	**1.** Customer input points 1 and 2 can be disabled using CRT terminal (DP 3008 and DP 3159 in Section 321-3211-301).
3 Customer Outputs	**1.** Customer output point enabled.	**1.** Customer output points can be disabled using CRT terminal (DP 3016/3060/3061 in Section 321-3211-301).
4 Maintenance Control Unit/MCU Not Responding.	**1.** MCU removed. **2.** MCU fail.	**1.** Replace MCU (RP 6000 in this section).

TABLE 5 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5 M13 Communication	**1.** Monitor and Control module OFF.	**1.** Verify Monitor and Control module ON (DP 2000 in Section 321-3211-202).
	2. Monitor and Control module disabled.	**2.** Verify Monitor and Control module enabled.
	3. DM-13 communication wiring is wrong.	**3.** Check DM-13 communication wiring (DP 1013 and 1023 in Section 321-3211-201).
	4. Monitor and control module optioning is incorrect.	**4.** Verify Monitor and Control module ON (DP 2000 in Section 321-3211-202).
6 Power Supply Unit	**1.** PSU OFF.	**1.** Replace PSU (RP 6000 in this section)
	2. PSU removed.	
	3. PSU fail.	
7 Service Channel Unit	1. SCU removed.	**1.** Replace SCU (RP 6000 in this section.
	2. SCU fail.	
8 Fuse Alarm	**1.** FMT-150 shelf fuse (5A GMT) blown.	**1.** Replace blown fuse. (RP 6001 in this section).

TABLE 5 (concluded)

	ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
9	Network not operational. No communication between MCU and other nodes.	1. Optical fiber cut.	1. Verify optical fiber continuity.
		2. MCU fail.	2. Verify MCU at each node.
			3. Check CU optioning (DP 2012 in Section 321-3211-202).
10	Network Controller Fail.	1. MCU fail.	1. Replace MCU.

CAMMS INTERFACE TO LOCATE FAULTS IN FMT-150

This chart explains how to use CAMMS interface to locate and identify faults in an FMT-150 system.

Note: If more than one site in an FMT-150 network exhibits an alarm condition, start with major alarms. Additionally, the troubleshooter should try to determine which alarms are the source of the problem, leaving downstream alarms as a lower priority.

Procedure:

1. Display the global alarm conditions for the FMT-150 system (referring to DP 3304 of Section 321-3211-303). Examine the display screen for major alarms (A) and minor alarms to determine at which node(s) they occur. Classify each alarm as due to:

- Optics modules
- Translator modules
- DM-13 multiplexers
- Common equipment
- Customer input
- Performance event alarm

2. Display the sub-alarm screen associated with each of these four categories for the node at which the alarm has occurred.

Optics alarm	DP 3308	Section 321-3211-303
Translator alarm	DP 3309	Section 321-3211-303
DM-13 multiplexer alarm	DP 3310	Section 321-3211-303
Common equipment alarm	DP 3311	Section 321-3211-303

Note: For a DM-13 multiplexer alarm, the optics/DM-13 alarm screen should be displayed to determine which DM-13 multiplexer (1 to 3) has gone into alarm (DP 3305 of Section 321-3211-303).

3. Locate and classify the alarm from the more detailed alarm screens.

Refer to the following tables for indication interpretation, and suggested maintenance action:

Description	Figure	Table
Network alarm screen	18	6
Network optics and DM-13 alarm screen	19	7
Translators alarms screen	20	8
Optics alarms screen	21	9
DM-13 multiplexer alarms screen	22	10
Common equipment alarms screen	23	11
Customer input screen	24	12
Performance event alarm	25	13

Alarm at All Nodes

FMT-150

node	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Optics	$\boxed{1}$	.	.	.	.	.	.	$\boxed{1}$
TRN	$\boxed{2}$	.	.	.	.	.	.	$\boxed{2}$
M13	$\boxed{3}$	.	.	.	.	.	.	$\boxed{3}$
Com	$\boxed{4}$	.	.	.	.	.	.	$\boxed{4}$
Cust Inp	$\boxed{5}$	.	.	.	.	.	.	$\boxed{5}$

node	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Optics	$\boxed{1}$	.	.	.	.	.	.	$\boxed{1}$
TRN	$\boxed{2}$	.	.	.	.	.	.	$\boxed{2}$
M13	$\boxed{3}$	.	.	.	.	.	.	$\boxed{3}$
Com	$\boxed{4}$	.	.	.	.	.	.	$\boxed{4}$
Cust Inp	$\boxed{5}$	.	.	.	.	.	.	$\boxed{5}$

- - - - - Time: 89/11/27 18:30 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 18

NETWORKS ALARM SCREEN INTERPRETATION

TABLE 6

	ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1	An alarm concerning an optics module has occurred at the specified node.	1. The optical input to the module has failed due to fiber breakage, disconnection, or far-end laser fail.	1. Display the optics alarm screen (DP 3308 in Section 321-3211-303) to obtain more detail about the alarm. Then refer to the appropriate table to respond to the specific alarm condition.
		2. The laser on the optical Tx/Rx module itself has failed.	
		3. The optical Tx/Rx module(s) has (have) failed.	
		4. The optical Tx/Rx module has been removed or is not communicating properly with the MCU.	

TABLE 6 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
2 An alarm concerning a translator has occurred at the specified node.	**1.** The received STX signal into the translator is not detected or has degraded, because the associated optical Tx/Rx module has failed, or a fiber breakage has occurred.	**1.** Display the translator alarm screen (DP 3306 in Section 321-3211-303) to obtain more detail about the alarm. Then refer to the appropriate table to respond to the specific alarm condition.
	2. The translator itself has failed in the receive direction.	
	3. The translator has been removed or is not communicating properly with the MCU.	
3 An alarm concerning a DM-13 multiplexer has occurred at the specified. node.	**1.** A low- or high-speed line failure has occurred.	**1.** Display the networks optics and DM-13 alarms screen (DP 3305 in Section 321-3211-303) to determine which multiplexer (1 to 3) has gone into alarm.
	2. A module of the DM-13 multiplexer has failed.	
	3. The monitor and control module has been disabled.	
	4 Communication with the MCU has been disrupted.	

TABLE 6 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
4 An alarm concerning common equipment has occurred at the specified node.		**1.** Display the common equipment and customer input/output screen (DP 3311 in Section 321-3211-303) to obtain more detail about the alarm. Then refer to the appropriate table to respond to the specific alarm condition.
5 A customer input has gone. active	1. An input to the back of an FMT-150B or D shelf has gone to ground.	**1.** Display the detailed customer input/output screen (DP 3312 in Section 321-3211-303), identify the number of the input that has gone active, and troubleshoot based on this information (Figure FP 5003-7, Table FP 5003-G).

Alarm at All Nodes

FMT-150

Optics and M13

node	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Optics	AB	AB	AB	AB	AB	AB	AB	AB
.	1	. .	. .	. .	. .	. .	. .	1
M13	123	123	123	123	123	123	123	123
	2	. .	. .	. .	. .	. .	. .	2

node	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Optics	AB	AB	AB	AB	AB	AB	AB	AB
.	1	. .	. .	. .	. .	. .	. .	1
M13	123	123	123	123	123	123	123	123
	2	. .	. .	AA	. .	. .	. .	2

- - - - - Time: 89/09/15 11:35 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 19

NETWORK OPTICS AND DM-13 ALARMS SCREEN INTERPRETATION

TABLE 7

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 An alarm indication at either the A or B optics module at the specified node.	1. The optical input to the module has failed due to fiber breakage, disconnection, or far end laser fail.	1. Display the optics alarm screen (DP 3308 in Section 321-3211-303) to obtain more detail about the alarm. Then refer to the appropriate table to respond to the specific alarm condition.
	2. The laser on the optical Tx/Rx module itself has failed.	
	3. The optical Tx/Rx module(s) has (have) failed.	
	4. The optical Tx/Rx module has been removed or is not communicating properly with the MCU.	

TABLE 7 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
2 An alarm concerning a DM-13 multiplexer has occurred at the specified node.	1. A low- or high-speed line failure has occurred.	1. Display the DM-13 alarms screen (DP 3310 in Section 321-3211-303) to obtain more detail about the alarm. Then refer to the appropriate table to respond to the specific alarm condition.
	2. A module of the DM-13 multiplexer has failed.	
	3. The monitor and control module has been disabled.	
	4 Communication with the MCU has been disrupted.	

Alarm for Translators

FMT-150

At Node 3 Name _ for_Node_3	A			B		
	1	2	3	1	2	3
TRANSLATOR						
Tx Fail	1	.	.	.	.	1
No DS3 Input	2	.	.	.	.	2
No STX Input	3	.	.	.	.	3
DS3 Signal Degrade	4	.	.	.	.	4
DS3 Frame Loss	5	.	.	.	.	5
STX Frame Loss	6	.	.	.	.	6
Rx Fail	7	.	.	.	.	7
Incorrect Config	8	.	.	.	.	8
Service Fail	9	.	.	.	.	9
Maint Bus Error	10	.	.	.	.	10
Unit Removed	11	.	.	.	.	11

- - - - - Time: 89/11/27 18:30 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 20

TRANSLATOR ALARMS SCREEN INTERPRETATION

TABLE 8

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Tx Fail. The VLSI chip on the translator for the transmit direction has failed.	**1.** The translator module has failed.	**1.** Replace the translator module. (RP 6000 in this section)
2 No DS-3 input is detected by the DS-3 translator.	**1.** A line failure to the FMT-150 shelf connector may have occurred, or DS-3 cabling is loose or incorrect.	**1.** Examine all DS-3 cabling to see that all connections are correct and secure.
	2. The device generating the DS-3 signal may have failed (possibly a DM-13 multiplexer, or other DS-3 source).	**2.** Determine any alarm conditions in the upstream equipment, such as a DM-13 multiplexer or radio link. Treat alarms for this equipment.

TABLE 8 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
3 No STX input in the receive direction, the STX signal is no longer detected.	**1.** The optics module has been removed, or the input fiber has been disconnected.	**1.** Examine related optics modules for alarm indications. Treat according to this table.
	2. The near-end optical receiver has been damaged.	**2.** If other STX signals are lost, the fault probably lies with the optics modules (near end or far end) or the fiber path. Verify both carefully.
	3. A fiber cut has occurred.	**3.** Verify that the far end translator is operating properly.
	4. The far-end translator has failed.	
	5. The far-end translator is defective or has been removed.	
4 DS-3 Signal Degrade. In the receive direction, the quality of the DS-3 signal has degraded.	**1.** The FMT-150 fiber link may be introducing errors due to incorrect link budget calculations or a failing laser at the far-end optical Tx/Rx module.	**1.** Verify optical link by checking optical output power, received optical power, and receiver sensitivity. Look for any alarms concerning associated optical Tx/Rx modules. Replace failed modules as necessary.
	2. The far end or the near end optical Tx/Rx modules may have failed.	

TABLE 8 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5 DS-3 Frame Loss. In the receive direction, framing of the DS-3 signal has been lost.	**1.** At the remote site, the opposing translator has failed or has been removed.	**1.** If not all three A or all three B translator modules indicate a DS-3 frame loss, then replace the translator opposite (far end) to the translator(s) indicating frame loss. Make sure modules are properly installed.
	2. If all three A or not all three B translator modules indicate a DS-3 frame loss, then optical Tx/Rx modules (local or remote) may have failed or have been removed. Also, a fiber cut or disconnection may have the same effect.	**2.** If all three A or all three B translator module indicate frame loss, then verify proper operation of both local end remote optical Tx/Rx modules, taking appropriate action. Verify proper optical continuity and correct any problems.

Alarm for Optics

FMT-150

At Node 3 Name _ for_Node_3

	A	B
OPTICS		
Laser Degrade	1	1
Laser Fail	2	2
Tx Optics Fail	3	3
Rx Optics Fail	4	4
Optical Input Fail	5	5
Service Fail	6	6
Maint Bus Error	7	7
Unit Removed	8	8

- - - - - Time: 89/09/15 18:30 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 21

TABLE 8 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
10 Maintenance Bus Error. Communication error between MCU and translator.	**1.** The translator bus is defective.	**1.** If communication has been lost (Maint. Bus Errors) with several modules, the MCU is probably faulty. If communications with only one module have failed, that module is probably faulty. Replace modules as necessary. (RP 6000 in this section).
	2. The maintenance control unit (MCU) is faulty.	
11 Unit Removed.	**1.** A module has been removed from its slot.	**1.** Insert the module into its correct shelf position. If it is desired to "learn out" a new configuration, perform the "Learn at Node Command" (DP 3044 in Section 321-3211-301).

TABLE 8 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
6 STX Frame Loss. In the receive direction, the framing of the specified STX signal has been lost.	**1.** The DS-3 input to the far end FMT-150 shelf may have been removed or may have become loose.	**1.** At the far end, verify all DS-3 connections (inputs) to the FMT-150 shelf.
	2. The device generating the DS-3 signal at the far end has failed or has been disabled.	**2.** Verify operation of the DM-13 multiplexer (or other source) at the far end to the STX frame loss.
	3. If DS-3 frame loss is detected for the same translator, then possible causes include those listed for item 3.	**3.** If DS-3 frame loss is also detected, perform the recommended action of item 3.
7 Rx Fail. The VLSI chip on the translator of the receive direction has failed.	**1.** The translator module has failed.	**1.** Replace the translator module. (RP 6000 in this section).
8 Incorrect Configuration.	**1.** The LBO switches on the A and B translators are not at the same setting.	**1.** Correct the LBO switch settings o the A or B translators so that both are set to in or out. (DP 2009 in Sectino 321-3211-202).
9 Service Fail.	**1.** Loss of traffic (indicated by "A").	**1.** Observe other displayed alarm conditions, then use this table to pinpoint the problem.

OPTICS ALARMS SCREEN INTERPRETATION

TABLE 9

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Laser Degrade.	**1.** Optical Tx/Rx module fail. Laser degrade on optical Tx/Rx module.	**1.** Replace optical Tx/Rx module. (RP 6000 in this section).
2 Laser Fail.	**1.** Optical Tx/Rx module fail. Laser degrade on optical Tx/Rx module.	**1.** Replace optical Tx/Rx module. (RP 6000 in this section).
3 Tx Optics Fail.	**1.** Optical Tx/Rx module fail. VSLI fail on optical Tx/Rx module.	**1.** Replace optical Tx/Rx module. (RP 6000 in this section).
4 Rx Optics Fail.	**1.** Optical Tx/Rx module fail. VSLI fail on optical Tx/Rx module.	**1.** Replace optical Tx/Rx module. (RP 6000 in this section).
5 Optical Input Fail. No optical input.	**1.** Optical fiber cut.	**1.** Verify optical fiber continuity.
	2. Patch cord/pigtail not connected to optical Tx/Rx module.	**2.** Verify patchcord/ pigtail connections.
	3. Remote optical Tx/Rx module fail.	**3.** Verify operation of remote optical Tx/Rx module.
	4. Received optical power less than minimum requirement.	**4.** Verify optical link budget.

TABLE 9 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
6 Service Fail.	**1.** Loss of traffic (indicated by "A").	**1.** Observe other displayed alarm conditions, then use this table to pinpoint problem.
7 Maint. Bus Error. Communication error between MCU and optical Tx/Rx module.	**1.** Optical Tx/Rx module fail.	**1.** Replace optical Tx/Rx module. (RP 6000 in this section).
	2. MCU fail.	**2.** Replace MCU. (RP 6000 in this section).
8 Unit Removed.	**1.** Optical Tx/Rx module removed.	**1.** Insert optical Tx/Rx module. (RP 6000 in this section).

Alarm for M13 Number 2

FMT-150

At Node 12 Name _ for_Node_12

DS3 Line Fail	.	M13 communication	.
Monitor Disable	.	HS/LS Major	.
Ext Clk Fail	.	HS/LS Minor	.

M/C	.	GP1	.	TX	. . . .	RX	. . . .
HSA	.	GP2	.	TX	. . . .	RX	. . . .
HSB	.	GP3	.	TX	. . . .	RX	. . . .
DS1	.	GP4	.	TX	. . . .	RX	. . . .
DS1C	.	GP5	.	TX	. . . .	RX	. . . .
DS2	.	GP6	.	TX	. . . .	RX	. . . .
PSU	.	GP7	.	TX	. . . .	RX	. . . .

- - - - - Time: 89/09/15 18:30 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 22

DM-13 MULTIPLEXER ALARMS SCREEN INTERPRETATION

TABLE 10

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 DS-3 Line Fail.	1. No DS-3 input to DS-3 translator module.	1. Verify DS-3 input to DS-3 translator module.
2 Monitor Disable.	1. Monitor and control module disabled using faceplate push buttons.	1. Reset monitor and control module. (DP 3107 in Section 321-3211-302).
3 External CLOCK Fail.	1. External clock source fail.	1. Verify external clock source.
4 Loopback.	1. A remote loopback is activated on the multiplexer.	1. Display the switch screen of the multiplexer in question to determine which tributary is looped back (DE 3338 in Section 321-3211-303). 2. Release the loopback (DP 3341 in Section 321-3211-303).

TABLE 10 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5 M13 Communication. No communication between DM-13 and MCU.	**1.** Monitor and control module is off.	**1.** Turn monitor and control module on (DP 2000 in Section 321-3211-202).
	2. Monitor and control module disabled.	**2.** Enable monitor and control module (DP 3107 in Section 321-3211-302).
	3. DM-13 communication wiring is incorrect.	**3.** Verify DM-13 communication wiring (DP 1013 and DP 1023, in Section 321-3211-202).
	4. Monitor and control module optioning is incorrect.	**4.** Verify monitor and control module optioning (DP 2000 in Section 321-3211-202).
6 HS/LS Major.	**1.** DM-13 major alarm (service affecting failure).	**1.** Observe other displayed alarm condition, then use this table to pinpoint problem.
7 HS/LS Minor.	**1.** DM-13 minor alarm (service affecting failure).	**1.** Observe other displayed alarm condition, then use this table to pinpoint problem.

TABLE 10 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
8 M/C	**1.** Monitor and control module power is off.	**1.** Turn monitor and control module power on (DP 2000 in Section 321-3211-202).
	2. Monitor and control module fail.	**2.** Reset monitor and control module (DP 3107 in Section 321-3211-302).
		3. Replace monitor and control module (RP 6000 in this section).
9 HSA	**1.** DS-3 Tx/Rx module fail.	**1.** Reset monitor and control module (DP 3107 in Section 321-3211-302).
	2. Incompatible releases of monitor and control modules and DS-2 Tx/Rx have been mixed. The NT7H61BA monitor and control module. Releases 600 and lower, cannot be used with the NT6H68AA DS-2 Tx/Rx module.	**2.** Replace DS-3 Tx/Rx module.
		3. Replace monitor and control module (RP 6000 in this section).

TABLE 10 (continued)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
$\boxed{10}$ HSB	**1.** DS-3 Tx/Rx module fail.	**1.** Reset monitor and control module (DP 3107 in Section 321-3211-302).
		2. Replace monitor and control module (RP 6000 in this section)
$\boxed{11}$ DS-1	**1.** Standby DS-1 Tx/Rx module fail.	**1.** Reset monitor and control module (DP 3107 in Section 321-3211-302).
		2. Replace DS-3 Tx/Rx module (RP 6000 in this section).
$\boxed{12}$ DS-1C	**1.** Standby DS-1C Tx/Rx module fail.	**1.** Reset the monitor and control module (DP 3107 in Section 321-3211-302).
		2. Replace monitor and control module (RP 6000 in this section).
$\boxed{13}$ DS-2	**1.** Standby DS-2 Tx/Rx module fail.	**1.** Reset the monitor and control module (DP 3107 in Section 321-3211-302).
		2. Replace DS-2 Tx/Rx module (RP 6000 in this section).

TABLE 10 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
14 Power Supply Unit.	**1.** PSU is off, removed, or has failed.	**1.** Turn ON, reinsert, or replace PSU (RP 6000 in this section).
15 GP1-GP7	**1.** DS-1/DS-1C/DS-2 Tx/Rx module fail.	**1.** Reset the monitor and control module (DP 3107 in Section 321-3211-302).
	2. DS-1 line failure (transmit) if NT6H71AA Release 500 or NT6H71BA is used.	**2.** Replace DS-1/DS-1C/DS-2 Tx/Rx module (RP 6000 in this section).
16 Tx GP1 - Tx GP7. DS-1/DS-1C/DS-2 line fail.	**1.** Loss of DS-1/DS-1C/DS-2 input to FMT-150 shelf backplane.	**1.** Verify DS-1/DS-1C/DS-2 input to FMT-150 shelf backplane.
		2. Reset the monitor and control module (DP 3107 in Section 321-3211-302).
17 Rx GP1 - Rx GP7. DS-1/DS-1C/DS-2 frame loss.	**1.** Any upstream equipment has failed.	**1.** Verify entire optical path, optics modules, translators, DS-3 Tx/Rx modules, and DS-3 cabling.
	2. Remote DM-13 has fewer low speed group cards equipped.	**2.** Reset the monitor and control module (DP 3107 in Section 321-3211-302).
		3. Perform the line learn command (DP 3018 in Section 321-3211-301).

Alarm for Common Equipment

FMT-150

At Node 4 Name _ for_Node_ 4

Network Status
Node Number

1	$\boxed{1}$	9	$\boxed{1}$
2	$\boxed{1}$	10	$\boxed{1}$
3	$\boxed{1}$	11	$\boxed{1}$
4	$\boxed{1}$	12	$\boxed{1}$
5	$\boxed{1}$	13	$\boxed{1}$
6	$\boxed{1}$	14	$\boxed{1}$
7	$\boxed{1}$	15	$\boxed{1}$
8	$\boxed{1}$	16	$\boxed{1}$

	1	2	3	4
	$\boxed{2}$			
MCU Not Resp	$\boxed{3}$			$\boxed{3}$
M13 Comm	$\boxed{4}$	.	.	$\boxed{4}$
Power Support Unit	$\boxed{5}$	.	.	$\boxed{5}$
Service Channel Unit	$\boxed{6}$	.	.	$\boxed{6}$
Fuse Alarm	$\boxed{7}$	.	.	$\boxed{7}$
Network Not Operating	$\boxed{8}$	.	.	$\boxed{8}$

- - - - - Time: 89/09/15 11:35 - - - -
- - - Syst Id: Name for System - - -

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To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 23

DM-13 MULTIPLEXER ALARMS SCREEN INTERPRETATION

TABLE 11

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Node Number.	**1.** Alarm at specified node.	**1.** Use other indications and this table to pinpoint problem.
2 MCU Not Responding.	**1.** MCU removed.	**1.** Replace MCU (RP 6000 in this section).
	2. MCU fail.	
3 M13 Communication.	**1.** Monitor and control module OFF.	**1.** Verify monitor and control module ON (DP 2000 in Section 321-3211-202).
	2. Monitor and control module disabled.	**2.** Verify monitor and control module enabled (DP 3107 in Section 321-3211-201).
	3. DM-13 Communication wiring is incorrect.	**3.** Verify DM-13 communication wiring (DP 1013 and DP 1023 in Section 321-3211-201).
	4. Monitor and control module optioning is incorrect.	**4.** Verify monitor and control module optioning (DP 2000 in Section 321-3211-202).
4 Power Supply Unit.	**1.** PSU OFF.	**1.** Replace PSU (PR 6000 in this section).
	2. PSU removed.	
	3. PSU fail (RP 6000 in this section).	

TABLE 11 (concluded)

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
5 Service Channel Unit.	**1.** SCU removed.	**1.** Replace SCU (PR 6000 in this section).
	2. SCU fail.	
6 Fuse Alarm.	**1.** FMT-150 shelf fuse blown.	**1.** Replace blown fuse (RP 6001 in this section).
7 Network not operational. No communication between MCU and other nodes.	**1.** Optical fiber cut.	**1.** Verify optical fiber continuity.
	2. MCU fail.	**2.** Replace MCU (RP 6000 in this section).
	3. MCU optioning is incorrect.	**3.** Check MCU optioning (DP 2012 in Section 321-3211-202).
8 Network Controller Fail.	**1.** MCU fail.	**1.** Replace MCU (RP 6000 in this section).

Alarm for Customer Inputs/Outputs **FMT-150**

1	2	3	4	5	6	7	8
$\boxed{1}$	.	.	.	.	.	.	$\boxed{1}$

9	10	11	12
$\boxed{1}$	.	.	$\boxed{1}$

1	2	3	4	5	6	7	8
$\boxed{2}$	.	.	.	.	.	.	$\boxed{2}$

9	10	11	12	13	14	15	16
$\boxed{2}$	.	.	.	.	.	.	$\boxed{2}$

- - - - - Time: 89/09/15 11:35 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 24

Note: The NT7H75BA/XA provide 12 inputs and 4 outputs.
The NT7H75BB/XB provides 8 input and 16 outputs.

CUSTOMER INPUTS/OUTPUTS SCREEN

TABLE 12

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Customer Input.	**1.** A ground condition has occurred at the rear of the FMT-150B or D shelf. The ground condition is driven by the customer's external circuit.	**1.** Identify the significance of the active input according to the customer's local alarm network. Troubleshoot accordingly.
2 Customer Output.	**1.** A customer output has become active because it has been switched from the CRT interface, *or*	**1.** Display the configuration of the customer output in question using DP 3451 in Section 321-3211-304. If the activating inputs have been cleared, the output will automatically clear, unless latched. If latched, the output can be cleared using DP 3464 in Section 321-3211-304.
	2. Any of the conditions assigned to the customer output has become active (NT7H75BB/XB only).	

Performance Alarms

FMT-150

At Node 3 Name _ for_Node_3	A			B		
	1	**2**	**3**	**1**	**2**	**3**
TRANSLATOR						
Perf Event Alarm 1	1	.	.	.	.	1
Perf Event Alarm 2	1	.	.	.	.	1
Perf Event Alarm 3	1	.	.	.	.	1
Perf Event Alarm 4	1	.	.	.	.	1

- - - - - Time: 89/11/27 18:30 - - - -
- - - Syst Id: Name for System - - -

To backspace, use the QUIT key.
To enter numbers, use F1 to F8 (1 to 8),
Page Up (9), Page Down (0)

Figure 25

PERFORMANCE EVENT ALARM SCREEN

TABLE 13

ALARM INDICATION	PROBABLE CAUSE	ACTION TO TAKE
1 Performance Event Alarm.	1. The specified translator has indicated that a performance event alarm has occurred for the received DS-3 signal. In other words, the preset threshold of error seconds (Type A, B, or C) or the preset threshold of parity errors or frame loss errors has been exceeded.	1. Display the performance alarm event definition screen (DP 3459 in Section 321-3211-304) to identify the alarm.
		2. Check other translator performance information (DP 3468 in Section 321-3211-304) to determine if the problem is due to the optical path/optical modules or the far-end translator.
		3. Verify the complete optical path leading to the translator giving the alarm.
		4. Relace the far-endtranslator (RP 6000 in this section).

APPENDIX E

16-KEY MONITOR AND CONTROL FACEPLATE

PURPOSE

This section describes the 16-Key Monitor and Control Faceplate utilized in the FMT-150B/C/D.

OBJECTIVES

Using student guide, classroom notes, and NTPs, the student will be able to:

1. List the functions available on the FMT-150B/C/D Monitor and Control Module with the 16-key faceplate

2. Describe each function of the Monitor and Control Module with the 16-key faceplate

16-KEY MONITOR AND CONTROL FACEPLATE

TABLE OF CONTENTS

16 KEY MONITOR AND CONTROL FACEPLATE

The 16 key Monitor and Control faceplate is located within each DM-13 of the FMT-150C shelf. This faceplate contains all of the information necessary to operate and maintain the FMT-150C system.

The faceplate contains LEDs for status and alarm indications, a 16-character LCD screen to display detailed information about the system, and a membrane keypad for entering commands and requests.

There are six LEDs in the bottom right corner of the faceplate to indicate various alarm and status conditions. They are as follows:

Major	Total loss of DS-3 service
Minor	Any other alarm
Equip Fail	Failure within the FMT-150C system
Line Fail	Failure outside the FMT-150C (10 sec holdoff)
AIS/Blue	Upstream failure: keep-alive signal detected
Remote	FMT-150C is being controlled via E2A interface

A sixteen-character LCD screen reports detailed alarm and status information to the operator. It also prompts the operator during the input of multiple-keystroke sequences. Under normal operating conditions, the display will be blank.

Control Functions

Three control functions are provided for maintenance and testing purposes. They are as follows:

- Lockout
- Loopback
- Force Switch

There are individual keys for each of these functions. Implementing a control function also requires the use of the selection keys (for group and tributary number, if applicable) and the Clear and Enter key.

In addition, Lockout and Force Switch may be implamented over the E2A serial interface through a remote command request.

Lockout

The Lockout function allows the operator to deny protection to any number of selected signals.

Lockout of a high-speed transmit/receive module denies protection to the DS-3 line in case of a high-speed failure.

Note: Locking out a high-speed transmit/receive module will in turn deny protection to the corresponding DMI-F45 optical module.

Lockout of a working low-speed transmit/receive module denies protection to any tributary associated with that module (any tributary within the locked-out group).

Lockout of a standby low-speed transmit/receive module denies protection to all tributaries associated with that standby module (all tributaries of that type group, whether DS-1, DS-1C, or DS-2).

If the Lockout function is in use, a yellow LED lights within the Lockout key on the faceplate.

Loopback

The Loopback function allows the operator to remotely loopback any number of DS-1 or DS-1C tributaries. This allows two-way testing of the transmission link from a single site.

Remote loopback is not offered for DS-2 tributaries.

For the Loopback function to operate, the far-end multiplex must be a FMT-150A multiplexer or compatible. Before being looped back, live traffic should be removed from the affected tributaries and a test set should be patched in at the cross-connect .

If the Loopback function is in use, a yellow LED lights within the Loopback key on the faceplate and a Minor alarm is displayed in the system.

Note: There may be instances where it is desirable to inhibit incoming loopback commands at a particular location. In these instances, a "Disable Loopback" command may be performed. The command will result in a solidly lit LED within the loopback button and inhibits all loopbacks with the DM-13.

Remote Loopback

The remote loopback function is used primarily for testing purposes. It eliminates the need to have personnel and DS-1 test sets at both ends of the transmission link.

A remote loopback command may be entered for any DS-1 or DS-1C tributary. This sends a command to the far-end multiplexer to take the output of that tributary and to use it as the input in the opposite direction. A single test input; therefore, can monitor the quality of transmission in both directions.

Force Switch

Force Switch allows the operator to overrule any existing protection switch, at both the low-speed and high-speed/optical levels. It takes priority over any existing protection switch; therefore, the Force Switch command should always be used carefully to avoid causing a service failure.

Entering a Force Switch on a low-speed transmit/receive module (if equipped). Since this is a non-revertive switch, the Force Switch LED of the Monitor and Control module does not light. (The LED will light if traffic is Force Switched to a failed module.)

Entering a Force Switch on a low-speed transmit/receive module will switch all tributaries on that module to the associated standby module (if equipped). This will take priority over other protection switch commands, so a yellow LED will light within the Force Switch key on the faceplate.

A low-speed Force Switch can be cleared by a simila set of keystrokes. This will cause traffic to revert to the working low-speed module and the LED will go out.

A Force Switch cannot be initiated from any standby module.

DIAGNOSTIC COMMANDS

The Monitor and Control faceplate also provides two diagnostic commands which provide summaries of system status and alarms. These are the Status and History functions.

Status Function

The Status function displays the present status of a designated module or trivutary, chosen through the selection keys below the LCD screen. It also allows the operator to examine the inventory of plun-in modules as well as the address selected for serial alarm interfacing.

The status is displayed in short one or two work summaries which are easily understandable without reference materials: "LINE", "IDLE", and "FAIL PROT" are typecal examples.

History Function

The History function allows the operator to scroll through the twelve most recent alarms encountered by the system. The alarms are stored in a 12-position stack, with more recent alarms pushing older alarms out of memory. The first alarm displayed on the History screen is the most recent event; alarms may be scrolled by holding doun the key.

The alarms are displayed by simple code words, such as "FRAME" for frame loss, "BIT-CHK" for bit-by-bit checking error or "AFIBER" for an optical fiber failure. Some of these alarms are not sufficiently serious to raise a minor alarm and are referred to as "soft" alarms.

MONITOR CONTROL FUNCTIONS

There are three functions which provide direct control of the monitor's operations. These are as follows:

- Monitor Test
- Monitor Disable
- Monitor Reset

Monitor Test

The Monitor Test key instructs the Monitor and Control module to perform a thorough self-test of all operations. Successful completion causes the words "SELF TEST PASS" to be briefly displayed on the LCD screen.

A self-test is automatically executed on power-up and during a Monitor Reset. The operator may perform a self-test at any time by simply pressing the Monitor Test key.

Monitor Disable

The Monitor Disable function disables the Monitor and Control module from control of the system. This must be executed whenever modules are to be replaced or system configurations are to be changed. To prevent accidental disabling, the Monitor Master Control key must be held down when this key is pressed.

Certain key software routines are continually self-checked by the Monitor and Control module. If one of these appears to be in error, the faceplate will automatically disable itself. Therefore, a Monitor Disable, whether manual or automatic, will raise a minor alarm. A red LED within the Monitor Disable key will also light when the faceplate has been disabled.

Always disable the monitor before inserting and/or removing modules.

Monitor Reset

The Monitor Reset will re-initialize all software, learn the configuration of the system, take inventory of active modules, and perform the power-up diagnostics. To avoid accidental resets, the Monitor Master Control key must be held down when this key is pressed.

A reset will cause the words "SELF TEST PASS" to be displayed on the LCD screen, followed by "FMTxx: INITIALIZE", where "xx" is the software version installed. The Minor alarm light and the red LED within the Reset key will light momentarily.

A Reset should be executed whenever modules have been replaced or system configurations have been changed.

MASKING LOW-SPEED ALARMS

Since low-speed traffic requirements (at the DS-1, DS-1C, or DS-2 level) are often subject to change, the Monitor and Control faceplate makes allowance for masking certain alarms. These alarms not only can be annoying, but could cause the operator to accidentally ignore actual alarms.

Line Learn Mode

In a drop/insert configuration, the far-end multiplexer may often be equipped with a different number of low-speed transmit/receive modules. Normally, the Monitor and Control faceplate would raise a minor alarm and a Line Fail alarm. These alarms may be disabled by the Line Learn function.

Simply press the Status key and then the Enter key. The words "LINE LEARN MODE" will be briefly displayed, and then the LCD screen will return to blank. The Minor and Line Fail alarms should be cleared.

Line Learn will be erased by a Monitor Reset. Therefore, it must be re-entered after a reset or a power-down.

IGNORING LOW-SPEED INPUT FAIL ALARMS

In some applications, the low-speed tributaries may be frequently re-configured due to changing customer needs. In such cases, it is annoying to have a minor alarm raised every time a low-speed tributary is removed (such as pulling a DS-1 signal out at the cross-connect).

A switch setting on the Monitor and Control face plate allows these low-speed failure alarms to be ignored (nulled). Although the Line Fail LED will light (as usual), reconfiguring the low-speed inputs will then not raise monor alarms.

OTHER FUNCTIONS

The faceplate also provides four other functions:

ACO (Alarm Cut-Off) for DM-13	Silences office audible alarms
Lamp Test	Tests the LCD screen and all LEDs on the faceplate and the plug-in modules of the DM-13
Automatic Polling	Every five seconds, the Monitor and Control module polls all active modules in the multiplexer. This causes the red LEDs on each module to flash briefly.
Alarm Simulation	This sets every alarm point "high" for a period of five seconds.