

DIGITAL TRANSMISSION SYSTEM
828A DIGITAL MULTIPLEXER
GENERAL DESCRIPTION

1. GENERAL

- 1.01 This section is a cover sheet for the Telco Systems Fiber Optics Corporation Digital Transmission System 828A Digital Multiplexer General Description. This section is reproduced with permission of Telco Systems Fiber Optics Corporation and is the equivalent of Telco practice 828-102-001, Issue 3.
- 1.02 Whenever this section is reissued the reason(s) for reissue will be listed in this paragraph.
- 1.03 This section describes the basic functions and features of the 828A Digital Multiplexer.
- 1.04 If corrections are required in the attached document, use Form-3973 as described in Section 000-010-015.
- 1.05 If equipment design and/or manufacturing problems should occur, refer to Section SW 010-522-906 for procedures on filing an Engineering complaint.

2. ORDERING PROCEDURE

- 2.01 For information concerning equipment and parts availability contact Telco Systems, Order Administration Department, in Norwood, Massachusetts, at:

1-800-44-SALES
1-617-551-0300

- 2.02 To order additional copies of this practice, use TELC 365-407-841SW as the section number.

3. REPAIR/RETURN

- 3.01 For defective modules and assemblies contact the Repair and Return Department at the following number:

8:00 a.m. - 5:00 p.m. (617) 551-0300 - Ext. 2778

Attachment: Telco Systems Fiber Optics Corporation
Digital Transmission System
828A Digital Multiplexer
General Description

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DIGITAL TRANSMISSION SYSTEM
 828A DIGITAL MULTIPLEXER
 GENERAL DESCRIPTION

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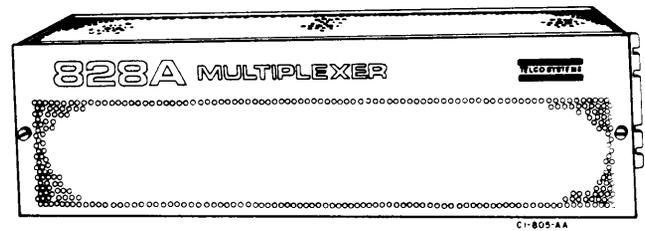


Figure 1-1. 828A Digital Multiplexer

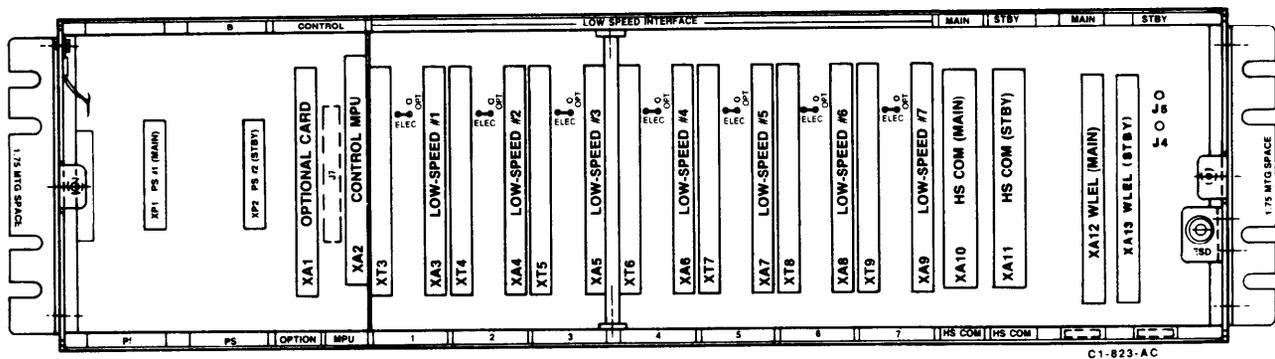


Figure 1-2. 828A Digital Multiplexer (Cover Removed)

2. MANUAL ORGANIZATION

2.01 This manual contains the following sections:

SECTION 1. GENERAL DESCRIPTION
provides an overview of the 828A operation with emphasis on features and functions incorporated into equipment design.

SECTION 2. THEORY OF OPERATION
presents a detailed discussion of 828A equipment subsystems and circuit card operation to block diagram level.

SECTION 3. ORDERING INFORMATION
provides guidelines for subassembly and circuit card ordering.

SECTION 4. SPECIFICATIONS
details unit-level physical and electrical specifications.

SECTION 5. INSTALLATION
provides instruction on unit installation, cabling, and equipment configuration.

SECTION 6. INITIAL OPERATION TESTING
details all procedures required for circuit card optioning, unit turn-up, and equipment testing and alignment.

SECTION 7. MAINTENANCE
details all procedures required for unit-level maintenance including fault isolation, card and module replacement, and the procedures necessary for return and repair of equipment.

SECTION 8. SPECIAL TEST CARDS
provides a description of the Manual Control Interface card and the T1 monitor card and the various functions of these cards.

SECTION 9. DRAWINGS

provides equipment reference drawings, motherboard wiring schematics, and assembly prints to be used as an aid for detailed troubleshooting or installation, as required.

3. GENERAL INFORMATION

A. Safety Precautions

3.01 As with any product, care must be exercised when working near the -48 Vdc power source and connections. Potentially high electrical currents might flow if the -48 Vdc terminals of TB-1 are inadvertently shorted to ground. Terminals TB-2, TB-3, and TB-4 of the 828A, and Terminal TB-2 of the Fuse and Alarm Panel should be connected to the site ground system to reduce T1 line noise and provide electrical protection.

3.02 All cards and modules contained in the 828A unit, with the exception of the Power Supply modules, are designed to enable removal or installation without defusing the equipment.

3.03 Circuit cards can be damaged by electrostatic discharge. Before handling any circuit cards, connect your wrist to an equipment frame ground, using an approved antistatic wrist strap (EMX031-1). Ensure that all circuit cards removed from the equipment are properly stored in antistatic packing material (PKG033-1). When working with circuit cards, always place the card on an electrically grounded approved antistatic mat.

B. References

3.04 Since the 828A may interface to a FOX-2R/FOX-2 wall-mount unit as part of a DS-2 optical extension span, a Channel Bank, TELTRAC, or another 828A/828AF, other reference material may be required for system-level installation and test. The following is a list of Operation and Maintenance manuals and practices that may be useful in the planning or installation phases of 828A systems interfacing with other Telco Systems transmission products.

TELCO SYSTEMS FIBER OPTICS CORPORATION:

828AF Digital Multiplexer Operation and Maintenance Manual

FOX-2 DS-2 Optical Extension Operation and Maintenance Manual

FOX-2R DS-2 Optical Extension Operation and Maintenance Manual

TELTRAC Users Manual and TELTRAC Configuration Manual

TELCO SYSTEMS NETWORK ACCESS CORP:

DCB-24 Channel Bank: Description/
Installation/Maintenance Practice
Section 2424-00-101
Installation/Maintenance Practice
Section DCB-24-200

DDI-24 Digital Drop/Insert System:
Description Practice
Section 2400-00-101
Installation Practice
Section 2400-00-200

TPS-4002 Digital Time Slot Processing
System: System Practice
Section 4002-100

NDI-2000 Network Digital Interface
Sections 2010-00-100,
2020-00-100, and 2030-00-101

4. PRODUCT OVERVIEW

A. Unit Description

4.01 The 828A is a self-contained multiplexer capable of combining DS-1, DS-1C, and DS-2 electrical or DS-2 optical signals in any combination up to the equivalent of 28 DS-1 channels into a single industry-standard DS-3, B3ZS data channel. Receive circuitry demultiplexes an industry-standard DS-3 B3ZS electrical signal into its DS-1, DS-1C, DS-2 electrical or DS-2 optical components. The unit is constructed as a single 23-inch rack-mountable cage which can be installed in a standard equipment rack or within custom cabinetized systems. The 828A can be employed as a DS-3 B3ZS electrical input to digital microwave, high-density fiber-optic, or other transmission systems. The 828A can also be operated as an 828AF fiber-optic DS-3 terminal by installing High-Speed XCVR (Transceiver) cards in place of WLEL (Wire-Line Entrance Link) cards, for direct DS-3 45 Mb/s optical span interface to another 828AF multiplexer or a Telco Systems M560 fiber-optic transmission system.

4.02 The 828A carries up to 672 64 kb/s channels per unit, in any combination of DS-1, DS-1C, and/or DS-2 signals up to the equivalent of 28 DS-1 channels.

4.03 The low-speed interface cards contain all circuitry necessary to interface with DS-1 (AMI or B8ZS), DS-1C, or DS-2 (B6ZS) electrical signals, or 3B6B encoded DS-2 optical signals from FOX-2/FOX-2R optical extensions, and multiplex them to the NRZ (Non-Return to Zero) DS-2 level with full 1:1 redundancy of the M12 MULDEM (DS-1 to DS-2 Multiplexer/Demultiplexer) circuitry.

4.04 When equipped with an LTU (Line Terminating Unit) card in the low-speed section, the 828A can have DS-2 signals optically extended to Remote FOX-2/FOX-2R units for T1 or T1C distribution. Each optical DS-2 channel is 3B6B coded into a 12.624 Mb/s optical data stream and accommodates an overhead channel for the 828A and FOX-2/FOX-2R MPUs (Micro-processor Units) to communicate (MPU-to-MPU communications) for the purpose of reporting remote FOX-2/FOX-2R fault alarms to the 828A unit (see SECTION 828-102-002C).

4.05 The M23 MULDEM (DS-2 to DS-3) circuitry within the 828A HS COM (High-Speed Common) card time-division multiplexes the seven DS-2 outputs of the low-speed interface cards into a single DS-3 (44.736 Mb/s) data stream. The M23 MULDEM also demultiplexes the received DS-3 electrical data stream to provide DS-2 channels to the receive circuitry of the low-speed interface cards.

4.06 The WLEL converts the unipolar data and timing signals from the HS COM card into an industry-standard DS-3 B3ZS data stream for coaxial cable interface to digital microwave or fiber-optic transmission equipment. The WLEL card also converts the received DS-3 B3ZS electrical signal into two unipolar signals which are applied to the HS COM card for demultiplexing into component DS-2 data streams and for clock recovery.

4.07 The Control MPU card monitors all cards and modules within the 828A unit, and illuminates the appropriate fault indicators in the event of a failure. Hardware failures result in fault LED indications only on the faulty card. The microprocessor also

calculates the DS-3 BER (Bit Error Rate), and illuminates appropriate LEDs when the BER rate exceeds a predetermined customer-selectable threshold. The quality of transmission is also monitored for electrical and optical low-speed cards, via BPVs (Bipolar Violations) or coding errors. Through the use of lockout software, sympathetic alarms that may illuminate fault LEDs are masked or "locked" out. This prevents multiple downstream alarms, and thereby assists in fault isolation.

4.08 If equipped with a RAC-II (Remote Alarm Card II) card at each end, an 828A system provides eight relay contact closures at one end of the system as indications of active inputs at remote ends of the system. An 828A system equipped with a RAC-II card can also be used to extend RS-422 serial remote monitoring communications, such as TELTRAC, to a remote-site, for monitoring and control of equipment without requiring use of a modem, Service Channel unit, or any other separate communications channel (see SECTION 828-102-002G).

4.09 Equipped with the Optional MPU-II card, the 828A system can extend TELTRAC communications to remote FOX-2 and FOX-2R units interfaced with the remote 828A/828AF multiplexer. Through the MPU-II card, output relay contacts on the RAC-II cards can be individually controlled by TELTRAC. Also, up to a total of eight unique inputs originating in RAC-II cards of the FOX-2R units, and the alarm input points on the Power Supply modules in FOX-2 units, and/or on the MPU-II card itself, can be reported at the local end by means of output relay contact closures in the local-end RAC-II card. See SECTION 828-102-002G and SECTION 828-102-002I

B. Features**Equipment Size**

4.10 A single 828A measures 23-in. wide by 6-in. high by 11.5-in. deep, allowing up to twelve units to be mounted in a standard 7-foot rack, with a Fuse and Alarm Panel.

State-of-the-Art Technology

4.11 Circuit cards used in the 828A employ the latest VLSI technology, including the use of programmable gate arrays, thin-film, and surface-mount technology for superior reliability and lower power consumption.

Transmission Capacity

4.12 The 828A is capable of carrying the equivalent of 28 DS-1 channels. With the proper Low-Speed Interface card, traffic can be accepted as DS-1 (1.544 Mb/s), DS-1C (3.152 Mb/s), or DS-2 (6.312 Mb/s) electrical signals, 3B6B encoded DS-2 (12.624 Mb/s) optical signals, or any combination thereof up to an equivalent of 28 DS-1 channels.

Selectable Low-Speed Interface

4.13 Each 828A unit can be equipped for T1, T1C, or T2 channel interface by installing the appropriate Low-Speed Interface card.

4.14 User selectable AMI (Alternate Mark Inversion) or B8ZS (Bipolar with Eight-Zero Substitution) T1 line coding can be optioned on a per channel basis via a four-pole front-mounted DIP switch on the T1 Low-Speed Interface card (CCA161G2).

Equipment Protection

4.15 All power, low-speed and high-speed multiplexing, high-speed line coding, and optical interface circuitry can be 1:1 protected. The T1 and T1C Low-Speed Interface cards employ integrated 1:1 circuit protection which resides on the same card, while the other cards are protected by a redundant card. Any combination of low-speed cards will, or can be 1:1 protected. The Control MPU card initiates automatic switching to the STBY circuitry when a hardware failure occurs, or when the predetermined BER switching threshold is exceeded. For maintenance purposes, the multiplexer can be switched manually to redundant circuitry via the Control MPU card, the Manual Control Interface card, or an external monitoring system such as the TELTRAC system.

Remote Alarm Reporting

4.16 Through mux-to-mux (multiplexer-to-multiplexer) communication, remote monitoring and control functions are possible. Mux-to-mux communication is carried by an overhead channel in one of the DS-2 data channels. A local 828A unit is capable of reporting the presence of a MAJOR or MINOR alarm in a multiplexer at the far end. This is accomplished by illuminating the BAY indicator alarm on the local 828A Fuse and Alarm Panel and REM LEDs on the corresponding card in the local-end 828A unit. If the 828A system has been appropriately configured and is equipped with RAC-II cards, the REMOTE indicator on the ACX025 Fuse and Alarm Panel will also be illuminated to indicate that the fault is at the remote end. Remote switching and status reporting are possible if the 828A unit is equipped with a Manual Control Interface card or with TELTRAC.

Fuse and Alarm Panels

4.17 The ACX025 Fuse and Alarm Panel (see Figure 1-3) mounted in the rack provides individually filtered and fused power lines for up to twelve main and standby power supply units. In addition to power distribution, the panel provides wire-wrap pin blocks for alarm reporting, and TELTRAC interface connectors.

4.18 The ACX025 Fuse and Alarm Panel provides BAY, FUSE, ACO (Alarm Cutoff), INT FUSE, and REMOTE alarm indicator lights for visual alarm indications and relay contact closures (see Figure 1-3). Form A relays provide for visual and audible MAJOR and MINOR alarms. Form C FUSE, ACO, and REMOTE relay contacts are available as separate closures.

4.19 The ACX043 Fuse and Alarm Panel provides individually filtered

and fused power lines for up to six main and standby power supply units. In addition to power distribution, the panel provides wire-wrap pin blocks for alarm reporting, TELTRAC interface connectors and wire-wrap pin blocks which interface with the eight opto-isolator inputs and output contacts of RAC-II cards in the 828A units in the bay (see Figure 1-4).

External Alarm Reporting

4.20 Each 828A unit is equipped with two relays (MAJOR and MINOR) used to report corresponding alarms to the Fuse and Alarm Panel. From the Fuse and Alarm Panel, these alarms can be connected to on-premises customer alarm reporting equipment. During maintenance procedures the audible alarms and, optionally, the visual alarms may be silenced or cut off with the ACX025 Fuse Panel.

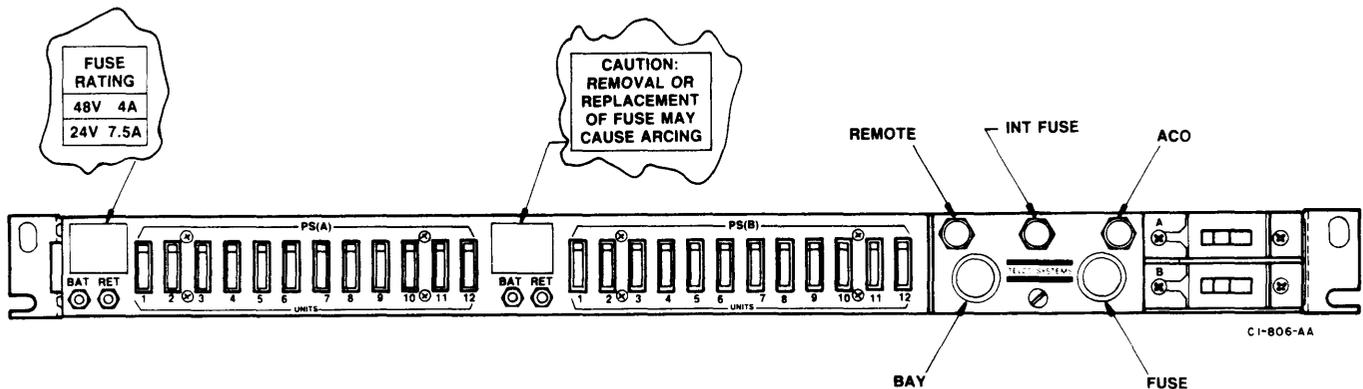


Figure 1-3. ACX025 Fuse and Alarm Panel

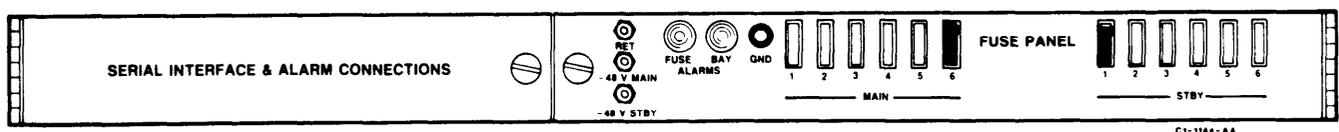


Figure 1-4. ACX043 Fuse and Alarm Panel

Maintenance Interface Card

4.21 Through use of the Maintenance Interface card (see Figure 1-5), changeout of T1 and T1C Low-Speed Interface cards and of Control MPU cards is possible without temporarily losing traffic. This card is required because the T1 and T1C cards have the protection circuitry on the same card. The Maintenance Interface card provides for off-line testing of spare T1 or T1C Low-Speed Interface cards before placing them in service. Test data is inserted into the spare cards through test jacks built into the Maintenance Interface card. The card provides for either T2 loopback of the test data or receive bridging to on-line traffic. The Maintenance Interface card is also used to inhibit access to the MPU data bus during MPU replacement procedures.

Manual Control Interface Card

4.22. The Manual Control Interface card is an I/O (Input/Output) board, allowing immediate and direct access to the Control MPU card. This access is used to initiate test functions, and provide status through interrogation of the local and remote terminals.

Remote Monitoring Systems

4.23 The Control MPU card can interface with a TELTRAC network. Remote monitoring systems, such as TELTRAC and TBOS (Telemetry Byte Oriented Serial), provide comprehensive network remote alarm and status reporting. In addition, diagnostic fault isolation and remote controlled switching capabilities are provided.

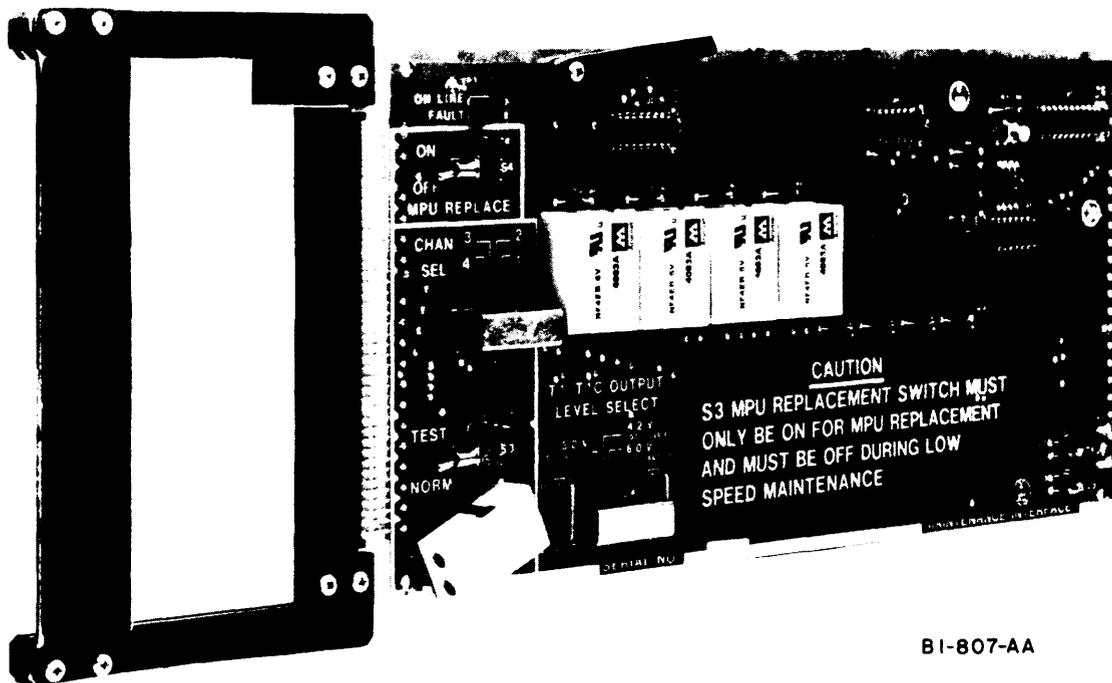


Figure 1-5. Maintenance Interface Card

5. SYSTEM APPLICATIONS

5.01 The following section explores system application possibilities of the 828A to address specific network requirements.

A. 828A Multiplexer to Digital Microwave or High-Density Fiber Optic Transmission System

5.02 Figure 1-6 illustrates use of the 828A Digital Multiplexer as part of a digital microwave system, and Figures 1-7 and 1-8 illustrate a similar use in digital fiber-optic transmission systems. Incoming DS-1, DS-1C, and/or DS-2 data streams

are multiplexed to the DS-3 level. The DS-3 electrical signal is interfaced in industry-standard B3ZS line coding to the digital microwave or high-density fiber-optic transmission system, such as Telco Systems TLX-140 or M560, or other fiber-optic transmission system, where it is multiplexed with other DS-3 inputs for transmission over an optical fiber cable span in a high-density optical data stream.

5.03 The DS-3 B3ZS electrical signal received from the microwave or high-density fiber-optic equipment is demultiplexed into its component DS-1, DS-1C, and/or DS-2 data streams.

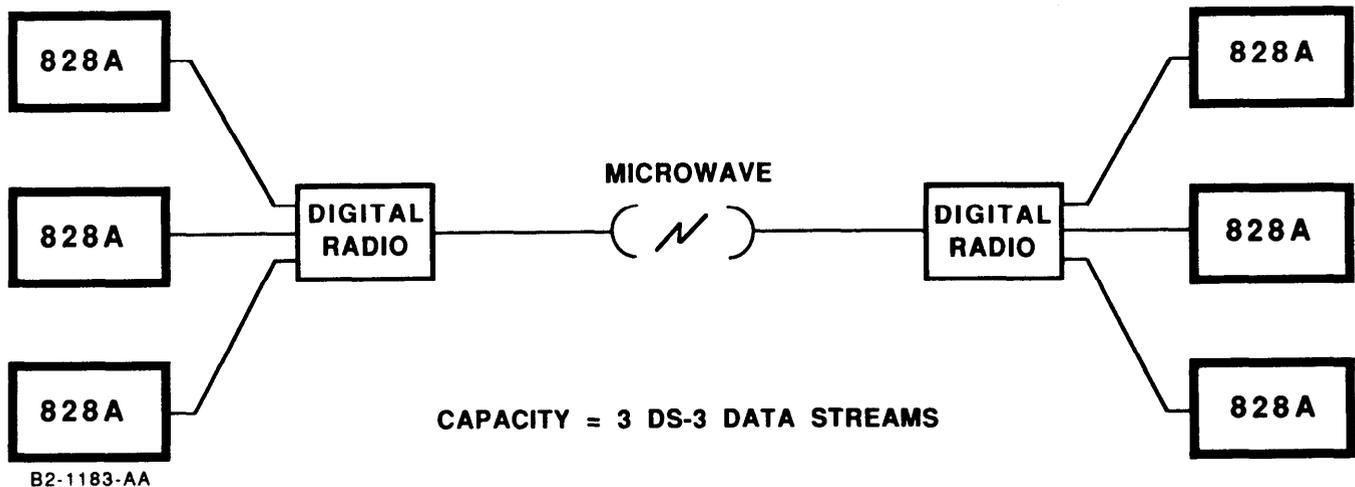


Figure 1-6. 828A Digital Multiplexer in a Digital Microwave System

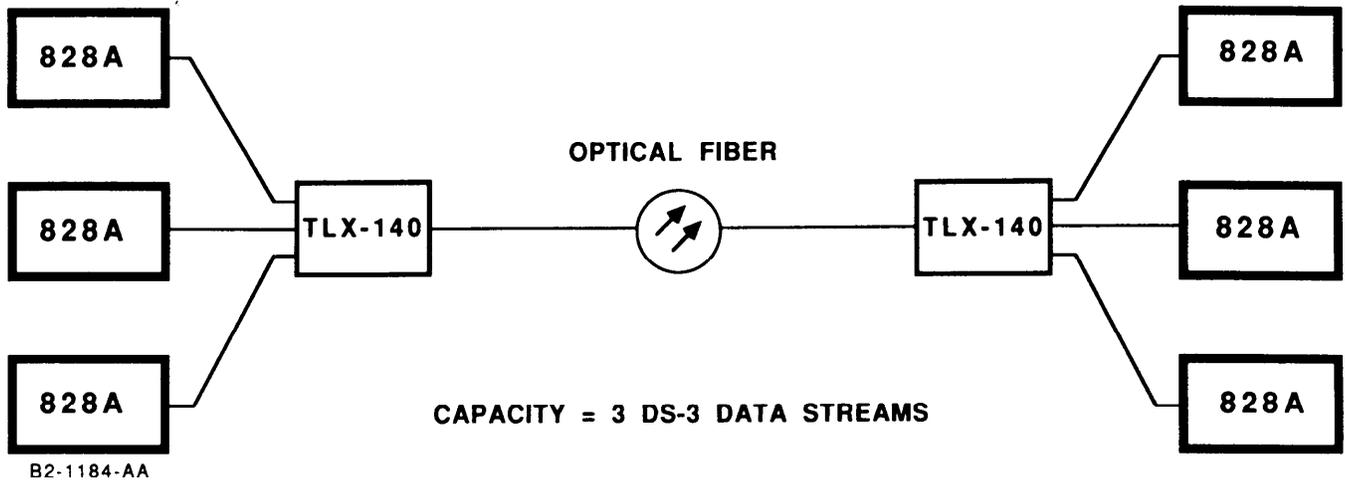


Figure 1-7. 828A Digital Multiplexer in a TLX-140 Fiber-Optic Transmission System

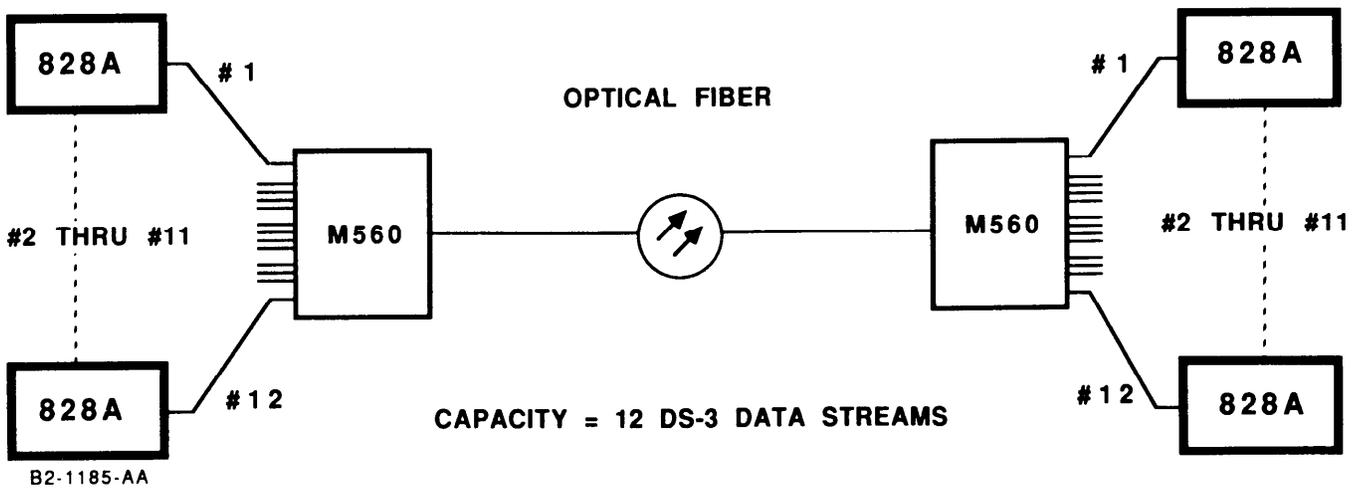


Figure 1-8. 828A Digital Multiplexer in an M560 Fiber-Optic Transmission System

B. DS-2 Fiber-Optic Extension and Hub Applications

5.04 Figure 1-9 illustrates the 828A in a DS-2 fiber-optic extension application. While most of the DS-1, DS-1C, and/or DS-2 data streams are distributed from the 828A site, two of the DS-2 data streams have been extended via a 3B6B encoded optical spur to a FOX-2R unit for distribution at a remote site.

5.05 Figure 1-10 illustrates use of the 828A in a DS-2 fiber-optic hub application. The optical DS-3 transmission trunk interconnecting a central office and a hub distribution center can be subdivided into six 3B6B encoded DS-2 optical extensions to provide DS-2 transmission to individual terminal end users. LTU cards in the low-speed section of the 828A multiplexer, as required, provide independent DS-2 optical spur links from the central hubbing location to remote FOX-2/FOX-2R units.

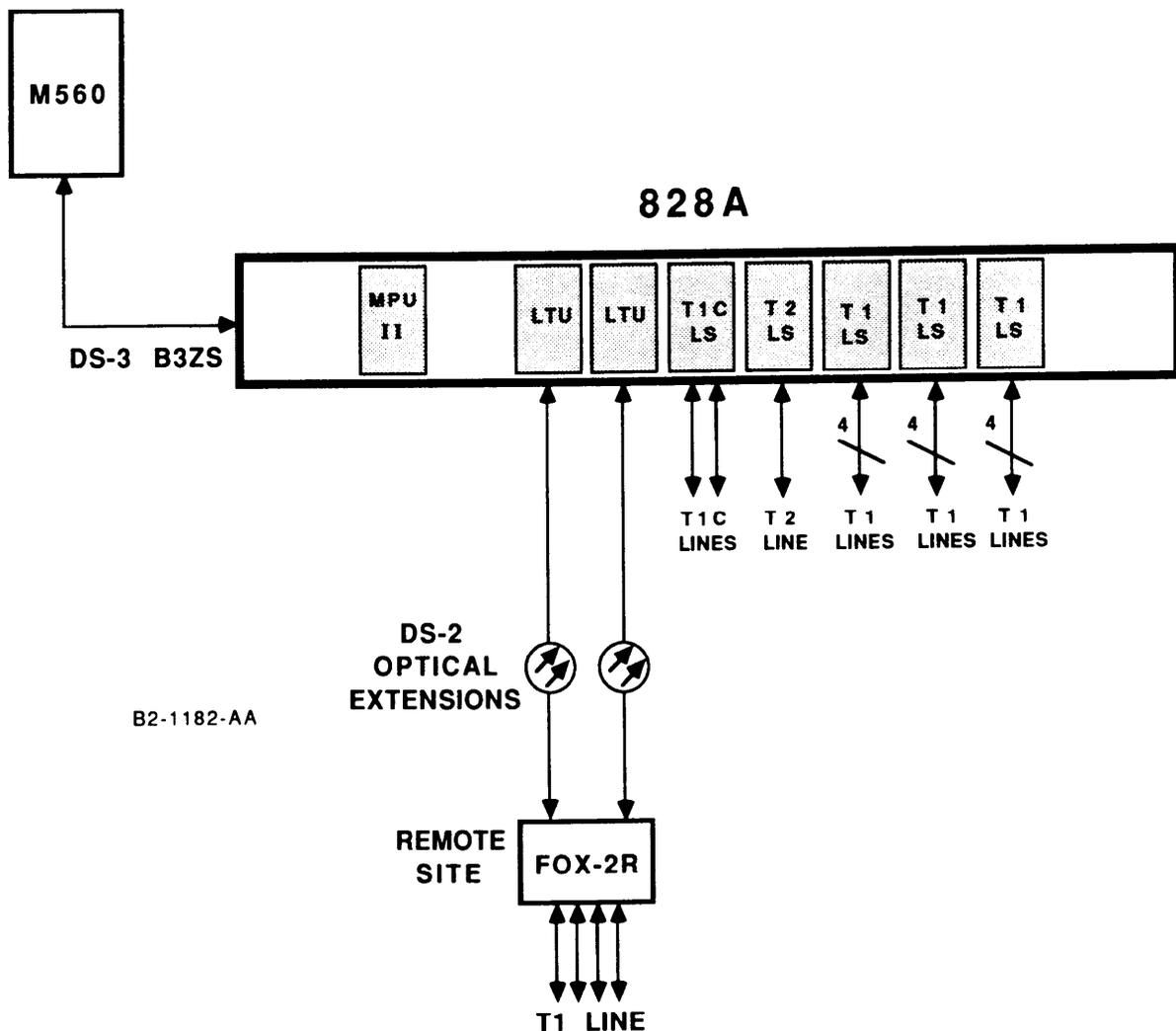


Figure 1-9. 828A/FOX-2/FOX-2R Optical Extension Application

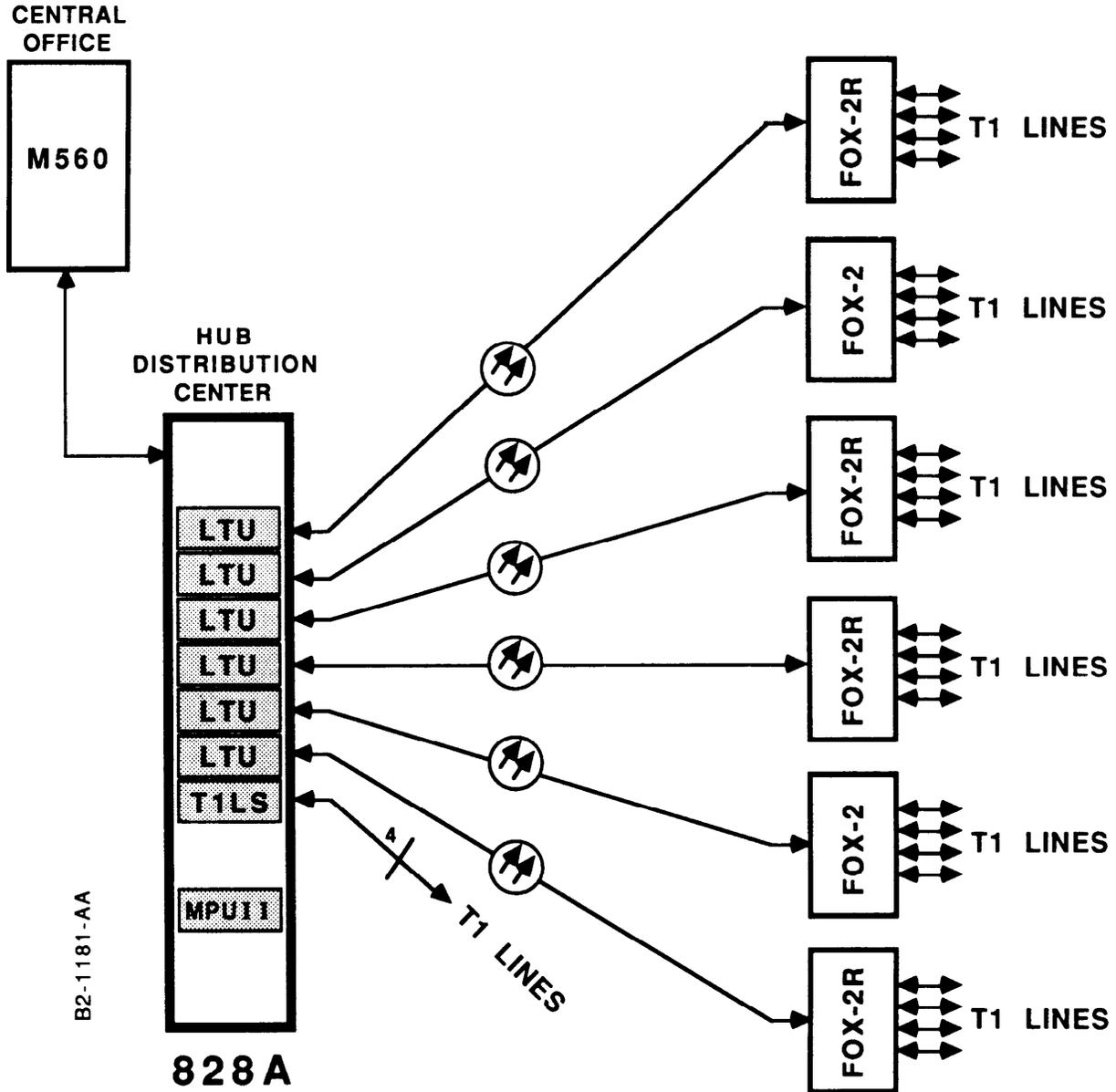


Figure 1-10. 828A/FOX-2/FOX-2R DS-2 Fiber-Optic Hub Application

C. TELTRAC Extension

5.06 Figure 1-11 illustrates the 828A in a TELTRAC extension application. Use of the RAC-II card enables the TELTRAC signal to be bridged onto the 828A DS-3

electrical data stream, utilizing a user definable DS-3 X-bit overhead channel, and to be transported to and from the remote site without requiring use of a modem, Service Channel, or other communication channel facility.

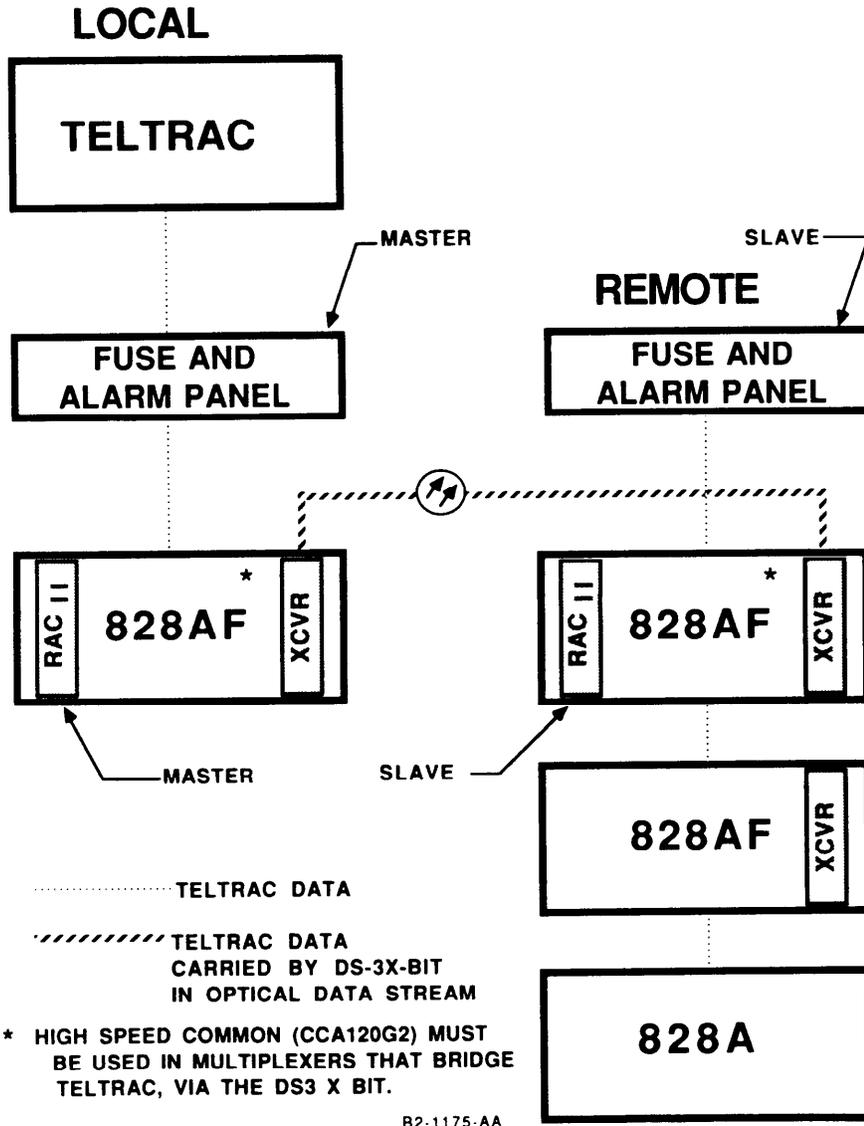


Figure 1-11. 828A TELTRAC Extension Application

D. External Remote Alarm Reporting

5.07 Figure 1-12 illustrates an end-to-end 828A system equipped with RAC-II cards and a hub MPU-II card to provide capability for reporting indications of active external inputs at the remote end through a total of eight output relay contact closures on the RAC-II card of the Local 828A unit. Through communications between the Control MPU in the Hub 828A unit and the microprocessor on the MPU-II card, output relay contact closures on all RAC-II cards in the remote FOX-2R units can be individually controlled by TELTRAC.

Control of relays on the RAC-II cards in the FOX-2R fiber-optic extension units is accomplished through overhead data embedded in the 3B6B encoded optical data streams of the LTU cards.

5.08 The MPU-II card provides up to eight unique external active inputs at the remote and hub end, from the MPU-II card and from remote RAC-II cards in FOX-2R units or Power Supply modules in FOX-2 units, to be transported to the local-end RAC-II card by overhead channels embedded in the data, and indicated by output relay contact closures on the local-end RAC-II card.

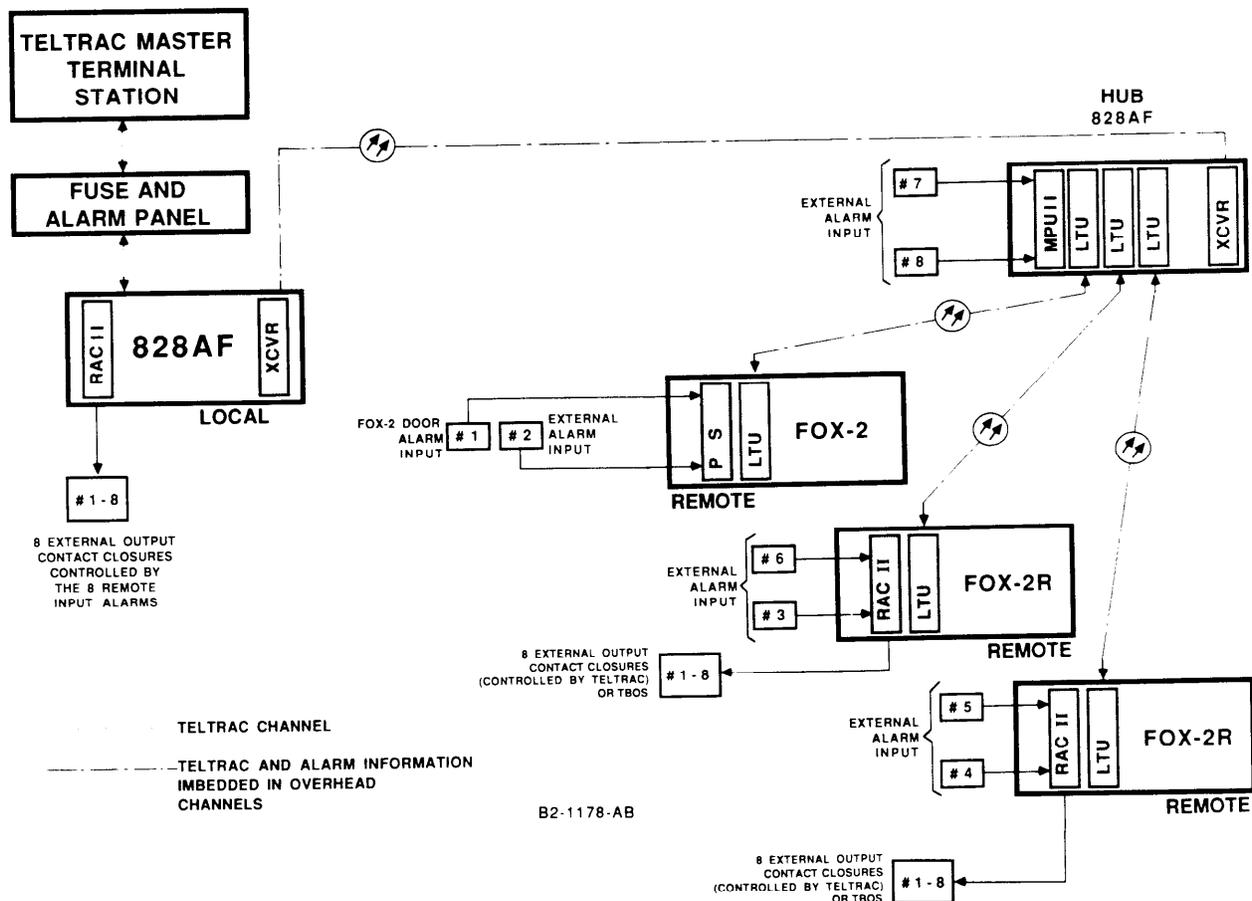


Figure 1-12. 828A External Remote Alarm Reporting Application

6. MAINTENANCE PHILOSOPHY

6.01 The 828A is constructed of solid-state components mounted on replaceable circuit cards or module assemblies. Telco Systems' maintenance philosophy is based on the use of built-in diagnostic tests to check the operation of local circuits as well as to monitor system conditions. Another aspect of this philosophy is to trace a problem to the faulty unit, using LED alarm indicators. The unit is then replaced with a spare, and the replacement unit is tested before being put on line.

6.02 The equipment is intended to be maintained without interrupting service. Whenever possible, troubleshooting of the failed equipment,

repair, and checkout are accomplished without interrupting traffic. However, when an out-of-service condition exists, the first priority is to return the system to full service; then perform detailed fault analysis with the faulty equipment off line.

6.03 Corrective maintenance consists of isolating a fault to a particular module or other component so that the faulty equipment can be removed from service, and the system restored to full operation as soon as possible. The Maintenance Procedures Section (828-102-007) provides a step-by-step approach to corrective maintenance. In addition, card replacement procedures are available to enable maintenance personnel to thoroughly check the card before it is placed in service.