

**363-205-002**

**``SLC(R)'' SERIES 5 CARRIER SYSTEM FIBER-TO-THE-HOME  
FEATURE USER'S MANUAL - 363-205-002 - ISSUE D**

Refer to Chapter 11

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## 1. About This Manual

### 1.1 Overview

This manual contains information concerning the description, applications, engineering, installation, and maintenance of the *SLC(R)* Series 5 Carrier System Fiber-To-The-Home feature. This document provides only information pertinent to the Fiber-To-The-Home (FTTH) feature and its use with the *SLC* Series 5 Carrier System. Detailed information pertaining to the *SLC* Series 5 Carrier System is not presented here but can be found in other AT&T documents (refer to the Related Documentation part).

This manual is reissued to update information concerning the mechanized loop testing (MLT) procedures contained in Chapter 8 and to make minor editorial changes throughout the document.

This manual contains an admonishment in the form of a *WARNING*.

AT&T welcomes your comments on this manual. Your comments will aid us in improving the quality and usefulness of AT&T documentation. Please use the Feedback Form provided immediately after the title page in this manual.

This document is for planning purposes only, and is not intended to modify or supplement specifications or warranties relating to AT&T products and services. For additional information or assistance, contact your AT&T Account Executive.

### 1.2 Related Documentation

The following AT&T Practices are associated with this User's Manual:

- o AUA400 (RT) Channel Unit - Data Sheet, AT&T 363-005-260
- o AUA401 (RT) Channel Unit - Data Sheet, AT&T 363-005-261
- o AYB1B Optical Unit - Data Sheet, AT&T 363-005-262
- o ASH1 Power Converter Unit - Data Sheet, AT&T 363-005-263
- o ASJ1 Channel Unit - Data Sheet, AT&T 363-005-264
- o AUA402 Alarm/Fan Control Unit - Data Sheet, AT&T 363-005-265
- o AUA403 RT Test Channel Unit - Data Sheet, AT&T 363-005-266
- o AUA404 (RT) Channel Unit - Data Sheet, AT&T 363-005-267

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- o AUA405 (RT) Channel Unit - Data Sheet, AT&T 363-005-268
- o ASJ2 Channel Unit - Data Sheet, AT&T 363-005-269
- o EAF1 Drop Test Module - Data Sheet, AT&T 363-005-270
- o Series 5 - Ordering Guide - Loop Transmission Systems (Issue 2), AT&T 363-205-000
- o Series 5 - General Description (Issue 4), AT&T 363-205-100
- o Craft Interface Unit - Description, AT&T 363-205-101
- o Extended Test Controller - Description, Installation, and Maintenance, AT&T 363-205-300
- o Series 5 COT Acceptance and Turnup (TOP), AT&T 363-205-400
- o Series 5 RT Acceptance and Turnup (TOP) (Issue 5), AT&T 363-205-401
- o Series 5 Channel Unit Installation (TOP), AT&T 363-205-402
- o Series 5 End-to-End System Test (TOP) (Issue 4), AT&T 363-205-406
- o Series 5 Maintenance and Trouble Clearing (TOP) (Issue 4), AT&T 363-205-500
- o Controlled Environment Vaults (CEVs) - Description, AT&T 622-506-050
- o KS-23038 CEV (Controlled Environment Vault) - Description, AT&T 622-506-052
- o Placing Lashed Aerial Cable - General, AT&T 627-320-011
- o Lightguide Cable Placing - Underground, AT&T 628-200-216
- o Guidelines for Placing Buried Plant, AT&T 629-200-206
- o Buried Plant - Plowing, AT&T 629-200-215
- o Plowing Guidelines for Placing Lightguide Cable, AT&T 629-240-001
- o Clustered Pedestal DT Closure - Installation, AT&T 631-604-220-1
- o Lightguide Distribution Shelves - Description and Installation, AT&T 636-299-103

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- o Lightguide Sheath Preparation, Grounding, Blocking, and Buffering, AT&T 636-299-110
- o High Density Fiber Interconnect System - Installation Instructions, AT&T 636-299-115-1
- o 80E-BP (Bulk Power) Cabinet (Group 1) Splicing and Cabling Arrangements for FTTH (Fiber-To-The-Home) Feature, AT&T 640-250-259
- o Precabled 24-Foot CEV Using Bulk Power and Protection - Splicing and Cabling Arrangements, AT&T 640-250-280
- o 191A OTDR (Optical Time Domain Reflectometer) - Description and Use, AT&T 640-252-106
- o LGA 2 Lightguide Cable Splicing and Splice Testing, AT&T 640-252-125
- o Lightguide Cable - Single-Mode and Multimode RMS (Rotary Mechanical Splice), AT&T 640-252-176
- o Rapid Ribbon Splicing - Lightguide Ribbon Cable, AT&T 640-252-177
- o Automated Repair Service Bureau - General Description, AT&T 660-168-200
- o SLC Series 5 Carrier System - Application Engineering - Facility Design Systems, AT&T 915-710-115
- o SLC Series 5 Carrier System - Channel Unit Application and Prescription Settings, AT&T 915-710-116

### 1.3 Training

The training courses for SLC(R) Series 5 Carrier Systems equipped with FTTH feature are being offered by the AT&T corporate education and training (CET) organization. These courses are being offered at the AT&T Dublin Training Center or they can be suitcased to customer desired locations. For information concerning course price and availability contact the training center at the following location:

AT&T Training Center  
5151 Blazer Memorial Parkway  
Dublin, OH 43017  
Telephone: (614) 764-5454

A description of these courses follows:

**TR4404 - SLC Series 5 Carrier System Fiber-To-The-Home Feature Installation**

Audience: This course is designed for telephone company outside plant installers and maintenance personnel. Staffers, planners, sales people, engineers, and managers can also benefit.

Prerequisites: Students need a working knowledge of the SLC Series 5 Carrier System as provided by course TR4601, SLC Series 5 Carrier System Turn-Up and Test.

Description: This course covers the operation and installation of the Fiber-To-The-Home feature of the SLC Series 5 Carrier System. Students perform hands-on turnup of the carrier system using a functional system and associated test equipment. Fiber and distant terminal equipment installation is emphasized.

Key Topics:

- System arrangement and features
- Transmission concepts
- Remote terminal equipment and powering
- Distant terminal (DT) equipment
- DT cluster arrangements and powering
- System turnup and test
- End-to-end testing and fault locating
- Maintenance and troubleshooting.

Media: Course TR4404 is a combination of instructor lectures and group discussions reinforced with practical hands-on exercises on an operational system. Students gain experience working with a SLC Series 5 Carrier System equipped with the Fiber-To-The-Home feature.

Length: 2 days

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Related Course: TR4601, *SLC Series 5 Carrier System Turn-Up and Test*.

### **TR4602 - *SLC Series 5 Carrier System Fiber-To-The-Home Feature Turn-Up & Test***

Audience: This course is designed for telephone company outside plant installers and maintenance personnel. Staffers, planners, sales people, engineers, and managers can also benefit.

Prerequisites: Students need a working knowledge of the *SLC Series 5 Carrier System* as provided by course TR4601, *SLC Series 5 Carrier System Turn-Up and Test*.

Description: This course covers the operation and installation of the Fiber-To-The-Home feature of the *SLC Series 5 Carrier System*. Students perform hands-on turnup of the carrier system using a functional system and associated test equipment. The present course covers POTS only. As special services, integrated services digital network (ISDN), cable TV, and remote switching equipment are added, the course length will increase appropriately.

#### Key Topics:

- System arrangement and features
- Transmission concepts
- Remote terminal equipment and powering
- Distant terminal (DT) equipment
- DT cluster arrangements and powering
- System turnup and test
- End-to-end testing and fault locating
- Maintenance and troubleshooting.

Media: Course TR4602 is a combination of instructor lectures and group discussions reinforced with practical hands-on exercises on an operational system. Students gain experience working with a *SLC Series 5 Carrier System* equipped with the Fiber-To-The-Home feature.

Length: 2 days

Related Course: TR4601, *SLC Series 5 Carrier System Turn-Up and Test*.

**TR4621 - SLC Series 5 Carrier System Fiber-To-The-Home Feature Seminar Course**

Audience: This course is designed for telephone company outside plant engineers and maintenance personnel. Staffers, planners, sales people, and managers can also benefit.

Prerequisites: Students need a working knowledge of the SLC Series 5 Carrier System as provided by course LE1010, SLC Series 5 Carrier System Seminar.

Description: This course covers the operation and installation of the Fiber-To-The-Home feature of the SLC Series 5 Carrier System. The present course covers POTS only. As special services, integrated services digital network (ISDN), cable TV, and remote switching equipment are added, the course will be updated.

Key Topics:

- System arrangement and features
- Transmission concepts
- Remote terminal equipment and powering
- Distant terminal (DT) equipment
- DT cluster arrangements and powering
- End-to-end testing and fault locating
- Maintenance and troubleshooting.

Media: Course TR4621 is a combination of instructor lectures and group discussions.

Length: 1 day

Related Course: LE1010, SLC Series 5 Carrier System Seminar.

## 2. Introduction

### 2.1 Overview

This chapter provides an overall general description of the *SLC(R)* Series 5 Carrier System equipped with the Fiber-To-The-Home (FTTH) feature. This chapter also describes applications pertinent to the FTTH feature.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 2.2 Description

The FTTH is a feature of the *SLC* Series 5 Carrier System that provides lightguide fiber distribution from the remote terminal (RT) location to the customer residence via a distant terminal (DT) located adjacent to the residence or in a remote pedestal location. This feature permits the introduction of lightguide fiber in the distribution plant that had, until now, used metallic cable, thus allowing for an all fiber loop.

### 2.3 Applications

Lightguide fiber multiplexer systems, such as the DDM-1000, are being employed in the feeder routes with *SLC* Series 5 Carrier Systems to provide inexpensive high capacity service. Lightguide fiber multiplexer systems are used to replace the T1 lines from the central office terminal (COT) or central office digital switch to the RT. These systems allow the channel capacity to be increased by adding electronics without adding more fiber to an often congested feeder route. Stabilizing the feeder routes with the use of fiber systems also reduces maintenance and rearrangement expenses.

The FTTH feature allows service offerings requiring large amounts of bandwidth to be provided over the distribution facility to the customer premises. One service offering presently under development for inclusion with the standard telephony service provided by the FTTH feature is a video broadcast transport capability or cable television (CATV). This video service will initially provide 36 channels to each customer with a future expansion to 54 channels. Initially, this system will be optically independent from the low speed telephony services but future plans call for an integrated CATV and POTS service on one transport media. The addition of the FTTH feature to the *SLC* Series 5 Carrier System facilitates the introduction of fiber in the distribution plant and is based on providing standard telephony service.

## 3. Architecture

### 3.1 Overview

This chapter contains a description of the universal and integrated configurations of the *SLC(R)* Series 5 Carrier System equipped with the FTTH feature. This chapter also contains a brief description of the services provided by and equipment peculiar to these FTTH feature configurations.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 3.2 Universal/Integrated Configurations

The FTTH feature provides an all-fiber loop for residential distribution. This is the first step in the evolution of an all-fiber network which will provide the capability for the future transport of revenue-generating broadband services. This system provides residential customers with single party POTS service and other 2-wire dial-up services including coinless pay telephone and dial-up modem data. In general, the operations as seen by the customer are the same as with service over copper distribution plant. Benefits to the telephone company include reduced maintenance and rearrangement costs, as well as operating administrative benefits. The FTTH feature is available in both a universal (Figure 1) and an integrated configuration (Figure 2).

The universal configuration uses a Series 5 system equipped with feature package C (FPC) or FPC with AutoCut option capability. Additionally, a Series 5 RT equipped with feature package B (FPB) with special services may be used with a *SLC* 96 COT. The integrated configuration with special services uses a Series 5 system equipped with FPB integrated mode capability.

In the universal configuration the FTTH feature uses the *SLC* Series 5 Carrier System or *SLC* 96 Carrier System COT equipped with existing DUAL POTS channel units. In the integrated configuration a control switch equipped with a TR08 DS1 interface [for example, a *5ESS(R)* switch equipped with the digital carrier line unit (DCLU)] provides a direct digital facility.

### 3.3 Equipment Associated With the FTTH Feature

The channel units that can be used at the COT are the standard dual POTS channel units (for example, Series 5 POTS channel units AUA31 or AUA38 or *SPOTS(R)* channel units AUA32 or AUA39 if the central office is in the loop-start mode). At the RT, four channel units are available for use. Two of the channel units (AUA400 and AUA404) occupy one slot and provide two voice-frequency (VF) channels per fiber. The

remaining channel units (AUA401 and AUA405) are two slots wide and provide four VF channels per fiber.

The integrated configuration uses a Series 5 RT equipped with FPB with special services. This arrangement provides the capability to directly terminate on a digital switch via the TR08 interface using mode I or mode II.

The RT structures containing FTTH equipment for either the universal or integrated configuration are the same and are bulk powered only.

In addition to the four channel units, the RT location will provide the following equipment to support the use of fiber cable between the RT and the customer residence:

- o High density fiber interconnect (HDIC)
- o Optics shelf assembly
- o RT optics power shelf assembly.

To terminate the fiber at or near the customer residence (living unit), the FTTH feature uses a distant terminal (DT). The DT provides the optical-to-electrical and electrical-to-optical conversion interface between the fiber and customer equipment. The DT is provided with either AC or DC power and battery backup (during periods of power interruption) to power the electronics at the DT. Provisions are also available for mounting a group of DTs in a pedestal closure or cluster arrangement when serving single and 2-family dwellings or multifamily buildings, respectively. The pedestal closure accommodates from one to three DTs.

Single family developments can be served economically by pedestal closures. For 2-family dwellings, DTs on the side of the dwelling could be considered; however, the number of dwellings per DT would be less than for a pedestal.

The use of cluster arrangements at multifamily buildings provides for the most economic deployment of fiber. The costs of using cluster arrangements will generally be less than for single-family developments for the following reasons:

- o Less fiber cable is required per living unit.
- o Less electronics is required per living unit.
- o A pedestal closure is not required.
- o Powering costs are lower.
- o A relatively unlimited number of DTs can be placed at one point and added as necessary for additional line demand.

- o Craft access to DTs is easier and faster than in a pedestal closure.

The fiber extending from the RT to the DT is one single mode fiber operating at a line rate of 1.544 Mb/s. Bidirectional optical transmission is accomplished at the 1300 nm wavelength. The system is capable of operating over the full carrier serving area (CSA) range.

### **3.4 FTTH Feature Service Offerings**

The FTTH feature offering provides standard 2-wire analog, single party, loop-start POTS service. Additional services provided by the initial offering include:

- o Coin-less pay telephone service
- o Compatibility with calling party identification
- o Compatibility with dial-up alarm-telemetry options
- o Compatibility with modem data on POTS voice-frequency (VF) circuits
- o On-hook transmission when used with compatible Series 5 channel units.

Some of the services not available during the initial offering are standard coin, multiparty, digital data, or other special services.

## 4. Physical and Functional Description

### 4.1 Overview

This chapter provides a description of the equipment and apparatus required at the COT, RT, and DT locations to support the *SLC* Series 5 Carrier System equipped with the FTTH feature.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 4.2 Central Office Terminal/Switch

In a universal or integrated configuration, there will be no changes to the equipment at the COT or switch location, respectively, due to the addition of the FTTH feature. However, as mentioned previously, there is a restriction on the type of channel units that can be used on a system employing the FTTH feature. The COT channel units supported are existing standard dual POTS channel units for VF channels (for example, Series 5 POTS channel units AUA31 or AUA38 or *SPOTS* channel units AUA32 or AUA39 if the central office is in the loop-start mode).

### 4.3 Remote Terminal

#### 4.3.1 General

The *SLC* Series 5 Carrier System dual bank assembly and associated FTTH equipment are designed to be installed in either a controlled environment vault (CEV), hut, or an 80E cabinet. When located in a CEV or hut, the FTTH equipment is installed in a 7-foot high bay and arranged according to Figure 3. In an 80E cabinet there is space to mount a maximum of four dual bank assemblies with associated FTTH equipment and a DDM-1000 multiplexer (Figure 4).

Although the *SLC* Series 5 Carrier System RT dual bank assembly used in the FTTH configuration has not been changed, equipment has been added at the RT location to support the FTTH feature. The equipment that has been added at the RT includes the following:

- o AUA400 channel unit (CU)
- o AUA401 CU
- o AUA402 alarm/fan control unit (AFCU)
- o AUA404 CU
- o AUA405 CU
- o AYB1B optical unit (OU)

- o J1C182PA optics shelf assembly
- o J1C182PB RT optics power shelf assembly
- o High density fiber interconnect (HDIC).

**NOTE:**

Copper and lightguide channel units cannot be mixed in a dual bank assembly.

A restriction has been placed on the channel units that can be used in an RT dual bank assembly supporting the FTTH feature; all channel units must be fiber channel units (AUA400, AUA401, AUA404, or AUA405). Channel units designed for use on copper lines *must not* be used.

**4.3.2 AUA400 Channel Unit**

The AUA400 CU (Figure 5) provides standard 2-wire analog, single party, POTS applications with loop-start supervision; fast forward disconnect is provided. This plug-in provides two channels of VF service to a single customer over the 1.544 Mb/s line. The AUA400 CU connects to an AYB1B OU located in the optics shelf.

The faceplate of the AUA400 CU contains two indicators. One indicator (BUSY) lights when the channel unit is busy, and the other indicator (out of service - OOS) lights when the channel unit detects a possible failure at the RT, the DT, or on the fiber between the RT and the DT.

There are no options or settings that need to be selected on this channel unit.

**4.3.3 AUA401 Channel Unit**

The AUA401 CU (Figure 6) provides standard 2-wire analog, single party, POTS applications with loop-start supervision; fast forward disconnect is provided. This plug-in occupies two channel unit slots and provides four channels of VF service to a single customer over the 1.544 Mb/s line. The AUA401 CU connects to the AYB1B OU located in the optics shelf.

The faceplate of the AUA401 CU contains two indicators that are functionally identical to the two indicators on the AUA400 CU.

There are no options or settings that need to be selected on this channel unit.

**4.3.4 AUA404 Channel Unit**

The AUA404 CU contains all the features of the AUA400 CU plus the ability to perform extended testing that includes a full channel test and drop test capability when used in coordination with an ASJ2 CU and EAF1 drop test module (DTM) located at the DT.

#### 4.3.5 AUA405 Channel Unit

The AUA405 CU contains all the features of the AUA401 CU plus the ability to perform extended testing that includes a full channel test and drop test capability when used in coordination with an ASJ2 CU and EAF1 DTM located at the DT.

#### 4.3.6 AYB1B Optical Unit

The AYB1B OU (Figure 7) is used at the RT and DT locations to provide electrical-to-optical and optical-to-electrical conversions at each end of the optical line. At the RT, the AYB1B OU receives an electrical 1.544 Mb/s signal from a channel unit. It converts the electrical signal to an optical signal and transmits it over one single mode fiber, operating in a bidirectional transmission mode at 1300 nm, to the AYB1B OU at the DT. The AYB1B OU uses a Class I, single-mode laser diode in the transmitter circuit to convert the electrical signal into pulses of light. It also uses a positive-intrinsic-negative (PIN) diode detector in the receiver circuit to convert the pulses of light into electrical pulses. There are no options or settings that need to be selected on this unit.

#### 4.3.7 J1C182PA Optics Shelf

The J1C182PA optics shelf consists of one row of 48 AYB1B OUs. Two optics shelves are required for each RT dual bank assembly containing FTTH channel units. The optics shelves are cooled by forced convection from 2A (CEV/hut) or 2B (80E cabinet) fan shelves.

#### 4.3.8 J1C182PB RT Optics Power Shelf Assembly

The J1C182PB RT optics power shelf assembly (Figure 8) consists of eight AUA11B or AUA11C power converter units (PCUs), one AUA402 alarm/fan control unit (A/FCU), and four 40D bank fuse units (BFUs) on one shelf. One RT optics power shelf assembly is required for powering up to four optics shelves, two or three fan shelves, and two dual bank assemblies.

Each AUA11B or AUA11C PCU supplies +-5 VDC to 24 AYB1B OUs. Each PCU obtains -48 VDC from the bulk powering source, via the 40D BFU, and converts it to three +5 VDC and one -5 VDC sources, which is supplied to the optical units. Each one of the +5 VDC outputs supplies power to 8 OUs and the single -5 VDC output supplies power to all 24 OUs.

The faceplate of the PCU contains two pin jacks and one indicator. The FAIL indicator lights to indicate an overvoltage or undervoltage condition for the +-5 VDC supplies. The two jacks (-48 and GND) are used to measure the -48 VDC input to the PCU. There are no options or settings that need to be selected on the PCU.

**NOTE:**

The AUA11 PCU *cannot* be used in applications with the FTTH feature.

The AUA402 A/FCU (Figure 9) performs various functions including:

- o Alerting the RT dual channel banks of a power failure on the optics shelf assemblies
- o Detecting the absence of a PCU in the RT optics power shelf assembly
- o Accepting alarm inputs from the PCUs when the +-5 VDC outputs are lost

**NOTE:**

A failed PCU in the optics power shelf assembly causes the COT and RT ADU MJ and all BCU DIGROUP indicators to light.

- o Detecting blown fuses in the BFU
- o Controlling the fans in the 2A or 2B fan shelves via a temperature sensor circuit
- o Provides alarming to the bulk power closure (BPC) line when AC power to the bulk power supply is lost.

The faceplate on the A/FCU contains two indicators [MJ (red) and MN (amber)] to identify major and minor alarms occurring on the RT optics power shelf assembly. Alarms for PCU1 through PCU4 are sent to the lower RT dual bank assembly in the bay and alarms for PCU5 through PCU8 are sent to the upper RT dual bank assembly.

The four 40D BFUs in the RT optics power shelf assembly distribute -48 VDC to the dual bank assemblies and optics shelves. Two of the BFUs (1 and 2) provide -48 VDC to the optics shelves and the remaining two BFUs (3 and 4) provide -48 VDC to the dual bank assemblies. Each 40D BFU contains two 81-type fuses (10A) and five 80-type fuses (5A). Figure 10 shows the distribution of power from each of the BFUs. Blown 80- and 81-type fuses are indicated by faceplate mounted indicators and are replaced through the faceplate. All fuses should be replaced without removing the BFU.

The bulk power supply connections to the RT optics power shelf assembly are via a 10-position terminal strip (**TB1**). This terminal strip is located behind the hinged access panel on the right side of the assembly (as viewed from the front).

Power distribution from the optics power shelf assembly to the remainder of the RT bay is shown in Figure 11.

#### 4.3.9 High Density Fiber Interconnect (HDIC)

The interconnection of lightguide cable at the RT location is accomplished using the HDIC. The HDIC (Figures 12 and 13), provides higher termination density than other fiber interconnects

and is the preferred apparatus for the FTTH applications.

The HDIC provides a flexible rearrangement point for connecting lightguide interconnection cables (LICs) from available optical units to the customer's outside plant fibers. It also provides the means for cable completion testing and for standard maintenance access.

The LICs that run from the optics shelves to the HDIC are available in two lengths, 18 feet and 35 feet. For full FTTH applications, the 35-foot length (FS48E-E-35) will accommodate most of the RT equipment arrangements in CEVs or huts. The LICs in 18-foot lengths (FS48E-E) are for use in 80E cabinet FTTH arrangements. Each optics shelf requires 48 optical fibers. Since each LIC contains 12 fibers, then a group of 4 LICs (labeled A, B, C, and D) will be ordered for each optics shelf. Each LIC is equipped with a blank identification label at each end to allow the system identification to be added on site. Each group of 4 LICs per optics shelf will carry the same system identification number.

The LIC fibers are jacketed jumpers that are factory terminated at both ends with an *ST(R)* lightguide cable connector. Each *ST* lightguide cable connector is equipped with a dust cap that should only be removed at the time of connection. Each LIC fiber is identified by a discrete odd number on each end (that is, 1, 3, 5, . . . ., 93, 95).

Each LIC is also encased in either a plastic spiral wrap or an *EXPANDO(R)* FR wrap. The *EXPANDO* FR wrap permits the LICs to be connected to the optics shelves without disturbing the outer wrap whereas, the plastic wrap must be trimmed back before the LICs can be attached to optics shelves.

The HDIC is designed for a maximum of 1152 LIC fibers on the optical unit side with an out-count of 1296 outside plant (OSP) fibers in a 7-foot RT frame. When incorporated into an 80E cabinet, the HDIC accommodates a maximum of 384 LIC fibers on the optical unit side and an out-count of 432 OSP fibers.

The HDIC utilizes a field of single mode *ST\1 lightguide cable connector couplings* to connect the LICs from the optics shelves to the OSP fibers. The OSP fibers are field terminated in *ST* lightguide cable connectors and then connected to the permanent field (inside) of the termination shelf. The single LIC fibers with factory equipped *ST* lightguide cable connectors, are connected to the couplings in front of the termination shelf with provision for slack storage. A storage shelf is provided as part of the HDIC for temporary storage of unused LICs during installation.

The HDIC is comprised of the following components:

- o ED8C500-50-G5 bay frame (CEV or hut only)

- o FM1-432 fiber apparatus mounting(s) (80E cabinet only)  
or  
FM1-648 fiber apparatus mounting(s) (CEV or hut only)
- o FTS1-24ST-C fiber termination shelves
- o HD1-20 bracket (cable clamp bracket assembly)
- o 147A1 bracket (door bracket package) (CEV or hut only).

The ED8C500-50-G5 bay frame, that is mounted in a CEV or hut, is 7-foot high and is the 23-inch unequal flange type that accommodates two FM1-648 apparatus mountings (Figure 12) and an HD1-20 cable clamp bracket assembly. The framework in the 80E cabinet accommodates one FM1-432 apparatus mounting (Figure 13) and an HD1-20 cable clamp bracket assembly.

The FM1-432 (COMCODE 105566178) and FM1-648 (COMCODE 105566186) fiber apparatus mountings are aluminum assemblies that house a maximum of 18 and 27 FTS1-24ST-C fiber termination shelves, respectively. The FM1-432 measures 24 inches high, 21 inches wide, and 12 inches deep and when fully equipped provides termination for up to 384 LIC fibers and 432 OSP fibers. The FM1-648 measures 34 inches high, 21 inches wide, and 12 inches deep and when fully equipped provides termination for up to 576 LIC fibers and 648 OSP fibers. An ED8C500-50-G5 bay fully equipped with two FM1-648 fiber apparatus mountings yields a maximum of 54 FTS1-24ST-C fiber termination shelves with connections for 1296 OSP fibers and 1152 optical jumpers. A 12.5% spare ratio between the incoming LIC fibers and the OSP fibers is provided.

Each fiber apparatus mounting is also equipped with a:

- o Seven-inch wide trough for routing optics shelf LICs
- o Storage shelf for storing up to 192 optics shelf LIC fibers
- o Fanout for organizing 576 (FM1-648) or 384 (FM1-432) LIC fibers
- o Two-inch wide trough for routing OSP fibers.

The FTS1-24ST-C fiber termination shelf (COMCODE 105566202) (Figure 14) is an aluminum shelf that can be equipped with 24 single mode *ST* lightguide cable connector couplings (C3000A-2) that join the LIC fibers to the OSP fibers. The shelf allows direct termination of *ST* lightguide cable connectors or splicing of lightguide cable pigtails when the splice tray is used. The shelf has a pivoting front panel that allows easy access to the individual lightguide couplings, OSP fiber connectors, and slack fiber inside the shelf. The horizontal trough on the front

panel allows smooth transition (3-inch bend diameter) of LIC fibers to the vertical trough area. The rear and front support bars prevent the fibers from sagging to the lower shelf.

The HD1-20 cable clamp bracket assembly (COMCODE 105566194) (Figure 15) provides clamping and grounding positions for a maximum of 20 OSP cables utilizing 12A1 cable clamps. The HD1-20 assembly consists of an upper and lower level clamping position with each level equipped with five individual mounting brackets. Since two 12A1 cable clamps can be mounted on each mounting bracket, it is recommended that 12A1 cable clamps be ordered in pairs. To allow maximum efficiency, the lower level should be fully equipped (10 cables and clamps) before using the upper clamping level.

Each 12A1 cable clamp contains all the material necessary for clamping and grounding one OSP cable. An OSP cable is secured between the clamp halves using the V groove insert to grip the cable. Grounding hardware is also provided to connect the metallic strength members of the fiber cable to an approved ground terminal.

The 147A1 bracket (COMCODE 105574735) consists of two steel door mounts, a steel horizontal baseplate (magnetic door catch), and mounting screws. The bracket allows the mounting of front doors (ED6C321-50-G5) to an ED8C500-50-G5 frame. This bracket must be mounted to the frame prior to installation of any other piece parts. Once the doors are in place, the two magnets on the horizontal baseplate will hold the doors in the closed position.

#### **4.3.10 LSC1U-024/5 Termination Shelf**

The LSC1U-024/5 termination shelf is located in the 80E cabinet only and is used to terminate up to two fiber feeder cables.

### **4.4 Distant Terminal**

#### **4.4.1 General**

The distant terminal (DT) (Figures 16 and 17) consists of a 900A1 (AC powered), 900A2 (DC powered), or 900A3 (DC powered) closure that houses three removable circuit packs and one battery pack. The 900A1 closure is also equipped with a transformer and a 3-foot long AC power cord. The 900A2 and 900A3 closures differ from each other only in the method used to make metallic drop wire connection within the closure. The 900A2 closure uses a 76-type binding post connection block for these connections and the 900A3 closure uses a 108 insulation displacement connection block.

The three circuit packs within the 900A-type closures include an AYB1B optical unit (OU), an ASJ1 or ASJ2 CU, and an ASH1 power converter unit (PCU). Figure 18 shows the interconnection of the three circuit packs, the battery pack, and the transformer for a 900A1 DT. The interconnection of the components within a 900A2 DT

is shown in Figure 19.

#### **4.4.2 AYB1B Optical Unit**

The AYB1B OU at the DT is identical to the optical unit used at the RT location described previously.

#### **4.4.3 ASJ1 Channel Unit**

The ASJ1 CU (Figure 20) provides the channel unit and line interface functions for the DT. This unit provides up to four VF lines and is compatible with all FTTH RT channel units. Since the ASJ1 CU is compatible with all FTTH RT channel units, changes are not necessary at the DT whenever service is expanded from two lines to four lines and the AUA400 or AUA404 CU is replaced with an AUA401 or AUA405 CU, respectively. The mother board provides the clock recovery, clock dividers, line mux, control, and signaling functions. It is connected to the AYB1B OU via four twisted pairs assembled in a ribbon.

The daughter board provides the battery feed; overvoltage protection; ringing; supervision; codec; hybrid; testing (BORSCHT) functions for the four POTS channels. All signaling control and filtering is provided on the mother board. Each POTS line is provided with a current limited line feed.

Mounted on the ASJ1 CU are four indicators: FAIL, BUSY, OOF, and ONBAT. The FAIL indicator lights when an internal failure within the ASJ1 CU is detected. The BUSY indicator lights to indicate that one or more of the four POTS lines are off-hook. The OOF indicator lights when the incoming fiber signal is lost, framing is lost, or during trunk processing. The ONBAT indicator lights when the DT is operating on reserve power (battery backup).

#### **4.4.4 ASJ2 Channel Unit**

The ASJ2 CU is functionally equivalent to the ASJ1 CU with the exception of additional demand testing and test data link circuitry present on the ASJ2 CU. The daughter board on the ASJ2 CU contains the test relays that provide full splitting test access to the four VF lines for pair gain test controller (PGTC) testing. Circuitry to detect test access and to control the test relays is contained on the mother board. When used with the EAF1 drop test module (DTM), the ASJ2 also provides a test data link between the DT and RT for controlling the state of the drop testing and reporting the results of the drop testing back to the RT.

#### **4.4.5 EAF1 Drop Test Module**

The EAF1 DTM (Figure 21) plugs into the side of the ASJ2 CU and is responsible for measuring the health of the drop beyond the DT and reporting this information to the RT via the DT to RT data link.

#### **4.4.6 ASH1 Power Converter Unit**

The ASH1 PCU (Figure 22) provides battery charger, rectifier, and ringing generator functions at the DT. The battery charger in the PCU is a constant voltage charger with an output that varies from 13.8 VDC to 15.0 VDC in accordance with the surrounding temperature. A thermostat on the PCU mother board will shut down the battery charger in the unlikely event the internal DT temperature exceeds 185<deg>F. The thermostat will allow the battery charger to turn on again when the temperature falls below 135<deg>F.

In a 900A1 DT, the rectifier in the ASH1 converts 17.6 VAC from the line transformer unit to +12 VDC. In a 900A2 and 900A3 DT, the rectifier converts the -24 VDC input to +12 VDC. The +12 VDC is fed to a series of DC/DC converters which in turn generate various voltages, including -5 VDC, +5 VDC, -37 VDC, +110 VDC, and -150 VDC, for use internally, by the ASJ1 or ASJ2 CU, and by the AYB1B OU.

The ringing generator circuitry in the PCU is capable of driving a maximum of 10 ringers.

The PCU also monitors the incoming power and provides an automatic transfer to battery backup if power fails.

Seven test points are provided on the PCU for measurement of the backup battery voltage and the power supplies generated internally. The test points provide access for measuring battery voltage, ringing voltage, -37 VDC, and +-5 VDC power supplies.

#### 4.4.7 900-Type DT Closure Design

The 900-type DT closure houses the equipment and apparatus necessary to terminate the lightguide distribution (OSP) fiber. The closure measures 13 inches high, 14 inches wide, 6 inches deep, and can be mounted in any of these three locations:

- o On the exterior wall of a living unit
- o In a pedestal DT closure (ED-1T283-30)
- o In a multifamily building cluster arrangement.

The closure is *UL*(R) approved and the closure cover is equipped with a locking mechanism that requires a special key (allen-type wrench; COMCODE 840841324) to operate it.

The equipment and apparatus housed within the closure are listed below and arranged as shown in Figures 16 and 17.

- o Ground bracket - Provides cable clamps for grounding the metal closure box and the metal components of the lightguide fiber cable

- o Transformer (900A1 DT only) - Converts AC power to 17.6 VAC for use by the ASH1 PCU
- o Circuit breaker (900A1 DT only) - Controls AC power to the transformer
- o Power control panel (900A2 and 900A3 DTs only) - Contains a power switch and an LED to control and indicate the presence of DC power input
- o Fiber retaining bracket - Holds excess lightguide fiber within the closure.

#### 4.4.8 Pedestal DT Closure

The ED-1T283-30 pedestal DT closure (Figure 23) provides an alternative to the dedication of one DT per single living unit. The closure can be stake or concrete pad mounted and is available in two arrangements to accommodate a maximum of either two or three 900A1 (AC powered), 900A2 (DC powered), or 900A3 (DC powered) DTs. Pedestal closures equipped to provide AC power can house only 900A1 DTs and pedestal closures equipped to provide DC power can house only 900A2 or 900A3 DTs. Table A provides the equipment codes for the different variations of the pedestal closure available as well as the equipment required to convert a two DT closure to a three DT closure in the field. The procedures for converting a two DT closure to at three closure are available in AT&T 631-604-220-1. Also note that the appropriate equipment must be added to the closure to provide either AC or DC power to 900A1 or 900A2 and 900A3 DTs, respectively, installed in the closure.

A pedestal closure containing three DTs can provide service to a maximum of eight living units. Since each DT is capable of providing up to four POTS lines, this leaves four spare lines to be used as replacement channels during periods of failure or breakage or to provide additional channels of service to any of the eight living units.

The ED-1T283-30 pedestal closure measures either 21-1/2 inches (Groups 1, 11) or 28-1/2 inches (Groups 2, 12) wide, 14-1/2 inches deep, and 26-1/2 inches high. The closure can be mounted at the

front or rear of a residential lot. When video service is available, an extension box is attached to the side of the closure to house the video equipment. In addition to the space required to mount the DTs, the closure also contains the following:

- o AC power box (AC powered pedestal only): The AC power box enclosure (Figure 24), supplied with ED-1T283-30, Group 21, provides four AC power outlets, two on/off switches, and a 6 amp fuse. The AC power outlets supply AC power to the 900A1 DTs in the pedestal. Each of the two switches control AC power to two of the power outlets. The fuse provides over current protection for the equipment connected to the AC power outlets.
- o DC power box (DC powered pedestal only): The DC power box enclosure (Figure 25), supplied with ED-1T283-30, Group 22, contains a 10-pair terminal block (binding post terminals) and provides mounting space for a power interface circuit pack and chassis assembly (COMCODE 846530293). The terminal block terminates the power wiring received from a maximum of eight living unit DC power sources and supplies the power to the power interface circuit pack via a 16-pin connector. The interconnection of the backpowering power sources, the terminal block, and the power interface circuit pack is shown in Figure 26. After receiving the -48 VDC from the power sources, the power interface circuit board provides the following to each DT in the pedestal: -48 VDC Class II power to the battery heaters and -24 VDC Class II power to the ASH1 PCUs.

Power cross and lightning protection for the power interface circuit pack is provided by plug-in protection circuit modules (COMCODE 846530319). The power interface circuit pack accepts up to four protection modules that are plugged into the side of the power interface circuit pack. Each protection module provides protection for two backpowered lines.

Test points are available on the power interface circuit pack to permit measuring DC backpowering power source output voltage and the input voltage to the ASH1 PCU(s) in the DT(s). Two LED indicators are also present on the faceplate of the power interface circuit pack to indicate the presence of the DC input voltage from the power sources and the DC output voltage to the DT(s).

- o Storage space for excess fiber and copper lines.
- o Protected terminal blocks: Twelve protector blocks provide connection for the VF copper drop lines and circuit protection for over voltage conditions.
- o Cable termination hardware.

- o 2500 splice case (optional) for distribution cable splicing.

#### 4.4.9 DT Primary Power Source

##### 4.4.9.1 General

This section describes the methods of providing primary power, both AC and DC, to a DT. The method of powering a DT mounted on a living unit wall, either individually or cluster mounted (for example, a condominium complex), is described first followed by a description of a pedestal mounted DT.

##### 4.4.9.2 DT Located on Living Unit Wall

The recommended method of powering a DT located on a living unit wall is via customer provided AC power. The 900A1 DT receives its power from an AC outlet located in either a *HOFFMAN*(R) A-6R44 3R unit or an Ekstrom enclosure/power ring that is installed by the power company prior to installation of the power meter.

The *HOFFMAN* A-6R44 3R unit is a weatherproof box located on the outside wall of the living unit. This unit is installed by an electrician and connected to a single circuit breaker located in the customer's circuit breaker panel. The Ekstrom enclosure/power ring is a power ring attached to a weatherproof enclosure that taps off 120 VAC at the power meter and feeds it to a circuit breaker and an AC outlet located inside the enclosure. Due to the differences in power meters used by the various power companies, ordering information for this powering arrangement must be obtained from the manufacturer (Ekstrom Industries, Inc., 23850 Freeway Park Drive, Farmington Hills, Michigan 48024-1197).

##### 4.4.9.3 DT Located in Pedestal DT Closure

The ED-1T283-30 pedestal is designed to be powered by either 120 VAC or -48 VDC power. The powering method used is determined by the type of DTs installed in the pedestal. If 900A1 DTs are installed in a pedestal, 120 VAC is supplied to the power outlets in the AC power box and the DT power cords are inserted into these outlets. If 900A2 or 900A3 DTs are installed in a pedestal, DC power is obtained from a DC backpowering system involving each pedestal DT customer (Figure 27).

The backpowering system consists of a DC backpowering power source enclosure, that is mounted on each living unit connected to the DT pedestal closure, and a DC power box enclosure located in the pedestal. The DC backpowering power source enclosure provides environmental protection for a -48 VDC backpowering power source (COMCODE 406177006) and, in some instances, a 120 VAC outlet. The power source is a *UL* listed power supply enclosed in a metal case (Figure 28). It converts customer supplied 120 VAC to low current -48 VDC (Class II under National Electric Code Standards) power

which is supplied, via copper wire drop cable, to the DC power box enclosure. Powering for the DTs in a pedestal is shared among all of the living units served from the pedestal as long as each living unit has an operating DC power source. However, in situations where only one living unit is supplying power to a pedestal, power will be provided to a maximum of two DTs.

The type of enclosure used to house the DC power source is left to the discretion of each individual telephone company. However, some examples of approved enclosures that are available are described in the following paragraphs and shown in Figure 29. The option number below each enclosure in Figure 29 correlates to the option number in the following description.

OPTION 1

A J806HPL *UL* Listed, oiltight, dust free, fiberglass outdoor enclosure measuring 8 inches high, 6 inches wide, and 4-3/8 inches deep. The enclosure has silicone gaskets, integral mounting feet, and a fiberglass door with stainless steel piano-type hinges, a latch, and padlock hasp. The enclosure can be purchased from Robroy Industries, Belding, MI. In addition to the DC power source, the enclosure must be equipped with the following:

- o *ST-1* Myers Hub or Thomas & Betts 370 Hub mounted through the box wall to act as an entrance hole for AC power line connection
- o Surface mount utility box measuring 4 inches long and 2-1/8 inches wide
- o Single position 120 VAC outlet
- o Single position outlet coverplate
- o -48 VDC entrance grommet (COMCODE 803764208 or AT&T Part Number WP 92128, L3) mounted through the bottom of the box to act as an entrance hole for the DC metallic drop cable
- o Right and left backpowering power source mounting brackets (COMCODE 846513893 and 846513885, respectively). Also orderable with the -48 VDC entrance grommet through AT&T Part Number WP 92128, L3.

OPTION 2

A J606HPL outdoor enclosure (COMCODE 406177014 or AT&T Part Number 92128, L2), measuring 6 inches high, 6 inches wide, and 4-3/8 inches deep, is equipped with the DC

backpowering power source and a flexible conduit power cord. This enclosure must be used with a lockable enclosure such as a *HOFFMAN* A-6R44 3R unit or an Ekstrom enclosure/power ring in order to receive AC powering. The enclosure/power ring can be purchased from Ekstrom Industries, Inc., Farmington Hills, MI. Due to the various types of power meter pans/sockets used by the power companies, coordination between the telephone company, the power company, and Ekstrom Industries is required in order to assure that the power ring adapters are compatible with the meter pans/sockets. Before installing this enclosure, verify that it is equipped with an 8 amp circuit breaker.

OPTION 3

An enclosure/power ring assembly with an enclosure measuring 6 inches high, 6 inches wide, and 4-3/8 inches deep. This enclosure/power ring is equipped with a 120 VAC outlet, a circuit breaker, and backpowering power source mounting brackets. This enclosure/power ring can be purchased from Ekstrom Industries, Inc., Farmington Hills, MI. Due to the various types of power meter pans/sockets used by the power companies, coordination between the telephone company, the power company, and Ekstrom Industries is required in order to assure that the power ring adapters are compatible with the meter pans/sockets.

OPTION 4

A J606HPL outdoor metal enclosure measuring 6 inches high, 6 inches wide, and 4-3/8 inches deep. This enclosure is equipped with a 120 VAC outlet, circuit breaker, and backpowering power source mounting brackets. Two models of this enclosure are available: model 1000-SP2493 is equipped with a 1/2-inch conduit hub on the back and model 1000-SP2484 is equipped with a 1/2-inch conduit hub on the top. This enclosure can be purchased from Ekstrom Industries, Inc., Farmington Hills, MI.

#### 4.4.10 Battery Backup

To avoid service interruption during periods of power loss at the DT, battery supplied backup power is provided. The backup KS-21906, L16 battery pack is composed of six Gates Cyclon sealed rechargeable cells connected in series. The battery pack provides from 8 to 20 hours of backup power depending on the number of lines off hook. The overall battery pack is rated 12 volts, 5.0 Ah at an ambient temperature of 77<deg>F. The cells are arranged in a 6-pack configuration in the bottom of the 900-type DT closure.

In the 900-type DT closure, a thermostatically controlled battery heater is bonded to the battery shelf. In the 900A1 DT closure, the battery heater is powered by 17.6 VAC supplied by the ASH1 PCU. In

the 900A2 and 900A3 DT closures, the battery heater is powered by -48 VDC from the power interface circuit pack.

In situations where DC powered DTs are located in a fully configured pedestal closure, with eight living units connected for service, and more than five backpowering power sources are out of service, power is provided by the backup batteries in the DTs.

## 4.5 Installation And Maintenance Equipment

### 4.5.1 J99407TA-1, L1 Analyzer

#### 4.5.1.1 General

The J99407TA-1, L1 analyzer (Figure 30) (COMCODE 601252604) is a modified DT that is shock mounted in a portable carrying case. The analyzer is used during channel turn up and, when necessary, to assist in isolating faulty circuit components in a SLC Series 5 Carrier System equipped with the FTTH feature. The analyzer is provided with a single optical access point and is powered by rechargeable batteries which require recharging after a power-up interval of approximately 4 hours.

The analyzer is equipped with the following items:

- o **POWER** switch: Removes or connects battery feed to the electronics.
- o **BATTERY VOLTAGE** meter: Indicates true loaded battery voltage when the **POWER** switch is **ON**.
- o Indicators: **FAIL**, **BUSY**, **OOB**, and **ON BAT**.
- o **Fuse** holder: Contains a 6 amp fuse that protects the battery from overcurrent loads and is located inside the analyzer.
- o Four RJ11 type modular telephone jacks (**CH1-CH4**): Connection points for a telephone or butt set.
- o **Battery Charger Jack**: Accepts the plug on the battery charger cord and is located inside the analyzer.
- o Battery charger: Charges the analyzer battery pack when connected to a 120 VAC outlet and the cord plug is inserted into the **Battery Charger Jack** located inside the analyzer.
- o Modular plug adapter: Allows telephone butt set access to modular jacks.
- o Fiber jumper: A fiber jumper cable terminated with a blank optical circuit board equipped with an *ST* lightguide cable connector.

- o Relief valve: Before opening the analyzer lid, this valve is pressed to relieve gas pressure that may be present inside the analyzer.
- o Three circuit boards: **ASH1**, **ASJ1** or **ASJ2**, and **AYB1B**.
- o **AUA403** test channel unit: Inserts into a channel unit slot at the RT during maintenance and testing.
- o KS-21906, L18 battery pack: Composed of six Gates Cyclon sealed rechargeable cells connected in series. The battery pack is rated at 12 volts, 2.5 Ah and provides up to 4 hours of power.

#### 4.5.1.2 Analyzer Battery Pack Replacement Procedure

An increase in power time can be accomplished if the KS-21906, L18 battery pack in the J99407TA-1, L1 analyzer is replaced with a KS-21906, L16 battery pack. The KS-21906, L18 battery pack can be replaced with the KS-21906, L16 battery pack using the following procedure:

- (a) Refer to Figure 31 and remove the KS-21906, L18 battery pack as follows:
  - (1) Open the battery charger door.
  - (2) Remove and save the battery charger and top foam insert.
  - (3) Disconnect the wiring harness from the battery pack.
  - (4) Remove and discard the battery pack and the lower foam insert located directly below the battery pack.
- (b) Refer to Figure 32 and install the KS-21906, L16 battery pack as follows:
  - (1) With the top of the KS-21906, L16 battery pack oriented toward the front of the analyzer housing, insert the battery pack into the battery well.
  - (2) Connect the wiring harness to the battery pack.
  - (3) Replace the top foam insert and battery charger.
  - (4) Close battery charger door.

#### 4.5.2 Optical Backplane Maintenance Kit

The J994090B-1, L1 optical backplane maintenance kit (OBMK) (COMCODE 601300742) is used to clean the optical backplane

couplings on optics shelves of any dust particles that may be present on the optical sleeves. The sleeve is located inside the coupling and maintains the alignment of the two lightguide ferrule plugs. The OBMK also serves to insert and remove the protective plugs located on the front (circuit pack side) of the backplane couplings during initial customer turnup or customer service termination. The protective plug prevents the accumulation of dust particles on the sleeve of the optical backplane coupling which could lead to premature failure of the coupling.

The OBMK (Figure 33) consists of the following items:

- o Alignment card - A modified AYB1B OU bare board equipped with a guide tube that is positioned in line with the backplane coupling when the card is inserted into an equipment slot.
- o Handle - An aluminum rod approximately 6 inches long with a knurled knob on one end and a chuck on the other end. The handle attaches to the plug insertion tube and plug removal rod and also accepts a swab used in cleaning an optical coupling.
- o Swabs - An individual swab is attached to the end of the handle and, after being moistened with alcohol, is used to clean a backplane optical coupling.
- o Air tube - An aluminum tube approximately 9 inches long that installs on the nozzle of compressed air can.
- o Protective plugs - Installs on backplane optical couplings to protect couplings from dust.
- o Plug insertion tube - Aluminum tube approximately 3-3/4 inches long that attaches to the end of the handle. It is used to install protective plugs on backplane optical couplings.
- o Plug removal rod - Aluminum rod approximately 3-1/2 inches long that attaches to the end of the handle. It is used to remove protective plugs from backplane optical couplings.

All the components of the optical backplane maintenance kit are packaged in a rigid plastic carrying case along with instructions.

An optics shelf backplane coupling can be cleaned with the optical backplane maintenance kit per the following procedure:

1. Insert a swab into the chuck of the handle and tighten chuck into handle.
2. Insert handle, with swab into the guide tube of the alignment card.

3. Moisten the tip of the swab by dipping it into alcohol (isopropyl reagent).
4. Remove excess alcohol with an alcohol moistened *KIMWIPES*(R) wiper or equivalent.
5. Insert the alignment card into the slot of the optics shelf while keeping the handle inside the guide tube. Latch the alignment card into place.
6. Push the handle into the guide tube until the knob of the handle contacts the guide tube.
7. Rotate the knob of the handle three turns clockwise then three turns counter-clockwise.
8. Remove the handle with swab from the guide tube.
9. Discard the swab and store the handle in the J994090B case.
10. Assemble the air tube over the nozzle on the can of compressed air.
11. Insert the air tube with can of compressed air into the guide tube of the alignment card until the tube stops forward progress.
12. Using the can of compressed air, blow three short blasts of air into the coupling.
13. Remove the air tube with can of compressed air from the guide tube. Disassemble and store the air tube in the J994090B case.
14. Remove the alignment card and store it in the J994090B case.

The following steps should be followed when using the optical backplane maintenance kit to install a protective plug on the backplane coupling of the optics shelf:

1. Load the protective plug into the connector end (end opposite the latch) of the guide tube on the alignment card. Verify that the nipple of the protective plug faces the coupling.
2. Insert the alignment card into the slot of the optics shelf and latch it into place.
3. Slide the plug insertion tube over the chuck of the handle.
4. Insert the handle/plug insertion tube assembly into the guide tube of the alignment card. Apply light pressure on the knob of the handle until forward progress stops.

5. Unlatch the alignment card.
6. Remove the handle/plug insertion tube assembly from the guide tube.
7. Remove the plug insertion tube from the handle and store it in the J994090B case.
8. Remove the alignment card from the optics shelf slot and store it in the J994090B case.

The following steps should be followed when using the optical backplane maintenance kit to remove a protective plug from the backplane coupling of the optics shelf:

1. Insert the alignment card into the slot of the optics shelf and latch it into place.
2. Insert the plug removal rod into the chuck of the handle. Tighten the chuck into the handle.
3. Insert handle/plug removal rod assembly into the guide tube on the alignment card until the knob stops forward progress.

**NOTE:**

An attempt should not be made to withdraw the handle/plug removal rod from the guide tube while the alignment card is latched in place. The protective plug being removed will not fit through the guide tube.

4. Simultaneously remove the alignment card and the handle/plug removal rod assembly.
5. Remove the protective plug from the connector end of the alignment card and store it in the J994090B case.
6. Remove the handle/plug removal rod assembly from the alignment card.
7. Remove the plug removal rod from the handle and store it in the J994090B case.
8. Store the alignment card in the J994090B case.

#### 4.5.3 Optical Access Shelf

The KS-23557, L1 access shelf (COMCODE 405772591) is required at the RT whenever access to the rear of an optics shelf is required. The access shelf is attached to the front of the frame to provide a convenient place to rest an optics shelf during:

- o Initial installation of the LIC assembly

- o Replacement of defective LIC fibers
- o Access to the electrical pin field in the backplane
- o Replacement of a defective backplane coupling.

## 4.6 FTTH Video Capability

### 4.6.1 General

A fiber optic video transport feature is to be added to the Series 5 FTTH system to provide the capability to deliver high quality video signals to the subscriber. The initial video transport feature will provide the video signal to FTTH pedestals using a fiber separate from the one used to carry VF (POTS) signals. The capability to provide both VF and video signals over a single fiber will be available at a later date. The video signal delivered to the subscriber is in the same format as that used by traditional cable television (CATV) systems. This user friendly interface allows the subscriber to use existing televisions and recorders without set top converters.

### 4.6.2 Broadcast Video Transport

The video feature uses an optical fiber to transport the 1300 nm video signal from the RT to the DT. The signal format delivered to the customer will be standard vestigial sideband amplitude modulation with frequency division multiplexing. This signal format will be identical to that used for CATV delivery and is therefore fully compatible with existing service vendor equipment and end-customer TV and VCR products. To allow product upgrade with minimal disruption at the RT location, the video equipment will be located in separate equipment shelves from the low-speed POTS equipment.

### 4.6.3 Service Description

The broadcast video transport capability will be similar to the entertainment video service presently available via coaxial cable. The video services that could be delivered by the video transport might include:

- o Basic tier services (for example, network programming, MTV(TM), ESPN(R), etc.) which are delivered as a package at a fixed monthly subscription charge.
- o Premium services (for example, HBO(R), CINEMAX(R), ESPN, etc.) which are offered individually at a fixed monthly charge each.
- o Limited Pay-Per-View (PPV) channels, if locally available, which are offered on per viewing charge basis.

Initially 36 channels will be delivered to each customer with a future expansion to 54 channels. The service will be consistent with 1-way addressable interdiction or set-top converter schemes and will be capable of directly interfacing with existing CATV vendor headend equipment and end customer cable ready TVs or VCRs.

#### **4.6.4 System Architecture**

The video system architecture is shown in Figure 34. Programming originates at a CATV headend in standard VSB-AM frequency division multiplexed format. Using a high performance optical video feeder system, the signal is delivered, via the telephone company CO, to the RT. At the RT, the signal is converted to electrical format, fanned out, converted to optical format by a video line card (one per pedestal), and transmitted to each pedestal. For the initial cluster video, a separate video fiber is required to the pedestal. In a future upgrade, the video signal will be carried on the same fiber as the POTS signal. At the pedestal, the video signal is converted to an electrical signal and delivered to the customer on 75 ohm coaxial cable. The maximum recommended distance for this cable is 650 feet.

#### **4.6.5 System Alarms**

Various alarms are provided to monitor the status of the video signal and the equipment at the RT and the DT. At the RT, relay closures are provided to transmit alarms upstream via available Series 5 or DDM-1000 miscellaneous alarm channels. At the DT, local alarm indicators are available initially with future expansion to include alarm transport to the RT.

#### **4.6.6 Physical Arrangements**

The broadcast video service optical-electrical hardware will be compatible with existing RT hardware located in CEVs and huts. The RT equipment requires a minimum of 2 adjacent bays. The feasibility of providing video service from an 80E cabinet is under investigation.

At a pedestal location, the video system will be housed in an enclosure adjunct to any collocated POTS DTs. For multifamily buildings with wall mounted systems, the video package can be mounted on the same inside backboard as the POTS DTs. If demand arises, an enclosure for wall mounted DTs and video equipment may be developed.

#### **4.6.7 Video Powering**

Electrical powering for the video equipment at both the RT and DT locations will be derived from the same power source as the collocated POTS equipment. If the video is stand-alone, a power source, similar to the one used for pedestals, must be derived. There will be no battery backup associated with the video service.



## 5. System Engineering

### 5.1 Overview

This chapter contains engineering considerations and guidelines for SLC(R) Series 5 Carrier System FTTH RT and DT equipment and distribution fiber. Since cluster DT arrangements provide more flexibility than the single DT mounted on the side of the living unit, this chapter also contains planning and design information specifically for cluster systems.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 5.2 Application Planning Considerations

When planning a fiber distribution system, the following items should be considered:

- o When planning the central office termination and the RT structure, the expected per-customer line demand must be taken into consideration to account for unused lines that are dedicated to a customer, to insure that sufficient COT and RT banks are available, and that the proper 2- and 4-line RT channel unit mix is ordered to meet the demand.
- o Since the fiber distribution capability of the FTTH feature and the DS1 feeder interface operate independently of one another, metallic T1 lines can be used for the feeder facility, although it is usually assumed that if the distribution plant is fiber served, then the feeder plant will also be fiber. In fact, the introduction of fiber distribution may trigger the conversion of the existing T1 feeder transmission system to fiber.
- o In a fiber distribution area, one fiber is used to serve a single DT with two or four dedicated VF channels (these channels are not available for use at any other location). In planning for a normal RT location with copper wire distribution, the primary factor to be considered is the number of lines to be served. When planning for an RT in a fiber distribution system, the primary factor to be considered is the number of locations or DTs to be served.
- o When determining the appropriate RT closure, the RT planner must consider the space required for the FTTH feature equipment, the fiber entrance cables, and the fiber termination arrangement.
- o Local AC power is required for some DTs. To utilize the electrician's time more efficiently in new construction where the DT is to be mounted on the side of or adjacent to the residence, power specifications should be discussed with and provided to the

home builder before construction starts. Accessing local AC power in existing homes could be an expensive task for which telephone company craft are not trained and/or not allowed to perform. When the DT(s) is to be located in a pedestal enclosure or cluster configuration, the various methods of powering the DT should be discussed with the local power company and the electrician in order to decide the best method for powering the DT.

- o Administrative methods will differ somewhat for fiber distribution when compared with copper distribution.
- o Provisioning operations will differ, particularly for a 2- to 3-line arrangement where line and station transfers may be necessary.
- o Maintenance methods, skills, and equipment are different since the system is all-digital to the DT and craft trained in fiber fault locating and splicing must be available for facility maintenance.

Part of the planning process involved in deploying FTTH service concerns generating an implementation schedule to track the different work activities and their respective time intervals. A generic implementation schedule has been generated in the form of a Gantt chart (Figure 35) that includes the minimum time interval it will take to implement FTTH system activities.

The Gantt chart consists of a listing of 36 activities with each activity assigned a specific time interval. The time interval for a particular activity signifies the average time that it takes to complete that activity. To minimize the amount of time it takes to complete the entire schedule, some activities in this particular schedule are performed in parallel (two or more activities performed during the same time interval). If it is decided that these activities are to be performed in series instead of in parallel, additional time must be added to the overall schedule. When using this schedule, the following items must be assumed:

- o The telephone company personnel has had previous experiences deploying *SLC* Series 5 Carrier Systems.
- o The site selection has been completed.
- o The right-of-way and all easements have been obtained.
- o Each group responsible for a specific activity has agreed to complete it and the personnel are available to perform the needed work functions.

A short explanation of each activity in the Gantt chart is given below.

1. OSP Planning: Develop plan to provide OSP facilities in a timely manner to meet both the current and future needs of the subscribers.
2. Feeder Design: Design the feeder portion of the OSP facility from the central office to the RT site.
3. Distribution Fiber Design: Design the distribution portion of the OSP facility from the DT or pedestal site to the RT site. If a pedestal is deployed, design the copper drops from the customer's premises to the pedestal for both the VF lines and the DC backpowering lines.
4. OSP Engineering: The OSP engineer develops a work print from the feeder and distribution fiber design (or copper drops in the pedestal deployment) that includes information identifying the location, existing plant in the vicinity of the work, other utilities (particularly electrical), right-of-way, permits required from government authorities, and all information related to the work to be completed.
5. Order Feeder: Place an order with AT&T for the fiber feeder cable.
6. Order Distribution Fiber: Place an order with AT&T for the distribution fiber and the drop cable (the drop cables could be either copper or fiber, depending on the type of DT deployment).
7. Equipment Engineering (OSP Hardware): Prepare the OSP hardware order for the splice cases, hand hold units, and pedestals.
8. Equipment Engineering (SLC, DDM, HDIC): Prepare the hardware order for all the equipment needed in the CO, RT, pedestal, and DT sites.
9. Equipment Order (SLC, DDM, HDIC): The equipment engineer orders all the necessary plug-ins for the COT/RT; XTC; frames, shelves, cables, and other equipment for the RT; high density fiber interconnect (HDIC); DT closure; and DDM-1000 multiplexer.
10. Order OSP Hardware: Order the hardware for the OSP.
11. RT Structure Design: Prepare the order for the RT structure, RT platform and floor plan (CEV or maxi-hut), and equipment for the platform.
12. Order RT Structure and Platform: Place an order for the RT structure and platform (CEV or maxi-hut) with the manufacturer and the service center, respectively.
13. Assemble RT Platform: Assemble the RT platform in the service

- center or factory and place the frames and equipment racks in it.
14. Install Feeder: Place the feeder fiber cable. Splice and install the needed connectors.
  15. Fiber Acceptance Test: Test the newly placed fiber cable for acceptance (that is, receive signal/power verification, path loss, power meter of system emulation).
  16. Ship RT Structure and Platform: Ship completed RT platform and RT structure (CEV or hut) from the service center and manufacturer, respectively, to the site.
  17. Place RT Structure: At the RT site, place the RT structure. Place the RT platform in the structure if the RT is installed in a CEV or maxi-hut.
  18. Series 5 and FTTH Training: The craft responsible for the *SLC* Series 5 Carrier System and FTTH attend a training course.
  19. Fiber Training: The craft responsible for the installation and maintenance of the fiber cable attend a training course.
  20. Install Pedestal and OSP Hardware: Place the splice cases, hand hold units, and FTTH pedestals.
  21. Install Distribution Fiber: Place the distribution fiber cable. Splice and install the needed connectors.
  22. Fiber Acceptance Test: Test the newly placed fiber cable for acceptance (that is, receive signal/power verification, path loss, power meter of system emulation).
  23. Ship COT, XTC: Ship the COT, DDM-1000 multiplexer, and XTC equipment to the COT site.
  24. Install COT, XTC: Install the COT, DDM-1000 multiplexer, and XTC in the CO.
  25. Ship RT, HDIC, and DDM-1000 Multiplexer: Ship the RT, HDIC, and DDM-1000 multiplexer frame and equipment racks to the RT site.
  26. Install RT, HDIC, and DDM-1000: Install the RT, HDIC, and DDM-1000 multiplexer frames and equipment racks in the RT structure.
  27. Ship Plug-ins: Ship the COT, RT, XTC, DT, and DDM-1000 multiplexer plug-ins.
  28. Turnup DDM-1000 multiplexer, COT/RT: Turnup the DDM-1000 multiplexer and *SLC* Series 5 Carrier System and perform end-to-end system tests.

29. Begin Installation of AC/DC Power: Start the installation of the AC power outlet at the customer's premises and if the DC pedestal backpowering feature is used, the AC to DC conversion units.
30. Begin Installation of NIU: Start the installation of the NIU boxes at the customer's premises.
31. Install Drop: Install the fiber drop between the DT and the distribution fiber cable or install copper drops (these copper drops are for VF service and could be for DC backpowering) between the pedestal and the customer's premises and perform the necessary splicing.
32. Install DT Closure: Start the installation of the DT closures at either the customer's premises or the pedestal.
33. Install FTTH Electronics: Install the FTTH plug-ins in the RT and DT.
34. Turnup FTTH System: Turnup the FTTH system end-to-end and complete test calls on the system.
35. FTTH Hands-On Training: Start an informal training session with the telephone company personnel on the actual FTTH equipment at the RT, pedestal, and DT sites.
36. Begin Customer Turnup: Start the turnup of customers on the FTTH system.

## **5.3 Engineering Planning and Design for Cluster Systems**

### **5.3.1 General**

FTTH cluster systems offer more flexibility and design choices than the side of the residence systems. To assist engineers, this section covers several aspects of cluster system planning and design including the following:

- o Where to deploy FTTH cluster systems
- o Design choices available and recommended solutions
- o Remote terminal capacity planning.

### **5.3.2 Where To Deploy**

The cost of a fiber system can be controlled by minimizing the amount of media and optoelectronic hardware deployed per living unit (LU). Media costs are generally lower for small lots. Optoelectronic costs are generally lower when more LUs are served by each cluster.

### 5.3.3 Cluster System Design

#### 5.3.3.1 General

A system design with DTs clustered allows more cost effective installation of fiber than a system design with individual DTs per LUs. The only choices available with the latter design involves outside plant (OSP) layout. For a cluster system, the primary design inputs, or choices, are listed and discussed below:

- o OSP layout
- o Living units per cluster (LU/C)
- o Nominal fibers per cluster (F/C)
- o RT bay arrangement (spaces for one slot and two slot telephony CUs and associated OUs).

In addition, after the system is in operation there are choices in provisioning strategy concerning the ongoing installation of units at the RT and cluster.

Design and provisioning practices will have the goals of minimizing first cost and making the system easy to operate.

#### 5.3.3.2 OSP Layout

**NOTE:**

A detail description of OSP layout is presented later under **Distribution Fiber**.

When comparing any fiber system, whether side of the house or cluster, to a conventional copper system, the following general guidelines apply:

- o Cable routes should be as direct as possible; avoid indirect or winding routes.
- o Taper splices for smaller cables are not economical in most instances.
- o Placing parallel cables in a trench may be more economical than using a branch splice.

#### 5.3.3.3 Living Units per Cluster (LU/C)

For pedestals, the number of LU per pedestal will generally be between three and ten, with a fully loaded pedestal providing a maximum of twelve POTS lines. For a multifamily building (MFB) served by DTs in an equipment room or on the outside wall, the number of LU/C is determined by the building size. Increasing the number of LU/C will generally reduce the individual living unit cost of fiber media,

feeder systems, fiber video equipment, and pedestals and related electronic equipment. The cost of the fiber telephony system is relatively insensitive to the number of LU/C, provided DTs are only provisioned as needed. From a cost point of view, therefore, it is more economical to serve as many living units as possible from a cluster. It is not possible to make the number of LU/C arbitrarily large, however, because of drop length limitations and the possibility of cluster exhaust.

In general, serving more than six LUs from a pedestal may be difficult for front lot feed since video drop lengths are limited to a maximum of 400 feet (650 feet by special engineering).

Pedestal exhaust occurs when the line demand at a pedestal exceeds twelve lines. This can happen for lower line takes than might be expected. For example, if  $LU/C = 8$ , it might appear that a line take of 1.5 could be handled. In fact, such a line take would, on the average, cause more than one-third of the pedestals to exhaust because more than four additional lines can be required at a given pedestal. Since a pedestal exhaust requires placing a second, collocated pedestal served by spare fibers in the distribution cable, if available, then this exhaust rate example is clearly unacceptable. Since pedestal exhaust will move around with changing additional line demand, any chance of exhaust is undesirable because even a low exhaust rate would eventually cause many exhausted pedestals. To keep the exhaust rate negligible the following guidelines should be followed:

- o For  $LU/C = 8$ , projected additional line demand should be less than 13 percent.
- o For  $LU/C = 7$ , projected additional line demand should be less than 25 percent.
- o For  $LU/C < 7$ , probabilities of exhaust will be low for normal additional line demands, provided the cluster has access to three fibers (12 lines).

By choosing the highest practical value of  $LU/C$ , subject to limitations of drop length and pedestal exhaust, the designs will minimize per LU first costs. In addition, the OSP design should minimize breakage which occurs when the number of LUs served by a distribution cable is not a multiple of the desired  $LU/C$  (for example, 20 LUs on a cable when the number of  $LU/C = 8$ ). Sometimes rerouting cables or reallocating LUs between cables can reduce breakage.

#### 5.3.3.4 Fibers per Cluster (F/C)

The term F/C refers to the number of fibers in the distribution cable, excluding spare fibers, serving a particular cluster arrangement. The number of F/C is always given as a nominal (integer) value. The number of spare (dark) fibers required in addition to the inservice fibers is usually equivalent to 20% of the inservice fibers. For

pedestals with video, the number of F/C can be three for LU/C = 4 or less, but should be four for LU/C = 4 - 8.

### **5.3.3.5 RT Bay Arrangement**

RT bay arrangement choices are available for the narrowband system only. For the video system, one channel unit is required for every video terminal. The differences in RT bay arrangements for the narrowband system are due to the availability of two types of channel units at the RT location [AUA400/404 (one-slot, two DS0 channels) and AUA401/405 (two-slot, four DS0 channels)]. Therefore, it is possible to transmit either two or four DS0 signals over a single mode fiber to the associated DT.

The simplest bay arrangement provides two-slot spaces (four DS0 channels) for all the fibers except spares. The spare fibers are terminated in the HDIC. This arrangement provides the greatest line capacity at the clusters but uses the greatest amount of feeder channels. This arrangement would use 96 two-slot channel units in an RT bay (192 slots in two Series 5 dual channel banks). These 96 channel units could serve 48 clusters at two telephony fibers per cluster or 32 clusters at three telephony fibers per cluster (for LU/C > 4). Optical units and lightguide interconnection (LIC) fibers would only be required in alternate optics shelf slots.

For low additional line demand, feeder and RT utilization could be improved by providing some fibers and DTs with only two lines on a rearrangeable basis.

### **5.3.3.6 Provisioning**

Provisioning concerns the rules for the ongoing installation of fiber links of DTs, video terminals (VTs), CUs, OUs, and HDIC arrangements.

The range of DT and VT provisioning procedures is covered by the following alternatives (intermediate strategies are also possible):

1. Initially install the maximum DTs/VTs allowed by the fibers to the clusters.
2. Initially install only DTs/VTs needed to satisfy line/video channel demand and add DTs as required.

### **5.3.3.7 Multifamily Buildings with LU/C > 8**

The discussion up to this point has been focused on pedestal arrangements where the number of LU/C is between three and eight and generally under the control of the designer. Larger values of LU/C generally apply to MFBs, where the number of LU/C is determined primarily by building size and layout. A simple extension of the previous discussion would apply to these cases.

### **5.3.4 RT Capacity Planning**

#### 5.3.4.1 HDIC Capacity

The HDIC provides terminations at the RT location for the OSP fibers. The HDIC terminates one video fiber, two or three telephony fibers, and any spare fibers for each pedestal served. The HDIC connects these fibers to LIC fibers running to the telephony and video bays. The HDIC is the key to RT capacity because one HDIC bay serves several telephony and video bays.

An HDIC bay in a CEV or hut contains two 648 OSP fiber apparatus mountings (FM1-648). The FM1-648 apparatus mounting can terminate up to 576 LIC fibers. Any LIC fiber assigned to an apparatus mounting can be connected to any OSP fiber from that mounting but not to any other mounting. Thus, the apparatus mountings represent the interconnect modularity. The difference in the number of OSP fiber terminations and LIC fiber terminations allows for spare fibers in the OSP cables.

In an 80E cabinet, the HDIC will generally consist of a single FM1-432 apparatus mounting. The FM1-432 apparatus mounting terminates up to 432 OSP and 384 LIC fibers.

#### 5.3.4.2 Capacity--CEV/Hut

In an actual system design, the HDIC capacity should be checked on both OSP and LIC fiber termination sides to verify that there are adequate terminations for both OSP cables and telephony and video equipment fibers. For planning purposes, however, it is useful to have estimates of the number of telephony and video bays associated with an HDIC bay. These estimates can be obtained from the HDIC LIC fiber capacity rather than the OSP capacity, which includes spare allowance.

A CEV or hut equipped with two FM1-648 apparatus mountings in the HDIC (1152 LIC fibers) can serve either 384 (1152/3) or 288 (1152/4) pedestals assuming the pedestals require three or four fibers (F/C), respectively, including video fibers.

The nominal number of 96-fiber video bays associated with an HDIC bay is either three or four when  $F/C = 4$  ( $288/96 = 3$ ) or  $F/C = 3$  ( $384/96 = 4$ ), respectively. Since the first video bay contains only 80 links, the HDIC can actually support one more video bay, containing only a single shelf serving 16 links, yielding a maximum of five ( $F/C = 3$ ) or four ( $F/C = 4$ ) video bays.

The maximum number of telephony bays associated with an HDIC bay depends on the number of pedestals per telephony bay (refer to Table B) and can vary from 6 ( $=384/64$ ) to 9 ( $=288/32$ ).

The FTTH RT equipment associated with one HDIC bay is therefore:

- o A maximum of 4-5 video bays

- o A maximum of 6-9 telephony bays.

In addition, there will be multiplexers, powering equipment, batteries, and the video feeder system (from headend) which may be either fiber or coaxial.

The number of customers supported by an RT structure will depend on bay arrangement, LU/C and F/C. Some typical quantities of bays, F/C, pedestals, and LUs are given in Table B.

If the telephony feeder multiplexer/cross-connect and video feeder equipment can fit in one bay, an additional video bay could be accommodated in a 24-foot CEV (total 15 bays). The bay would provide service to 16 additional pedestals, increasing the maximum LU in Table B to 1536 for LU/C = 4, 1728 for LU/C = 6, and 2304 for LU/C = 8.

For MFBs, the ratio of telephony and video fibers will vary with take so each area will need to be designed individually. Typically, better utilization is realized for MFBs than for pedestals because VTs and video fibers can be matched more closely to actual demand.

#### **5.3.4.3 Capacity--80E Cabinet**

The 80E cabinet will generally use an HDIC, equipped with an FM1-432 fiber apparatus mounting, whose capacity will be adequate for the four FTTH dual channel banks in almost all situations, including video. The 384 LIC fiber capacity can support 128 pedestals for F/C = 3 and 96 pedestals for F/C = 4, including video. The maximum LUs would therefore be 512 for LU/C = 4, 576 for LU/C = 6, and 768 for LU/C = 8. Under present designs, video distribution equipment must be located externally to the 80E narrowband cabinet with video distribution fibers brought to the narrowband cabinet via the HDIC.

#### **5.3.4.4 HDIC Shelf Arrangement**

The OSP fibers to the pedestals would typically be arranged and terminated on the HDIC shelves so that all the fibers from a particular pedestal would be adjacent to each other on the shelf. Therefore, the video LIC fibers would be mixed in with the telephony fibers; typically, one video is followed by two or three telephony fibers.

The number of LIC fibers entering the HDIC may not be the same as the number of outgoing OSP fibers (excluding spares) since some of the LIC fibers may be shared in certain bay arrangements.

### **5.4 Central Office Terminal**

Guidelines for central office terminal (COT) engineering are the same as the existing Series 5 guidelines given in AT&T Practice 915-710-115, *SLC Series 5 Carrier System*, Application Engineering.

## 5.5 Remote Terminal

### 5.5.1 General

The 24-foot controlled environment vault (CEV) and hut and the 80E cabinet are the only RT structures that will be offered for *SLC Series 5 Carrier Systems* employing FTTH feature applications.

### 5.5.2 24-Foot CEV/Hut

Equipment arrangements in the 24-foot CEV (covered in ED-7C683-30, Issue 4) provide one existing option (group 2) and three additional standard options (groups 3, 4, and 5) that are designed to optimize CEV/hut space and provide systematic growth strategy for each option. These arrangements also use a common cable racking system that provides separate cross-aisle racks for slack storage of LIC cables.

These equipment arrangements require an HDIC for the termination of OSP fiber cables and LIC cables. The HDIC bay is a 7-foot frame that has provisions for terminating wavelength division multiplexers (WDMs) and a termination capacity of 1296 OSP and 1152 LIC fibers per bay.

The ED-7C683-30 CEV, group 2 (existing arrangement that can be used with a combination of copper and lightguide distribution) provides space for a maximum of nine *SLC Carrier System* equipment bays. Space is reserved for the following:

- o Three HDIC bays
- o Two nonstandard battery bays
- o One power plant bay
- o One multiplexer (MUX) bay
- o One DSX cross-connect bay.

Except for the battery and power bays, all bays use the standard 7-foot framework (ED-8C500-50, G5). Four AT-9049D protector and cable enclosures with a capacity of 3600 pairs are provided for terminating copper cables. This option has the batteries positioned on the far wall diagonally opposite the ladder. Fifteen-inch cable racking is provided above all equipment and power bays except the protector and cable enclosures. Two 15-inch cross-aisle cable racks, each equipped with 3 KS-20018-L9E shelves, are provided for slack storage of LIC cables. Two 12-inch and one 5-inch cross-aisle cable racks are also provided for derived, digital, power, and miscellaneous copper cables.

The ED-7C683-30 CEV, group 3 (copper and lightguide distribution) provides space for a combination of FTTH and standard *SLC Series 5 Carrier System* bays (maximum of eight equipment bays). Space is reserved for the following:

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- o Three HDIC bays
- o Three battery bays
- o One power plant bay
- o One multiplexer/digital signal cross-connect bay
- o One spare bay.

Except for the power bay, all the bays use standard 7-foot framework (ED-8C500-50, G5). Four AT-9049D protector and cable enclosures are provided for terminating copper cables. This option has the batteries positioned on the near wall (adjacent to the ladder). Fifteen-inch cable racking is provided above all the equipment and power bays except the protector and cable enclosures. Two 15-inch cross-aisle cable racks, each equipped with three KS-20018-L9E shelves, are provided for slack storage of lightguide jumper cables. Two 12-inch and one 5-inch cross-aisle cable racks are also provided for derived, digital, power, and miscellaneous copper cables.

The ED-7C683-30 CEV, group 4 (FTTH feature only) provides space for the following:

- o Ten FTTH bays
- o Three HDIC bays
- o Three battery bays
- o One power plant bay
- o One MUX/DSX bay
- o One spare bay.

Except for the power bay, all the bays use standard 7-foot framework (ED-8C500-50, G5). This option has the batteries positioned on the near wall (adjacent to the ladder) in standard 7-foot frames. Fifteen-inch cable racking is provided above all bays. Two 15-inch cross-aisle cable racks, each equipped with three KS-20018-L9E shelves, are provided for slack storage of LIC cables. Two 12-inch and one 5-inch cross-aisle cable racks are also provided for digital, power, and miscellaneous copper cables.

The ED-7C683-30 CEV, group 5 (FTTH feature only) provides space for the following:

- o Ten FTTH feature bays
- o Four HDIC bays

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- o Two nonstandard battery bays
- o One power plant bay
- o One MUX/DSX bay
- o Two spare bays.

Except for the power bay and battery bays, all the bays use standard 7-foot framework (ED-8C500-50, G5). This option has the batteries positioned on the far wall (diagonally opposite to the ladder) and accommodates nonstandard frames (battery racks). Fifteen-inch cable racking is provided above all bays. Two 15-inch cross-aisle cable racks, each equipped with three KS-20018-L9E shelves, are provided for slack storage of LIC cables. Two 12-inch and one 5-inch cross-aisle cable racks are also provided for digital, power, and miscellaneous copper cables.

### 5.5.3 80E Cabinet

An equipment arrangement in the 80E cabinet (covered in ED-7C707-30) provides one option (group 1) that includes space for the following FTTH equipment:

- o Four *SLC* Series 5 Carrier System J1C182AE dual bank assemblies
- o Eight J1C182PAB optics assembly shelves
- o Two J1C182PB optics power shelf assemblies
- o Seven 2B fan units
- o One FM1-432 fiber apparatus mounting (HDIC)
- o One LSCIU/24/5 termination shelf.

In addition to the FTTH equipment, the 80E cabinet also contains space for the following:

- o One ED-7C704 rectifier panel
- o One ED-83114 control and distribution panel
- o Four 100 Ah battery strings
- o One DDM-1000 multiplexer shelf

- o Two J98725CA T1 repeater shelves (optional)
- o One ED-7C645 remote measurement unit (RMU) (optional)
- o Two 307-type protector blocks
- o One Miscellaneous Pair Panel (MPP)
- o Two 112A fan and alarm controls
- o One 307 DSX or 800-Series DSX tie-block.

## **5.6 Distant Terminal**

The distant terminal (DT) has been discussed in Chapter 4 (Physical and Functional Description). The DT consists of the following:

- o 900A-type closure
- o ASH1 power converter unit
- o ASJ1 or ASJ2 channel unit
- o EAF1 drop test module (optional)
- o AYB1B optical unit
- o KS-21906, L16 battery pack.

The circuit packs are shipped separately from the 900A-type closure. It is intended that the closure be mounted without the circuit packs and battery pack which will be installed when the system is ready for turnup. Consideration will have to be given as to where these piece parts will be stored until needed in the field.

The 900A1 DT is powered by 120 VAC which is supplied by either a dedicated outlet at the customer's residence or an outlet located inside the pedestal DT closure. The 900A2 and 900A3 DTs are powered by -48 VDC acquired from a backpowering arrangement located at the customer's residence. Requirements and installation of the AC and DC power sources are discussed in Chapter 7 (Construction and Installation) and Appendix E [REF. 9.4]. In the case of new construction where the DT will be mounted on the side of the residence, the contractor or land developer will have to be supplied with specifications for the DT equipment or backpowering power arrangement and their desired mounting locations. These specifications and mounting locations are found in Chapter 7 and Appendix D [REF. 9.3]. It will be necessary to track this activity closely to assure that the correct equipment and placement procedures have been followed.

Systems engineering for the physical placement and wiring of DTs in cluster configurations on multifamily buildings is very similar to the single family FTTH installations. Location of the DTs, the method of AC powering, and treatment of drops must be considered. The DTs can be mounted either outside the multifamily building or inside the building in an appropriate equipment room or closet.

The 900A1 DTs are equipped with a 3-foot power cord which must be plugged into a standard 120 VAC receptacle. In single DT installations the DT power cord plugs into an AC receptacle that is mounted in a lockable rainproof closure. This same arrangement of one receptacle and closure per one DT is also acceptable for a multi-family building installation. However, a more aesthetic appearance might be realized by strategically placing the DTs so that all power cords enter one closure containing multiple receptacles. If the addition of video service is planned for the future, the installation of a spare AC receptacle during initial installation should be considered.

The customer drop cables from the DTs should be handled in the same manner as metallic drop cables are handled today to provide protection, cross-connect, and customer access, as desired. There are closures available today that provide configurations of protectors and cross-connect fields of 25, 50, or 100 pairs with either insulation displacement terminals or 76-type binding posts. Space is also available for standard splicing if desired. These closures are available for both indoor and outdoor environments.

## **5.7 Distribution Fiber**

### **5.7.1 General**

Design for fiber distribution is similar to that for metallic distribution; a star topology is used with one or more fibers dedicated to each DT. The principal differences are as follows:

- o The present higher costs of fiber cable and splicing make it more important to design the network to minimize initial costs. On the other hand, maintenance costs for the fiber distribution are expected to be less than for copper.
- o For fiber, a feeder distribution interface (FDI) is not required; fibers run directly from the DT to the RT. Therefore, distribution area sizing guidelines are no longer binding and RT placement has greater flexibility.
- o Fiber loops of arbitrary length can be used if a transmission loss design is performed. Except for aerial plant using multifiber array splices, such a design is not generally necessary for loops within the 12 kft carrier serving area (CSA) limit.

Distribution plant design can be conceptually divided into five functions which will be described in their order of occurrence:

1. Gather input information.
2. Select design options (network and hardware).
3. Choose RT site and cable routes.
4. Perform balancing and trade-offs.
5. Check transmission design.

### **5.7.2 Gather Input Information**

The usual developer's plots must be obtained and possible RT sites determined. To perform economic trade-offs, distribution material and labor costs are required.

### **5.7.3 Select Design Options**

#### **5.7.3.1 General**

This step has the most influence on the cost and effectiveness of the project. Many of the options involve the same choices as in copper design, but the economic consequences may be greater. Following are the most common options.

#### **5.7.3.2 Network Layout and Placement Options**

##### **5.7.3.2.1 General**

Examples of network options are aerial or buried installation, front or rear lot location, and number of houses per drop access point. The overall aim in selecting options is to achieve the lowest cost combination of initial and maintenance costs. Local practices should be followed when required.

##### **5.7.3.2.2 Aerial, Buried, or Underground Cable**

Direct burial of the fiber distribution cable is recommended where possible. Aerial placement of distribution cable requires span design engineering to limit stresses on the fibers and also subjects the network to temperature extremes. Rigid duct over 2 inches in diameter should be used if the distribution cable is placed in underground conduit.

##### **5.7.3.2.3 Individual, Pedestal, or Cluster Mounted DTs**

Mounting DTs in pedestal closures or in cluster arrangements permits more than one living unit to be served from each DT thus reducing the cost per living unit. However, other factors affecting the individual, pedestal, or cluster mounted DTs decision need to be considered that may make the use of the pedestal closure or cluster arrangement impractical; leaving the individually mounted DT the only choice.

**5.7.3.2.4 Fibers Per House**

Where the DT is mounted on the side of the house, the FTTH feature requires only one fiber to each house. Due to local requirements, however, it may be necessary to provide two fibers to each house. Spare fibers are required for unexpected growth and for customers needing more than four POTS lines. The number of spares as for copper cable, should generally be around 10-20% but can vary locally. Because fiber cables are normally low count, it may be desirable to reserve a minimum number of spares.

**5.7.3.2.5 Fibers Per Pedestal DT Closure**

During VF applications, each DT in the pedestal requires one fiber and the video enclosure requires one fiber with the maximum of four working fibers per pedestal.

**5.7.3.2.6 Front or Rear Lot**

With DTs mounted on the side of houses, the location of fiber cables and drop access points at the rear of the property, with each terminal serving four houses, will generally have a lower initial cost than locating the drop access point at the front of the property and serving only two houses. However, other factors affecting the front lot/rear lot decision may outweigh this consideration. The location of a pedestal DT closure is restricted by the maximum cable distance allowed between the DT and the house (approximately 400 feet). Taking this maximum distance into consideration, the pedestal DT closure should be located where the DTs in the closure can be accessed by the maximum number of houses, not to exceed eight houses.

**5.7.3.2.7 Houses Per Drop Access Point**

For either front or rear lot distribution, costs can be reduced by serving more houses from each drop access point. Front lot distribution with four houses per drop access point or rear lot with six to eight houses may be attractive options, provided there is no problem with the rights of way for the drops to the distant houses. Provision must also be made for storing these drops if the distant houses have not been built.

**5.7.3.2.8 Street Crossings**

The maximum number of street crossings allowed for a cable and drop must be decided. This decision is more significant for fiber than for copper cable due to the expense of fiber splices.

**5.7.3.2.9 Structure Utilization**

The maximum number of fiber cables per structure (pole line, trench, conduit) must be determined. The cost of fiber splices may make it beneficial to install parallel cables in the same structure. In such cases, cable identification methods must be determined.

### 5.7.3.3 Hardware Options

#### 5.7.3.3.1 Cable Sheath

The AT&T lightguide express entry (LXE) sheath is recommended for distribution networks because it allows easy core access. If dielectric cables are used, some method of locating the cable after it has been buried (such as metal tape) should be provided. Preconnectorized fiber service cable (drop) is also available in lengths of 200, 300, 400, 500, and 600 feet. Each end of the fiber cable is terminated with a cable connector that secures the cable to the DT closure and the distribution closure. Each fiber in the cable is also terminated with an *ST* connector.

#### 5.7.3.3.2 Cable Size

Cable sizes (fiber count) are determined by allowing one fiber per DT plus appropriate spares.

Distribution fiber splices that are field installed should require a minimum of special equipment. Mass splicing of distribution fibers can be accomplished using AT&T's factory-installed silicon chip array splices. Single fiber splicing is possible using AT&T's rotary mechanical splice which is quick, requires no special equipment, and can be safely performed in manholes.

All these splices generally have sufficiently low loss so that the 12 kft CSA loop limit is attainable for loops containing a normal number of splices. If the plant is aerial and subject to temperatures below  $-10^{\circ}\text{F}$ , the allowable loop length may be less if all mass splices are used.

The AT&T *ST* lightguide cable connector should be used in all cases. The system cannot be guaranteed to work with other connectors or other splices.

### 5.7.4 Choose RT Site and Cable Routes

#### 5.7.4.1 General

Determining CSAs and establishing potential RT sites will have been done at a previous time in most situations. The two items that may affect the RT placement are as follows:

- o Fiber loops do not have to be restricted to 12 kft provided the loss is measured and environmental adders are accounted for in each case. Often it will be possible to exceed 12 kft by a considerable margin, allowing more flexibility in locating the RT site.
- o The FTTH feature requires more RT space than copper digital loop carrier (DLC). Typically, a 24-foot CEV can serve between 6000 and 7500 lines from a copper DLC (*SLC* Series 5 Carrier System)

and up to 2000 customers (2 or more lines each) from the fiber system in its initial configuration.

Once the design options have been selected, cable routes must be determined. Cable route design is generally similar to that for copper; units are accumulated back from the farthest points of the area as directly as possible to the RT. Where two cables come together at a branch point, it is not always best to splice as for copper. It may be cheaper to run the cables parallel to the next splice point back. Also, tapers on long fiber cable runs should be cost justified.

Cable route determination can conceptually be broken up into three steps, though all are interacting to some degree and will probably be performed as a single process:

- Break up area into independent housing clusters
- Determine the routes for each cluster
- Extend these routes back to the RT.

#### **5.7.4.2 Break Up Area**

In most cases, particularly with rear lot line distribution, houses in any given area can be served in many different ways. The idea behind breaking up the area is to simplify the choice of alternatives. Most areas are broken up by major roads into clusters of houses which can only be served by cable running within the cluster. If cable drops are allowed to cross streets, additional alternatives are possible and the clusters may have to be formed arbitrarily. Housing clusters formed for front lot distribution are usually small and well defined. Within each cluster, cable routes will interact with respect to the houses in a way that it may be possible for a house to be fed by more than one route.

An example of a cluster is the lots around a cul-de-sac with front lot feed. Such a street can be fed by a distribution cable from either side. These cable routes interact in a way that the houses at the end of the cul-de-sac can be fed by either cable. The process of choosing the cable for each house is called balancing the cable routes and will be discussed later.

There are generally more potential interactions if rear lot feed is allowed, as parallel cable routes may be able to feed groups of houses from either side.

The idea of the independent clusters is there are no interactions between cables in different clusters.

#### **5.7.4.3 Determine Routes for Clusters**

The cable routes are determined by the options selected (for example, if long drops are not allowed, a cable route must touch every lot) and

by the cost requirement that the routes be kept as straight and short as possible. Ideally, cable routes should run in a straight line from the RT or the pedestal DT closure to the house, but street geometry may prevent this. Cables that meander or loop to reach houses that are difficult to access are not recommended. Consideration should be given to using long drops or running another cable route when these circumstances arise. Instead of running the main distribution cable around cul-de-sacs, which is common practice with copper cable, lower costs can be achieved by dedicating one or two cables to the cul-de-sac or, if the run is short, to serve it with long drops.

Subject to the above guidelines, cable routes should be chosen so that cables pass or serve as many lots as possible, thus minimizing the number of routes.

#### **5.7.4.4 Extend Routes Back to RT**

It may be necessary to extend cable routes within one cluster back through other clusters in order to reach the RT. In so doing, the existing rights-of-way of cables from the cluster to the RT should be used, when possible, so that the number of trenches (or other structures) will be reduced. Deciding whether to lay the cables parallel or to combine them by splicing into a single backbone is a question of trade-offs to be discussed later.

#### **5.7.5 Perform Balancing and Trade-Offs**

##### **5.7.5.1 General**

By the time the cable routes are selected, the engineer will have a rough idea of the cable sizes and layout. It is now time to determine these precisely using two processes designated balancing and trade-offs. Balancing consists of allocating lots in a cluster to the different cable routes so that cost and possibly other quantities (for example, splicing time) are optimized. Trade-offs consist of determining the precise cable cross-sections by deciding where cables will be spliced and how they will be tapered, again with minimum cost in mind.

##### **5.7.5.2 Balancing**

Balancing is done on a cluster basis. First, the lots in the cluster are counted. Certain of these lots may be served by only one cable route within the options selected and they should be marked off. The remaining lots, which may be served by more than one route, must be allocated to a route using the following criteria:

- Preferred cable sizes (those with lower cost per fiber) should be used if possible.
- If array splicing is allowed, cables sizes which are multiples of 12 are preferred.
- Cables should be as fully utilized as possible. That is, after

allowing for the necessary spares, all other fibers should be used for customers. It may be beneficial to have a table of available and spare fibers for each cable size.

- Large cables should be kept as short as possible. Of course, the natural tendency is the other way, as larger cables serve more units.
- Considering the previous criteria, the number of drop closures should be minimized. For example, with front lot feed and no long drops, there will normally be two drops per closure, so a cable should not serve an odd number of lots if possible.
- Balancing the cable sizes is interactive with their routes as determined previously. That is, it may be desirable to change a previous route selection if the resulting cables are more fully optimized.

As an example, consider 20 houses situated along a cul-de-sac. Since a 12-fiber cable can serve 10 units with 10% spare, the choice of using two 12-fiber cables to serve the cluster is clearly better than breaking up the 20 (12/8) and using a 14- and a 10- fiber cable. Dividing the houses up into an 11/9 split would not be any better since a 14- and a 10- fiber cable would still be required and the number of drop closures would be increased. It would also be possible to serve the cul-de-sac with one 24-fiber cable, but in this case it would probably be more expensive, as twice as many fibers would go all around. While this is true for a large cul-de-sac, a single cable may be best for a medium cul-de-sac (approximately 6 - 8 units). Small cul-de-sacs (4 - 6 units) are best served with long drops if possible.

### **5.7.5.3 Trade-Offs**

#### **5.7.5.3.1 General**

After choosing the appropriate distribution cables, drop closures, and drops serving all the lots in a cluster, the final step in cable route design is to decide the following questions:

- Branch cable question: When two cables come together in a common route on their path back to the RT, should the cables be spliced to a single backbone cable or continue parallel?
- Taper question: Should a long single distribution cable be tapered?

Since these two questions are primarily cost related, the answers to them depend on the trade-off between cable and splicing costs. The required maximum number of splices to a customer should also be satisfied. The costs determined earlier should be used in answering these questions. The calculations necessary to answer the questions may be done by hand or a simple spreadsheet program may be written.

### 5.7.5.3.2 Branch Cable Question

The major factor to be considered when answering this question concerns the trade-off between the cost of splicing the branch cables to the backbone versus the extra sheath and placing costs for parallel placement. Cable costs can be exact, or modeled on an  $A+Bx$  basis (where  $x$  is the number of fibers). The cost of splicing includes costs for closures, splicing material, splice pit, and appropriate labor. It may be convenient to make up a table of the total splicing costs of cables by size for various splicing methods.

Trade-off results will be either dollars saved for a given backbone length or break-even backbone length (for which the costs are equal). The latter may be more convenient if several splice locations are possible. For a single large backbone cable, all spares are available to provide service to any customer on the backbone. For parallel cables, spares are only accessible by customers in the same sheath. This advantage applies to customers served by the backbone only; for customers on the branches, spares are limited to the branch spares whether spliced or parallel.

### 5.7.5.3.3 Taper Question

Taper can be defined in a broad sense as reduced fiber cross-section. Tapering can be accomplished in one of the two following ways:

- (a) By splicing a large cable from the RT to a smaller cable farther out, as is commonly done for copper.
- (b) By running parallel cables, one cable runs from the RT all the way out and a second cable runs from the RT only part way out.

For example, a 2000 ft. 24-fiber cable may be tapered by a 1000 ft. 24-fiber cable and a 1000 ft. 12-fiber cable, or a 2000 ft. 12-fiber cable and a 1000 ft. 12-fiber cable.

The spliced taper does not often pay off for the small size cables typically found in distribution. Any savings are usually small and another splice has been introduced to increase loss. Therefore, it is not recommended that splice tapering be used for cables of less than about 48 fibers and only then if transmission is not a problem.

Parallel tapers, in the majority of cases, pay off for cables of 24 fibers or larger; the cost of the extra sheath is more than offset by the fiber saved. Taken to the limit, this would mean that parallel tapering should always be used down to 24 fibers so that all end cables would be 12 fibers or less. In practice, the savings for short cable lengths are small so parallel tapering is only worthwhile when a single cable is of substantial length. The savings for actual cases encountered can be easily calculated by the engineer.

## 5.7.6 Check Transmission Design

Outside plant design is based solely on a system design loss budget as derived from the system gain and system margin. The outside plant design loss budget is defined to include only the loss allowable to the outside plant fiber and splices not connectorization loss at the RT or DT nor margins allocated to repair splices.

In early fiber applications it will probably be desirable to check the transmission design in all cases. As experience is gained, this should not be necessary for the majority of loops that are less than 12 kft as long as AT&T cable splices and connectors are used.

The procedure is to design a fiber distribution area and then check the loss based on system gain and system margin. The system gain and system margin parameters are described as follows:

- System Gain: The algebraic difference in dB between the transmitted power as measured at the optical line card connector and the receiver sensitivity when measured at the optical line card connector. The transmitted power and receiver sensitivity are defined as follows:
  - (1) Transmitted Power ( $P_{o}$ ): The power measured at the optical line card connector in dBm when measured into a wide area detector (photon bucket). The loss of the optical connector does not appear in this measurement.
  - (2) Receiver Sensitivity ( $P_{s}$ ): The power required at the input of the optical line card in dBm in order to meet a specified system performance parameter (for example, bit error rate for a digital signal). The loss of the optical connector appears in this measurement.
  
- System Margin: The reduction in the system gain to account for known and potential variations in the transmitted power, receiver sensitivity, and facility loss. The system margin parameters include:
  - (1) Allocated Margin ( $M_{a}$ ): A reduction in system gain to account for known variations such as aging, wavelength variations, etc.
  - (2) Unallocated Margin ( $M_{u}$ ): The reduction in the system gain to account for unknown, but potential variations in system parameters.

The procedure for calculating the OSP design loss is described in the

following three cases:

- Case 1: If only VF service is being installed and the addition of video service is not anticipated, the OSP design loss can be obtained from the following calculations (see Figure 36) OSP Design Loss = System Gain - System Margin - Connector Loss

$$\text{OSP Design Loss} = (P_{\text{o}} - P_{\text{s}}) - (M_{\text{a}} + M_{\text{u}}) - \text{Connector Loss.}$$

Using the appropriate design values for the VF optical link,

$$P_{\text{o}} = -26.0 \text{ dBm}$$

$$P_{\text{s}} = -40.0 \text{ dBm}$$

$$(\text{System Gain} = 14.0 \text{ dB})$$

$$M_{\text{a}} = 1.5 \text{ dB}$$

$$M_{\text{u}} = 1.5 \text{ dB}$$

$$2 \text{ Connectors (@ } 0.6 \text{ dB ea.)} = 1.2 \text{ dB}$$

yields the following calculation:

$$\text{OSP Design Loss} = (-26.0 - -40.0) - (1.5 + 1.5) - 1.2$$

$$\text{OSP Design Loss} = 9.8 \text{ dB.}$$

- Case 2: Video augmentation provides for the amplitude modulation (AM) transmission of the standard CATV spectrum over a separate fiber (Figure 37). The system gain for the video system is less than that for the VF system. Consequently, if the installation of video service is expected, the video system gain should be used in the calculation:

$$\text{OSP Design Loss} = \text{Video System Gain} - \text{Connector Loss}$$

$$\text{OSP Design Loss} = (P_{\text{o}} - P_{\text{s}})_{\text{video}} - \text{Connector Loss.}$$

Note the absence of System Margin. Since an AM system degrades very gracefully with increasing loss, no Unallocated Margin need be used; also, no Allocated Margin is necessary.

Using the appropriate design values for the video optical link,

$$P_{\text{o}} = 0.0 \text{ dBm}$$

$$P_{\text{s}} = -9.2 \text{ dBm}$$

(System Gain = 9.2 dB)

2 Connectors (@0.6 dB ea.) = 1.2 dB

yields the following calculation:

OSP Design Loss = (0.0 - -9.2) - 1.2

OSP Design Loss = 8.0 dB.

-- Case 3: For applications where video services are expected to be added over the same fiber as VF services, 2 or the 8 dB calculated in the previous case must be reserved for the future installation of wavelength division multiplexing components. Therefore,

OSP Design Loss = 6.0 dB

must be used to retain this upgrade option.

Completion of the previous steps should yield a distribution design having a reasonably minimized first cost. In practice, these steps will normally be integrated into a single process, though they have been separated here for purposes of explanation. The engineer will soon develop an intuitive feeling for the various trade-offs and should be able to design much of an area from experience, without the need to make a lot of detailed calculations, as presently done for copper.

## 6. Operations and Administration

### 6.1 Overview

This chapter discusses the work operations to be performed during provisioning of a *SLC(R)* Series 5 Carrier System equipped with the FTTH feature and compares these work operations with those required during provisioning of a system with copper distribution cable. This chapter also presents the methods used to rearrange existing FTTH equipment and to administer assignment records.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 6.2 Provisioning

The major work operations required to provide the FTTH feature are basically the same as those for the digital loop carrier (DLC) in a copper environment with some additions and modifications. Figure 38 is a general flowchart outlining these operations.

The following is a discussion of the differences between fiber and copper distribution cable as applied to work operations numbered 1 through 8 on the flowchart. Work operations numbered 9 through 14 concerning assignment are discussed in Part 6.

- (a) OPERATION 1: Prepare outside plant engineering job order for distribution fiber cable and RT structure.

In addition to the details normally required for DLC installations employing copper cable (refer to AT&T 916-100-102), the following items are required for DLC installations equipped with the FTTH feature.

- o Additional RT structure (80E cabinet, CEV, or hut) mounting details for *SLC* Series 5 Carrier System, RT optics shelves, and high density fiber interconnect (HDIC) equipment.
- o Dedication of individual fibers to each location served.
- o Placement and splicing of fiber drop to each location.
- o Rearrangement of any existing HDIC connections required.
- o Connection of fiber from RT optics shelf cable to distribution fiber at the HDIC.
- o Remote terminal record for optical units, similar to plug-in records for DLC.
- o Cable designation for fiber cable to allow identification as

a fiber facility [i.e., DF311 would be a distribution (D) fiber (F) cable number 311].

- o Since multiple lines will be served by a single fiber, a pseudo cable pair numbering scheme must be used that will allow records to be handled as they are presently. Pseudo cable pair will consist of a maximum 4-digit identification number (refer to Figure 39). The first three digits represent the fiber number and the last digit represents the channel number (for example, pseudo cable pair 231 represents fiber 23 and channel 1). Refer to Part 6 for additional information concerning the numbering scheme. Refer to Chapter 7 (Construction and Installation) for additional information concerning fiber placing and splicing requirements.

(b) OPERATION 2: Prepare equipment engineering job order for SLC Series 5 Carrier System and FTTH equipment.

- o Requires modified floor plan layout if RT structure is CEV/hut.
- o Requires mounting and cabling details for FTTH equipment.
- o Refer to the Appendix A [REF. 9.1] for ordering information.

(c) OPERATION 3: Place main distribution cable from HDIC facility.

At the RT location, the main distribution cable will be terminated in an *ST* lightguide cable connector at the HDIC. The HDIC is the preferred lightguide interconnect for FTTH and should always be used.

(d) OPERATION 4: Place closure, RT common plug-ins, and HDIC.

Requires the same operations as a standard DLC installation with the following exceptions:

- o The fiber cable assembly from the optics shelf to the HDIC is shipped separately and must be field installed. (There are two fiber cable assemblies per dual bank.)
- o Fiber from the optical unit (OU) is dedicated and connected to the main distribution fiber at the HDIC.

(e) OPERATION 5: Place branch distribution cable.

Refer to OPERATION 7.

(f) OPERATION 6: Place fiber drop and pedestal DT closure (if required).

Refer to OPERATION 7.

- (g) OPERATION 7: Place 900A-type distant terminal (DT) and, if pedestal DT closure is used, place individual customer metallic drops.

Refer to Chapter 7 for information concerning the placement of the branch distribution cable, fiber drop, and 900A-type DT.

Operations 5, 6, 7 are interdependent and are capable of being placed in any one of the following 4 sequences for installations where the DT is located on the side of the living unit:

- (1) Place branch cable, place and splice drop to branch cable, place 900A-type DT, and place *ST* connector on drop on the same authority. This can only be accomplished when all site and external building work is completed.
- (2) Splice drop to branch cable and store when branch cable is placed. Return and place drop, *ST* connector, and 900A-type DT at location when all site and building work is completed.
- (3) Place branch cable. Return and place drop, splice drop to cable, place 900A-type DT, and place *ST* connector when site and building work are complete.
- (4) Place branch cable, place drop to location, and splice drop to cable. Return and place 900A-type DT and *ST* connector when building work is complete.

If the pedestal DT closure is being deployed, operations 5, 6, 7 are capable of being placed in any one of the following 3 sequences:

- (1) Place branch cable, place and splice fiber drop to branch cable, place individual customer metallic drops, place pedestal DT closure, place 900A-type DT(s), and place *ST* connector on fiber drop at pedestal on the same authority. This can only be accomplished when all site and external building work is completed.
- (2) Splice fiber drop to branch cable, place pedestal DT closure, place individual customer metallic drops and store when branch cable is placed. Return and place *ST* connector and 900A-type DT(s) at pedestal when all site and building work is completed.
- (3) Place branch cable. Return and place fiber drop, splice fiber drop to cable, place individual customer metallic drops, place pedestal DT closure, place 900A-type DT(s),

and place *ST* connector when site and building work are complete.

(h) OPERATION 8: Place channel units and optical units at RT.

The channels units and optical units for the FTTH feature should be placed to satisfy the near term forecasted demand. A minimum quantity of spare units should be provided for growth. These units should be provided on an engineering work authority as per OPERATIONS 1 and 2.

### 6.3 Rearrangement

In terms of rearrangement, one of the major differences encountered in providing fiber to the home as opposed to providing copper occurs when an unplanned third line (or channel) is requested for a system arrangement using the 900A-type DT closure on the side of the living unit.

Normally, during initial installation, if only one or two lines are desired at the customer premises, a dual channel unit (AUA400 or AUA404) will be placed at the RT and the output fiber will be connected to the distribution fiber at the HDIC. The AUA400 or AUA404 channel unit (CU) utilizes one slot in the Series 5 channel bank.

If a third line is requested at a location served by a dual CU, the loop assignment center (LAC) should request the outside plant engineering (OSPE) forces to provide facilities for the third line.

If an unused quad CU (AUA401 or AUA405) is available at the RT, the OSPE will issue a job order to rearrange the OIC connection from the dual CU to the quad CU and advise the LAC. The existing CO connections must be rearranged from the existing CU to the new CU concurrent with the OIC rearrangement.

If a quad CU is not available, the OSPE will:

- (1) Request the equipment plug-in coordinator to provide the quad CU and the optical unit if needed.
- (2) Issue the job order specifying slots to be used by the CU and the rearrangement required as per paragraph (1).

After performing these two steps, the continuing property, engineering, assignment, maintenance, and other support system records must be updated.

### 6.4 Growth

Installed fibers can be activated very easily. After a fiber is terminated at a DT, it will also have an appearance on the HDIC. This appearance must be added to the terminal assignment cards (TACs) along

with the corresponding street address of the living unit or the pedestal DT closure location. The remaining assignment is made at the time a customer requests service.

## 6.5 Assignment

With the bandwidth of lightguide cable being very wide, it is anticipated that in the future many services (channels) will be provided to an individual location via a single fiber.

A *SLC Series 5 Carrier System* equipped with the FTTH feature will initially provide four 64 kb voice channels to each DT. Future service offerings will support four 64 kb voice channels and several telemetry type channels plus the possibility of wideband services on the same physical fiber via an outboard wavelength division multiplexer (WDM). To allow fiber cable to be administered in the assignment records in the same manner as copper cables, the records for fiber distribution cables should be set up as pseudo pairs in complements of ten channels per fiber.

As mentioned previously, the distribution cable identification could be set up to identify the cable as a fiber facility, that is, DF311 would identify a fiber distribution cable numbered 311. What would normally be considered as pairs 230-239, for example, would actually represent fiber number 23 channels 0-9. Channel 0 (pair 230) would be reserved for future wideband usage; channels 1,2,3, and 4 (pairs 231-234) would be used to provide paths for the VF signals. Using this method of identification will set up *SLC Series 5 Carrier System* FTTH feature in a normal pair gain configuration and will be administered as it is today [for example, four FTTH systems installed and set up as Pair Gain cable 5: 1-400 with channels 45 and 46 of the first system (PG 5 pairs 45, 46) connected to fiber 23 channels 1, 2 (DF311 pairs 231, 232) and shown as primary facilities for the location being served].

Since the single distribution fiber to each DT will serve multiple lines, it will be necessary to modify other existing assignment records to reflect this condition. The derived feeder record (DFR), which is used to record and administer the *SLC Series 5 Carrier System* channel unit positions at the COT and RT, will require minor modification. The LINE STATUS channel unit entry for the COT will remain the same, however, the RT entry could be either EFD (dual channel unit) or EFQ (quad channel unit) as shown on the DFR in Figure 39. The connect-through/dedicated plant assignment card (CT/DPAC) could be modified by utilizing NFT (fiber through) to show that the 900A-type DT and fiber have been placed, and FT (in lieu of CT) to show that the CU, RT optical unit (OU), fiber, DT OU, and voice-frequency interface (VFI) have been placed in those locations served by fiber distribution facilities. Refer to Figure 40 for CT/DPAC example layouts.

In a nonCOSMOS loop assignment center (LAC) the first stop in the

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service order flow will be at the CT/DPAC production center. The service order address will be matched to the CT/DPAC address. If the address is in a fiber distribution area with an NFT available but no FT (refer to Figure 40), the service order will be assigned an F2 facility designation indicating the need for a DT OU and a VFI in position 1 at the customer location. The service order (SO) entry would be similar to this:

```
IF2 /CA DF512/PR211
/TEA 900A1 DT/ I DT OU I VFI/P1
```

If a DT OU is present at the customer location but a VFI is needed for line 2, the SO entry would be similar to this:

```
IF2 /CA DF512/PR241
/TEA 900A1 DT/ E DT OU I VFI/P2
```

If a DT OU is present and a VFI is available for the line (FT), the SO entry would be similar to this:

```
IF2 /CA DF512/PR221
/TEA 900A1 DT/ E DT OU E VFI/P1
```

If neither an FT nor a NFT is available at the RT, or no fiber is shown available at this location, the SO should be routed to the exchange customer cable record (ECCR) production position.

If, however, the necessary equipment and fiber is available, the ECCR production position will assign the order and advise the CT/DPAC position to update it's records. The SO entry would be similar to this:

```
IOE 012 01 19/CUC E ES
IF1 /CA PG5/PR1/P1
```

```
                /TEA F 512 LAMAR;PLJ  
/PGS SLC5 05/CUR E EFD/LT1  
IF2                /CA DF512/PR201/J20  
                /TEA 900A1 DT/ I DT OU I VFI/P1
```

In this example the 900A1 DT following /TEA of the F2 facility indicates that the fiber and a 900A1 DT is in place at the customer location.

If a channel unit or RT OU is needed at the RT or fiber is not available to the location, a request should be sent to the OSPE forces for additional facilities.

The use of the proposed facility identifiers (FID) [EFD for the RT dual (two lines) channel unit and EFQ for the RT quad (four lines) channel unit], the proposed fiber distribution cable designations, and pseudo pair layout will allow the FTTH system to be assigned and administered in the same manner as existing copper facilities with the following exception: all fiber connections and fiber placements should be authorized by an engineering work order.

## 7. Construction and Installation

### 7.1 Overview

This chapter provides construction and installation procedures for equipment, apparatus, and fiber cable located at the remote terminal (RT) and distant terminal (DT) locations of a *SLC(R)* Series 5 Carrier System equipped with the FTTH feature. Acceptance and turnup procedures for the RT and DT are not contained in this chapter but can be found in AT&T 363-205-401, *SLC* Series 5 Carrier System, Remote Terminal Acceptance and Turnup.

Whenever this chapter is revised, the reason(s) for revision will be listed in this paragraph.

### 7.2 Remote Terminal Installation

#### 7.2.1 General

The RT equipment associated with the FTTH feature can be installed in either a CEV, hut, or an 80E cabinet structure. Since all RT equipment and interconnect cabling in an 80E cabinet, except the lightguide interconnection cables (LICs) and OSP cables, are installed and connected prior to placing the cabinet, installation and connection procedures for the 80E cabinet will be limited to the LICs and OSP cables.

#### 7.2.2 RT Frame

##### 7.2.2.1 General

Assuming that the RT frame has been installed, this part contains the procedures necessary to install all of the equipment in an RT frame (Figure 3) which includes:

- o Series 5 RT dual bank assemblies
- o RT optics power shelf assembly
- o Optics shelves
- o 2A fan units.

##### 7.2.2.2 RT Dual Bank Assembly

###### 7.2.2.2.1 General

Equipment required to install an RT dual bank assembly includes:

- o Two alignment pins (provided)
- o Eight No. 12-24 mounting screws (provided)

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- o KS-22605, L1 access shelf (optional).

An RT frame can accommodate up to two RT dual banks for the FTTH feature applications. Since both assemblies do not have to be installed at the same time, the procedures for installing either one or both assemblies are included.

### 7.2.2.2 Installation of First RT Dual Bank Assembly (Lower)

If only one dual bank assembly is to be installed, it must be located in the lower position and installed as follows:

1. Install the access shelf in the appropriate position to mount the lower dual bank assembly (No. 1) and secure it with 4 No. 12-24 screws.
2. Locate the structure cables for the lower dual bank assembly and dress them to the front.
3. Dress the cables for the upper dual bank assembly (if present) into the duct work since they will not be used at this time.
4. Place the lower dual bank assembly on the access shelf.
5. Free all bank assembly dangling cables and connectors and secure the dual bank assembly with the 8 No. 12-24 mounting screws.
6. Remove the access shelf.

### 7.2.2.3 Installation of Second RT Dual Bank Assembly (Upper)

Installation of a second dual bank assembly in an RT frame should be performed as follows:

1. Install the access shelf in the appropriate position to mount the upper dual bank assembly (No. 2) and secure it with 4 No. 12-24 screws.
2. Locate the structure cables for the upper dual bank assembly and dress them to the front.
3. Place the upper dual bank assembly on the access shelf.
4. Free all bank assembly dangling cables and connectors and secure the dual bank assembly with the 8 No. 12-24 mounting screws.
5. Remove the access shelf.

### 7.2.2.4 Installation of Two RT Dual Bank Assemblies

If two dual bank assemblies are to be installed, start at the top position and install them as follows:

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1. Install the access shelf in the appropriate position to install the upper dual bank assembly and secure it with 4 No. 12-24 screws.
2. Locate the structure cables for the upper dual bank assembly and dress them to the front.
3. Dress the cables for the lower dual bank assembly to the rear inside the unequal flange duct space. This will ensure later accessibility.
4. Place the upper dual bank assembly on the access shelf.
5. Free all bank assembly dangling cables and connectors and secure the dual bank assembly with the 8 No. 12-24 mounting screws.
6. Remove the access shelf.
7. Install the access shelf in the appropriate position to install the lower dual bank assembly and secure it with 4 No. 12-24 screws.
8. Place the lower dual bank assembly on the access shelf.
9. Free all bank assembly dangling cables and connectors and secure the dual bank assembly with the 8 No. 12-24 mounting screws.
10. Remove the access shelf.

### 7.2.2.3 J1C182PB RT Optics Power Shelf Assembly

All equipment required to install the RT optics power shelf assembly comes furnished with the shelf: two alignment pins and 4 No. 12-24 mounting screws.

**NOTE:**

The RT optics power shelf assembly has several long connectorized cables attached to the bottom of the shelf and projecting from each side. It is suggested that these cables be loosely coiled and placed into the power shelf assembly to protect the cables during mounting and to facilitate easier handling.

Install the RT optics power shelf assembly as follows:

1. Refer to Figure 3 and locate the holes in the RT frame to receive the mounting screws.
2. Install the two alignment pins into the two lower screw holes in the frame that align with the mounting holes in the power shelf.
3. Mount the power shelf in the frame while verifying that the alignment pins are inserted through the lower mounting holes in the power shelf.

4. Secure the top of the power shelf using two No. 12-24 screws in the two top mounting holes.
5. Replace the alignment pins with the two remaining No. 12-24 screws.

#### **7.2.2.4 JIC182PA Optics Shelf**

All equipment required to install each optics shelf (Figure 41) comes furnished with the shelf and includes:

- o Two alignment pins
- o Four No. 12-24 mounting screws
- o Backplane cover.

Install each optics shelf as follows:

1. If the LICs are not being installed on the optics shelf at this time, install the backplane cover (Figure 42).
2. Refer to Figure 3 and locate the holes in the RT frame to receive the mounting screws.
3. Install the two alignment pins into the two upper screw holes in the frame that align with the mounting holes in the optics shelf.
4. Mount the optics shelf in the frame while verifying that the alignment pins are inserted through the upper mounting holes in the optics shelf.
5. Secure the bottom of the optics shelf using two No. 12-24 screws in the two bottom mounting holes.
6. Replace the alignment pins with the two remaining No. 12-24 screws.

#### **7.2.2.5 2A/2B Fan Unit**

The 2A fan unit is used in CEV and hut applications and the 2B fan unit is used only in 80E cabinet applications. These installation instructions apply to both applications.

All equipment required to install each fan unit includes:

- o Two alignment pins
- o Four No. 12-24 mounting screws.

Install each fan unit as follows:

1. Refer to Figure 3 and locate the holes in the RT frame to receive the mounting screws.
2. Install the two alignment pins into the two lower screw holes in the frame that align with the mounting holes in the fan unit.
3. Mount the fan unit in the frame while verifying that the alignment pins are inserted through the lower mounting holes in the fan unit.
4. Secure the top of the fan unit using two No. 12-24 screws in the two top mounting holes.
5. Replace the alignment pins with the two remaining No. 12-24 screws.

#### **7.2.2.6 Electrical Connections**

After all of the units in the RT frame have been installed, the electrical connections between the RT dual bank assemblies, RT optics power shelf, optics shelves, and 2A fan units should be made as follows (refer to Figure 43):

**NOTE:**

Slack should be left in the cable harness to the optics shelves so that the shelves can be pulled out, turned over, and fiber jumpers installed without disconnecting the metallic connectors.

1. Interconnect optics shelf No. 1 and No. 2 connectors P101, P102, P103, and P104 to the lower dual bank assembly connectors J101, J102, J103, and J104, respectively.
2. Interconnect optics shelf No. 3 and No. 4 connectors P101, P102, P103, and P104 to the upper dual bank assembly connectors J101, J102, J103, and J104, respectively.
3. Make a loop with the frame ground lead from the optics shelf and connect it to a suitable mounting hole on the frame.
4. Connect optics shelf No. 1 (bottom) leads P120 and P121 to RT optics power shelf leads J120-1 and J121-1, respectively.
5. If bay is equipped with 2 or more optics shelves, connect leads P120 and P121 from optics shelf No. 2 to RT optics power shelf leads J120-2 and J121-2, respectively.
6. If bay is equipped with 3 or more optics shelves, connect leads P120 and P121 from optics shelf No. 3 to RT optics power shelf leads J120-3 and J121-3, respectively.
7. If bay is equipped with 4 optics shelves, connect leads P120 and P121 from optics shelf No. 4 (upper) to RT optics power shelf leads J120-4 and J121-4, respectively.

8. Connect RT optics power shelf connectors J108A-1 and J108B-1 to the lower dual bank assembly connectors P108A and P108B, respectively.
9. Connect RT optics power shelf connectors J108A-2 and J108B-2 to the upper dual bank assembly connectors P108A and P108B, respectively.
10. Connect RT optics power shelf connectors J114-1 and J114-2 to the P114 connectors on the 2A fan units No. 1 and No. 2, respectively.
11. Connect RT optics power shelf lead P403A to 2A fan unit No. 2 connector J115-1.
12. Connect RT optics power shelf lead P403B to 2A fan unit No. 1 connector J115-1.
13. Connect lower bank assembly connector P115 to 2A fan unit No. 2 connector J115-2.
14. If the bay is equipped with 2 RT banks, connect upper bank assembly connector P115 to J115 of patch cable.
15. If the bay is equipped with 2 RT banks, connect patch cable connector P115 to 2A fan unit No. 2 connector J115-3.
16. Connect -48V and -48VRTN from the bulk power plant to terminals -48V1 - -48V3 and -48VRTN1 - -48VRTN3, respectively on terminal board TB1 of the RT optics power shelf (refer to SD-7C118-02).

Make all required external frame connections (digital lines, miscellaneous pair panel, DC test pair, telemetry alarms, and grounding) per Figure 44.

#### **7.2.2.7 Optical Fiber Connections**

The items required to install LICs on the optics shelf include:

- o KS-23557-L1 access shelf
- o Screwdriver
- o Screw starter
- o Two No. 12-24 mounting screws
- o 300A *ST*(R) lightguide cable connector microscope (COMCODE 104055025)
- o Scissors

- o *KIMWIPES*(R) wipers (Lint Guard Poly Shield, Stock No. 34155) or equivalent
- o Alcohol (isopropyl reagent)
- o 1/4-inch nut driver
- o Can of compressed air
- o Five 1/4-inch cable ties or equivalent.

**NOTE:**

Before connecting the LICs to the optics shelves, verify that all metallic connections have been made.

The following is the procedure for connecting the lightguide interconnection cables from the HDIC to the rear of the optics shelves:

1. Verify that the LIC (4 groups of 12 jumpers per optics shelf) is properly stored in the overhead rack slack storage shelves.
2. Remove the last 9 feet of the four 12-fiber LIC group from the overhead rack slack storage shelves and dress it in the cable trough.
3. Tie the LIC group to the frame at approximately 1 foot from the top of the bay using a large cable tie (preferably 1/4-inch tie).
4. If the LIC cable is enclosed in spiral wrap, remove the spiral wrap on the bundles according to Table C. Ignore Table C if the cable is enclosed in *Expando*(R) FR wrap.
5. Attach the access shelf (KS-23577, L1) below the optics shelf using the mounting holes immediately below the optics shelf mounting flange with two No. 12-24 mounting screws and a screw starter. The mounting flanges of the access shelf should be placed **under** the metallic cables.
6. Remove the screws holding the optics shelf to the frame.
7. Pull the optics shelf straight forward far enough for it to clear the adjacent shelves when it is rotated.
8. Rotate the optics shelf 90<deg>, resting the front (designation strip side) of the shelf on the access shelf. In this position, the backplane couplings are clearly visible.
9. Remove the backplane dust covers in groups of 6.
10. Remove the dust cap from each *ST* lightguide cable connector and

inspect the end of the connector with an *ST* lightguide cable connector microscope or equivalent (one connector at a time). If any dust particle is visible, clean the connector using *KIMWIPES* wipers or equivalent dipped in alcohol. Blow air on the end of the *ST* lightguide cable connector using a can of compressed air held 4 to 6 inches from the tip of the fiber then reinspect the connector with the *ST* lightguide cable connector microscope.

11. Attach the fiber to its corresponding coupling (for example, P01 to CP1, P10 to CP10, etc.).
12. Repeat the two previous steps for each *ST* lightguide cable connector.
13. Rotate the optics shelf forward again 90<deg>, resting the top of the shelf on the access shelf. At this position, the bottom of the shelf is fully visible exposing the fiber troughs and fiber retainers A, B, C, and D (Figure 45).
14. Dress the jumpers around the bend radius limiter and place them in the fiber trough in groups of 6 per trough starting with jumper P01.

**NOTE:**

Each fiber retainer consists of 2 accessible cavities with each cavity accommodating up to 24 fiber jumpers. The cavities are designated cavity 1 and cavity 2. Cavity 1 is located closer to the front of the optics shelf.

15. Place fibers P01 to P23 in cavity 1 of fiber retainers A, B, C, and D. Avoid making any sharp bends.
16. Place fibers P25 to P47 in cavity 1 of fiber retainers B, C, and D.
17. Place fibers P49 to P71 in cavity 2 of fiber retainer C and D.
18. Place fibers P73 to P95 in cavity 2 of fiber retainer D.
19. Inspect all jumpers to guarantee that they do not violate the 11/2-inch bend radius as shown in Figure 45.
20. Rotate the optics shelf back 90<deg> resting it on its designation strip. Mount the backplane cover (shipped loose) by loosening the 4 screws on the backplane with a 1/4-inch nut driver and sliding the backplane cover between the screw and the backplane. Tighten the screws.
21. Rotate the optics shelf 90<deg> back to its upright position.
22. Install the shelf in the frame using the four No. 12-24 screws.

23. Remove the access shelf and repeat the entire procedure for the next optics shelf.
24. Upon completion of the LIC installation, store the access shelf in the RT for future use.
25. Dress the metallic cables in the cable trough first, then place the fiber cables carefully in front of the metallic cables.

### **7.2.3 High Density Fiber Interconnect (HDIC) Facility**

#### **7.2.3.1 Frame Installation**

The HDIC frame installation begins with the installation of the ED8C500-50 G5 network bay frame. The ED8C500-50 frame is installed per instructions provided in ED8C505-50. This equipment drawing describes the procedure and hardware needed to bolt the frame to the floor. The frame should also be secured to the overhead framing superstructure following standard installation practices. The HDIC frame components are fastened together in the field with hardware in accordance to the instruction sheets supplied with each frame.

#### **7.2.3.2 Outside Plant Cable Placement**

The cabling strategy brings nonbuffered OSP cables directly to the frame thus bypassing an intermediate splice. Outside cables are reinforced, normally with metallic strength members, which makes them more rigid and difficult to bend. The metallic strength members may also be exposed to electrical hazards and therefore require grounding.

Outside plant cables are usually routed to the frame via ducts or conduit. An OSP cable may also be run in an overhead rack. These cables are dropped into the frame in the open cable duct on the left side of the frame. Cables are placed into the frame from the front. Cables are formed with an *S* curve so that they exit the duct into the clamp area in the vicinity of the shelf where they are to be terminated. Here the cable ends are secured and grounded and fiber ends are prepared and passed into the termination area.

The HDIC frame can accommodate any AT&T cable construction including ribbon and *Lightpack*(R) lightguide cores in lightguide express entry (LXE) or crossply sheaths. The OSP cables can be terminated by direct termination of *ST* lightguide cable connectors or, if factory connectorized, in *ST* fanouts.

#### **7.2.3.3 Lightguide Interconnection Cables**

Lightguide interconnection cables (FS48E-E-35) are used as an interconnection in CEVs, huts, and 80E cabinets between the optics shelves and the HDIC. The LICs used in CEVs and huts are available in only one length, 35 feet. For mixed copper/FTTH applications and full FTTH applications, the 35-foot length will accommodate most of the bays. The LICs used in 80E cabinet installations are available in 18-

foot lengths. Each optics shelf requires 48 jumpers. There are 4 assemblies labeled cable A, B, C, and D per group. Each lightguide jumper cable assembly has 12 jumpers. Therefore, one group will be ordered for each optics shelf.

The LICs are jacketed jumpers that are factory terminated with *ST* lightguide cable connectors and each connector is equipped with a dust cap that should only be removed at the time of connection. The jumper cables are equipped with labels that provide address fields for both the HDIC and optics shelves. Each jumper also has a discrete numerical identification on each end. For the initial applications of the FTTH feature, the fibers will only be identified with odd numerals (that is, 1, 3, 5, . . . ., 93, 95).

The LICs can be installed either at the service center or in the field. When the cables are installed in a CEV or hut installation, the cables must be routed and fastened to the overhead cable racks. When cable ties are used for securing the cables, they should only contact the cable wrap to avoid any sharp bends on the fiber jumpers. The drop lengths for each end of the cable must be adhered to. Sharp bends are to be avoided and a minimum bend radius of 1.5 inches must be maintained. Two storage racks are provided on overhead cross-aisle racks for jumper cable slack only. The cable ends should be secured to and remain on the overhead racks until they are required for connection. At that time only one assembly (12 jumpers) should be handled. This procedure will help in minimizing errors and damage to the connectors. Additional information concerning lightguide fiber interconnections in the 24-foot CEV can be found in AT&T 640-250-280.

#### **7.2.3.4 Work Shelf**

The existing 26A work shelf is utilized as a work surface for performing fiber joining and connectorization at the frame. The 26A shelf will hold connectorization tools when installing connectors on buffered lightguide cables.

The 26A work shelf is mounted directly to the network bay frame flange on the front of the frame. Two 136A brackets are mounted on either side of the frame and the 26A work shelf is inserted onto these brackets. The height of the work shelf can be adjusted.

#### **7.2.3.5 HDIC Installation Instruction**

Installation instructions for the HDIC, including outside plant (OSP) fiber distribution cable and LIC installation, are available in AT&T 636-299-115-1 located in Appendix F.

#### **7.2.3.6 Customer Disconnect**

1. At the termination shelf, locate the LIC fiber and coupling associated with the customer to be disconnected.
2. Disconnect the *ST* lightguide cable connector of the LIC fiber

from the coupling identified previously.

3. Attach a red dust cap to the end of the *ST* lightguide cable connector and over the open end of the coupling.
4. Unlatch storage shelf door on the bottom of the mounting apparatus by pulling out on the plastic fastener plunger. Open the door and coil and store the removed LIC fiber in the shelf.
5. Close the storage shelf door and secure by pressing on the fastener plunger.
6. Dress the slack fiber in the vertical trough.

## 7.3 Distant Terminal Installation

### 7.3.1 General

The procedures for installing a distant terminal (DT) in each of the three following environments is presented in this section:

- o Individually mounted on the wall of a single or 2-family living unit
- o In a multifamily building cluster arrangement
- o In a pedestal DT closure.

Since the installation of an individually mounted DT and a DT mounted in a cluster arrangement in an MFB are similar, both types of installations will be covered in one set of procedures.

The procedures for supplying power (AC or DC) to the DT in these environments are also presented here.

The following items must be installed at the DT location:

- o AC power outlet (single or cluster mounted 900A1 DTs only)
- o DC backpowering arrangement (pedestal mounted 900A2 or 900A3 DTs only)
- o 900A1, 900A2, or 900A3 DT closure(s)

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- o Network interface unit
- o ED-1T283-30 pedestal DT closure (required for remotely located cluster mounted DTs).

In addition to the items just mentioned, the following miscellaneous items are required in order to perform this installation:

- o Special key (allen-type) (COMCODE 840841324) - for locking and unlocking door on DT closure
- o 216C tool - for locking and unlocking cover on pedestal closure
- o AT8762D impact tool (COMCODE 402024723) - for seating D station wire
- o AT8762D 88 blade (COMCODE 402024699) - for use with impact tool
- o 1032B tool kit (COMCODE 103808416) - installation tool for *ST* lightguide cable connectors
- o D-181338 kit of parts (COMCODE 104219761) - consumables for installing *ST* lightguide cable connectors
- o *ST* lightguide cable connectors
- o H1 connector (COMCODE 403370075) - use only with dielect type lightguide cable
- o No. 10 ground wire and clamp
- o D station wire
- o Ground rod (if required).

The DT consists of a metal 900-type DT closure, three circuit boards, and a battery pack which are shipped unassembled and are field assembled by the telephone company craft personnel. Installation of the batteries and the three circuit boards in the closure is not covered in this manual but can be found in AT&T 363-205-401.

### 7.3.2 Individual or MFB Cluster DT Installation on Living Unit Wall

#### 7.3.2.1 General

The 900A1 DT closure is normally installed at the living unit when the fiber drop is placed to the living unit, thus providing a place to store the drop until service is requested.

The DT closure is fastened to the living unit wall with four No. 12 x 1-1/2 round head wood screws (provided) and must be within 6 inches and to the left of the AC power box. The DT closure and the power box should be mounted 4-1/2 to 5 feet above final ground level. The NIU

may be placed to the top, left, or right of the other two boxes. With the placement restrictions of the DT closure and the power box in mind, these three boxes should be arranged to arrive at the most aesthetic appearance (see Figure 46).

The installation of the DT closure assumes that the AC power box has been mounted on the wall of the living unit, inspected, and approved. The DT closure should not be installed until the AC power box is present.

The DT closure weighs 32 pounds fully loaded and must be mounted on a sturdy surface such as wood or brick. If other building construction practices are used that will not provide adequate support for the closure (for example, stucco covered rigid foam), special arrangements must be made with the building contractor for mounting the closure.

The fiber drop, copper wiring to the NIU, and the power cord enter and exit the closure through three holes in the bottom of the closure. The fiber drop plus a ground wire pass through the center hole, the copper wiring to the NIU passes through the left hole, and the power cord passes through the right hole as viewed from the front.

The copper shield of the fiber drop is grounded to the DT closure which is grounded per normal station grounding procedures.

The fiber drop cable at the DT is terminated in an *ST* lightguide cable connector and the excess buffered fiber is wound around an oval storage area on the back wall of the closure. The fiber drop cable is available as a preterminated cable with the *ST* lightguide cable connector factory attached or as a non-preterminated cable where the *ST* lightguide cable connector is installed by the craft normally responsible for fiber terminations.

The battery pack, optical unit, power converter unit, and channel unit are installed in the DT closure when service is requested. The 4-pair drop cable from the NIU is also terminated on either a 108 block (insulation displacement) or 76-type binding posts located on the inside left wall of the closure.

Upon completion of the DT installation, the AC power box and the DT closure should be secured from unauthorized entry.

### **7.3.2.2 AC Power Outlet**

Primary power for the 900A1 DT is customer supplied 120 VAC power. The AC power must be made available on the wall of the living unit. If the AC power is supplied to a DT mounted on the exterior wall of a living unit, Appendix E [REF. 9.4] contains detailed specifications necessary for an electrician to mount and provide power to a single 15/20-amp receptacle, connected to a single circuit breaker, in a weatherproof box. Prior to making arrangements for AC power installation, an issue concerning local interpretation of

electrical codes must be addressed.

This issue concerns the use of a ground fault circuit interrupter (GFCI) with the AC power outlet. The use of a GFCI on the outlet should be avoided, if local electrical codes permit, due to the fact that the reliability of any equipment plugged into a GFCI equipped outlet could be greatly reduced. The National Electrical Code requires a GFCI for all 15/20-amp outlets installed on an exterior wall of a private residence, in bathrooms, and in garages. There is an exception that permits the installation of a standard outlet without a GFCI if the installed outlet is not readily accessible. Another exception covers an outlet on an exterior wall of a residence if there is not direct grade level access to the outlet. Readily accessible and direct grade level access are highly subject to interpretation by local electrical code inspectors.

The intent of the exceptions to the requirement for a GFCI appears to be that if the outlet is not readily accessible, then a GFCI is not required. Placing the outlet in a LOCKED metal weatherproof box satisfies this requirement for accessibility. After installation of AC wiring is complete, the AC outlet enclosure will be secured as dictated by local codes.

**NOTE:**

AT&T strongly suggests checking with the local electrical inspector prior to installation negotiations with an electrician.

There are various methods of providing AC power to the DTs in a cluster arrangement. One method involves dedicating one AC circuit to each DT in the cluster. This method of powering is similar to the method of powering an individual DT described previously. In contrast to the powering arrangement described previously, if the DT cluster arrangement is located in a closet or equipment room of the living unit, the AC outlet providing power to the DT does not have to be installed in a weatherproof box. Another method of powering involves dedicating one AC circuit to more than one DT. With this method of powering, the physical arrangement and 3-foot power cord length of the DTs must be taken into consideration if the DTs are to be served by only one outlet box or strip with multiple outlets. With the AC power cord on the DT being 3 feet long, the DTs must be installed so that the power cords from all of the DTs can be inserted into the AC outlets in the outlet box or strip.

One important item that must be taken into consideration when choosing the method of powering involves the number of DTs that will be affected during the loss of power to a single AC outlet. In the first method of powering only one DT will be affected, whereas, in the latter powering method the number of DTs affected is equivalent to the number of DTs being served by that particular circuit. Regardless of the powering method chosen, the use of a GFCI on the outlet(s) should be avoided if local electrical codes permit.

**7.3.2.3 Typical DT Installation**

Mount the 900A1 DT closure box (Figure 46) on the side of the structure using the following procedure:

1. Using the template supplied with the DT closure and the following information, hold the template at the correct mounting and level position, locate, and drill four holes in

the wall of the structure to receive the mounting screws:

- o The DT closure box is attached to the side of the structure using the mounting tabs located at the top and bottom of the closure.
- o For individually mounted DTs, the closure should be mounted approximately 6 inches to the left of the power outlet box.
- o For individually mounted DTs, the bottom of the closure should also be located at approximately the same height as the bottom of the power outlet box so that the power cord can be connected between the two boxes easily.

**NOTE:**

Four washers are provided with the closure to shim out the bottom of the closure so that the door swings open 180<deg> and maintains that position.

2. Use two finishing nails in the two holes of the top mounting tab as guide pins to help hold the DT closure in place as the screws are installed. Insert the four screws, provided with the closure, through the holes in the mounting tabs and attach the closure to the wall of the structure.
3. The SLU35 connector that is located in the bottom of the box directly above the middle hole(s) is used to attach the ground wire to the box. Loosen the screw on the SLU35 connector until the clamp is opened far enough to receive the ground wire. If the DT closure is equipped with two grommets in the middle of the bottom of the box, insert a 10-gauge ground wire through the smaller hole and into the SLU35 connector. Otherwise, insert a 10-gauge ground wire through the middle grommet hole in the bottom of the box and into the SLU35 connector. Tighten the screw on the SLU35 connector to secure the ground wire. Route and terminate the wire to an appropriate ground connection per locally approved practice.

**7.3.2.4 Power Cord Installation**

AC power is supplied to the 900A1 DT through a 3-foot long factory-provided power cord. The power cord will be 18/2 with ground, will have a molded plug at one end, and will be sleeved by a liquid-tight electrical conduit.

For individually mounted DTs, the molded plug and conduit will fit through the large knockout in the bottom of the *HOFFMAN* AC outlet box. The hardware needed for the craft to secure the conduit to the AC outlet box will come preinstalled on the DT power cord. After verifying that the AC power switch in the DT is in the OFF position, the telephone company craft personnel will plug the DT power cord into the AC power outlet (Figure 47) in the AC outlet box. Installation of an individually mounted DT AC power cord should be performed according to the following procedure:

**NOTE:**

Removal of the knockout and installation of a temporary plug in the AC outlet box may have been performed previously by the electrician when the AC outlet was installed.

1. If present, remove the knockout or temporary plug from the bottom of the AC outlet box.
2. Remove the first locknut from the AC power cord and insert the cord through the hole in the bottom of the AC outlet box.
3. Reinstall the locknut over the AC plug and secure the power cord to the box.
4. Secure the AC outlet box cover to the box per local practice (padlock, etc.).
5. Attach the conduit containing the AC power cord to the structure wall using metallic cable clamps.

For AC power cord installation in a cluster DT installation, simply remove the two locknuts and the reducer from the end of the power cord and insert the power cord plug into an AC outlet.

### **7.3.3 Installation in Pedestal DT Closure**

#### **7.3.3.1 General**

Installation instructions for the pedestal DT closure, including the procedure for converting a two DT pedestal closure to a three DT pedestal closure, are available in AT&T 631-604-220-1. This section describes the procedures for installing an AC or DC power box enclosure and either 900A1 or 900A2 and 900A3 DTs in a pedestal closure. For installation of DC powered pedestal closures, this section also contains the installation and connection procedures for the DC backpower power source and DC power box enclosure located at the living unit and pedestal DT closure, respectively.

#### **7.3.3.2 900A1 DT (AC power) Installation**

##### **7.3.3.2.1 General**

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The following procedures should be used to install a 900A1 DT and the AC power box enclosure in a pedestal closure. The procedure for installing the AC power box enclosure is only required when the ED-1T283-30 pedestal closure is ordered without Group 21.

### 7.3.3.2 AC Power Box Enclosure Installation

The following procedure should be used to install the AC power box enclosure in a pedestal closure that is to house 900A1 DTs. The procedure for wiring the AC power box to the AC power source is contained in AT&T 631-604-220-1.

1. Obtain an AC power box enclosure (ED-1T283-30, G21).
2. Use the 216C tool to unlock the pedestal closure cover.
3. Open the pedestal cover.
4. Attach the AC power box enclosure to the pedestal framework in the area directly below the protector blocks.

### 7.3.3.3 DT Installation

The following procedure should be followed when installing a 900A1 DT in an AC powered pedestal closure:

1. Remove the four nuts from the studs located in the **DT1** mounting position.
2. Place a 900A1 DT closure on the studs and secure with the nuts.
3. Route the DT AC power cord to the AC power box in the pedestal and insert the power cord plug into the outlet labeled **DT1**.
4. Locate the SLU35 connector in the bottom of the DT closure above the middle hole.
5. Loosen the screw on the SLU35 connector until the clamp is opened far enough to receive the ground wire.
6. Insert a #10 gauge ground wire through the middle grommited hole in the bottom of the closure and into the SLU35 connector. Tighten the screw on the connector to secure the ground wire.
7. Route the ground wire to the base of the pedestal and attach it to the ground bar.
8. Repeat the procedure for the second and third DT, as required, using mounting positions and AC outlets **DT2** and **DT3**, respectively.

### 7.3.3.3 900A2 and 900A3 DT (DC Power) Installation

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Along with the procedures for installing a DT in a pedestal, this part also contains the procedures for installing and connecting the components that comprise the DC backpowering system. The DC backpowering system provides powering for the DTs mounted in the pedestal.

A typical list of the procedures that must be performed to successfully install and provide DC power to a 900A2 or 900A3 DT in a pedestal is given below:

- o Install and connect power interface circuit pack and chassis assembly in DC power box enclosure
- o Install 900A2 or 900A3 DT(s) in pedestal closure
- o Install and connect DC backpowering power source and enclosure on living unit wall.
- o Verify that DC backpowering system is operating properly.

### 7.3.3.4 DC Power Box Enclosure Installation

The following procedure should be used to install and connect the DC power box enclosure and the power interface circuit pack in a pedestal closure that is to house 900A2 or 900A3 DTs. The procedure for installing the DC power box enclosure is only required when the ED-1T283-30 pedestal closure is ordered without Group 22.

1. Obtain the following items:
  - o DC power box enclosure (ED-1T283-30, G22), if required
  - o Power interface circuit pack and chassis assembly (COMCODE 846530293)
  - o 1 - 4 dual protection circuit modules (COMCODE 846530319), as required.
2. Use the 216C tool to unlock the pedestal closure cover.
3. Open the pedestal cover.
4. Attach the DC power box enclosure to the pedestal framework in the area directly below the protector blocks.
5. Insert the power interface circuit pack and chassis assembly into the track in the DC power box enclosure.
6. Use the fastener located near the bottom of the track to secure the power interface circuit pack and chassis assembly in the track and attach the green dangler wire to the pedestal ground bar.

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7. Connect the metallic drop power cables from each living unit power source to the 10-pair terminal block in the DC power box enclosure. Beginning with the top pair of terminals (number **1**), make connections in numerical order, without skipping any terminals, using the connection scheme in Table D. Organize the cables using the cable clip located on the lower terminal.
8. Insert the 16-pin connector on the 10-pair terminal block cable into connector **P1** on the side of the power interface circuit pack.
9. Refer to Table E and insert dual protection circuit modules into the **PROTECTION MODULE** connectors on the side of the power interface circuit pack. Insert only the number of modules needed to protect the lines present on the 10-pair terminal strip and insert the modules with the components facing upward.

### 7.3.3.5 DT Installation

The following procedure should be followed when installing a 900A2 or 900A3 DT in a DC powered pedestal DT closure:

1. Remove the four nuts from the studs located in the **DT1** mounting position.
2. Place a 900A2 or 900A3 DT closure on the studs and secure with the nuts.
3. Route the DT power cord to the DC power box enclosure.
4. Insert the power cord plug through the appropriate hole in the bottom of the DC power box enclosure and into the **DT1** connector on the side of the power interface circuit pack.
5. Locate the SLU35 connector in the bottom of the DT closure above the middle hole.
6. Loosen the screw on the SLU35 connector until the clamp is opened far enough to receive the ground wire.
7. Insert a #10 gauge ground wire through the middle grommeted hole in the bottom of the closure and into the SLU35 connector. Tighten the screw on the connector to secure the ground wire.
8. Route the ground wire to the base of the pedestal and attach it to the ground bar.
9. Repeat the procedure for the second and third DT, as required, using mounting positions and power interface circuit pack connectors **DT2** and **DT3**, respectively.

### 7.3.3.6 DC Backpowering Power Source Installation

This section contains the procedures for installing the various DC backpowering power source enclosures shown in Figure 28. To find the procedure that pertains to a particular type of enclosure, locate the type of enclosure and option number from Figure 28 and then locate the procedure with the corresponding option number.

OPTION 1

The installation of this enclosure involves preparation and mounting of the enclosure, the installation of an AC outlet by an electrician, and then the installation of the power source. The enclosure should be installed approximately 4-1/2 to 5 feet above final ground level.

Perform the installation according to the following procedure:

- (1) Obtain the following items:
  - o 6 inch high by 8 inch wide by 4-3/8 inch deep *UL* Listed, oiltight, dust free, fiberglass outdoor enclosure. Available from Robroy Industries, Belding, MI as part number J806HPL
  - o ST-1 Myers or Thomas & Betts 370 hub
  - o 4 inch long by 2-1/8 inch wide surface mount AC utility box
  - o Single position 120 VAC outlet
  - o Single position outlet coverplate
  - o -48 VDC entrance grommet (COMCODE 803764208 or AT&T part number WP 92128, L3)
  - o Right and left DC backpowering power source mounting brackets (COMCODEs 846513893 and 846513885, respectively, or AT&T part number WP 92128, L3 includes both brackets)
  - o DC backpowering power source (COMCODE 406177006 or AT&T part number WP 92128, L1).
- (2) Refer to Figure 48 and locate and drill a 0.687 (11/16) inch diameter hole in the bottom of the enclosure.
- (3) Make or obtain a template with the dimensions given in Figure 49. Position the template on the rear surface of the enclosure so that the four mounting holes in the enclosure are aligned with the template mounting holes. Locate and drill a 7/8-inch diameter

hole in the rear of the enclosure.

- (4) Remove the template from the enclosure and assemble a Myers ST-1 or Thomas & Betts 370 hub over the hole so that the hub protrudes outward from the rear surface.
- (5) Select a location on the living unit wall, near the drop cable conduit, to mount the enclosure.
- (6) Drill a 1-1/2 inch diameter hole (minimum) in the living unit to accommodate the hexagonal shaped nut on the hub. This hole will act as an AC power line access port.
- (7) Position the enclosure over the hole in the living unit with the enclosure hub inside the hole and the enclosure fitting flush against the wall.
- (8) Using the enclosure mounting tabs as a guide, locate and drill four holes in the living unit wall to receive the mounting screws.
- (9) Insert the mounting screws into the enclosure mounting tabs, located at the top and bottom of the enclosure, and secure the enclosure to the wall.
- (10) Arrange with electrician to have AC power line, 4 inch by 2-1/8 inch surface mount utility box, single position 120 VAC outlet, and single position outlet coverplate installed inside the DC backpowering power source enclosure.
- (11) Insert the -48 VDC split entrance grommet into the metallic drop access hole located in the bottom of the enclosure.
- (12) Attach the right and left mounting brackets inside the DC backpowering power source enclosure.
- (13) Install a DC backpowering power source into the enclosure and secure it to the mounting brackets using three No. 8-32 machine screws.
- (14) Feed the metallic drop cable through the split entrance grommet in the bottom of the enclosure.
- (15) If required, attach a bond assembly to the metallic shield on the drop cable and attach the spade terminal on the bond assembly wire to the screw of the AC outlet cover.
- (16) Connect the metallic drop cable wires to the

terminals on the power source per Table D.

**NOTE:**

The power source AC power cord plug should not be inserted into the 120 VAC outlet until the metallic drop cable has been connected to the 10-pair terminal block in the pedestal DT closure.

- (17) Insert the power source AC power cord plug into the 120 VAC outlet in the DC power source enclosure.
- (18) Close the door to the enclosure and secure per local practice.

OPTION 2

The installation of this enclosure involves preparing and mounting the enclosure, installing the power source, and installing the power source power cord. The enclosure should be installed approximately 4-1/2 to 5 feet above final ground level. An AC outlet box equipped with a 120 VAC outlet must also be mounted on the wall of the living unit approximately 6 inches from the backpowering power source. The AC outlet should be installed using the same procedures described previously in the section entitled **AC Power Outlet**. Perform the installation according to the following procedure:

- (1) Obtain a DC backpowering power source (COMCODE 406177014 or AT&T part number WP 92128, L2).
- (2) Arrange with electrician to have AC power line, *Hoffman* A-6R44 3R enclosure, 4 inch by 2-1/8 inch surface mount utility box, single position 120 VAC outlet, and single position outlet coverplate installed according to the instructions in Appendix E [REF. 9.4].
- (3) Select a location on the living unit wall, near the drop cable conduit, to mount the enclosure.
- (4) Using the enclosure mounting tabs as a guide, locate and drill four holes in the living unit wall to receive the mounting screws.
- (5) Insert the mounting screws into the enclosure mounting tabs, located at the top and bottom of the enclosure, and secure the enclosure to the wall.
- (6) Feed the metallic drop cable through the split entrance grommet in the bottom of the enclosure.
- (7) If required, attach a bond assembly to the metallic

shield on the drop cable and attach the spade terminal on the bond assembly wire to the screw of the conduit grounding bracket.

- (8) Connect the metallic drop cable wires to the terminals on the power source per Table D.

**NOTE:**

Removal of the knockout and installation of temporary plug in the AC outlet box may have been performed previously by the electrician when the AC outlet was installed.

- (9) If present, remove the knockout or temporary plug from the bottom of the AC outlet box.
- (10) Remove the first locknut from the AC power cord and insert the cord through the hole in the bottom of the AC outlet box.
- (11) Reinstall the locknut over the AC plug and secure the power cord to the box.
- (12) Attach the conduit containing the AC power cord to the structure wall using metallic cable clamps.

**NOTE:**

The power source AC power cord plug should not be inserted into the 120 VAC outlet until the metallic drop cable has been connected to the 10-pair terminal block in the pedestal DT closure.

- (13) Insert the power cord plug into the 120 VAC outlet.
- (14) Close the door to both enclosures.
- (15) Secure the AC outlet box cover to the box per local practice (padlock, etc.).

OPTION 3

The installation of this enclosure involves preparing and mounting the enclosure and installing the power source. The enclosure should be installed approximately 4-1/2 to 5 feet above final ground level. Perform the installation according to the following procedure:

- (1) Obtain the following items:
  - o Ekstrom enclosure with power ring adapter. The enclosure measures 6 inches high by 6 inches wide by 4 inches deep and is equipped with an AC power outlet and a breaker switch.

- o DC backpowering power source (COMCODE 406177006 or AT&T part number WP 92128, L1)
- (2) Arrange with an electrician to have the meter pan installed on the wall of the living unit before the power ring is installed.
- (3) Feed the metallic drop cable through the split entrance grommet in the bottom of the enclosure.
- (4) If required, attach a bond assembly to the metallic shield on the drop cable and attach the spade terminal on the bond assembly wire to the ground stud provided.
- (5) Install a DC backpowering power source into the enclosure and secure it to the mounting brackets using three No. 8-32 nuts (supplied).
- (6) Connect the metallic drop cable wires to the terminals on the power source per Table D.
- (7) Verify that the circuit breaker in the enclosure is in the OFF position.

**NOTE:**

The circuit breaker in the enclosure should not be placed in the ON position until the metallic drop cable has been connected to the 10-pair terminal block in the pedestal DT closure.

- (8) Insert the power cord plug into the 120 VAC outlet and operate the circuit breaker to the ON position.
- (9) Close the door to the enclosure and secure per local practice.

OPTION 4

The installation of this enclosure involves preparing and mounting the enclosure and installing the power source. The enclosure should be installed approximately 4-1/2 to 5 feet above final ground level. Perform the installation according to the following procedure:

- (1) Obtain the following items:

- o Ekstrom 1000-SP2484 or 1000-SP2493 enclosure.  
The enclosure measures 6 inches high by 4 inches wide by 4 inches deep and is equipped with an AC power outlet, a breaker switch, and ST-1 Myers hub.
  - o DC backpowering power source (COMCODE 406177006 or AT&T part number WP 92128, L1)
- (2) Select a location on the living unit wall, near the drop cable conduit, to mount the enclosure.
  - (3) Drill a 1-1/2 inch diameter hole (minimum) in the living unit to accommodate the hexagonal shaped nut on the hub. This hole will act as an AC power line access port.
  - (4) Position the enclosure over the hole in the living unit with the enclosure hub inside the hole and the enclosure fitting flush against the wall.
  - (5) Using the enclosure mounting tabs as a guide, locate and drill four holes in the living unit wall to receive the mounting screws.
  - (6) Insert the mounting screws into the enclosure mounting tabs, located at the top and bottom of the enclosure, and secure the enclosure to the wall.
  - (7) Arrange with electrician to have AC power line cabled to 120 VAC outlet in enclosure.
  - (8) Feed the metallic drop cable through the split entrance grommet in the bottom of the enclosure.
  - (9) If required, attach a bond assembly to the metallic shield on the drop cable and attach the spade terminal on the bond assembly wire to the ground stud provided.
  - (10) Install a DC backpowering power source into the enclosure and secure it to the mounting brackets using three No. 8-32 nuts (supplied).
  - (11) Connect the metallic drop cable wires to the terminals on the power source per Table D.
  - (12) Verify that the circuit breaker in the enclosure is in the OFF position.

**NOTE:**

The circuit breaker in the enclosure should not be

placed in the ON position until the metallic drop cable has been connected to the 10-pair terminal block in the pedestal DT closure.

- (13) Insert the power cord plug into the 120 VAC outlet and operate the circuit breaker to the ON position.
- (14) Close the door to the enclosure and secure per local practice.

### **7.3.3.7 Verify Operation of DC Backpowering System**

The following procedure should be used to verify that the proper DC voltage is available to the DT(s) located in the pedestal.

1. Use a VOM (volt-ohm-milliammeter) to verify that -28 to -63 VDC is present at the screw terminals on the DC backpowering power source.
2. Close the door to the DC backpowering power source enclosure and secure per local procedures.
3. At the pedestal DC power box enclosure, verify that -28 to -63 VDC is present at the appropriate terminals on the 10-pair terminal block (TB1).
4. Install the DC power box enclosure cover over the enclosure and secure it with a screw.
5. Operate the DT power switch to **ON** and verify that the LED adjacent to the switch is lighted.

### **7.3.4 Buried Service Lightguide Installation**

#### **7.3.4.1 General**

Buried service lightguide cable is available in either a preterminated or non-preterminated form. The preterminated cable is available in specified lengths and is factory terminated with an *ST* lightguide cable connector and a T&B mounting fitting. The non-preterminated cable is cut to the desired length and terminated with an *ST* lightguide cable connector after the cable is buried and installed in the DT closure. The procedures for installing both types of buried service lightguide cable are presented in this section.

#### **7.3.4.2 Non-preterminated Buried Service Lightguide Cable**

Install non-preterminated buried service lightguide cable in the DT closure as follows:

1. Remove the C service wire clamp temporarily.
2. Insert the buried service lightguide cable (drop) through the

middle grommated hole in the bottom of the closure. If the closure is equipped with two grommated holes in the middle of the bottom of the box, insert the cable through the larger hole.

3. Pull out all slack in the drop cable and cut it to a length of 4 feet from the bottom of the box.
4. Strip the outer sheath and metal shield, if present, from the end of the drop cable to within 1/2 inch from the point where the C service wire clamp was located.

**NOTE:**

It is important that the following step be performed properly to prevent electromagnetic currents from being conducted over the drop.

5. Strip the inner core tube to 6 inches above the metal shield.
6. Clean the gel from the buffered fibers.

**NOTE:**

If dielectric lightguide cable is used, replace the C service wire clamp with an H1 connector in the following step.

7. Reinstall the C service wire clamp on the metal shield of the cable and install the clamp and cable assembly into the ground bracket and tighten securely.
8. Insert the fiber behind the fiber protector bracket and tape over the opening to protect the fiber from coming out from behind the fiber protector bracket.
9. Install an *ST* lightguide cable connector on the end of the blue color coded fiber per the instruction sheets contained in the 1032B tool kit.

**7.3.4.3 Preterminated Buried Service Lightguide Cable**

Install preterminated buried service lightguide cable in the DT closure as follows:

**NOTE:**

The lightguide cable entrance hole in early version DT closures is not large enough to accommodate the cable connector on the preterminated cable. When an early version DT closure is encountered, the connector on the cable should be loosened, moved down the cable into the trench, and buried. The procedure for installing non-preterminated cable should then be used to install the lightguide cable. Refer to the grommets shown in Figure 50 to determine if the DT closure being installed will accept the preterminated cable.

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1. Remove the shipping protection from the end of the preterminated cable by carefully unscrewing the flexible tubing from the cable connector (Figure 51).
2. Remove the plastic support strap, vinyl tape, and clear plastic tube from the fibers.
3. Expose the cable shield for grounding in the C service wire clamp by removing a 1-inch long section of heat shrink tubing and outer cable sheath from around the cable.
4. Disassemble and separate the two pieces of the cable connector and remove the locknut from the double-ended threaded collar.
5. Insert the lightguide fibers, along with the large double-ended threaded collar portion of the connector, through the cable entrance hole in the closure. Position the collar in the center of the hole and secure it to the closure using the 1/2-inch locknut (Figure 52).
6. Pull the lightguide cable through the threaded collar portion of the connector and install the C service wire clamp on the metal shield. Install the clamp and cable into the ground bracket and tighten securely.
7. Attach the lower portion of the cable connector to the bottom of the threaded collar and tighten securely.

### 7.3.5 Connect Lightguide Fiber to DT Backplane

Connect the *ST*(R) lightguide cable connector on the fiber to the DT backplane as follows:

1. Wrap the fiber(s) counterclockwise inside the storage area.
2. Inspect the end of the *ST* lightguide cable connector with an *ST* lightguide cable connector microscope or equivalent. If any dust particle is visible, clean the connector using *KIMWIPES*(R) wipers (Lint Guard Poly Shield, Stock No. 34155) or equivalent dipped in isopropyl reagent alcohol. Blow air on the end of the *ST* lightguide cable connector using a can of compressed air held 4 to 6 inches from the tip of the fiber then reinspect the connector with the *ST* lightguide cable connector microscope.
3. Plug the fiber into the *ST* lightguide cable connector coupling on the DT backplane.

### 7.3.6 Station Wire Installation

The DT provides connection for up to 4 VF lines. These lines are connected to either a color coded 108 connector block (insulation displacement) or a 76-type binding post connector block located in the back left corner of the DT. The 108 connector block, located in the

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900A1 and 900A3 DTs, is equipped with 2 caps which may be used to seat the station wire in the connector terminal.

Install the station wire in DTs (900A1 and 900A3) equipped with a 108 connector block as follows:

1. Insert either one or two D station wires through the grommated hole in the bottom left corner of the closure.
2. Strip the outer sheath from the station wire.
3. Using the D impact tool, insert each station wire into the comb of the 108 connector block according to the color code.
4. Install the caps over the terminals containing the station wires and press on them firmly to seat the caps.
5. If the DT is located in a pedestal DT closure, route and attach the station wire to the protector block in the pedestal; otherwise, secure the station wire to the structure wall while routing it to the network interface unit.
6. If the DT circuit packs and batteries are not to be installed and connected at this time, secure the door of the closure.

Install the station wire in DTs (900A2) equipped with a binding post connector block as follows:

1. Insert either one or two D station wires through the grommated hole in the bottom left corner of the closure.
2. Strip the outer sheath from the station wire.
3. Strip the insulation from the end of each station wire.
4. Loosen the nuts on each binding post terminal to receive the station wire.
5. Wrap the end of each station wire around the appropriate binding post terminal and tighten the binding post nut securely.
6. If the DT is located in a pedestal closure, route and attach the station wire to the protector block in the pedestal; otherwise, secure the station wire to the structure wall while routing it to the network interface unit.
7. If the DT circuit packs and batteries are not to be installed and connected at this time, secure the door of the closure.

## 7.4 Distribution Fiber

### 7.4.1 General

The typical sequence of steps for installation and testing of the outside plant lightguide fiber cable are:

1. Cable placement
2. Fiber splicing
3. Connectorization
4. Completion testing.

Recommendations and guidelines to be used when performing these installation and testing procedures are summarized in this section.

#### **7.4.2 Cable Placement**

Lightguide cable should be placed in accordance with the procedures recommended in the following AT&T Practices:

- o AT&T 629-200-206 (Buried - Placing)
- o AT&T 629-200-215 (Buried - Plowing)
- o AT&T 629-240-001 (Plowing Guidelines)
- o AT&T 628-200-216 (Underground - Placing)
- o AT&T 627-320-011 (Aerial - Placing).

Lightguide cable placement should be monitored by on-site inspectors who are familiar with cable tension load ratings and minimum bend radius requirements. The cables received for placement have undergone extensive factory testing to insure quality. If the cables are placed properly, no testing is necessary to insure cable integrity.

#### **7.4.3 Fiber Splicing**

The passive rotary mechanical splice and the single-mode array splice are recommended for joining lightguide fibers for distribution area applications.

The array splice requires verification using the OTDR (optical time domain reflectometer) in order to meet the maximum individual and maximum average splice losses listed below:

- o As measured with a KS-22732 or Tektronix OF-150:  
  
Maximum individual splice loss = 2.0 dB  
  
Maximum average per array splice = 1.0 dB

- o As measured with an ANDO AQ1720/AQ1723, AQ1720B/AQ1723C, AQ7110, or ANRITSU MW98A/MH925A, MW910A-C, or equivalent single mode OTDR:

Maximum individual splice loss = 1.8 dB

Maximum average per array = 0.8 dB.

The array splice should be made in accordance with AT&T 640-252-177 and 640-252-125, respectively.

The rotary splice can be passively aligned using the alignment tabs on the mated glass plugs and a 1011B alignment tool, or it can be actively aligned using a light source and a 935A LSAM (local splice alignment and measurement) unit. The splice should be made in accordance with AT&T 640-252-176. If the splice is actively aligned, no further testing is required for splice verification. If it is passively aligned, then the splice can be verified by any of the following methods:

- Continuity verification: Use a source (945A-LSIM, 736A Transmitter, or SMOLTS) to inject (bare fiber adapter) or couple a signal into the fiber. Use the AT&T Fiber Identifier (836A Receiver or 936A) on each side of the splice. If the meter deflections are similar on both sides of the splice, there is splice continuity and continuity from the source.
- Path loss verification: Use a proper wavelength source to inject a signal through temporary ERMS spliced pigtailed and read the received power at the far end of the spliced-on cable with a bare fiber adapter and power meter. Compare this to the outside plant loss to verify that the loss of the spliced cables and the splices are within reason.
- OTDR verification: Use an OTDR to determine the individual splice loss. Unidirectional splice loss should not exceed 0.7 dB and the average of the splice losses measured from both directions should

not exceed 0.5 dB.

It is recommended that the splices be verified in some manner before the splice case is closed and placed.

#### 7.4.4 Connectorization

The outside plant fibers are to be terminated at the RT interconnect facility and the DT optical unit in single-mode *ST* lightguide cable connectors which should be installed according to the AT&T instruction manual for single-mode *ST* lightguide cable connectors. Once the connectors are installed, the loss measurements required for completion testing for the outside plant can be performed. Any attempt to make completion test measurements using anything other than permanent connectors is almost guaranteed to give inaccurate results.

#### 7.4.5 Completion Testing

Completion testing is the measurement of the loss that is associated with the outside plant fiber and splices and terminating connectors. The completion tests are performed when the fiber paths are permanently terminated in system connectors (*ST* lightguide cable connectors). The completion test is applied to each individual fiber path and provides the following:

1. Verification that the outside plant has been properly constructed
2. Verification that the outside plant meets the optical system limits
3. Maintenance records
4. Records for future upgrades.

Completion testing performed at 1310 nm, corresponding to the system design wavelength. The recommended acceptance/rejection criteria for completion testing for loop plant systems is path loss. Path loss is defined as the total loss of all the fibers, splices, and the two end-point connectors (equivalent to one complete *ST* lightguide cable connection) that constitute one complete fiber path from RT to DT.

The path loss maximum is the OSP Design Loss Budget plus 0.6 dB for the end connectors included in the measurement. For an OSP Design Loss Budget of 6.0 dB, the maximum path loss is 6.6 dB. Testing to this limit ensures that the installed outside plant is compatible with overall system gain and margin requirements.

To verify that the path has been properly constructed and conforms to the designed value, the path loss measurements should be compared to completion test targets, which are based on the actual components (length of fiber and the number and types of splices) in each path.

For detailed information on completion testing including test targets,

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recommended repair splice allowances, test procedures, and a troubleshooting guide, refer to the following document available from your local AT&T account representative:

*Fiber-To-The-Home (FTTH) Installation: Construction and Completion Testing Update - POTS Only and POTS/Video Separate Fiber Service.*

## 8. Maintenance and Testing

### 8.1 Overview

This chapter describes the methods and procedures used to indicate and isolate equipment and system failures on *SLC(R)* Series 5 Carrier Systems equipped with the FTTH feature. This chapter also contains a description of the maintenance equipment used to isolate failures on the FTTH segment of the system.

This chapter is revised for the following reasons:

- o Revise Tables J and L
- o Revise Figures 56, 58, 60, and 61
- o Remove Figures 74 and 75
- o Add Figure 86
- o Make minor editorial changes.

### 8.2 System Monitoring and Alarms at RT

Alarm monitoring and reporting at an RT located in a *SLC* Series 5 Carrier System equipped with the FTTH feature is identical to an RT located in a conventional *SLC* Series 5 Carrier System with the exception of two alarms. These two alarms are associated with the RT optics power shelf which provides power to the AYB1B OUs in the optics shelf assemblies, the 2A, 2B, or 2C fan units, and the dual bank assemblies. A common voltage loss to the RT optics power shelf will cause a power minor alarm to be reported to the CO and maintenance center. A major alarm will also be reported if a PCU fails or is missing from its slot in the RT optics power shelf.

Alarms for fan failure, blown fuses, etc. that are generated in conventional *SLC* Series 5 Carrier Systems are incorporated into the new power supply design and make use of identical harness connections as in the conventional systems. In addition, the new circuit packs designed for use with the FTTH feature are equipped with LED alarm indicators as in the conventional systems.

The loss of a valid fiber optical signal from the DT will result in an out-of-service (OOS) indicator lighted on the RT channel unit. This indication is not transmitted to the COT but is reported to the maintenance center through the mechanized loop testing (MLT) test access.

### 8.3 System Monitoring and Alarms at DT

Measuring points are accessible on the ASH1 PCU faceplate for evaluation monitoring and performance checking of the DT power plant. Four LED indicators are also provided on the DT CU (ASJ1 or ASJ2) and are described below:

- o **FAIL** - Indicates the condition and presence of the microprocessor
- o **BUSY** - Indicates an off-hook condition
- o **OOB** - Indicates the absence of a valid incoming fiber optical signal
- o **ONBAT** - Indicates the loss of AC power and shift to battery back-up supply.

In FTTH systems equipped with the enhanced testing features, the ASJ2 CU is also equipped with an EAF1 drop test module (DTM) to isolate and test the loop from the DT to the subscriber's set.

Since the *SLC* Series 5 Carrier System does not alarm on a per channel basis, none of the alarms at the DT are linked to the COT alarm panel or to the maintenance center.

### 8.4 Fiber-To-The-Home Maintenance Equipment

Maintenance equipment to support the FTTH feature includes a J99407TA-1, L1 analyzer. The analyzer has been developed for fault sectionalization by the telephone company craft personnel during installation and maintenance testing of the FTTH feature. The analyzer is a modified DT that is shock mounted in a portable carrying case and comes equipped with the additional items listed in Table F that support analyzer use and operation. The analyzer is powered by rechargeable batteries that must be recharged after 8 hours of use.

The analyzer is provided with one optical test access point (Figure 53). This access point can be used at the RT to provide an interface to the optical unit via the lightguide interconnect cable (Figure 54) or at the DT to provide an interface to the lightguide distribution fiber (Figure 55).

The analyzer weighs approximately 23 pounds and contains a window that allows viewing of the 4 LED indicators on the DT CU circuit pack. A meter is also located on the front panel of the analyzer to indicate the electrical state of the battery. Additional items located on the analyzer include:

- o **POWER** switch: Removes or connects battery feed to electronics. Panel meter indicates true loaded battery voltage when ON.

**WARNING:**

*The analyzer POWER switch should be turned off when not in use*

*to prevent damage to the internal batteries.*

- o Fuse holder: Contains a 6A fuse that protects the battery from overcurrent loads (located inside analyzer).
- o Fiber jumper: A fiber jumper cable terminated with a blank optical circuit board equipped with an *ST(R)* lightguide cable connector.
- o Four 6-pin modular jacks (RJ11 type): Connection points for telephone or butt set.
- o Battery charger jack: Accepts plug on battery charger (located inside analyzer).
- o Relief valve: Before removing the analyzer lid, this valve is pressed to relieve any air pressure that may be present inside the analyzer.

Performance of installation and maintenance tests normally requires that the COT-to-RT segment of the system be checked separately from the segment of the system containing the FTTH equipment. In order for COT-to-RT tests to be performed, the AUA400, AUA401, AUA404, or

AUA405 CU at the RT must be replaced with the AUA403 test CU. The AUA403 test CU is identical to the AUA58 CU with the exception of the tip (T) and ring (R) leads which have been broken so that tests can be performed from COT-to-RT and vice versa without damaging the optical units on the customer loop. This unit permits the crafts person to complete a conventional call to the CO milliwatt tone or to the quiet termination. The AUA403 test CU is stored in the analyzer.

## 8.5 DT/RT Restoration Procedures

In order to restore service to a customer experiencing trouble, the faulty system equipment components must first be located and then repaired or replaced. Manual and/or automated test methods may be used to help sectionalize the trouble to the faulty equipment component. The procedures for manually testing and isolating trouble will be presented in this section. The method for automated sectionalization using the MLT-2 loop test system (LTS) and the XTC/PGTC will be described later.

When using manual test methods to isolate faulty equipment, it is necessary to test the COT-to-RT segment of the system separately from the FTTH segment. The AUA403 test CU is used in place of the AUA400, AUA401, AUA404, or AUA405 CU at the RT to test only the COT-to-RT segment of the system. If trouble is found in the COT-to-RT segment of the system, trouble isolation can be performed using existing *SLC* Series 5 Carrier System procedures found in AT&T 363-205-500. If trouble is not found in the COT-to-RT segment of the system, then trouble isolation procedures should be performed on the FTTH segment.

The states of the OOS indicator at the RT and the out-of-frame (OOF) indicator at the DT localizes the fault to the RT-to-DT segment. The OOS/OOF indicators should indicate the ability of the receiving circuitry to detect a valid incoming 1.544 Mb/s rate signal from the fiber line.

When the fault is isolated to the FTTH equipment, the analyzer is connected to the fiber at the high-density fiber interconnect (HDIC) (see Figure 54). A test call is conducted via the butt set attached to the analyzer to determine if the signal fed to the customer fiber loop is operational. This test will check the FTTH RT CU (AUA400, AUA401, AUA404, or AUA405), the AYB1B OU, and the interconnect up to the HDIC panel. This access to the fiber is via the lightguide interconnection cable (LIC) attached to the front panel of the HDIC and requires an *ST* lightguide cable connector.

The analyzer can also be used at the customer end of the fiber to test the fiber. The first test should be to initiate a test call via the butt set at the customer's network interface unit (NIU). This test will check the communication link between the DT metallic input and the RT location. If this test is successful, the fault is in the house wiring or customer premises equipment. If the test fails, the next step is to test the wiring from the NIU to the DT telephone line drop terminals (108 insulation displacement or 76-type binding post block). To test the wiring, open the DT closure, connect a butt set with D cord to the telephone line drop terminals, and initiate a test call. If this test is successful, the fault is in the wiring between the NIU and the telephone line drop terminal block in the DT. If the test fails, then the analyzer should be connected as in Figure 55 and another test call conducted. If the test call is successfully completed, the circuit packs of the customer's DT should be substituted one at a time until a test call can be successfully completed.

If all tests at the DT fail and the RT is operating properly, then an optical time domain reflectometer (OTDR) can be used to test the health of the fiber and splices up to the DT equipment. This access is at the front panel coupling of the HDIC.

## 8.6 MLT Testing Without Enhanced Test Features

### 8.6.1 General

Remote testing of the FTTH feature is accomplished using MLT-2 and the pair gain test controller (PGTC). Additionally, with MLT-2 LTS, the XTC may be used to provide isolation testing.

Before a system equipped with the FTTH feature may be tested, the MLT system must be *programmed* (see MLT Requests User's Guide, ARSB-2 Front End System with LMOS-2, MLT-1, and MLT-2) to correctly interpret the two DC signatures one of which will be presented by the RT CU.

These DC signatures seen by the MLT, provide information about specific conditions of the local network. They are used for accurately troubleshooting the network and avoiding unnecessary dispatches.

In order for the MLT-2 interpretation of the signatures to be accurate, the DC test pair to the FTTH RT must have both series loop resistance at 2500 ohms maximum and leakage resistances for the T-R, T-G, and R-G greater than 2500 Kohms.

The circuit maintenance philosophy for isolating troubles on an individual customer circuit states that tests are to be performed in response to a customer trouble report and that existing technology and test equipment shall be used. Table G lists the software generics required for the automated repair service bureau (ARSB) equipment to support the maintenance plan for systems equipped with the FTTH feature.

The LTS firmware issues required for testing the FTTH feature are listed in Table H.

When MLT attempts to perform metallic testing of the drop beyond the RT via the DC bypass pair [or remote measurement unit (RMU)], it is connected to one of two DC signatures on the RT-CU instead. Without the enhanced test feature, neither channel tests nor metallic drop test results are available, but the status of the RT-to-DT fiber link is reported.

One DC signature indicates a good fiber drop and the other a bad fiber drop. A bad fiber drop signature indicates that an out-of-frame condition on the DT-to-RT link has been detected or the RT CU is faulty. A good fiber drop signature indicates that the RT CU is operating correctly and that the DT-to-RT link is not out-of-frame. Table I contains the results of the MLT drop test. If a DC bypass pair is not present due to the SLC system out of range of an MLT test vehicle or the feeder is all fiber, an RMU is required at the RT site to measure the *DC signatures* or the drops in conventional configurations. A single RMU can serve approximately 15 RT dual bank assemblies.

When you have an XTC which requires MLT-2 LTS [not a 5ESS(R) switch directly connected test unit (DCTU)], you can determine the condition of the COT CU. The test paths for the XTC are shown in Figure 56. (Please note that the XTC does not work in an integrated configuration, whereas, the PGTC does.) The channel isolation test is

performed by the XTC, but the test path is via the XTC test harness. This test will indicate either one of two conditions: COT CU good and RT CU bad, or COT CU bad and RT CU bad. Again, the RT CU will always fail the test because it does not contain the proper analog interface. The results of this test are summarized in Table J. When a customer trouble report is received, a repair service administrator (RSA) initiates an MLT test of the customer loop. Since the loop is fiber

not copper, the RT CU connects the DC bypass pair (RMU) to its DC signature circuit, which is set to one of the two signatures. The MLT measures this signature and traps it. During this time the SLC Carrier System channel test is being performed, and when the results are returned their display is masked by the trapping of the DC signature presented by the RT CU. As a result, one of two new programmable VER codes (1X or 2X) will be generated by MLT and displayed to the RSA indicating a system equipped with the FTTH feature.

At this point, the trouble report is passed through a screening process based on the VER code and the CO test results to a maintenance administrator (MA) for dispatch or further testing.

If an XTC is not available, dispatch can be made based on this signature alone: to the RT if the bad signature is detected and to the DT if the good signature is detected.

If an XTC is available, channel isolation tests are performed when a customer trouble report reaches the MA. Since the circuit is served by a SLC Series 5 Carrier System, a display is presented to the MA indicating the condition of the channel units.

Depending on the signature value detected previously and the CU test results, the crafts person is dispatched to the most probable trouble location as shown in Table J.

With these maintenance capabilities, even if a *test ok* is indicated to the MA, the DT could still have a failure. After the MA runs CO tests, the crafts person will in all probability need to be dispatched.

Before a system equipped with the FTTH feature may be tested, the MLT system must be *programmed* (see MLT Requests User's Guide, ARSB-2 Front End System with LMOS-2, MLT-1, and MLT-2) to interpret the two DC signatures which may be presented by the RT CU.

This programming is performed using a system administration and maintenance (SAM) mask to accomplish the following:

- o Identify to MLT the values of the DC signatures which are to be trapped during the loop test
- o Provide a new VER code(s) to allow for the proper screening of FTTH trouble reports.

### 8.6.2 XTC Fault Isolation Procedure

The SAM and trouble verification (TV) masks are now shown for the two possible DC signatures for the FTTH feature without enhanced test features. A SAM mask for programming the good signature is shown in Figure 57 and the corresponding TV mask result is shown in Figure 58. A SAM mask for programming the bad signature is

shown in Figure 59 and the corresponding TV mask result is shown in Figure 60.

**NOTE:**

The ranges shown on the SAM masks, with the DC test pair resistance calibrated out, may have to be adjusted for local conditions.

If both the MLT-2 LTS and the XTC are available for remote testing, then the maintenance flow is described as follows:

1. When the customer encounters trouble, they call the RSB number which connects them to an RSA.
2. The RSA enters the telephone number of the FTTH line into the loop maintenance operations system (LMOS) terminal and requests a FULLX test. Then the following two or three tests are included in the automatic testing sequence:
  - (a) The drop test by the MLT
  - (b) End-to-end channel tests of the *SLC* Series 5 Carrier System
  - (c) Since an XTC is available, channel isolation tests.
3. During the MLT drop test, the MLT-2 LTS should measure and trap the DC signature at the RT CU. If a signature is trapped, any channel test results are masked by LMOS; and only the programmable DC signature information is displayed.

**NOTE:**

A request must be made after access is obtained so that the correct signature will be returned.

4. If the *fiber link good* DC signature is measured and trapped, the following message is displayed on the LMOS terminal along with the signature information: *Fiber loop system indicated. RT-DT fiber link in frame. (Dispatch to DT).*
5. If the *fiber link bad* DC signature is measured and trapped, the following message is displayed on the LMOS terminal along with the signature information: *Fiber loop system indicated. RT-DT fiber link out of frame. (Dispatch to RT).*
6. The trouble report is then passed through the mechanized screener to an MA for further sectionalization.
7. The MA then requests isolation tests using either the *full* or *loop* MLT-2 test transaction.
8. If the COT CU or both CUs are operating correctly, the isolation tests will indicate: bad RT CU. Dispatch is to the RT or DT depending on the previous signature detected.

9. If the COT CU is bad, the isolation tests will indicate: bad COT CU and bad RT CU. Dispatch to the COT is required to replace the COT CU. Then the circuit is retested to determine if there are any other failures.
10. If the signature test results show the fiber link good, and the XTC indicates only the RT CU is bad, the sectionalization indicates the system is good up to the DT channel unit. If there is a problem (and there may not be a problem), the problem will probably be in the DT, the metallic drop, or at the customer premises. The crafts person must therefore be dispatched to the DT with the DT analyzer.
11. If the channel isolation test results show both COT and RT CUs bad, the sectionalization indicates at least the following: COT CU bad. The crafts person must therefore be dispatched to the COT to replace the COT CU. The circuit should then be retested for further trouble.
12. If the signature shows the fiber link bad, and the XTC indicates only RT CU bad, the sectionalization indicates the COT CU good and one of the following possibly bad: RT CU, RT OU, HDIC, fiber link, or DT. The crafts person must be dispatched to the RT with the DT analyzer.

## 8.7 MLT Testing With Enhanced Test Features

### 8.7.1 General

Remote testing of the FTTH feature is accomplished using MLT and the PGTC. If the system is equipped with an XTC, the XTC must have a PGTC expansion shelf and the PGTC cable (P109) must be installed between the XTC and the COT (Figure 61). The XTC uses only the PGTC capabilities during the testing; therefore only the PGTC will be mentioned in the following

description. The system must also be equipped with an AUA404 or AUA405 RT CU and an ASJ2 DT CU with an EAF1 DTM in order to take advantage of the enhanced test features.

The circuit maintenance philosophy for isolating troubles on an individual customer circuit states that tests are to be performed in response to a customer trouble report and that existing technology and test equipment shall be used. Table G lists the software generics required for the ARSB equipment to support the maintenance plan for systems equipped with the FTTH feature. The LTS firmware issues required for use with FTTH are listed in Table H.

Two tests are performed by MLT-2 to sectionalize trouble on a system equipped with the enhanced FTTH test capability. The test paths taken by these two tests are described as follows:

- o End-to-end channel test: This test is performed by the derived PGTC to check the quality of the Series 5 subscriber loop. The channel test covers the COT CU, the COT-to-RT link, the RT CU, the RT-to-DT optical link, and the DT CU. A pass/fail test result indication is reported by the PGTC to MLT-2.
- o Drop Tests: The metallic (copper) segment of the subscriber loop, from the DT to the subscriber's station (telephone set), is tested by the EAF1 DTM. This test begins when the PGTC signals the ASJ2 DT CU at the start of the end-to-end channel test. The results of the drop test are transmitted by the ASJ2 DT CU to the RT CU (AUA404 or AUA405), which converts them to one of the FTTH DC signatures. MLT-2 measures the DC signature parameters via either the DC test pair (a metallic loop connecting the MLT to the RT) or an RMU. A single RMU can serve approximately 15 RT dual channel banks and should be used if the RT is out of range of an MLT test vehicle or if the COT-to-RT link is all fiber. The signatures are measured when the MLT performs a drop test. Table K shows the breakdown of the FTTH system signatures.

Basic RT/DT equipment and RT/DT equipment with enhanced test capability can be intermixed, but the enhanced test capability is available only if both the RT and DT CUs have enhanced test capability.

When a customer trouble report is received, a repair service administrator (RSA) initiates an MLT test of the customer loop. Since the loop is fiber and not copper, one of the DC signatures is generated for MLT by the RT CU. The signature is measured by MLT and trapped. During this time, the SLC Carrier System channel test is also being performed and when the results are returned, their display is masked by the trapping of the DC signature presented by the RT CU. One of the new programmable VER codes will be generated by MLT and displayed to the RSA indicating a system equipped with the FTTH feature.

At this point, the trouble report is passed through a screening process based on the new VER code and the channel test results to a maintenance administrator (MA) for dispatch or further testing.

Channel tests are performed when a customer trouble report reaches the MA. Since the circuit is served by a SLC Series 5 Carrier System, a display is presented to the MA indicating the condition of the channel units. Depending on the signature value detected previously and the CU test results, the crafts person is dispatched to the most

probable trouble location as shown in Tables K and L. Other test systems may not have programmable DC signatures available but, if their test system is capable of measuring the DC resistances of the T-R-G delta equivalent circuit, they can also use Table K for craft personnel dispatch.

**NOTE:**

The test result code displayed at the conclusion of channel testing by the PGTC for FTTH CUs differs from that of Series 5 single-party CUs. The expected code displayed on the PGTC is "n", which indicates that the CU test is ok. The actual code displayed from testing the AUA404 or AUA405 and ASJ2 is "r", which indicates a failure of the "Detect on-hook" test for a multiparty CU.

With these maintenance capabilities, even if a *test ok* is indicated to the MA, the customer could still have a failure. When this situation occurs, standard test procedures should be followed to check the subscriber's equipment.

As a reminder, the MLT system must be *programmed* to correctly interpret the DC signatures which will be presented by the RT CU, before a system equipped with the FTTH feature may be tested.

This programming is performed using a system administration and maintenance (SAM) mask to accomplish the following:

- o Identify to MLT the values of the DC signatures and VER codes to be trapped during the loop test
- o Provide new VER codes to allow for the proper screening of FTTH trouble reports.

**8.7.2 Fault Isolation Procedure**

Series 5 with the FTTH feature equipped with the enhanced testing capability exhibits to the MLT, or an equivalent test system, during its drop test one of the DC signatures in Table K. The signature reflects the state of the metallic drop from the DT to the subscriber's equipment and the state of the RT-to-DT fiber link. The PGTC delivers pass or fail channel test results which MLT converts to VER codes, which show the condition of the pair gain channel from the CO to the DT CU.

**NOTE:**

When new service is just turned up and line records have not yet been built, the test system operator must use an appropriate override; for example, C40 for a SLC 96 Carrier System, C41 for a SLC Series 5 Carrier System, etc. In this temporary case, the test results will depend on the CO equipment being used, the state of the test system, etc., and not on the loop. Unless the proper override is used, the test results returned are not predictable.

A total of 13 masks, covering all possible equipment configurations, test failures, and missing line records, are available. The number of programmable masks needed can be reduced to 10 if channel test failures are always cleared before drop test failures. The drop test results can also be interpreted from Table K directly.

The pattern of these *DC signatures* is identical to the *DC signature* pattern described previously (XTC Fault Isolation Procedure). Each signature is composed of a set of three resistance values (Figure 57). Detection of one of these unique *DC signatures* is an indication that the test results received are from an FTTH circuit. The Tip-to-Ground (T-G) and Ring-to-Ground (R-G) resistance values [R(T-G) and R(R-G)] of 90.9K ohms identify the circuit under test as an FTTH circuit. The Tip-to-Ring (T-R) resistance value [R(T-R)] is set by the RT CU to reflect the results of the drop test or the failed state of the RT-to-DT fiber link. Table K shows the resistance values associated with the possible drop test results. The normal maintenance test flow follows:

1. When trouble exists, the customer calls the RSB number and is connected to an RSA.
2. The RSA enters the telephone number of the FTTH line into the LMOS terminal and requests a FULLX test. Then the following tests are performed automatically:
  - (a) End-to-end channel tests (COT-to-DT) of the *SLC* Series 5 Carrier System
  - (b) Drop tests (DT-to-subscriber's set) performed by the EAF1 DTM on the metallic drop
  - (c) Central office line circuit and dial tone tests.
3. After the channel tests are completed, the MLT-2 will trap a VER code to signal the pass or fail status of the pair gain channel. It will also trap the signature it measured, which is associated with an FTTH system. The TV mask associated with the VER code and signature combination will appear on the LMOS terminal.
4. The first line of the MLT-2 TV mask identifies the line as being part of a Series 5 FTTH feature by displaying the following: FIBER-TO-THE-HOME LOOP INDICATED. (The exact wording may vary according to local preference.) This shows that the MLT-2 system has successfully accessed the RT via the PGTC and in response to the test request it has received one of the FTTH signatures.
5. The second line of the TV mask text will indicate the state of the pair gain channel with one of the following responses: COT-TO-DT CHANNEL TEST OK or PAIR GAIN CHANNEL TEST FAILURE. Both messages are an indication that the RT-to-DT fiber link is in frame and functioning. The pair gain channel test failure message indicates an out-of-limit condition for one or more of the following tests:
  - o On-hook state

- o Off-hook state
- o Permanent ring ground
- o Echo return loss
- o Transmission channel loss
- o Idle channel noise
- o Ability to provide ringing voltage.

**NOTE:**

While a channel test failure message always means service degradation, it does not always mean an out-of-service condition. It is reasonable therefore to clear any drop test failures first, to reestablish service, and then clear the channel faults.

6. The RT-TO-DT FIBER LINK BAD - OOF message means a complete failure of the link. The fault can be in one or more of the following elements: RT CU, RT OU, HDIC, the fiber, DT OU, or the DT CU. Trouble clearing should begin at the RT using the J99407TA-1, L1 analyzer.

In order for the MLT-2 measurements and signatures to be accurate, the DC test pair to the FTTH RT must meet the following parameters:

Series loop resistance: 2500 ohms maximum

Leakage resistances: >2500K ohms T-R, T-G, and R-G.

If the DC test pair does not meet these parameters, the MLT-2 measurements can have sufficient error to cause the wrong TV mask to appear (that is, the next higher or lower signature value TV mask may appear).

Figures 57,58,59,60,61,62,63, 64,65,66,67,68,69,70,71, 72,73,74,75,76,77,78,79, 80,81,82,83 show the suggested MLT-2 SAM masks for SLC Series 5 Carrier System FTTH feature with the enhanced test capability. Each SAM mask is associated with a TV mask typical for the condition. A graphic interpretation of the test results is also shown. An alternate SAM and TV mask for signature #10 is shown in Figures 84 and 85, respectively. The purpose of this alternate is to save on the number of SAM and TV masks. This test signature #10 (alternate) should be used if the MLT administrator wants to limit the number of programmable signatures to ten. It is a suggested replacement for signatures #10 through #14. If a customer reaches the limit of programmable signatures and is looking to increase the number of signatures, this alternate can be used as a solution.

## 8.8 Testing With Other Than AT&T Equipment

When the local exchange carrier (LEC) uses a test system other than MLT, it may be possible to use that system to measure the DC signatures used to convey the status of the FTTH feature. The degree to which that testing system could be automated depends on the specific test system. This document provides adequate information to allow the LEC to use DC signatures with another test system. There is one exception: in a *DMS 100(TM)* switch, when using the TV mask for enhanced test signature #1 (see Figure 58), a VER:1 or VER:2X mask will not be received. The SAM mask that is associated with this TV mask is shown in Figure 86. There should be no differences in the other SAM and TV masks when using a *DMS 100* switch.

## 9. Appendices

### 9.1 Appendix A - Ordering Information

The information contained in this section is for planning purposes only. When actual purchase orders are being prepared, refer to AT&T 363-205-000, *SLC(R) Series 5 Carrier System, Ordering Guide*. This guide contains the latest ordering information for *SLC Series 5 Carrier Systems*.

This appendix is reissued to add a note to Table O.

The equipment and apparatus required for the FTTH feature include:

- o Standard *SLC* Carrier System Series 5 COT bank and plug-ins are the same as required for feature package C (FPC). Refer to the *SLC Series 5 Carrier System Ordering Guide*, AT&T 363-205-000, for a list of equipment and apparatus.
- o Support equipment used with *SLC* Series 5 Carrier System bulk powered RT bank can be found in Table M. A description of the equipment can be found in Chapter 4, Part 2.
- o Optics shelf assembly and RT optics power shelf assembly equipment are listed in Table N. A description of this equipment can also be found in Chapter 4, Part 2.
- o Standard *SLC* Series 5 Carrier System RT bank and common plug-ins are listed in Table O. A description of the plug-ins can be found in Chapter 4, Part 2.
- o Outside plant cable termination and interconnect facility equipment are listed in Table P. A description of this equipment can be found in Chapter 4, Part 2.
- o Distant terminal equipment at the residence or pedestal location is given in Table Q. A description of the DT equipment can be found in Chapter 4, Part 3. The set of hardware necessary to assemble a complete DT can be ordered as J99408DT-L1, J99408DT-L3, or J99408DT-L4 along with J99408DT-L1, J99408DT-L5, or J99408DT-L6.
- o Miscellaneous equipment necessary for installation and maintenance of *SLC* Series 5 Carrier System FTTH feature equipment is listed in Table R. A description of the miscellaneous equipment can be found in Chapter 4, Part 4.
- o Equipment associated with the DC backpowering system that provides power to 900A2 and 900A3 DTs in a pedestal closure is listed in Table S. A description of the DC backpowering system equipment can be found in Chapter 4, Part 3. Equipment

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associated with an AC powered pedestal providing power to 900A1 DTs is listed in Table T. A description of the AC powered pedestal equipment can also be found in Chapter 4, Part 3.

- o The minimum and maximum configuration for DC backpower pedestal DT closure equipment is listed in Table U and Table V, respectively. A description of this equipment is available in Chapter 4, Part 3.

## 9.2 Appendix B - Circuit Pack Data Sheets

### 9.2.1 General

A description of each of the circuit packs that have been added at the RT and DT to support the FTTH feature is contained in the circuit pack data sheets. A list of the AT&T practice numbers for the data sheets available for each of these units is given below. A copy of the actual data sheets follows.

- o AT&T 363-005-260 (AUA400 CU)
- o AT&T 363-005-261 (AUA401 CU)
- o AT&T 363-005-262 (AYB1B OU)
- o AT&T 363-005-263 (ASH1 PCU)
- o AT&T 363-005-264 (ASJ1 CU)
- o AT&T 363-005-265 (AUA402 A/FCU)
- o AT&T 363-005-266 (AUA403 Test CU)
- o AT&T 363-005-267 (AUA404 CU)
- o AT&T 363-005-268 (AUA405 CU)
- o AT&T 363-005-269 (ASJ2 CU)
- o AT&T 363-005-270 (EAF1 DTM)

This appendix is reissued to update the following circuit pack data sheets:

- o AT&T 363-005-267
- o AT&T 363-005-268
- o AT&T 363-005-269
- o AT&T 363-005-270

### 9.2.2 AUA400 (RT) Channel Unit - SC2DS0 5SCF410CXX Data Sheet SLC(R) Series 5 Carrier System

The AUA400 CU (channel unit) (COMCODE 104432851) is intended for standard 2-wire analog, single party, POTS applications with loop-start supervision. This plug-in is intended for use on *SLC* Series 5 carrier systems featuring Fiber-To-The-Home and will always be located in a remote terminal (RT - J1C182AE). This plug-in provides two channels of service at the 1.544 Mb/s rate to a single customer over a fiber optic loop. The COT (central office terminal) end of the channel is terminated via an AUA31, AUA32, or AUA38 POTS CU1; a fast forward disconnect is also provided. On the loop side, the plug-in interfaces an AYB1 OU (optical unit) via a balanced interface.

This practice is reissued to make minor editorial changes.

Figure 87 is a functional block diagram of the unit and Figure 88 shows the faceplate.

In the transmit direction (toward the customer), the AUA400 CU takes two 16-bit timeslots from the backplane bus, breaks them into PCM (pulse code modulation) and signaling bytes, buffers them, and then feeds them to the muldem. The muldem multiplexes the timeslots with framing bytes into a 1.544 Mb/s bit stream and feeds them to the AYB1 OU via a balanced interface using the line driver.

When data is received from the AYB1 OU, it is converted from balanced to unbalanced logic level; clock is recovered. The 1.544 Mb/s bit stream is demultiplexed by the muldem, checked for faults, and passed to the backplane access circuit for buffering and output to the backplane bus.

No *per-channel trunk processing* function is implemented on the AUA400 CU.

Faceplate LEDs indicate as follows:

- o OOS [out-of-service (amber LED)]: When lighted, indicates an out-of-frame condition at the RT.
  
- o BUSY (red LED): When lighted, indicates an off-hook state at the DT1 (distant terminal) as well as ringing or channel test toward the DT.

There are no options or settings that need to be selected on this channel unit.

Technical assistance for the *SLC* Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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### 9.2.3 AUA401 (RT) CHANNEL UNIT - SC4DS0 5SCF420CXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM

The AUA401 CU (channel unit) (DE 104432869) is intended for standard 2-wire analog, single party, POTS applications with loop-start supervision. This plug-in is intended for use on *SLC* Series 5 carrier systems featuring Fiber-To-The-Home and will always be located in a remote terminal (RT - J1C182AE). This plug-in provides four channels of service at the 1.544 Mb/s rate to a single customer over a fiber optic loop. The COT1 (central office terminal) end of the channel is terminated via an AUA31, AUA32, or AUA38 POTS CU; a fast forward disconnect is also provided. On the loop side, the plug-in interfaces an AYB1 OU (optical unit) via a balanced interface.

This practice is reissued to make minor editorial changes.

The AUA401 CU is a dual width unit comprised of two printed wiring boards joined together with one common faceplate. It occupies two adjacent channel unit slots in the RT shelf.

Figure 89 is a functional block diagram of the unit and Figure 90 shows the faceplate.

In the transmit direction (toward the customer), the AUA401 CU takes four 16-bit timeslots from the backplane bus, breaks them into PCM (pulse code modulation) and signaling bytes, buffers them, and then feeds them to the muldem. The muldem multiplexes the timeslots with framing bytes into a 1.544 Mb/s bit stream and feeds them to the AYB1 OU via a balanced interface using the line driver.

When data is received from the AYB1 OU, it is converted from balanced to unbalanced logic level; clock is recovered. The 1.544 Mb/s bit stream is demultiplexed by the muldem, checked for faults, and passed to the backplane access circuit for buffering and output to the backplane bus.

No *per-channel trunk processing* function is implemented on the AUA401 CU.

Faceplate LEDs indicate as follows:

- o OOS [out-of-service (amber LED)]: When lighted, indicates an out-of-frame condition at the RT.
- o BUSY (red LED): When lighted, indicates an off-hook state at the DT (distant terminal) as well as ringing or channel test toward the DT.

There are no options or settings that need to be selected on this channel unit.

Technical assistance for the *SLC* Series 5 carrier system can be

obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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#### **9.2.4 AYB1 OPTICAL UNIT 5SCF240BXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM**

The AYB1 OU (optical unit) (COMCODE 104432976) provides electrical-to-optical and optical-to-electrical signal conversions at each end of the fiber optic loop when used on *SLC* Series 5 carrier systems featuring FTTH (Fiber-To-The-Home). A *SLC* Series 5 carrier system equipped with the FTTH feature utilizes two AYB1 OUs; one is located at the RT (remote terminal) and the other is located at the 900A1 DT (distant terminal). At the RT location, the AYB1 OU is housed in an optical shelf and at the DT location, the AYB1 OU is housed in a 900A1 DT enclosure mounted on the side of the living unit.

This practice is reissued to correct the *CLEI\** code for this unit and to make minor editorial changes.

The AYB1 OU1 receives electrical 1.544 Mb/s signals from either the AUA400 or AUA401 CU (channel unit) at the RT or from the ASJ1 CU at the DT. It converts the electrical 1.544 Mb/s signal to an optical 1.544 Mb/s signal using a single-mode laser diode and transmits it over one single-mode fiber, using simultaneous bidirectional transmission at 1300 nm, to the opposite end of the loop. The optical 1.544 Mb/s signal is then converted by the AYB1 OU at that end of the loop to an electrical 1.544 Mb/s signal using a PIN (positive-intrinsic-negative) diode detector and fed to the adjoining CU.

Figure 91 is a functional block diagram of the unit and Figure 92 shows the faceplate.

Technical assistance for the f2SLC Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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#### **9.2.5 ASH1 POWER CONVERTER UNIT 5SCF150AXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM**

The ASH1 PCU (power converter unit) (COMCODE 104432836) is used in the 900A1 DT (distant terminal) and provides battery charger, rectifier, dc-to-dc voltage conversions and ringing generator functions at the DT end of a *SLC* Series 5 carrier system featuring Fiber-To-The-Home.

This practice has been issued to make minor editorial corrections.

Figures 93 and 94 are functional block diagrams of the ASH1 PCU mother

and daughter boards, respectively, and Figure 95 shows the faceplate.

The rectifier circuitry in the ASH1 PCU accepts 17.6 Vac from the line transformer unit and converts it to a nominal 12 Vdc (9 - 25 Vdc) at a maximum power of 25 watts (with all four POTS lines ringing). This rectifier output voltage is used by the battery charger circuitry to supply from 15 Vdc (at 32<deg>F) to 13.8 Vdc (at 140<deg>F) to the 12 V battery at the DT. Output voltage from the rectifier is also fed to the daughter board where it is converted to +110 Vdc, -150 Vdc, -37 Vdc, and +-5 Vdc. The +110 Vdc, -150 Vdc, and +-5 Vdc outputs are required by the ringing generator circuitry on the ASH1 PCU. The ringing generator circuitry produces a 75 Vrms, 20-Hz sine wave (frequency locked to the 1.544 MHz data rate) with -20 Vdc offset which is capable of driving a maximum of 10 REN (ringer equivalency number) ringers.

The circuitry on the daughter board also generates the phase-locked-loop sawtooth waveform and reference voltage.

Faceplate jacks are provided on the ASH1 PCU for access to the battery voltage (BAT), ringing voltage (-20HZ), ground (GND), and the outputs of each dc-to-dc converter (5, -5, -37, and GND).

Technical assistance for the SLC Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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## **9.2.6 ASJ1 CHANNEL UNIT 5SCF530DXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM**

The ASJ1 CU (channel unit) (COMCODE 104432844) is used in the 900A1 DT (distant terminal) and provides the channel unit and line interface functions for the DT end of a SLC Series 5 carrier system featuring Fiber-To-The-Home.

This practice is reissued to make minor editorial changes.

Figures 93 and 94 are functional block diagrams of the ASJ1 CU mother and daughter boards, respectively, and Figure 98 shows the faceplate.

The circuitry on the mother board processes the incoming and outgoing electrical signals from the AYB1 OU (optical unit) at the DT and provides the functions of clock recovery, clock dividers, line multiplexer, control, and signaling. Connection to the AYB1 OU is via four twisted pairs.

The circuitry on the daughter board provides the BORSCH (Battery feed; Overvoltage protection; Ringing; Supervision; CODEC; Hybrid) functions for the DT. Each POTS line is provided with a current limited line feed.

Faceplate LEDs indicate as follows:

- o FAIL (red LED): When lighted, indicates an internal failure with the PCU (power converter unit).
- o BUSY (red LED): When lighted, indicates an off-hook state on one or more of the four POTS lines.
- o OOF [out-of-frame (amber LED)]: When lighted, indicates an incoming fiber loss, loss of frame, or trunk processing.
- o ON BAT (green LED): When lighted, indicates the DT is operating on reserve (battery) power.

Technical assistance for the *SLC* Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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#### **9.2.7 AUA402 (RT) ALARM/FAN CONTROL UNIT 5SCF300CXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM**

The AUA402 A/FCU (alarm/fan control unit) (COMCODE 104432877) is intended for use on *SLC* Series 5 carrier systems employing the Fiber-To-The-Home feature. The unit is located in the RT optics power shelf assembly and provides signals (-48 and GND), via ringing generator alarm inputs (RGMJ and RGMN), to alert the *SLC* Series 5 carrier system RT (remote terminal) dual bank assembly of a power failure on the optical shelves.

This practice is reissued to make minor editorial changes.

Figure 99 is a functional block diagram of the unit and Figure 100 shows the faceplate.

The A/FCU accepts alarm inputs indicating a loss of +-5 Vdc to any of the eight AUA11B PCUs (power converter units) located in the RT optics power shelf assembly. The unit also detects the absence of a PCU in the RT1 optics power shelf assembly. Duplicate circuitry in the A/FCU monitors the PCUs as two groups of four (PCU1 - PCU4 in one group and PCU5 - PCU8 in the other group). Each circuit monitors alarms and detects the absence of a PCU from its particular group. Alarms for PCUs 1 through 4 are sent to the lower RT dual bank assembly (RGMJ1 and RGMN1). Alarms for PCUs 5 through 8 are sent to the upper RT dual bank assembly RGMJ2 and RGMN2). Loss of -48 Vdc power to the PCUs or +-5 Vdc to the AYB1 optical units is registered as a major alarm. Power loss on the lower two optical shelves will generate a major alarm at the lower RT dual bank assembly by causing -48 Vdc to be placed on the RGMJ1 line connected to the lower RT dual bank assembly.

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In the same manner, power loss on the upper two optical shelves will cause a major alarm to appear on the upper RT dual bank assembly via the RGMJ2 line.

The A/FCU contains a temperature sensor circuit which controls the operation of the fans in the 2A fan shelves. The fans will be turned on when the temperature exceeds 105<deg>F and will be turned off when the temperature drops below 68<deg>F. The fans may also be activated manually by the pushbutton switch on the faceplate of the A/FCU.

The A/FCU also provides -48 Vdc to the BPC (bulk power closure) line. This signal is sent back to the RT optics power shelf through a relay on the PMN line when ac power is lost to the bulk power supply.

Faceplate LEDs indicate as follows:

- o MJ1 (red LED): When lighted, indicates a major alarm and loss of customer service.
- o MN1 (amber LED): When lighted, indicates a loss of power to the A/FCU.

The [FAN/TEST] pushbutton switch on the faceplate is used to manually activate the fans in the A fan shelves.

Technical assistance for the SLC Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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### **9.2.8 AUA403 RT TEST CHANNEL UNIT - POTS 5SCUV00AXX DATA SHEET SLC(R) SERIES 5 CARRIER SYSTEM**

The AUA403 RT test CU (channel unit) (COMCODE 104432885) is intended for use only at the remote terminal (RT - J1C182AE) location of a SLC Series 5 Carrier System featuring Fiber-To-The-Home when performing turn-up and trouble isolation procedures. This plug-in is identical to the AUA58 CU with the exception of the tip and ring leads which have been broken so that tests can be performed on the system [COT(central office terminal) to RT and vice versa] without damaging the optical units on the customer loop. The only access to the tip and ring leads on the plug-in is via the jack on the faceplate of the unit.

This practice is reissued to add the CLEI\* code for this unit, to correct the colors of the faceplate LED indicators, and to make minor editorial changes.

This plug-in, just like the AUA58 CU, provides standard 2-wire analog, single party, POTS applications with loop-start supervision. This plug-in provides two channels of service and furnishes a current feed

interface to the connection at the faceplate jack. The COT end of the channel will normally be terminated with an AUA31 or an AUA38 POTS CU. A forward disconnect feature is also provided.

Figure 101 is a functional block diagram of the unit and Figure 102 shows the faceplate.

The test channel unit provides a voice-frequency interface with a structural impedance of 900 ohms in series with 2.15 uF. The balance network is also 900 ohms in series with 2.15 uF. The transmit and receive insertion losses are both 1 dB. During on-hook conditions, the test channel unit is not powered down. OHT (on-hook transmission), with an insertion loss of approximately 5 dB in each direction, is possible when the far end is terminated with an AUA38 CU.

Faceplate LEDs indicate as follows:

- o ODD BUSY (red LED): When lighted, indicates that the odd channel is busy.
- o EVEN BUSY (red & LED): When lighted, indicates that the even channel is busy.

The faceplate jack provides convenient access to the tip (T) and ring (R) of both the odd (O) and even (E) channels. Access to the faceplate jack is accomplished using the WP91067, L6 test cable (COMCODE 405525809).

Technical assistance for the SLC Series 5 carrier system can be obtained by calling the Regional Technical Assistance Center at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

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### **9.2.9 SLC(R) Series 5 Carrier System AUA404 (RT) Channel Unit - SC2DS0 5SCF410 Data Sheet**

This data sheet describes the AUA404 channel unit (CU) (COMCODE 104433115) and is intended for the end-user of the unit. The AUA404 CU is designed for standard 2-wire analog, single party, POTS applications with loop-start supervision. This unit is intended for use on SLC(R) Series 5 Carrier Systems featuring Fiber-To-The-Home and implements the Enhanced Testing Capability feature -- metallic drop test and derived channel test. The AUA404 CU is always located in the remote terminal (RT) and provides two channels of service at the 1.544 Mb/s rate to a single customer over a fiber optic loop. The central office terminal (COT) end of the channel is terminated via an AUA31, AUA32, or AUA38 POTS CU -- a fast forward disconnect is also provided. On the loop side, the unit interfaces an AYB1(B) optical unit (OU) via a balanced interface.

This data sheet is reissued to make minor corrections to the text.

Figure 103 is a functional block diagram of the unit and Figure 104 shows the faceplate.

With the Enhanced Test Capability feature, the mechanized loop test (MLT) can access the metallic drop beyond the distant terminal (DT). The Pair Gain Test Controller (PGTC) or the eXtended Test Controller (XTC) (in PGTC emulation mode) can test the derived channel with the test sequences as for a single-party POTS case. The Enhanced Test Capability feature requires the AUA404 or AUA405 CU at the RT, and the ASJ2 and EAF1 drop test module (DTM) at the DT.

In the transmit direction (toward the customer), the AUA404 CU takes two 16-bit time slots from the backplane bus, breaks them into pulse code modulation (PCM) and signaling bytes, buffers and feeds them to the muldem. The muldem multiplexes the time slots with framing bytes into a 1.544 Mb/s bit stream and feeds them to the AYB1(B) OU via a balanced interface using the line driver.

When data is received from the AYB1(B) OU, it is converted from balanced to unbalanced logic level -- clock is recovered. The 1.544 Mb/s bit stream is demultiplexed by the muldem, checked for faults, and passed to the backplane access circuit for buffering and output to the backplane bus.

No *per-channel trunk processing* function is implemented on the AUA404 CU.

The LED indicators located on the faceplate of the AUA404 provide the following functions:

**OOS** [out-of-service (Amber LED+1)]: When lighted, indicates an out-of-frame condition at the RT.

**BUSY** (Red LED): When lighted, indicates an off-hook state at the distant terminal (DT) as well as ringing or channel test toward the DT.

There are no options or settings that need to be selected on this channel unit.

#### 9.2.10 SLC(R) Series 5 Carrier System AUA405 (RT) Channel Unit - SC4DS0 5SCF420 Data Sheet

This data sheet describes the AUA405 channel unit (CU) (COMCODE 104447941) and is intended for the end-user of the unit. The AUA405 CU is designed for standard 2-wire analog, single party, POTS applications with loop-start supervision. This unit is intended for use on SLC(R) Series 5 Carrier Systems featuring Fiber-To-The-Home and implements the Enhanced Testing Capability feature -- metallic drop test and derived channel test. The AUA405 CU is always located in the remote terminal (RT) and provides four channels of service at the 1.544 Mb/s rate to a single customer over a fiber optic loop. The

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central office terminal (COT) end of the channel is terminated via an AUA31, AUA32, or AUA38 POTS CU1 -- a fast forward disconnect is also provided. On the loop side, the unit interfaces an AYB1(B) optical unit (OU) via a balanced interface.

This data sheet is reissued to make minor corrections to the text.

Figure 105 is a functional block diagram of the unit and Figure 106 shows the faceplate. The AUA405 CU is a dual-width unit comprised of two printed wiring boards joined together with one common faceplate. It occupies two adjacent channel unit slots in the RT shelf.

With the Enhanced Test Capability feature, the mechanized loop test (MLT) can access the metallic drop beyond the distant terminal (DT). The Pair Gain Test Controller (PGTC) or the eXtended Test Controller (XTC) (in PGTC emulation mode) can test the derived channel with the test sequences as for a single-party POTS case. The Enhanced Test Capability feature requires the AUA404 or AUA405 CU at the RT, and the ASJ2 and EAF1 drop test module (DTM) at the DT.

In the transmit direction (toward the customer), the AUA405 CU takes four 16-bit time slots from the backplane bus, breaks them into pulse code modulation (PCM) and signaling bytes, buffers them, and then feeds them to the muldem. The muldem multiplexes the time slots with framing bytes into a 1.544 Mb/s bit stream and feeds them to the AYB1(B) OU via a balanced interface using the line driver.

When data is received from the AYB1(B) OU, it is converted from balanced to unbalanced logic level -- clock is recovered. The 1.544 Mb/s bit stream is demultiplexed by the muldem, checked for faults, and passed to the backplane access circuit for buffering and output to the backplane bus.

No *per-channel trunk processing* function is implemented on the AUA405 CU.

The LED indicators located on the faceplate of the AUA405 provide the following functions:

**OOS** [out-of-service (Amber LED)]: When lighted, indicates an out-of-frame condition at the RT.

**BUSY** (Red LED): When lighted, indicates an off-hook state at the distant terminal (DT) as well as ringing or channel test toward the DT.

There are no options or settings that need to be selected on this channel unit.

### 9.2.11 SLC(R) Series 5 Carrier System ASJ2 Channel Unit -- 5SCF53C Sheet

This data sheet describes the ASJ2 channel unit (CU) (COMCODE

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104437132) and is intended for the end-user of the unit. The ASJ2 CUIs used in the 900A-type distant terminal (DT) and provides the channel unit, line interface, and demand testing functions for the DT end of a SLC(R) Series 5 Carrier System featuring Fiber-To-The-Home.

This data sheet is reissued to make minor corrections to the text.

Figures 107 and 108 are functional block diagrams of the ASJ2 CU mother and daughter boards, respectively, and Figure 109 shows the faceplate.

The circuitry on the mother board processes the incoming and outgoing electrical signals from the AYB1(B) optical unit (OU) at the DT and provides the functions of clock recovery, clock dividers, line multiplexer, control, and signaling. Connection to the AYB1(B) OU is via four twisted pairs.

The circuitry on the daughter board provides the Battery feed; Overvoltage protection; Ringing; Supervision; CODEC; Hybrid; and Testing (BORSCHT) functions for the DT. Each POTS line is provided with a current limited line feed.

The ASJ2 provides full splitting test access to the tip and ring pairs -- it provides the remote terminations and detectors required for the PGTC test sequence. An interface to the EAF1 drop test module (DTM) is provided along with a means to report the drop test results back to the AUA404 or AUA405 CU at the remote terminal.

The LED indicators located on the faceplate of the ASJ2 CU provide the following functions:

**FAIL** (Red LED): When lighted, indicates an internal failure with the power converter unit (PCU).

**BUSY** (Red LED): When lighted, indicates an off-hook state on one or more of the four POTS lines.

**OOF** [out-of-frame (Amber LED)]: When lighted, indicates an incoming fiber loss, loss of frame, or trunk processing.

**ON BAT** (Green LED): When lighted, indicates the DT is operating on reserve (battery) power.

### 9.2.12 SLC(R) Series 5 Carrier System EAF1 Drop Test Module - 5SPQAAN Data Sheet

This data sheet describes the EAF1 drop test module (DTM) (COMCODE 106020639) and is intended for the end-user of the unit. The EAF1 DTM is used in the 900A-type distant terminal (DT) and provides the drop testing capability for the DT end of a SLC(R) Series 5 Carrier System featuring Fiber-To-The-Home (FTTH).

This data sheet is reissued to make minor corrections to the text.

Figure 111 is a functional block diagram, and Figure 110 shows a front view of the EAF1 DTM.

When a remote channel test is activated, the ASJ2 channel unit (CU) connects the EAF1 DTM onto the drop of the channel under test, and the EAF1 DTM tests the drop and reports the test results back to the ASJ2 CU which forwards them to the remote terminal (RT).

The EAF1 DTM performs tests to detect the following faults on the drop beyond the DT:

- o Foreign voltage (FEMF)
- o Metallic leakage
- o Receiver off-hook (ROH)
- o Lack of continuity to the station set (OPEN).

If none of these faults are found, the EAF1 DTM reports a test OK.

These drop test results are used by the AUA404 or AUA405 CU at the RT to create a DC signature that can be interpreted by the mechanized loop testing (MLT) system. All tests are made against fixed thresholds that are stored on the EAF1 DTM.

Overvoltage and overcurrent protection are provided on the tip and ring conductors of the EAF1 DTM to prevent damage to the unit when it is connected to a line that already has a serious fault on it.

### **9.3 Appendix C - Floor Plan Data Sheets**

The floor plan data sheet covering the 7-foot frame used with *SLC(R)* Series 5 Carrier Systems equipped with the FTTH feature is shown in Figures 112 and 113.

### **9.4 Appendix D - Specification Summary**

#### **9.4.1 General**

The specifications for the channel banks, channel units, digital lines, closures used to house the *SLC(R)* Series 5 Carrier System RT and DT equipment, and placement of DT equipment in a *SLC* Series 5 Carrier System equipped with the FTTH feature is given below. Since the Series 5 system equipped with the FTTH feature is based on the *SLC* Series 5 Carrier System equipped with the FPB or FPC capability, the specifications given here will include only those that have been changed or added as a result of the addition of the new equipment.

#### **9.4.2 Channel Units**

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The only channel units allowed at the COT, RT, and DT are:

1. COT:
  - o Series 5 FPC - Dual channel POTS current sink (AUA31, AUA38, AUA32 - loop start, AUA39 - loop start).
  - o Series 5 FPB integrated - Dual channel POTS (WP10, WP36)
2. RT:
  - o Single customer 2DS0 POTS (AUA400 or AUA404).
  - o Single customer 4DS0 POTS (AUA401 or AUA405).
3. DT: Four channel POTS (ASJ1 or ASJ2).

### 9.4.3 Optical Units

The AYB1B OU is used at both the RT and the DT locations and operates within the following parameters.

#### 1. Receiver

- o Minimum sensitivity: -46 dBm worst case, end of life (EOL), over temperature, devices and circuitry for a 1300 nm laser transmitter at 10 <sup>9</sup> bit error rate (BER).
- o Dynamic range: 25 dB without automatic gain control (AGC).

#### 2. Transmitter

- o Average power output into single mode laser pigtail (at the laser): -20 +-2 dBm worst case, EOL.
- o Average power output (printed circuit board output): -23.7 +-2.5 dBm, worst case, EOL.
- o Laser safety factor: Class I.

### 9.4.4 Service Feature

The only service provided initially by the Series 5 system equipped with the FTTH feature is single-party POTS service with AUA31, AUA32, or AUA38 dual channel units (POTS) at the COT and AUA400 2DS0, AUA404 2DS0, AUA401 4DS0, or AUA405 4DS0 channel units (POTS) at the RT.

### 9.4.5 Terminal-To-Terminal Voice-Frequency Transmission

These specifications are given in Table W for single-party POTS channel units.

### 9.4.6 Signaling Mode

Loop start signaling with fast forward disconnect is provided with the channel units used in the Series 5 system using the FTTH feature.

#### 9.4.7 Optical Fiber Link

Operating specifications for the fiber link between the RT and the DT locations include:

- o Maximum length of fiber run RT-to-DT: CSA range.
- o Transmission: Simultaneous bi-directional.
- o Data rate: 1.544 +-130 ppm Mb/s optical line rate.
- o Coding: Scrambled non-return to zero (NRZ).
- o Center wavelength: 1300 +-50 nm over the full temperature range.
- o Bit error rate:  $10^{-9}$ .
- o Startup environment (humidity): A relative humidity of 5% to 95%.

#### 9.4.8 Circuit Maintenance

Circuit maintenance features that are available in addition to features presently provided for Series 5 systems include:

- o Channel unit (CU) testing performed by the maintenance center [using mechanized loop testing system version 2 (MLT-2), local test desk (LTD), or local test center (LTC)] via the pair gain test controller (PGTC) or extended test controller (XTC).
- o The J99407TA analyzer is used to isolate faulty circuit components including circuit packs and interconnections using fiber.
- o The RT optics power shelf assembly and fan shelf alarms will appear at the RT and COT.

**NOTE:**

Series 5 systems equipped with the FTTH feature are not compatible with the maintenance terminal unit.

#### 9.4.9 Equipment

The only equipment changes or additions occur at the RT and DT locations and are described below.

1. **RT Bulk Powered 7-Foot Frame:** For use in concrete huts, controlled environment vaults (CEVs), electronic equipment enclosures (EEEs), or other buildings.

- Houses four 96-line systems (2 dual channel banks), an RT optics power shelf assembly, 2 fan shelves, and 4 optics shelf assemblies.
  - Physical size: 84 inches high, 26 inches wide, and 12 inches deep.
  - Input power: Three power leads supplying -48 VDC (-54.5 VDC maximum, -42 VDC minimum).
  - Power dissipation (fully loaded and operational): 703.6 Watts.
  - Battery reserve: 8 hours recommended.
  - Line interface units (LIUs) and CUs include secondary lightning protection and power cross protection.
2. **80E Cabinet:** RT structure that houses and protects electronic equipment related to FTTH system operation.
- Houses eight 96-line systems (4 dual channel banks), 2 RT optics power shelf assemblies, 7 fan shelves, 8 optics shelf assemblies, a high density fiber interconnect, a termination shelf, a rectifier shelf, and a lightwave multiplexer.
  - Physical size: 75 inches high by 106 inches wide by 33 inches deep.
  - Input power: 120/240 VAC, 60 amp.
3. **ED-1T283-30 DT Pedestal Closure:** Houses and protects 900A-type DTs.
- Houses between one and three 900A-type DTs and either an AC or DC power box.
  - Physical size: 26-1/2 inches high, 21-1/2 inches (Groups 1, 11) or 28-1/2 inches (Groups 2, 12) wide, and 14-1/2 inches deep.
  - Input power: 120 VAC, 60 Hz for AC powered pedestals or -48 VDC for DC powered pedestals.
  - Concrete pad or stake mountable.
  - Contains 2500 splice case (optional) for distribution cable splicing and protector blocks for VF copper drop lines.
4. **900A-Type Distant Terminal:** Mounts on the side of customer residence or in a DT pedestal closure.

- o Houses one ASJ1 or ASJ2 channel unit (4 DS0 lines) with optional drop test module (ASJ2 CU only), one ASH1 power converter unit, one AYB1B optical unit, a transformer, batteries, and battery heater.
- o Physical size: 13 inches high, 14 inches wide, and 6 inches deep.
- o Input power: 120 VAC, 60 Hz (900A1 DT) or -48 VDC (900A2 and 900A3 DT).
- o Transformer power output (900A1 DT only): 17.6 VAC.
- o Backup battery pack: 6 Gates Cyclon cells rated at 12 volts, 5.0 Ah at 77<deg>F assembled in a 6-pack configuration.

## 9.5 Appendix E - Suggested Electrical Installation Specifications

A licensed electrician will mount a lockable, weatherproof AC outlet enclosure on the outside wall of the residence. This enclosure will be positioned approximately 3 feet to the right of the entrance hole for the inside house telephone wiring as shown in Figure 114. This enclosure is a *Hoffman*\* A-6R44 3R lockable unit. The *Hoffman* unit is 6 inches high by 4 inches wide by 4 inches deep with one bottom knockout. This knockout will not be used for AC power entrance into the enclosure; it will be reserved for use by the telephone company.

The electrician will punch a hole in the rear of the *Hoffman* box and install a surface mount duplex box equipped with a 15/20-amp single outlet and coverplate inside the enclosure. The duplex box must be positioned so that the top of the box lines up with the top lip on the enclosure as shown in Figure 114 (ensure that the electrician is made aware of this requirement). The 120 VAC wiring will be fed via conduit through the rear of the outlet box and enclosure. The conduit fittings are used to mount the duplex box to the enclosure. The hole in the rear of the enclosure will be drilled or punched out by the electrician and will line up with a knockout on the rear of the duplex box. The outlet will be wired to the residence circuit breaker distribution panel.

## 9.6 Appendix F - High Density Interconnect Installation

Procedures for installing a high density interconnect in an ED8C500-50-G5 frame is contained in AT&T 636-299-115-1 (Fiber Interconnection System - Installation Instructions). A copy of this practice follows.

See Figures [pra1], [pra2], [pra3], [pra4], [pra5], [pra6], [pra7], [pra8], [pra9], [pra10], [pra11], [pra12], [pra13], [pra14], [pra15], [pra16], [pra17], [pra18], [pra19], [pra20], [pra21], [pra22], and [pra23].

## 10. User Feedback Form

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 Feature User's Manual

Document Number: AT&T 363-205-002 Issue Number:D  
 Publication Date: January 1991

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## List of Tables

**Table A: Pedestal DT Closure Equipment Codes**

Equipment Description	Code
Stake mounted for two DTs	ED-1T283-30, GRP. 1
Stake mounted for three DTs	ED-1T283-30, GRP. 2
Equipment for addition of third DT to existing GRP. 1 pedestal	ED-1T283-30, GRP. 3
Concrete pad mounted for two DTs	ED-1T283-30, GRP. 11
Concrete pad mounted for three DTs	ED-1T283-30, GRP. 12
Equipment for addition of third DT to existing GRP. 11 pedestal	ED-1T283-30, GRP. 13
Equipment to provide 120 VAC input power to GRP. 1, 2, 11, or 12 pedestal	ED-1T283-30, GRP. 21
Equipment to provide -48 VDC input power to GRP. 1, 2, 11, or 12 pedestal	ED-1T283-30, GRP. 22

Table B: CEV/Hut RT Arrangements

Equipment	LU/C		
	4	6	8
F/C	3	4	4
HDIC Bays	1	1	1
Video Bays	4	3	3
Telephony Bays	8	9	9
Total Bays	13	13	13
Pedestals	368	272	272
Maximum LUs	1472	1632	2176

**Table C: Spiral Wrap Removal**

Exposed Fibers From Back of Connector to Beginning of Spiral Wrap	Distance (Inches)
P01 to P11	32
P13 to P23	30
P25 to P35	27
P37 to P47	25
P49 to P59	22
P61 to P71	20
P73 to P83	17
P85 to P95	15

**Table D: Dual Protection Circuit Module Connection Identification**

Protector Module #	Terminal Strip Pair
1	1 & 5
2	2 & 6
3	3 & 7
4	4 & 8

**Table E: Backpower Drop Cable Usage**

Distance From Pedestal to Power Source (Feet)	American Wire Gauge	Wiring Arrangement	Color Code	Terminal Connections
0 - 300	#22	2 pair	Red & Yellow Black & Green	Positive Negative
301 - 650	#19	2 pair	Blue/White Copper	Positive Negative

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**Table F: J99407TA-1, L1 Analyzer**

Item	Part Number	Comment
Gates Cyclon 12 V, 2.5 Ah battery	KS-21906, L18 COMCODE 406088906	Provided internally.
Battery charger -, Autl Inc., fast charge 15.2 V, 0.5 A, end charge 14.65 V	Part No. 5GA-12050-20	Used to recharge battery before the 10 V DC shutdown point.
WP 91067, List 6 test cable	COMCODE 405525809 or ITT Cannon part No. RTG16L2H07N	Used with the AUA403 test CU.
Harris Dracon modular adapter	Part No. 10113-000	Used to adapt the butt set alligator clips to modular plug.
AUA403 test CU	COMCODE 104432885	Used to isolate faults between RT and COT.
ST(R) lightguide cable connector	COMCODE 105271142	Connects analyzer to LICs.

**Table G: Software Generics**

ARSB Equipment	Software Generic
LMOS Host	G4 or later
LO CAP Front End - LMOS	G5, Iss. 2.1 or later
or	
HI CAP Front End - LMOS	G1, Iss. 1.0 or later
Front End - MLT	G5, Iss. 1.0 or later

**Table H: Firmware Issues**

Equipment	Issue
LTS (PGTC)	5
LTS (XTC)	6

**Table I: MLT Drop Test Results**

DC Signature	Indication	Dispatch To
Good	All good up to and including part of DT	DT
Bad	RT CU or OU failure (DT, fiber also possible)	RT

**Table J: XTC Loop/Isolation Test Results**

DC Signature	CU Isolation		Indication	Dispatch To:
	COT CU	RT CU		
Good	Good	Bad	Good up to, but not including DT CU	DT
Bad	Good	Bad	Problem in one or more of the following: RT CU, RT OU, DT optics or electronics, RT-to-DT fiber	RT
Good	Bad	Bad	Problem in COT CU	COT
Bad	Bad	Bad	Problem in COT CU and in one of the following: RT CU, RT OU, DT optics or electronics, RT-to-DT fiber	COT and RT

**Table K: FTTH Enhanced Test Capability DC Signatures For Drop Tests**

DC Signature (Resistance T-R) (Ohms)	Indication	Dispatch To
15K-24K	Fiber link good, basic FTTH DT, no enhanced test capability	DT
24K-34K	Bad or missing EAF1 DTM no drop test results	As indicated by channel test
34K-44K	Drop test OK	As indicated by channel test
44K-54K	No ringer on drop	DT
54K-64K	FEMF/Leakage on drop DANGER: Possible hazardous voltage on drop.	DT
64K-74K	Receiver off hook	DT or customer premises
74K-86K	[Not used]	-
86K-98K	Fiber link good, basic FTTH RT, no enhanced test capability	DT
>2500K	Fiber link bad	RT

**Table L: FTTH Enhanced Test Capability - PGTC Channel Test Results**

VER Code Returned	DC Signature (Resistance T-R) (Ohms)	Indication	Dispatch to
VER 95	24K-86K	Pass, channel good from COT to DT	As indicated by drop test*
VER 99*	24K-86K	Fail, fiber link good to DT, channel test fails, DC signature may indicate drop test failure	DT or as indicated by drop test
--	15K-24K	Fiber link good RT to DT, no channel test (ASJ1 CU present at DT)	DT
--	86K-98K	Fiber link good RT to DT, no channel test (AUA400/401 CU present at RT)	DT
--	>2500K	Fiber link bad (OOF) RT to DT, no channel test	RT

\* If drop and channel tests are ok, make a test call to subscriber location.

\*\* The VER 99 code may also appear for problems other than the ones listed here.

**Table M: Series 5 RT Support Equipment for FTTH Feature**

Equipment	Apparatus Code	COMCODE
Fan Unit	2A	104028758
Fan Unit	2B	105550420
RT Optics Power Shelf	J1C182PB	--
Optics Shelf	J1C182PA	--

**Table N: Equipment Located in Optics and Power Shelves at RT Location**

Equipment	Apparatus Code	COMCODE
OU (Optical Unit)	AYB1B	105550461
PCU (Power Converter Unit)	AUA11C*	105728042
A/FCU (Alarm/Fan Control Unit)	AUA402	104432877
BFU (Bank Fuse Unit)	40D	104031620
Lightguide Interconnection Cables (35')**	FS48E-E-35	105642565
Lightguide Interconnection Cables (18')***	FS48E-E	105771349
Single Lightguide Jumper (18')****	FS1E-E	846238384

\* The AUA11 PCU cannot be used in place of an AUA11B or AUA11C PCU.  
 \*\* CEV/hut use only.  
 \*\*\* 80E cabinet use only.  
 \*\*\*\* For use as a spare or for test purposes.

**Table O: Series 5 RT Bank and Circuit Packs for FTTN Feature**

Equipment	Apparatus Code	COMCODE
RT Channel Bank	J1C182AE-1, L1, L2	--
2DS0 Optical Channel Unit	AUA400	104432851
	AUA404	104433115
4DS0 Optical Channel Unit	AUA401	104432869
	AUA405	104447941
BCU (Bank Control Unit)	MC97756A1	--
	MC97771A1*	--
ADU (Alarm Display Unit)	AUB26	103841227
	AUB24*	103841201
LIU (Line Interface Unit)**	AUA61( )	105703946
	AUA62( )	105703953
	AUA64( )	105703961
LSU (Line Switch Unit)***	AUA73	103840948
TRU (Transmit Receive Unit)	AUA21	103840377
	AUA22B*	105710263
FCU (Fan Control Unit)	AUA24	103840401
CTU (Channel Test Unit)	AUB22 (PGTC)****	103841185
	AUB25 (XTC)****	103841219
PCU (Power Converter Unit)	AUA11C	105728042
CFU (Channel Fuse Unit)	39E	104014345
LFU (Line Fuse Unit)	39F	104031612

\* Used only with FPB integrated with special services.  
 \*\* LIUs with "D" codes should not be used on FPB systems equipped with special services.  
 \*\*\* Optional  
 \*\*\*\* The AUB22 and AUB25 CTU can be used at the RT location as long as an AUB2 CTU is used at the COT location.

**Table P: Termination/Interconnect Equipment for RT FTTH Feature (Note)**

Equipment	COMCODE
Clamp, Cable 12A1	104384490
FM1-432 Fiber Apparatus Mounting	105566178
FM1-648 Fiber Apparatus Mounting	105566186
FRS1-24ST(R) -C Fiber Termination Shelf*	105733042
FTS1-24ST-C Fiber Termination Shelf (Without ST Couplers)	105566202
FTS1-24ST-C (With 24 ST Couplers)	106011943
C3000A2 ST Coupler	105587059
P3020A-C-125 ST Connector	105271118
HD1-20 Cable Clamp Bracket Assembly	105566194

Note: Assumes single mode ST lightguide cable connectors direct termination CEV/Hut or 80E cabinet.

\* Equipped with 2 fanouts for ribbon cable use only.

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Table Q: Distant Terminal Equipment for Customer Location

J99408DT	COMCODE	Equipment	App. Code	COMCODE	CLEI Code	Quantity
List 1	601232184	DT Closure (AC Power)	900A1	104434873	--	1
List 2	601253453	DT Battery Pack	KS-21906,	405573841	PWPQ95TAXX	1
		DT PCU	L16	104432836	5SCF150AXX	1
		DT CU	ASH1	104432844	5SCF530DXX	1
		DT OU	ASJ1	105550461	5SCF24ABXX	1
			AYB1B			
List 3	601322324	DT Closure (DC Power)	900A2	106076094	--	1
List 4	601322340	DT Closure (DC Power)	900A3	106231889	--	1
List 5	601322365	D Kit of Parts	D-182371	106294184	--	1
List 6	601322373	DT Battery Pack	KS-21906,	405573841	PWPQ95TAXX	1
		DT PCU	L16	104432836	5SCF150AXX	1
		DT CU	ASH1	104437132	5SCF53CDAA	1
		DT OU	ASJ2	105550461	5SCF24ABXX	1
			AYB1B			
List 7	601322381	Drop Test Module	EAF1	106020639	5SPQAANAAA	1
List 8	601322399	DT Battery Pack	KS-21906,	405573841	PWPQ95TAXX	1
		DT PCU	L16	104432836	5SCF150AXX	1
		DT CU	ASH1	104437132	5SCF53CDAA	1
		DT OU	ASJ2	105550461	5SCF24ABXX	1
		Drop Test Module	AYB1B	106020639	5SPQAANAAA	1
			EAF1			

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**Table R: Miscellaneous Equipment**

Equipment	Apparatus Code	COMCODE
Analyzer Kit	J99407TA1, L1	601252604
D Test Cord*	AT8662	402023949
Craft Interface Unit**	J99404TA-1, L2	601202674
Access Shelf	KS-23557, L1	405772591
Allen-type Wrench	--	840841324
Optical Backplane Maintenance Kit	J994090B	601300742
Butt Set	1015B	103980710
Test Cord***	WP91067, L6	405525809
ST(R) Lightguide Cable Connector Microscope	300A	104055025
216-type Tool	--	--
Analyzer Battery Pack	KS-21906, L18	--
26A Work Shelf	--	--
136A Brackets	--	--

\* Supplied with Analyzer.

\*\* CIU is required only for turnup and not for normal operation.

\*\*\* Allows access to test jacks on AUA403 test CU.

**Table S: DC Backpowering DT Pedestal Equipment**

Equipment	Apparatus Code	COMCODE
FTTH Low Profile Pedestal	ED-1T283-30, G1, G2, G11, or G12	--
DT Closure	900A2 900A3	106076094 106231889
DC Power Box Enclosure	ED-1T283-30, G22*	--
Power Interface Circuit Pack and Chassis Assembly	--	846530293
Dual Protection Circuit Module	--	846530319
Dual Protection Circuit Module Shield	--	846530277
Backpowering Power Source Enclosure - Available From Robroy Industries, Belding, MI, Part No. J806HPL	--	--
Myers ST(R)-1 Hub or Thomas & Betts 370 Hub	--	--
Surface Mount AC Utility Box (4" x 2 1/8")	--	--
Single Position 120 VAC Outlet	--	--
Single Position Outlet Coverplate	--	--
-48 VDC Entrance Grommet	WP 92128, L3	803764208**
Right Mounting Bracket	WP 92128, L3	846513893**
Left Mounting Bracket	WP 92128, L3	846513885**
Backpowering Power Source	WP 92128, L3	406177006
Backpowering Power Source Mounting Screws (6 Machine Screws, No. 8/32, 1/4" long)	--	--
E-Type Armored Service Drop Burial Wire 22 Ga., 4-Conductor	AT-8776	--
C-Type Service Wire 22 Ga., 2- or 5-Conductor	AT-8545	--
E-Type Burial Wire 19 Ga., 2-Conductor	AT-8483	--

\* ED-1T283-30, G22 can be ordered separately or equipped in ED-1T283-30, G1, G2, G11, or G12.

\*\* Order all three items together using COMCODE 406185488.

**Table T: AC Powered DT Pedestal Equipment**

Equipment	Apparatus Code	COMCODE
FTTH Low Profile Pedestal	ED-1T283-30, G1, G2, G11, or G12	--
DT Closure	900A1	104434873
AC Power Box Enclosure	ED-1T283-30, G21	--

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**Table U: Minimum Configuration for DC Backpowering Pedestal Equipment**

Quantity	Equipment
1	FTTH Low Profile Pedestal
1	DT Closure (900A2 or 900A3)
1	DC Power Box Enclosure
1	Power Interface CP & Chassis Assembly
1	Dual Protection Circuit Module
1	Backpowering Power Source Enclosure & Hardware
1	Backpowering Power Source
1	Copper Drop Wire (Length as Required)

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**Table V: Maximum Configuration for DC Backpowering Pedestal Equipment**

Quantity	Equipment
1	FTTH Low Profile Pedestal
3	DT Closure (900A2 or 900A3)
1	DC Power Box Enclosure
4	Power Interface CP & Chassis Assembly
8	Dual Protection Circuit Module
8	Backpowering Power Source Enclosure & Hardware
8	Backpowering Power Source
8	Copper Drop Wire (Length as Required)

**Table W: Terminal-To-Terminal VF Transmission Characteristics (POTS Only)**

Parameter	Value at 77<deg>F
Loop Resistance (Beyond the DT Excluding the Set)	100 Ohms
1000-Hz Loss*	4.0 dB +-1 dB
Bandwidth (Relative to 1000-Hz Loss)	-0.5 to +3.0 dB at 300 Hz and 3000 Hz -0.5 to +1.5 dB at 400 Hz and 2800 Hz
Return Loss at the COT**	ERL >= 18 dB SRL >= 12 dB
Return Loss at the DT***	ERL >= 18 dB SRL >= 15 dB
Idle Channel Noise (at the DT)	<= 20 dBrnC
Signal-to-Distortion Ratio (at -10 dBm)	> 33 dB
Data Pulse Distortion (P/AR)	>= 90
Gain Tracking (1004 Hz)	
-37 dBm0 to +3 dBm0	+ -0.5 dB
-50 dBm0 to -37 dBm0	+ -1.0 dB
Intermodulation Distortion (-13 dBm0 Input)	A-B (R2) Product: > 43 dB 2A-B (R3) Product: > 44 dB
Single Frequency Distortion (0-12 kHz 0 dBm0)	< -28 dBm0
Impulse Noise****	<= 15 Counts in 15 Minutes
Overload at COT and DT	>= +3 dBm0
Longitudinal Balance at the DT*****	200, 500, 1000, 3000 Hz: >= 40 dB
Loop Current (I <sub>L</sub>)	27 mA <= I <sub>L</sub> <= 33 mA

\* Measured as insertion loss between a 900-ohm termination at the COT and a 600-ohm termination at the DT.

\*\* Measured with respect to 900 ohms and 2.16 uF with the 4-wire path broken or with the other end terminated in 600 ohms.

\*\*\* Measured with respect to 600 ohms with the 4-wire path broken or with the other end terminated in 900 ohms and 2.16 uF.

\*\*\*\* Measured with a holding tone of -13 dBm0 and a threshold of 59 dBrnC0.

\*\*\*\*\* Measured by Institute of Electrical and Electronics Engineers (IEEE) method 455-1985.

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Figure 1: ``SLC''(R) Series 5 Carrier System Fiber-To-The-Home Feature Universal Configuration

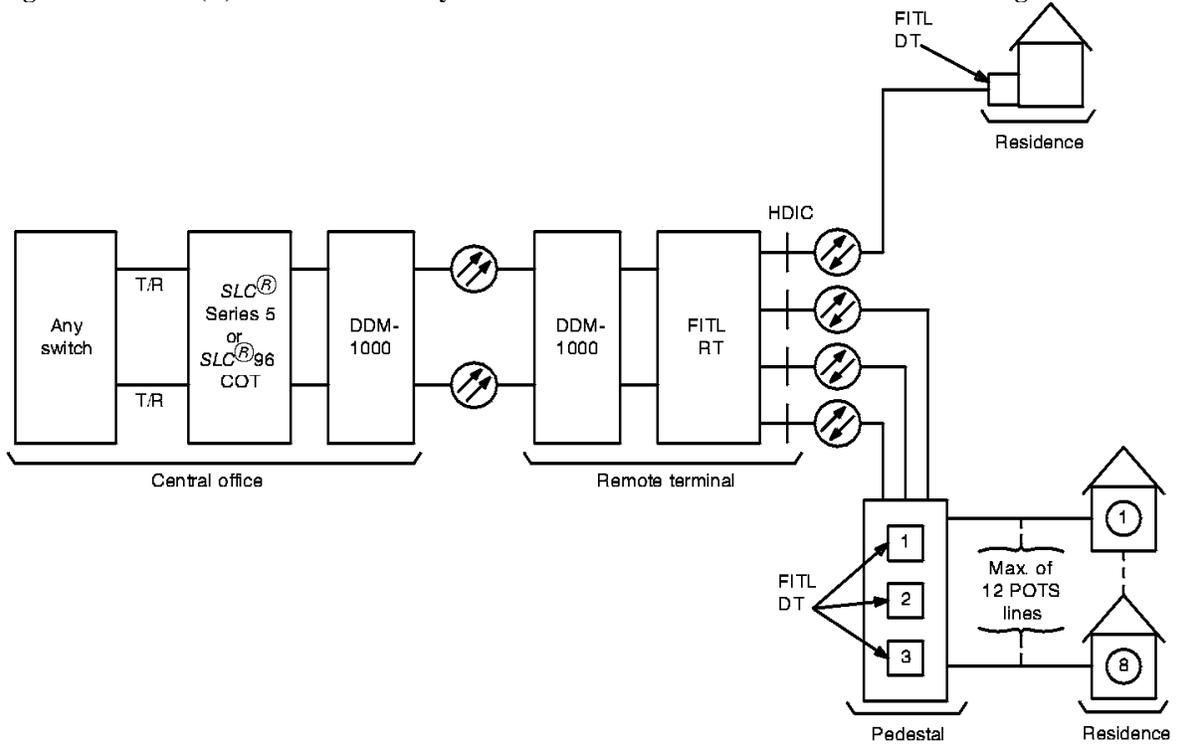


Figure 2: "SLC(R)" Series 5 Carrier System Fiber-To-The-Home Feature Integrated Configuration

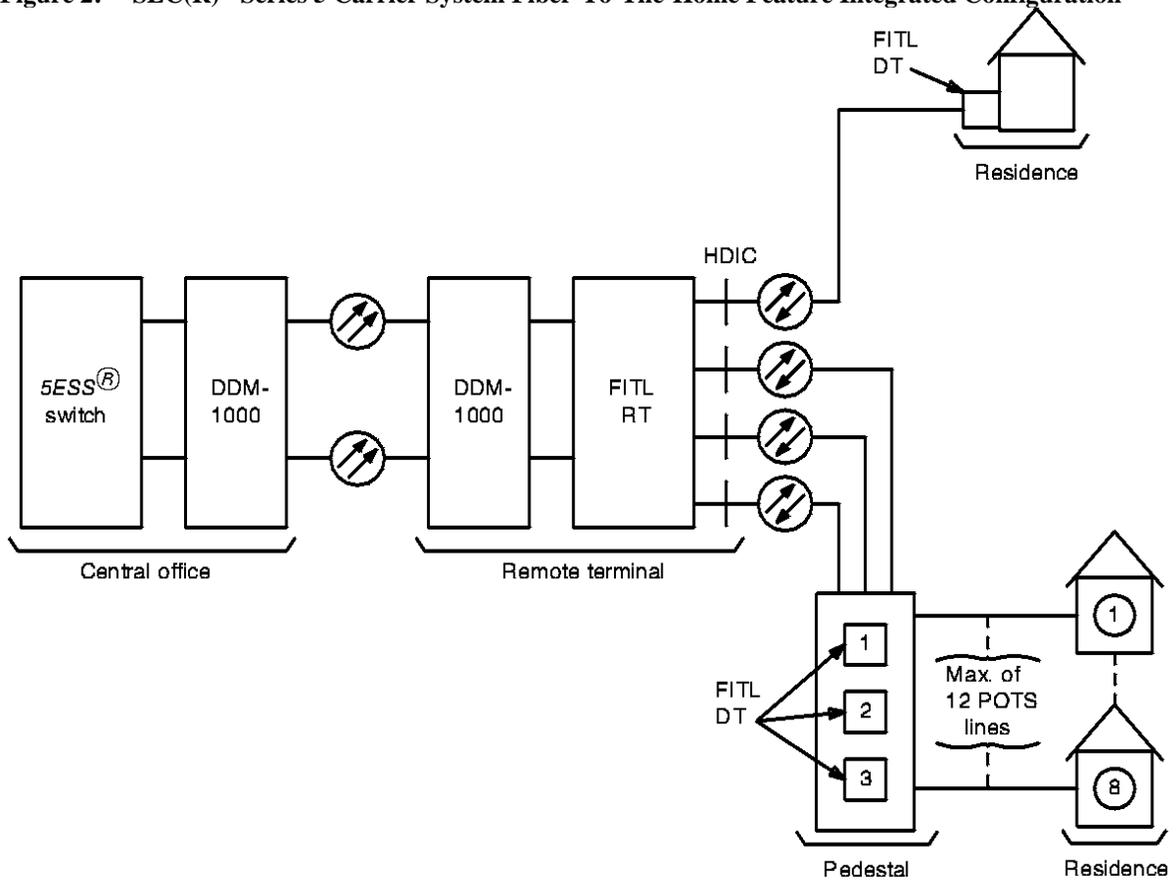
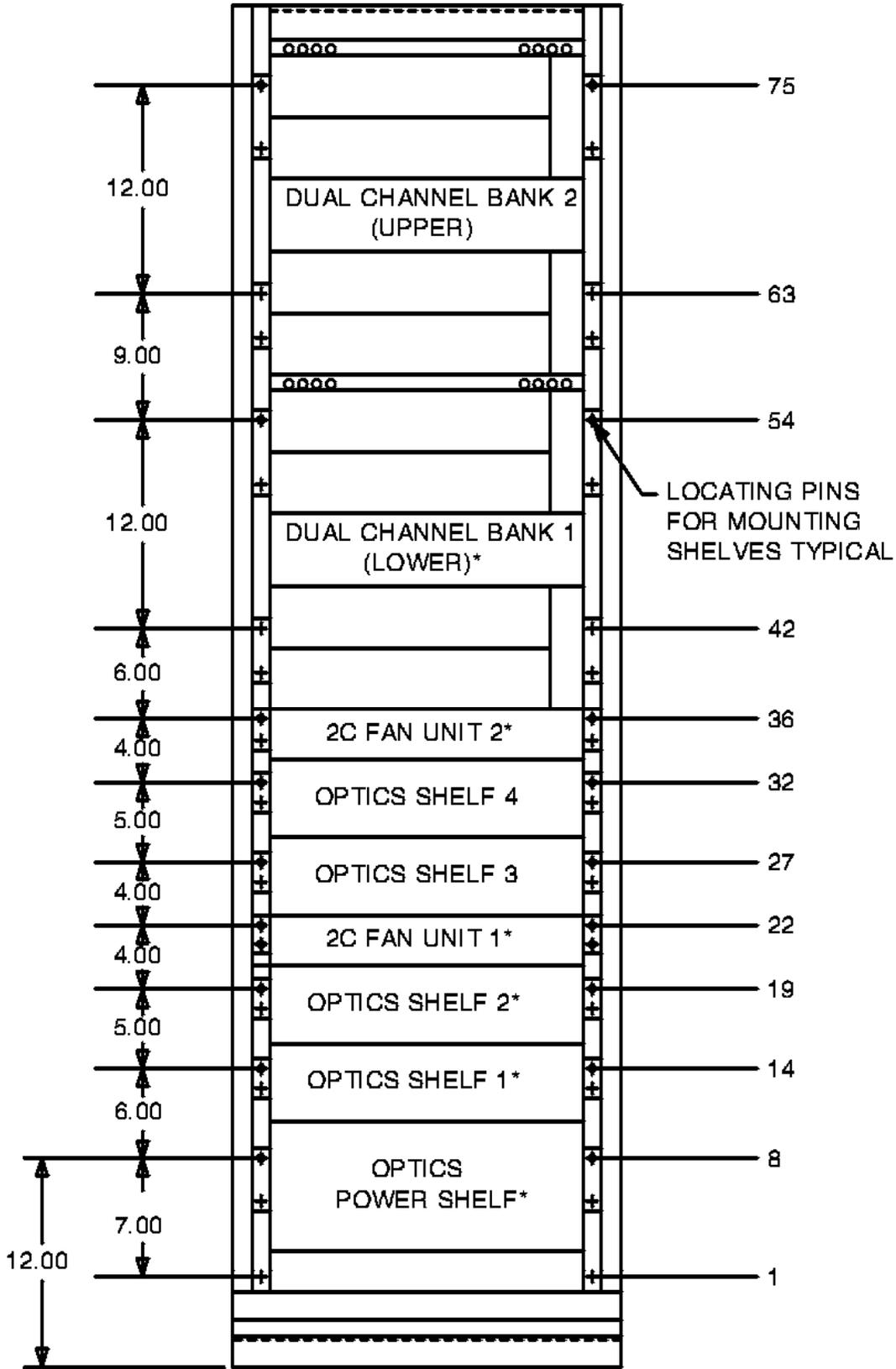


Figure 3: FTTH Remote Terminal Bay Layout



\*MINIMUM CONFIGURATION



Figure 4: 80E Cabinet FTTH Layout

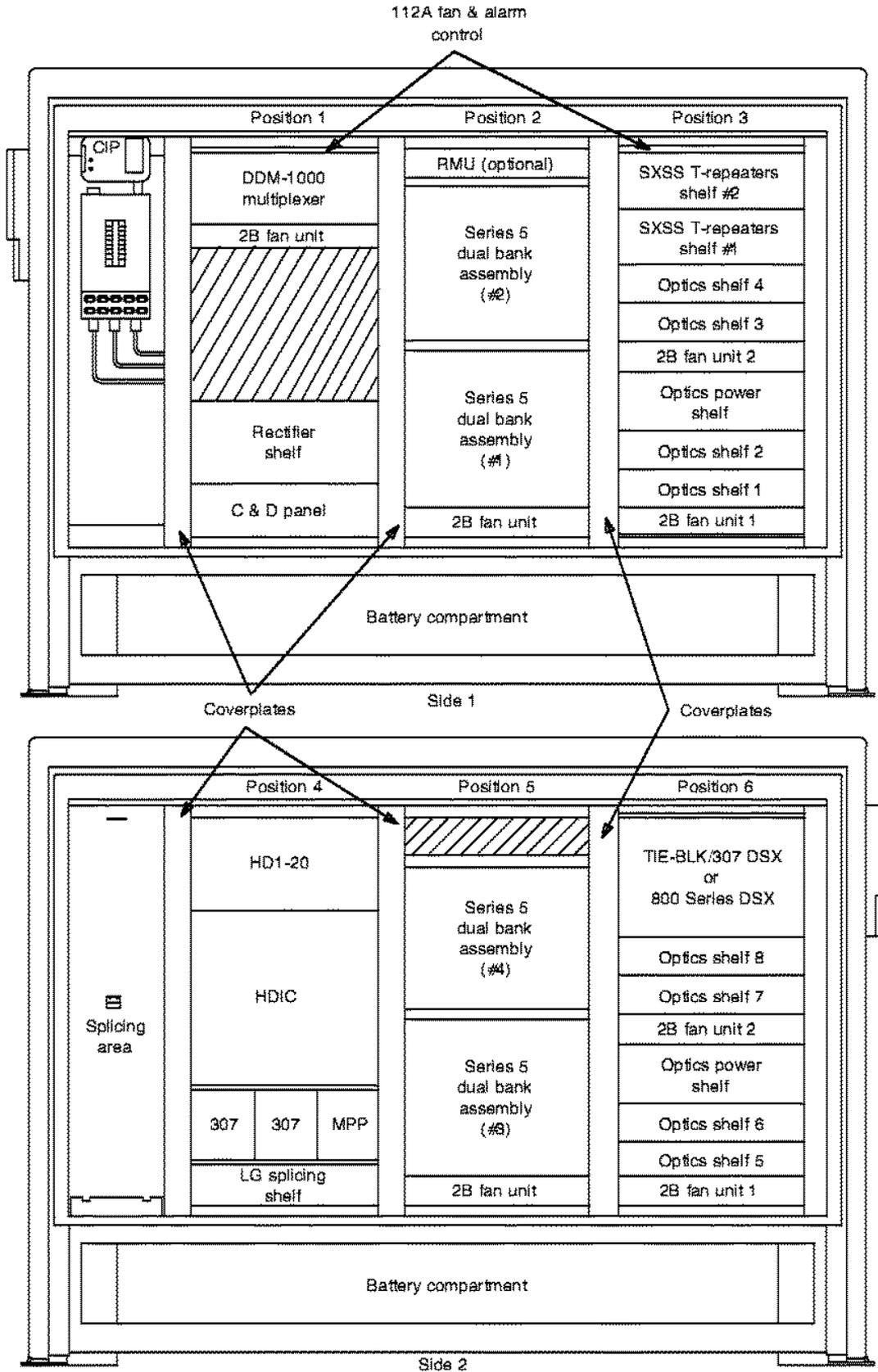




Figure 5: AUA400 Channel Unit

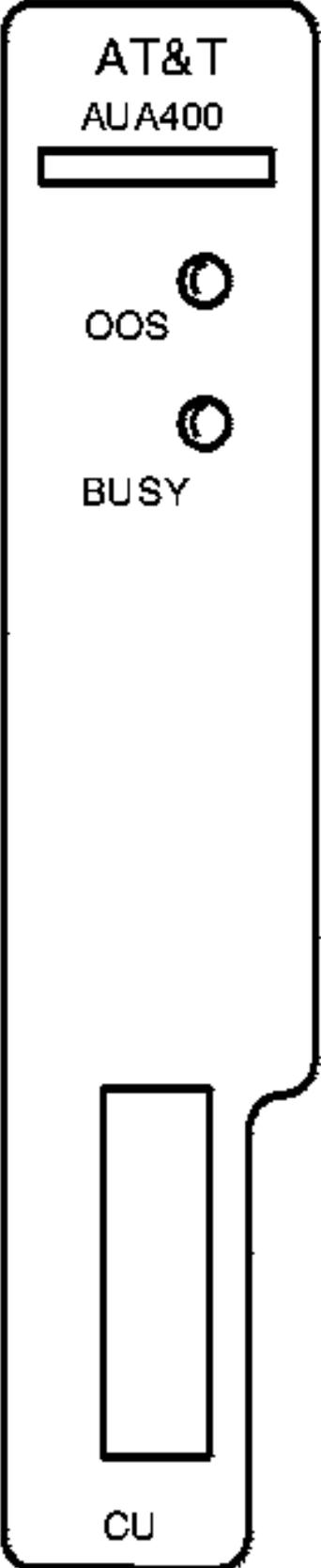




Figure 6: AUA401 Channel Unit

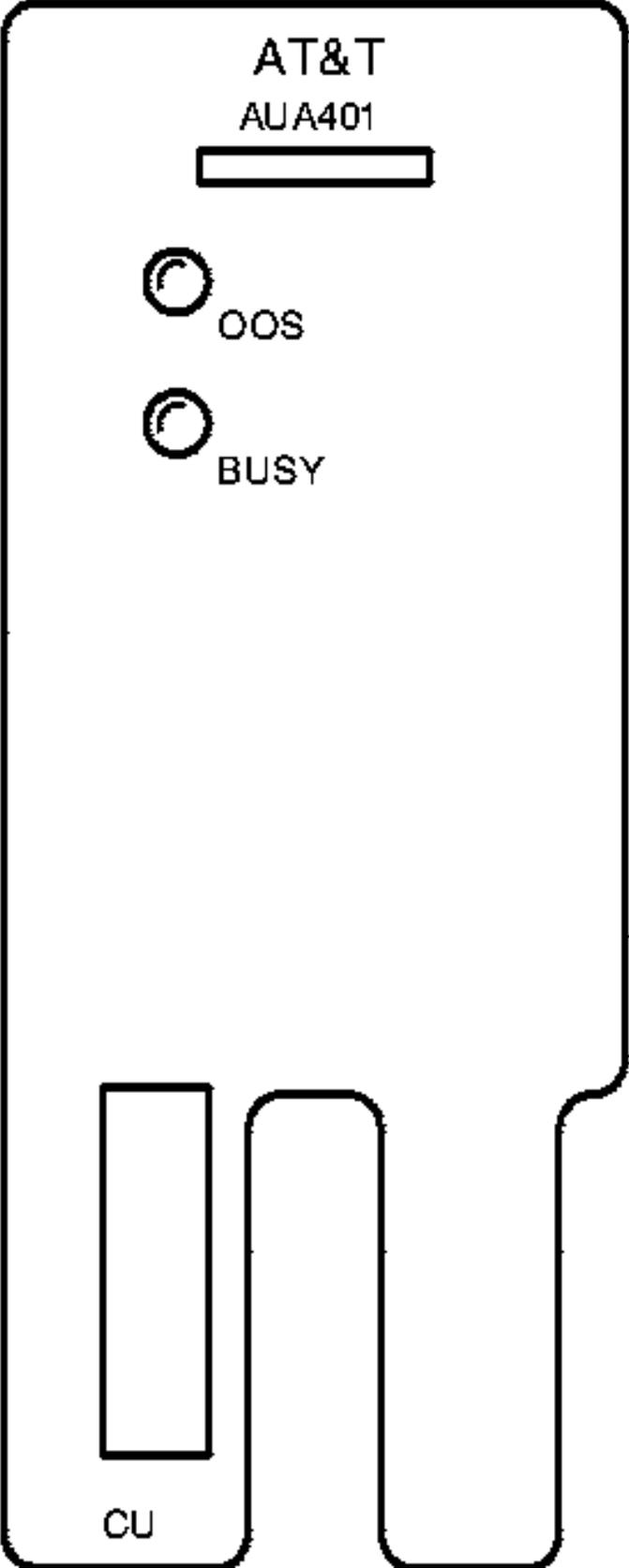




Figure 7: AYB1B Optical Unit

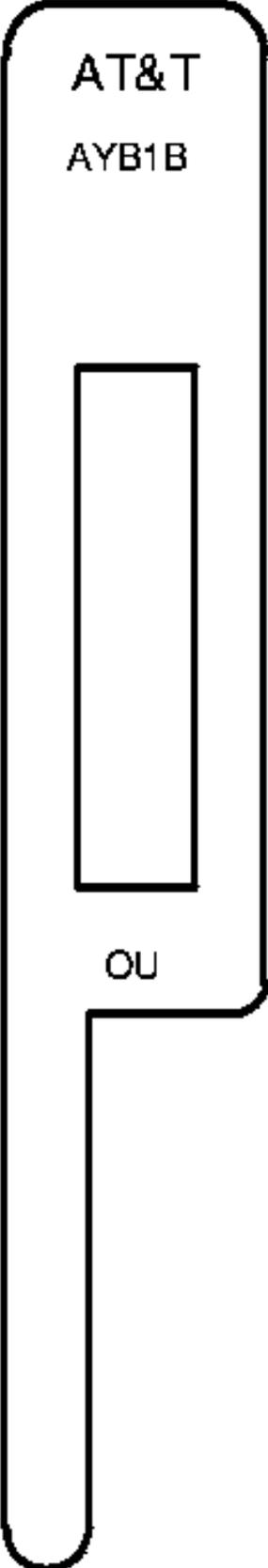
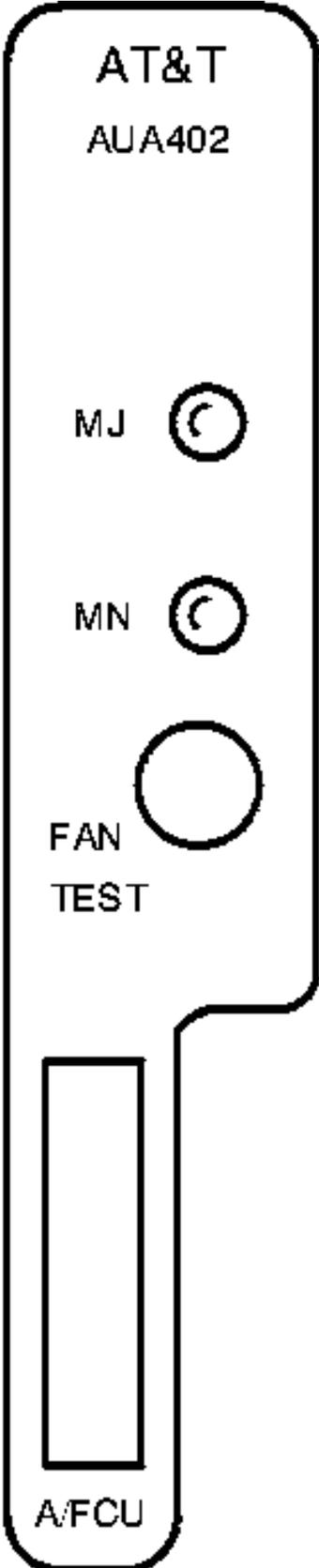




Figure 8: J1C182PB RT Optics Power Shelf Assembly



Figure 9: AUA402 A/FCU





**Figure 10: BFU Power Distribution**

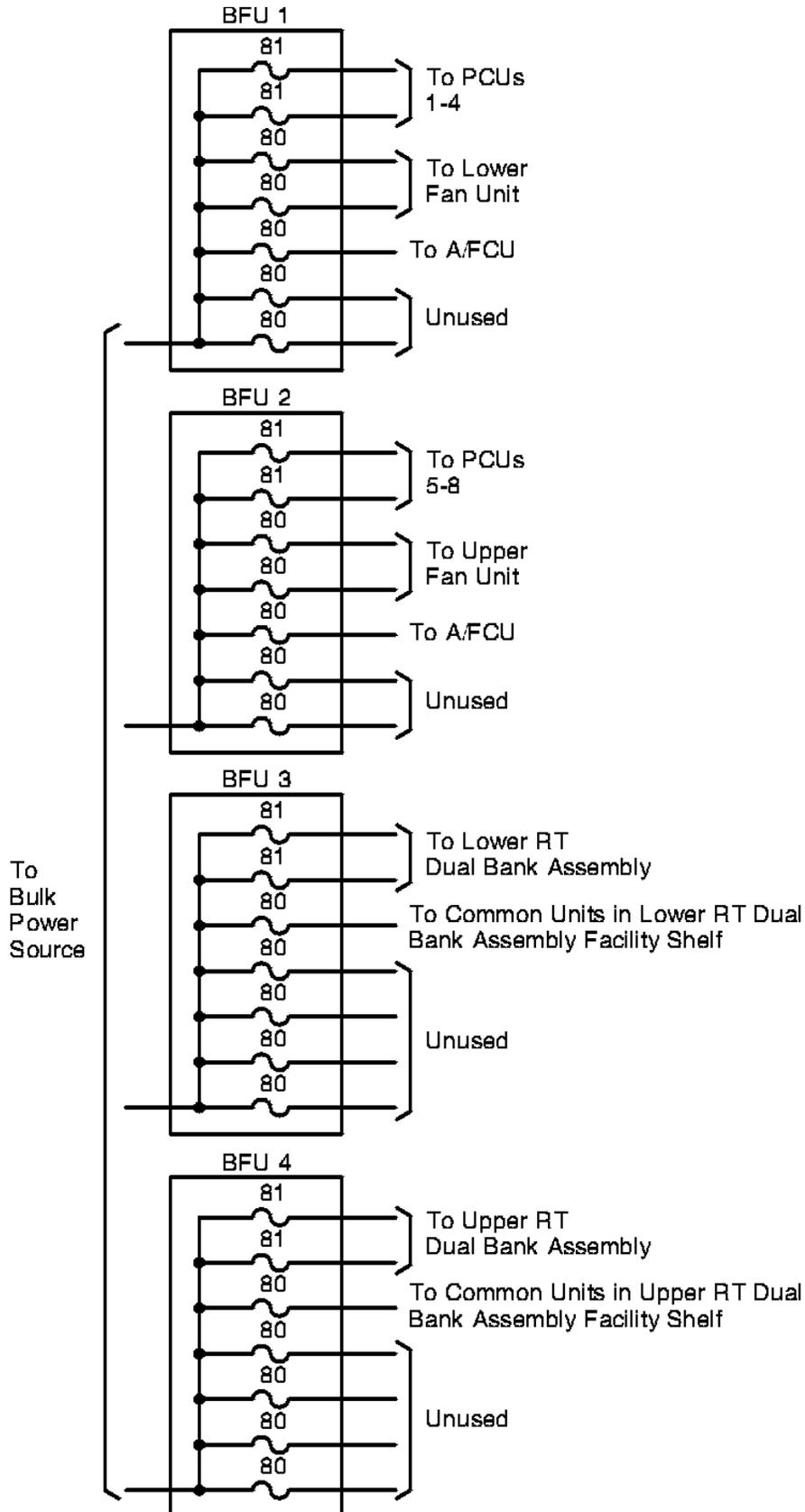




Figure 11: Optics Power Shelf Assembly Power Distribution in RT Bay

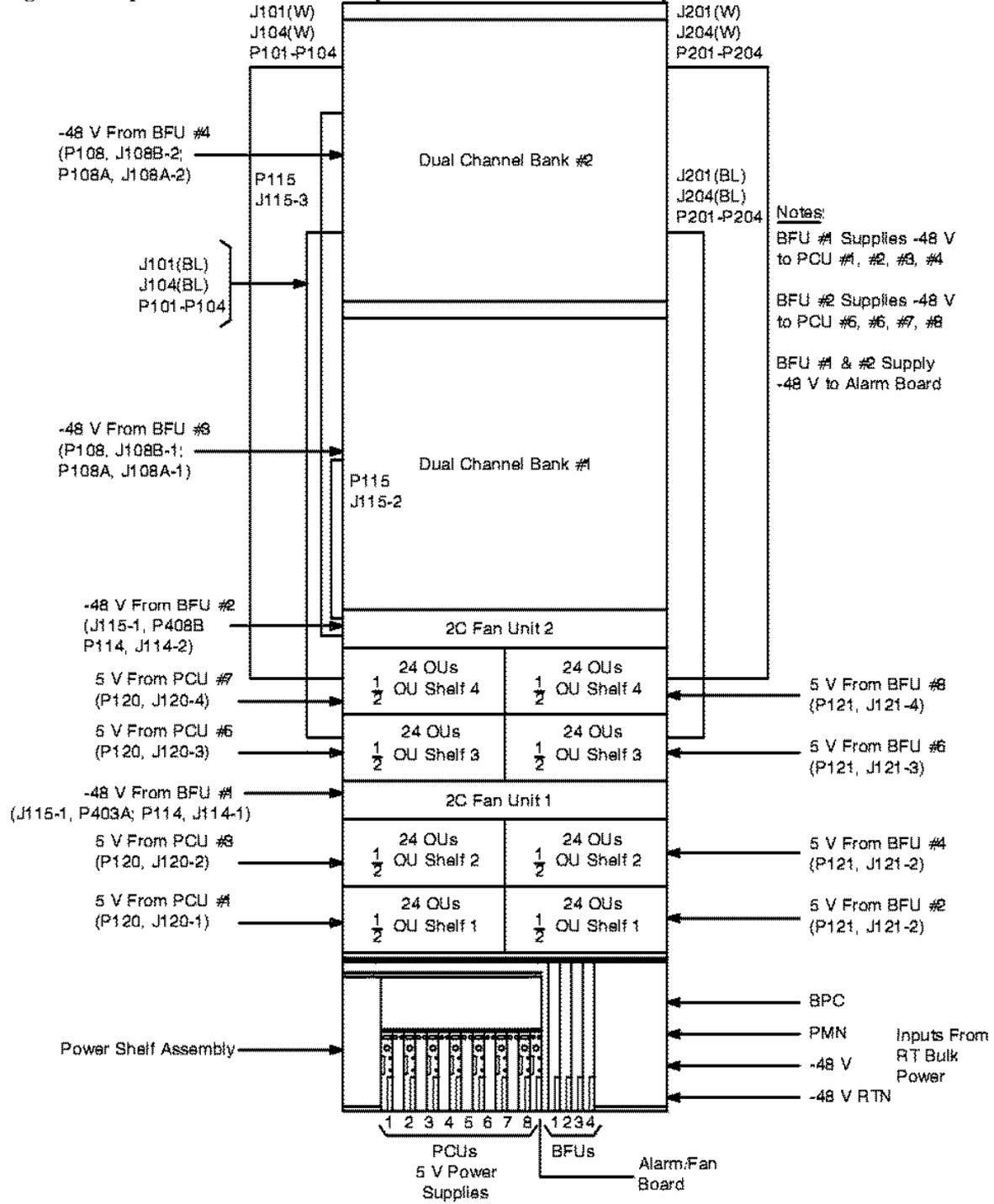
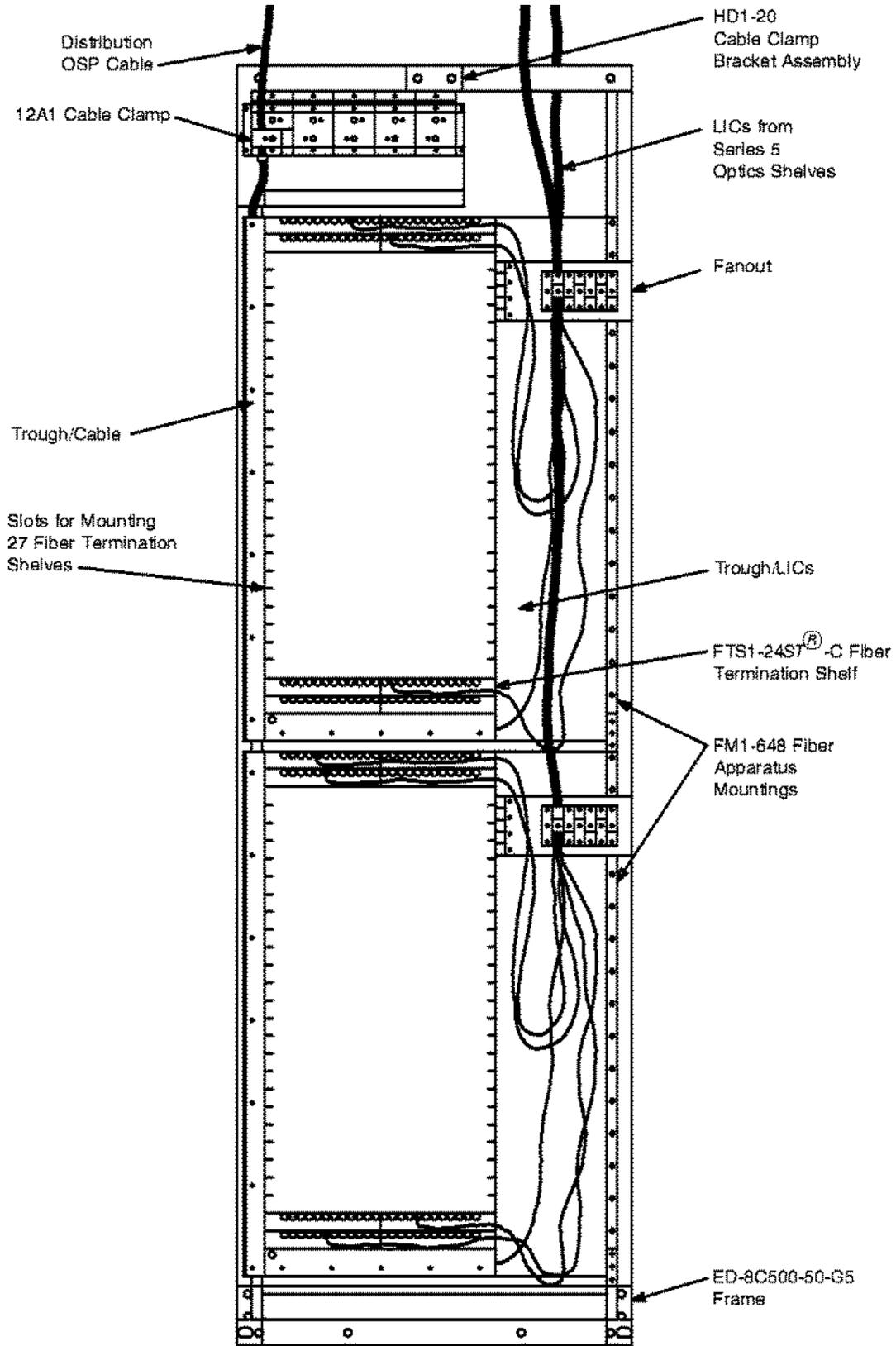


Figure 12: HDIC Located in CEVs and Huts



tpa 783148/01



Figure 13: HDIC Located in 80E Cabinets

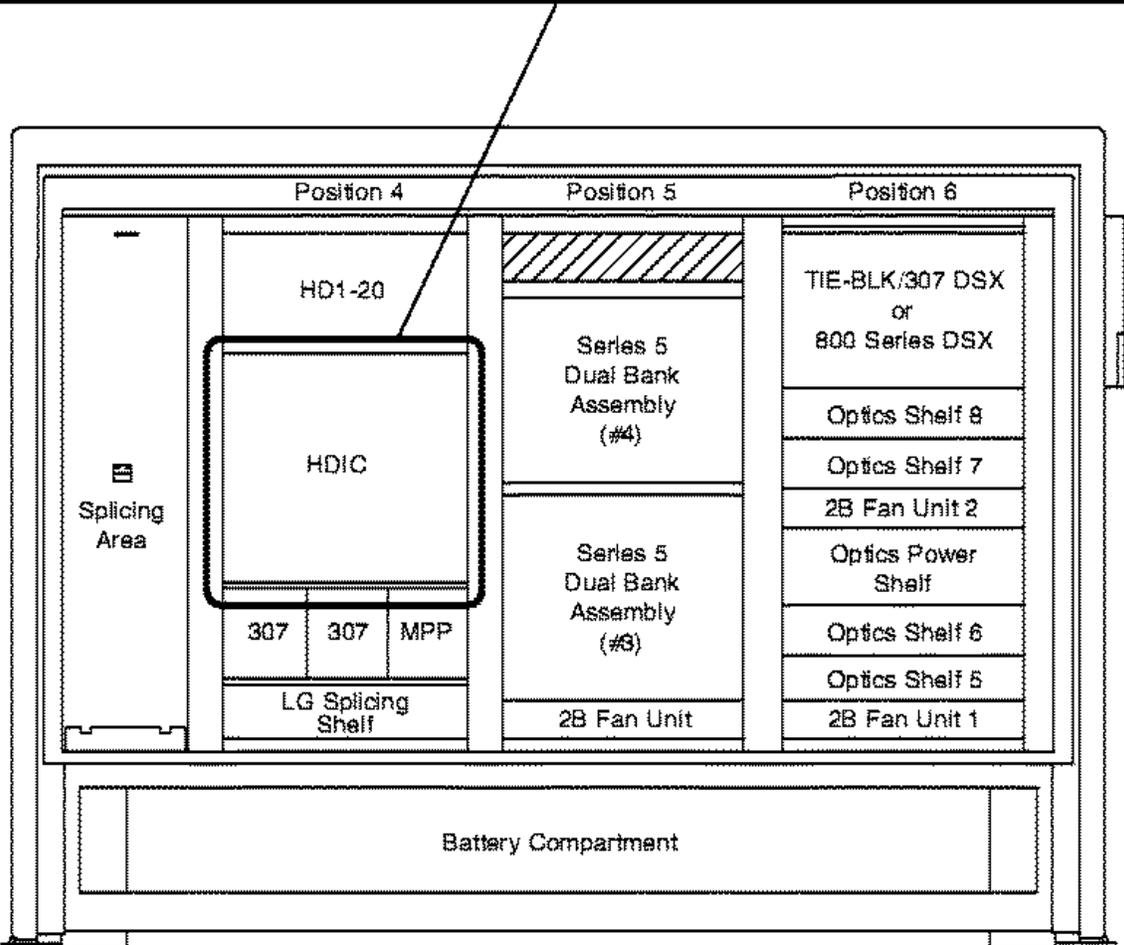
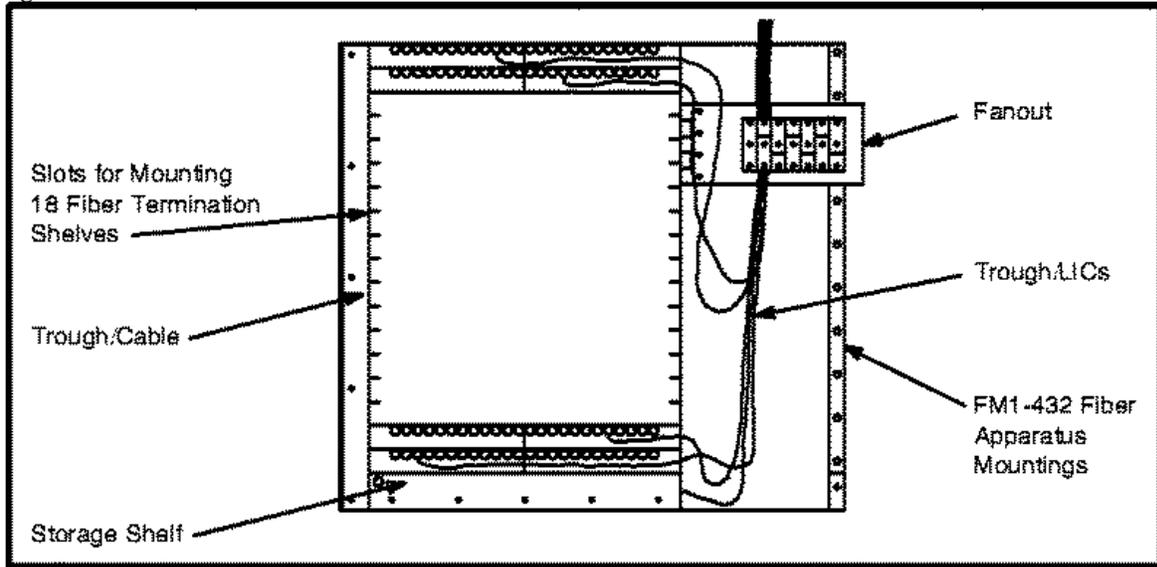


Figure 14: Fiber Termination Shelf

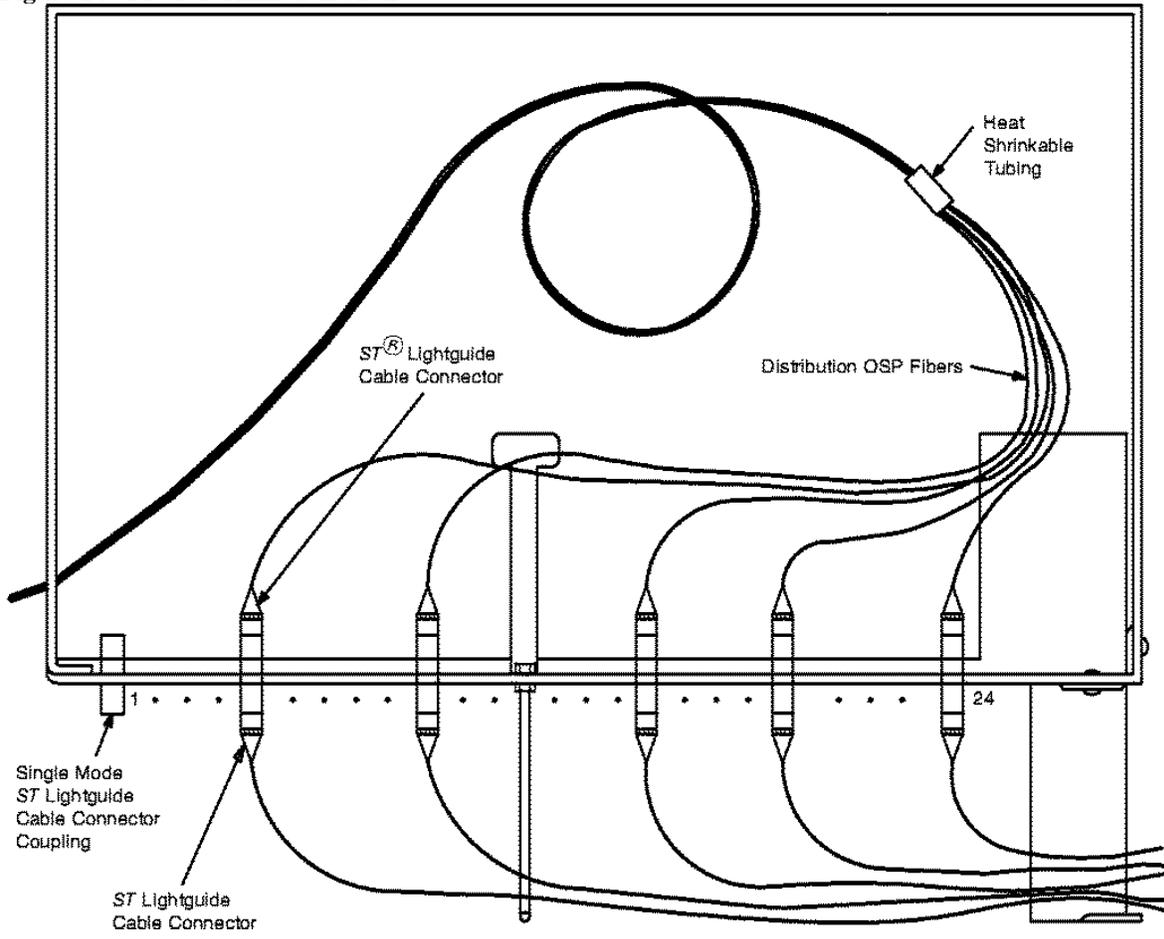


Figure 15: HD1-20 Cable Clamp Bracket Assembly

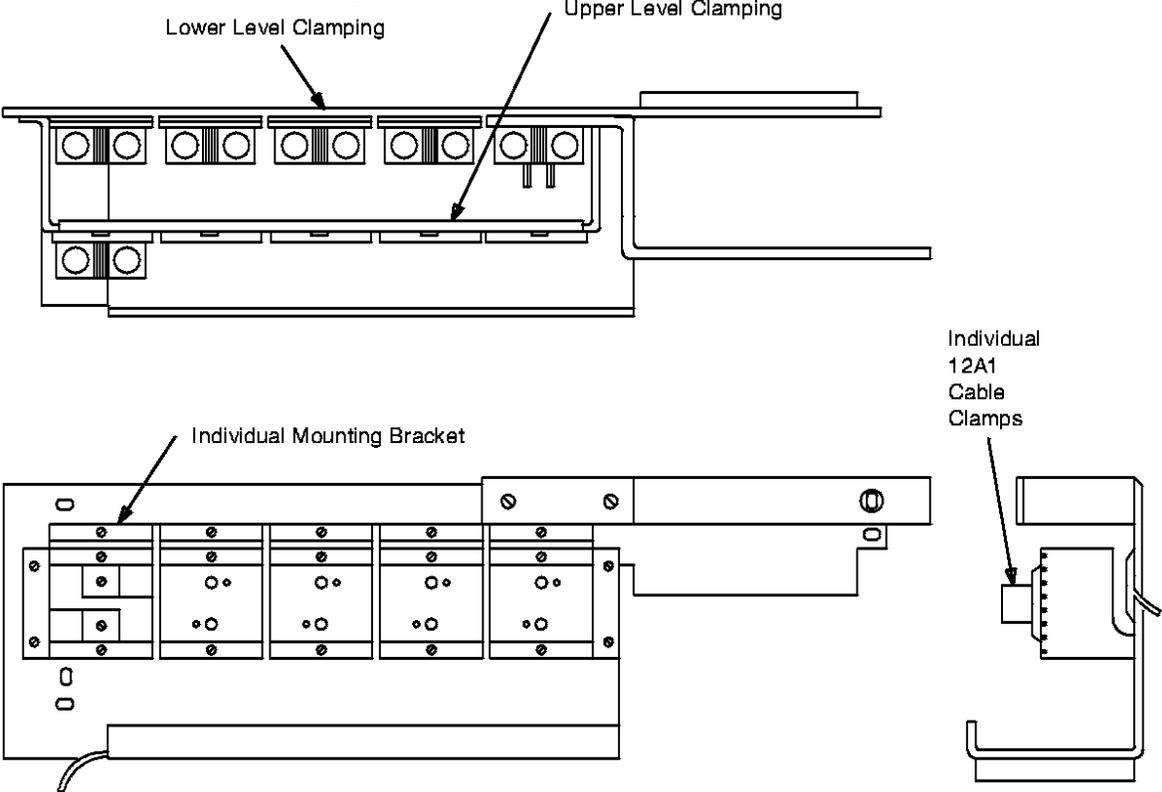


Figure 16: Distant Terminal (900A1 Closure)

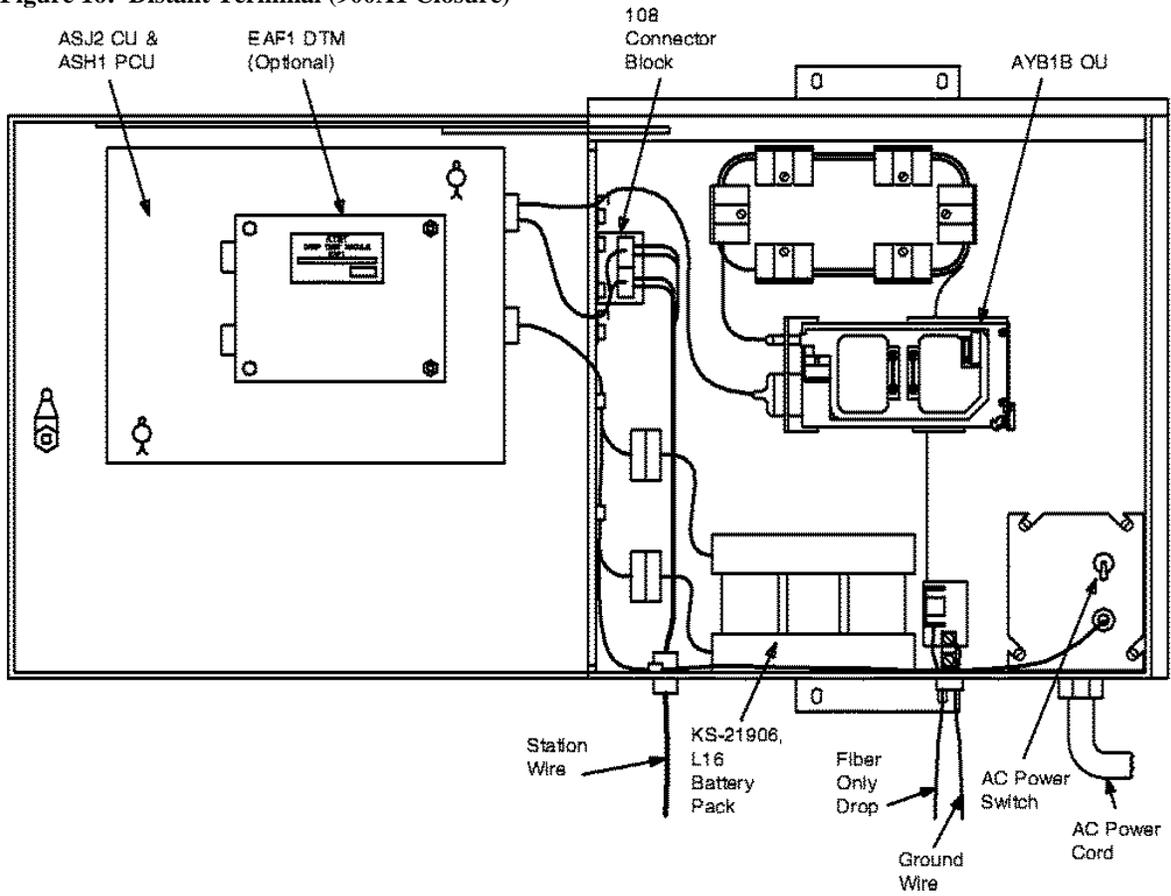


Figure 17: Distant Terminal (900A2 and 900A3 Closure)

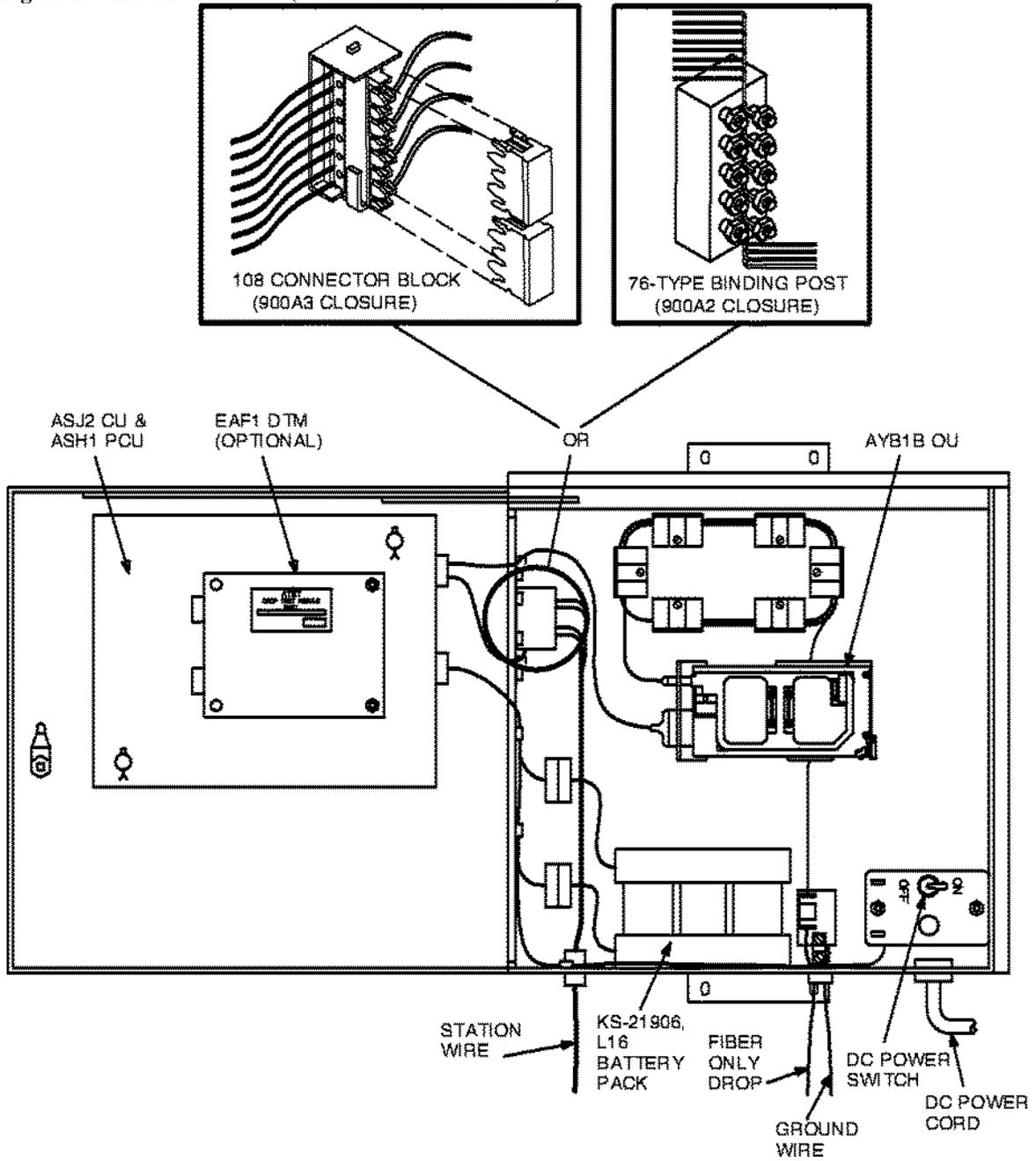


Figure 18: 900A1 DT Component Interconnection

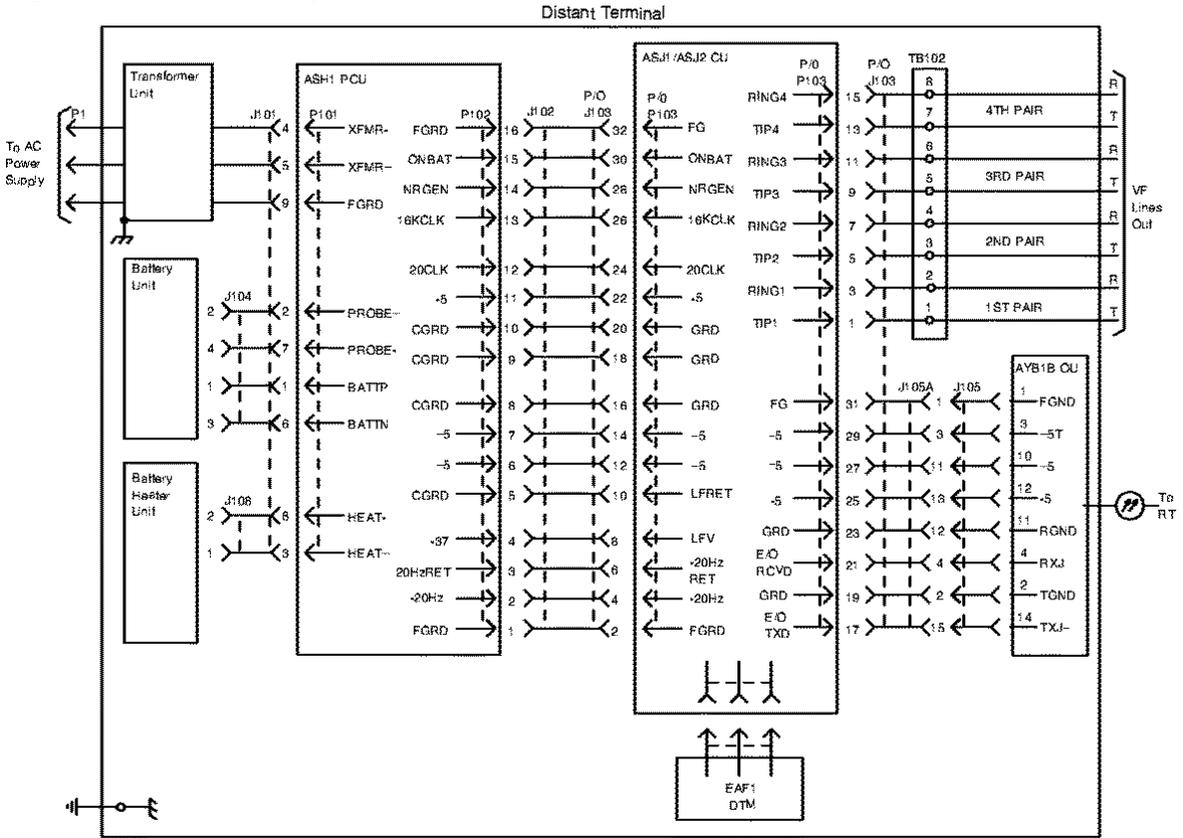


Figure 19: 900A2 and 900A3 DT Component Interconnection

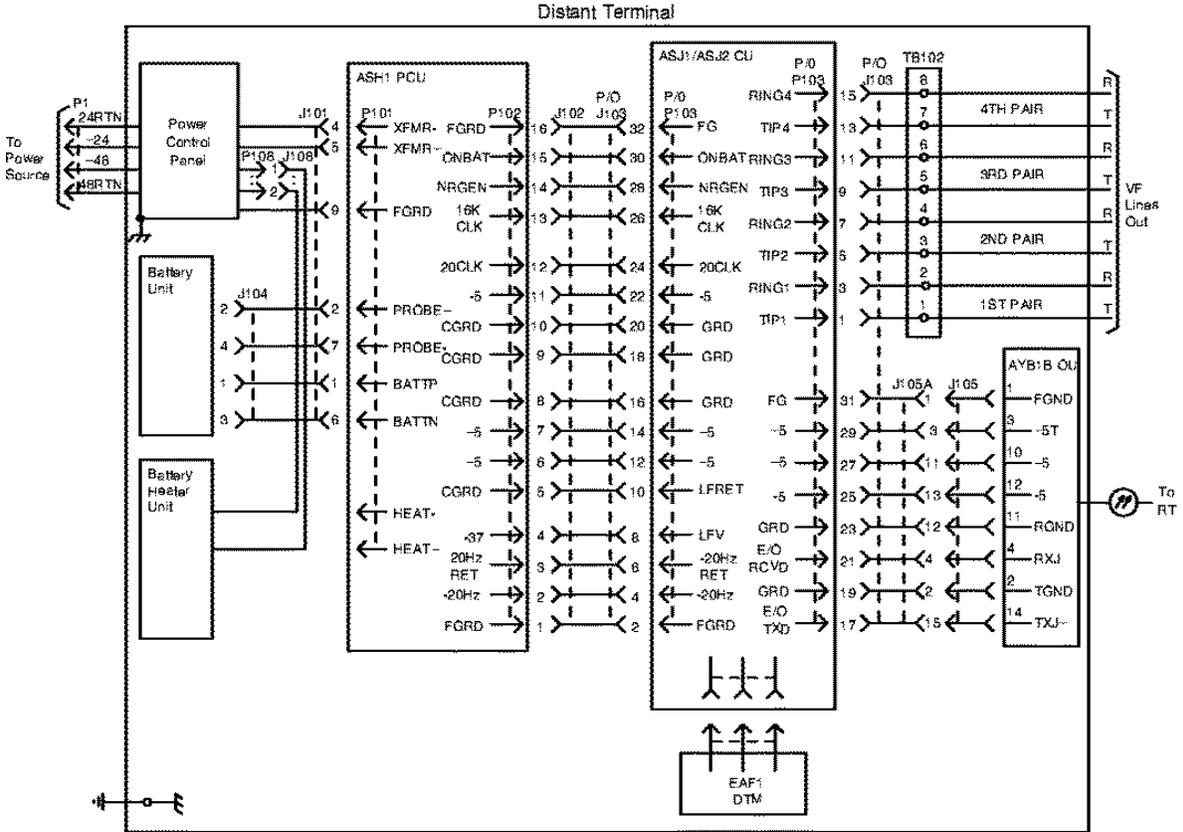


Figure 20: ASJ1 Channel Unit

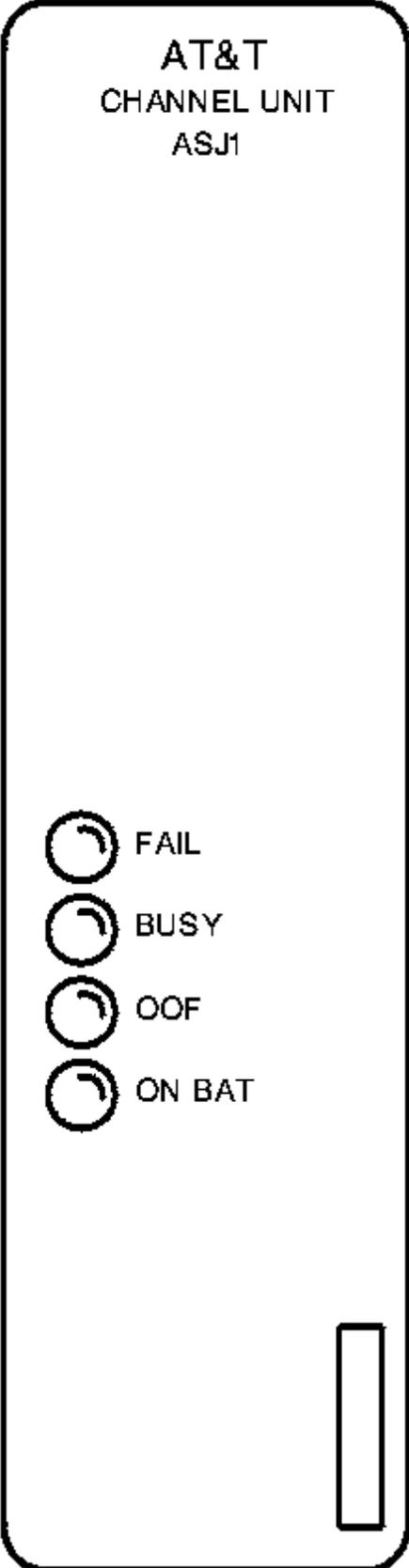




Figure 21: EAF1 Drop Test Module

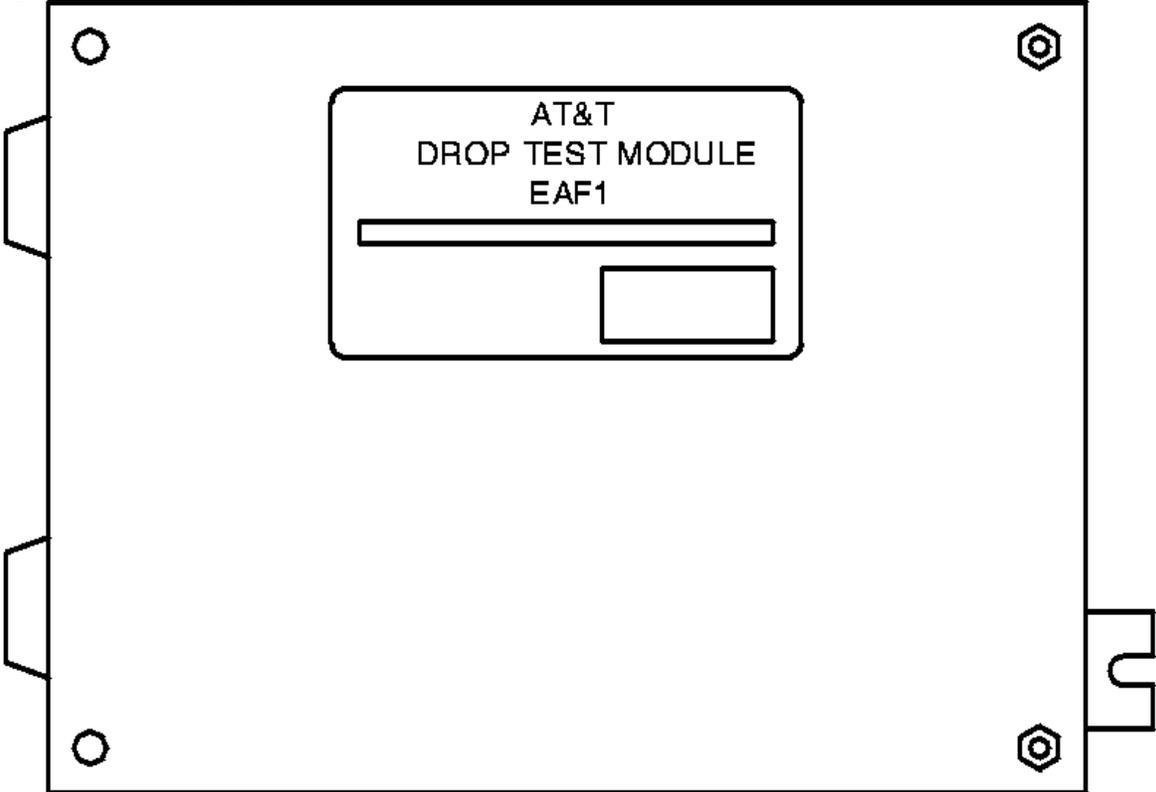


Figure 22: ASH1 Power Converter Unit

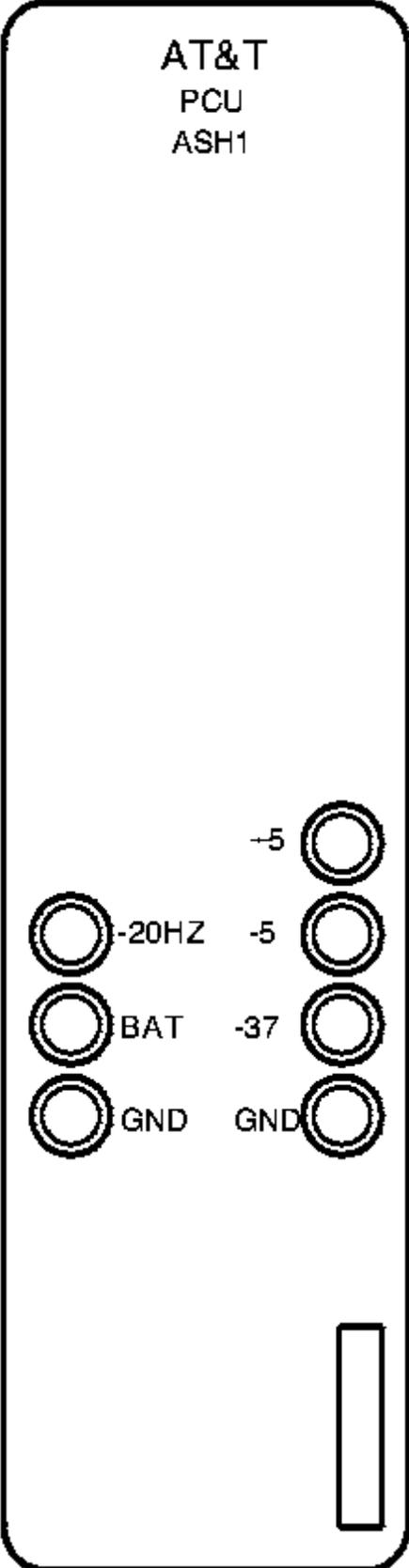




Figure 23: Pedestal DT Closure

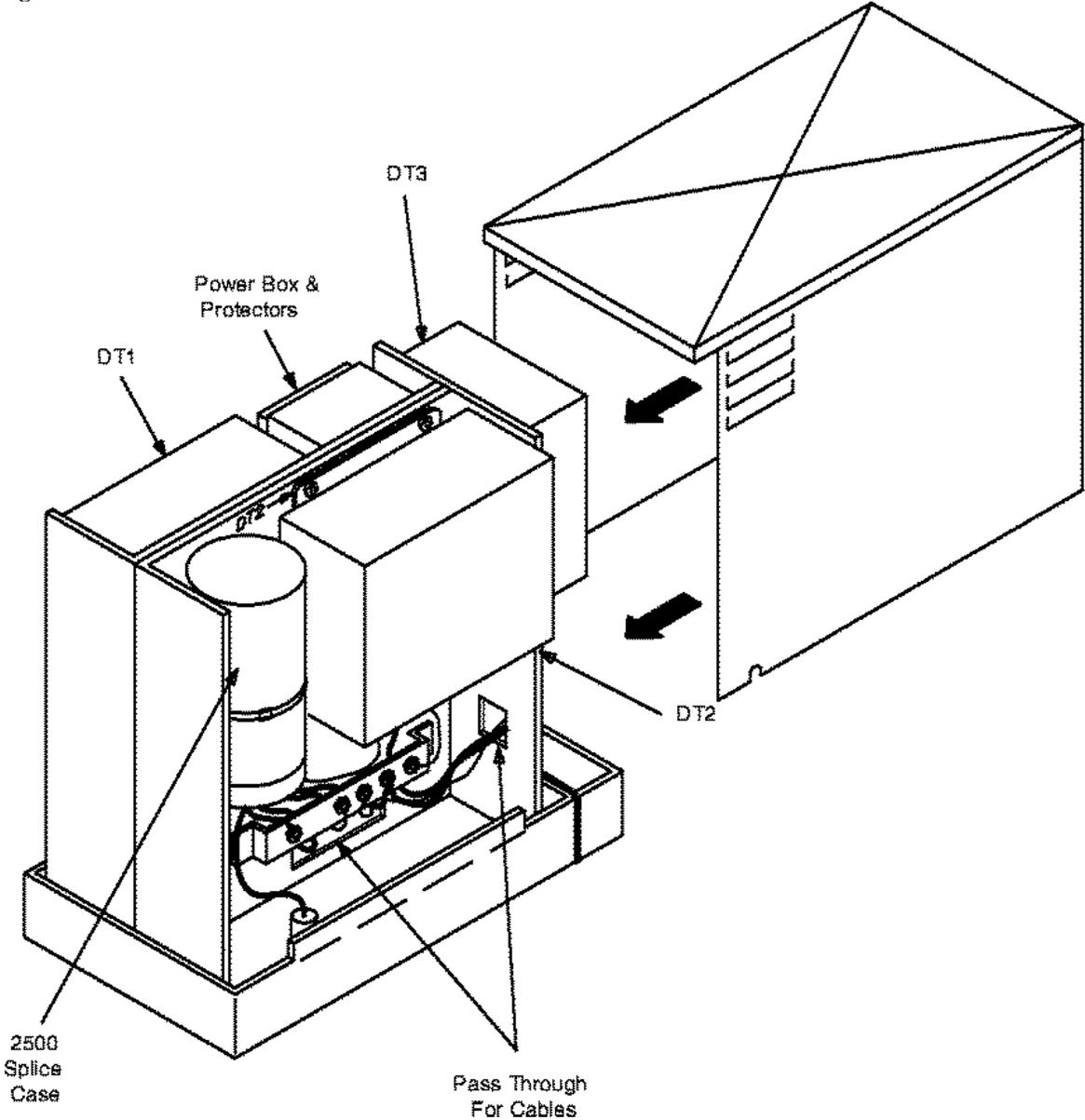


Figure 24: AC Power Box Enclosure

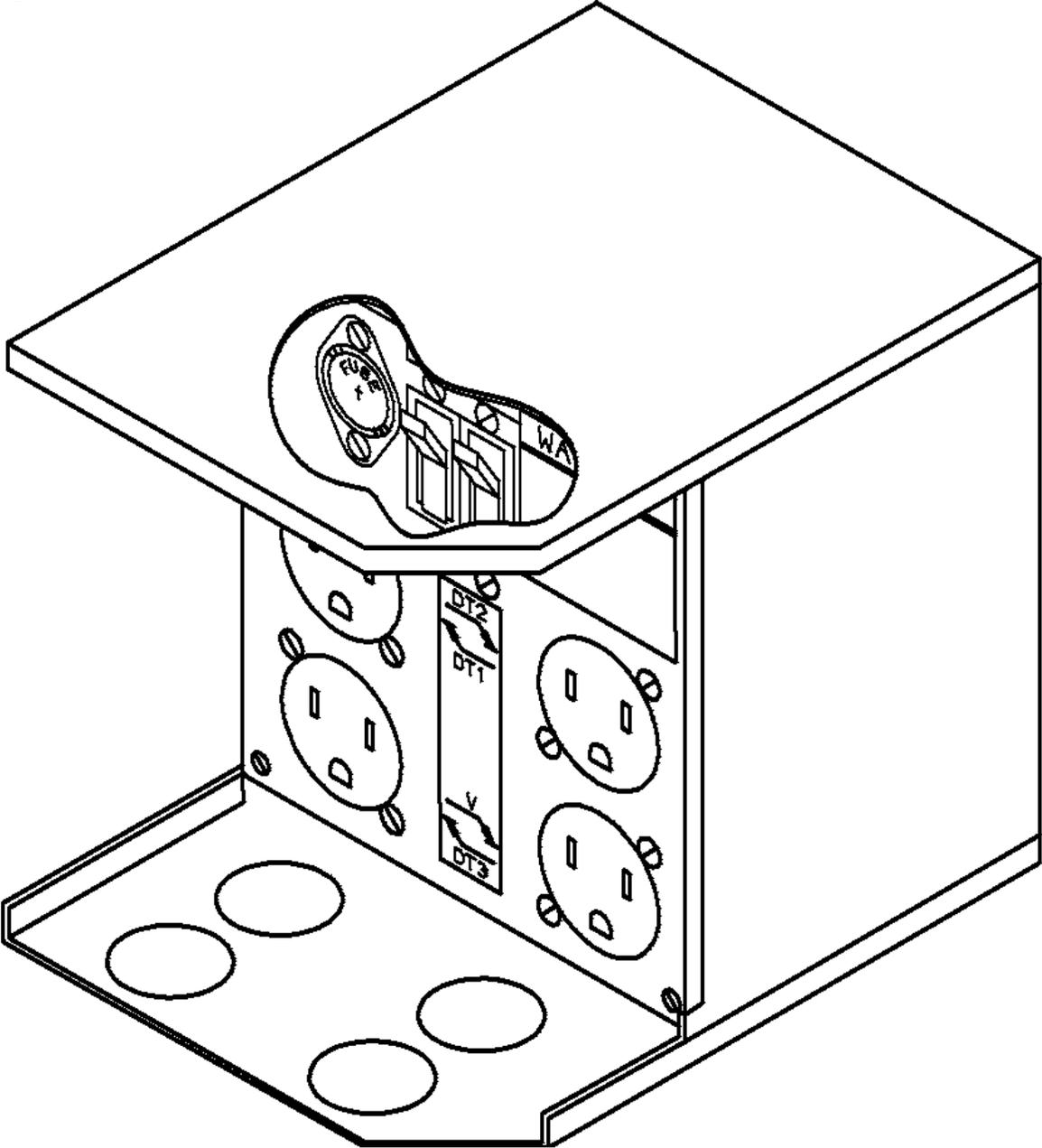
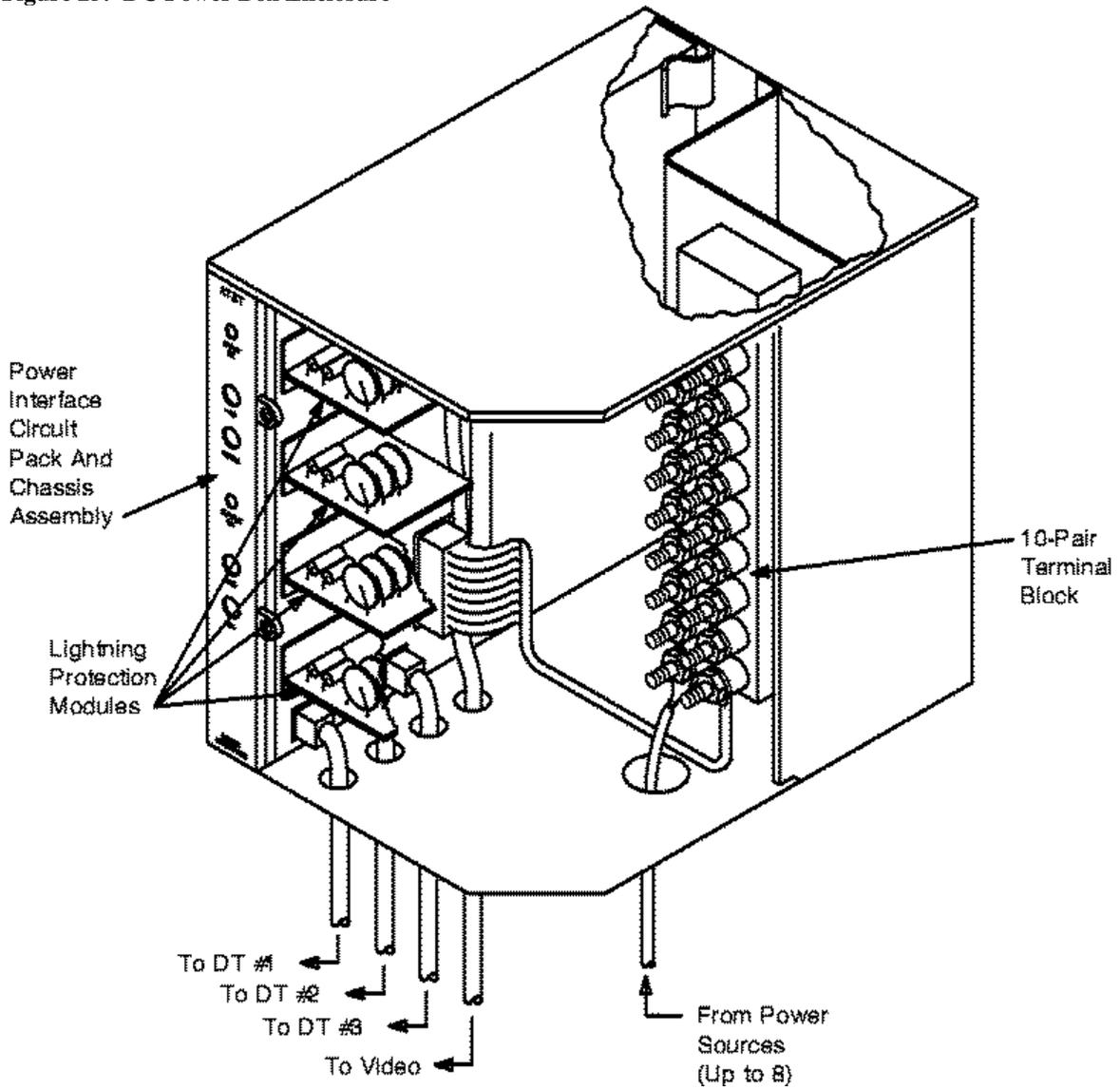


Figure 25: DC Power Box Enclosure



**Figure 26: Power Source to Power Interface Circuit Pack Interconnection**  
DC Power Box Enclosure

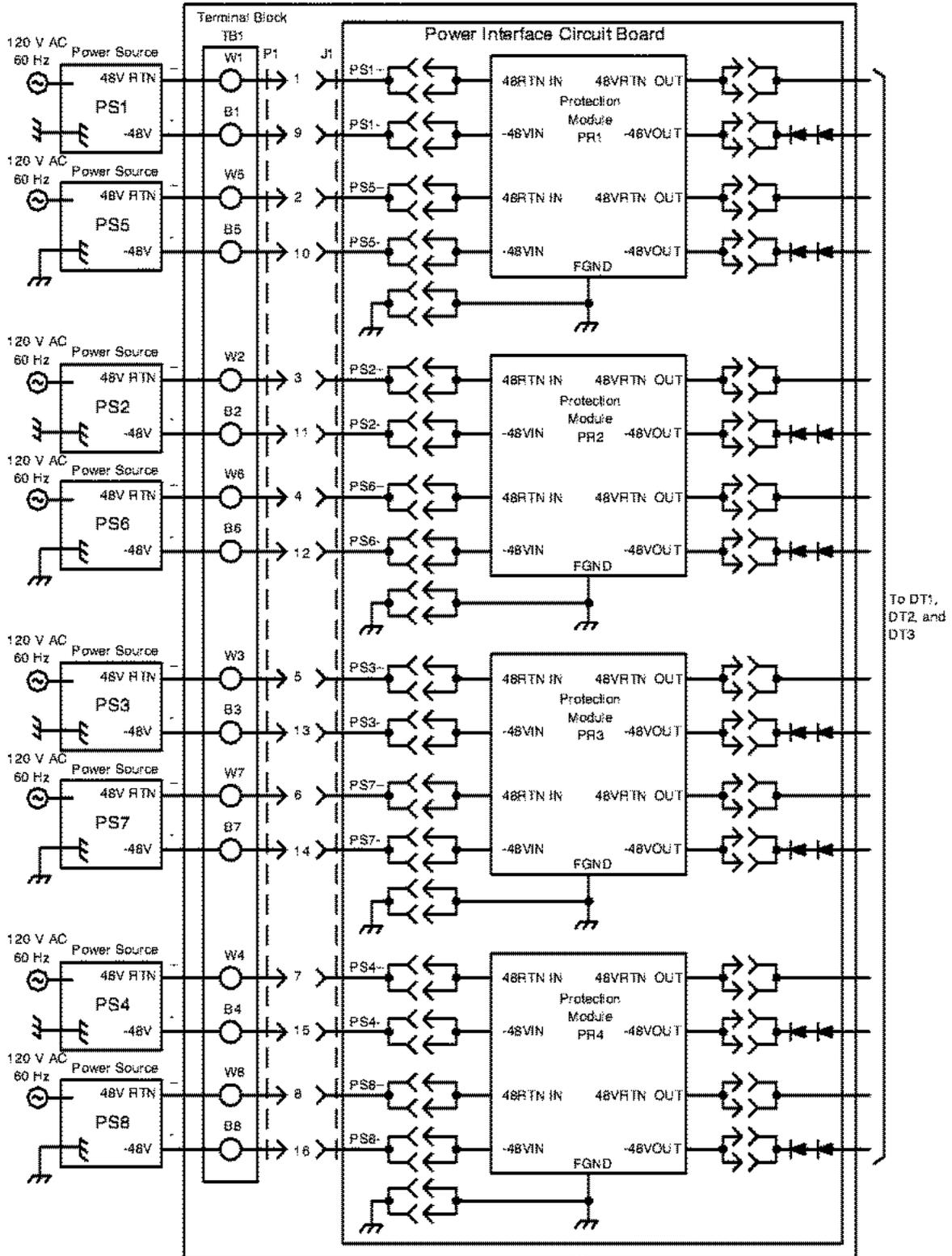


Figure 27: DC Backpowering Power System

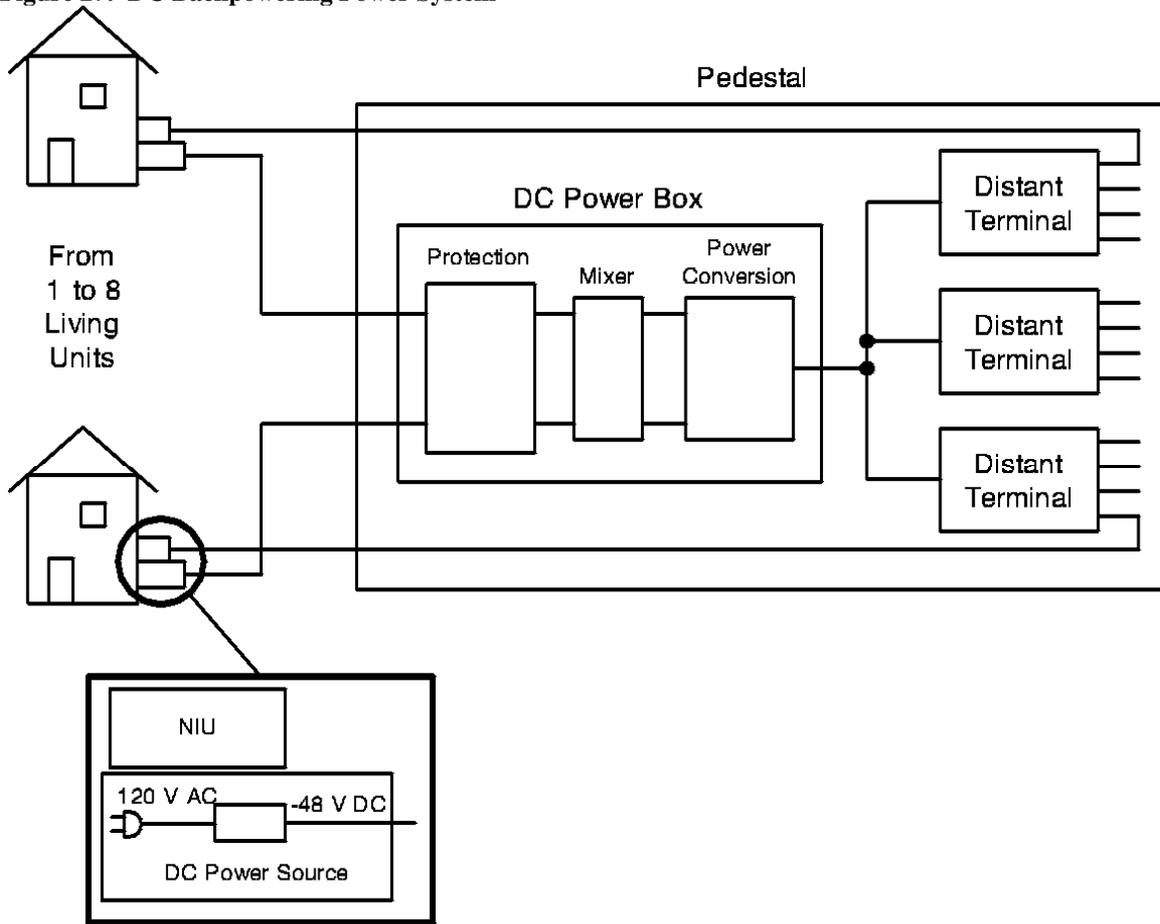


Figure 28: DC Backpowering Power Source

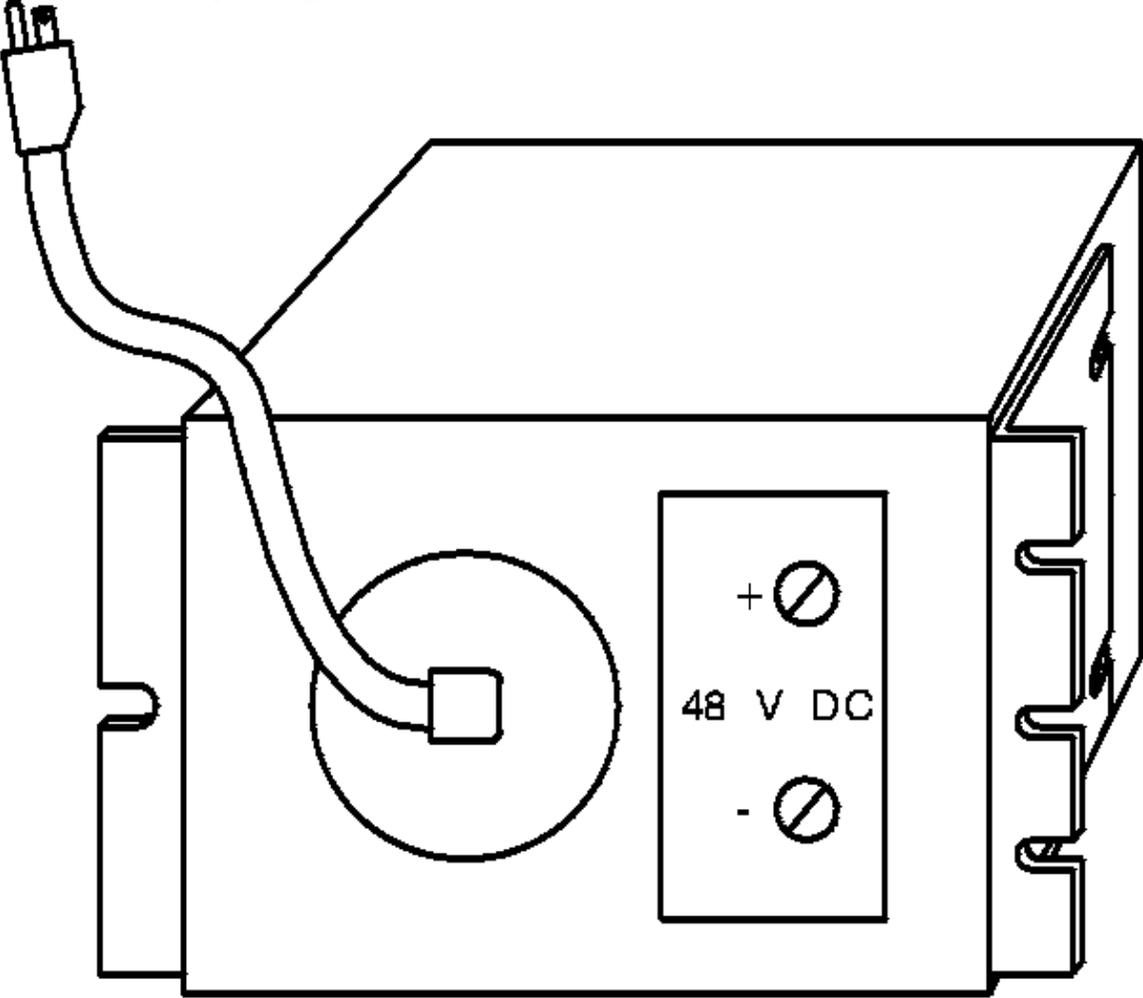


Figure 29: Backpowering Power Source Enclosures

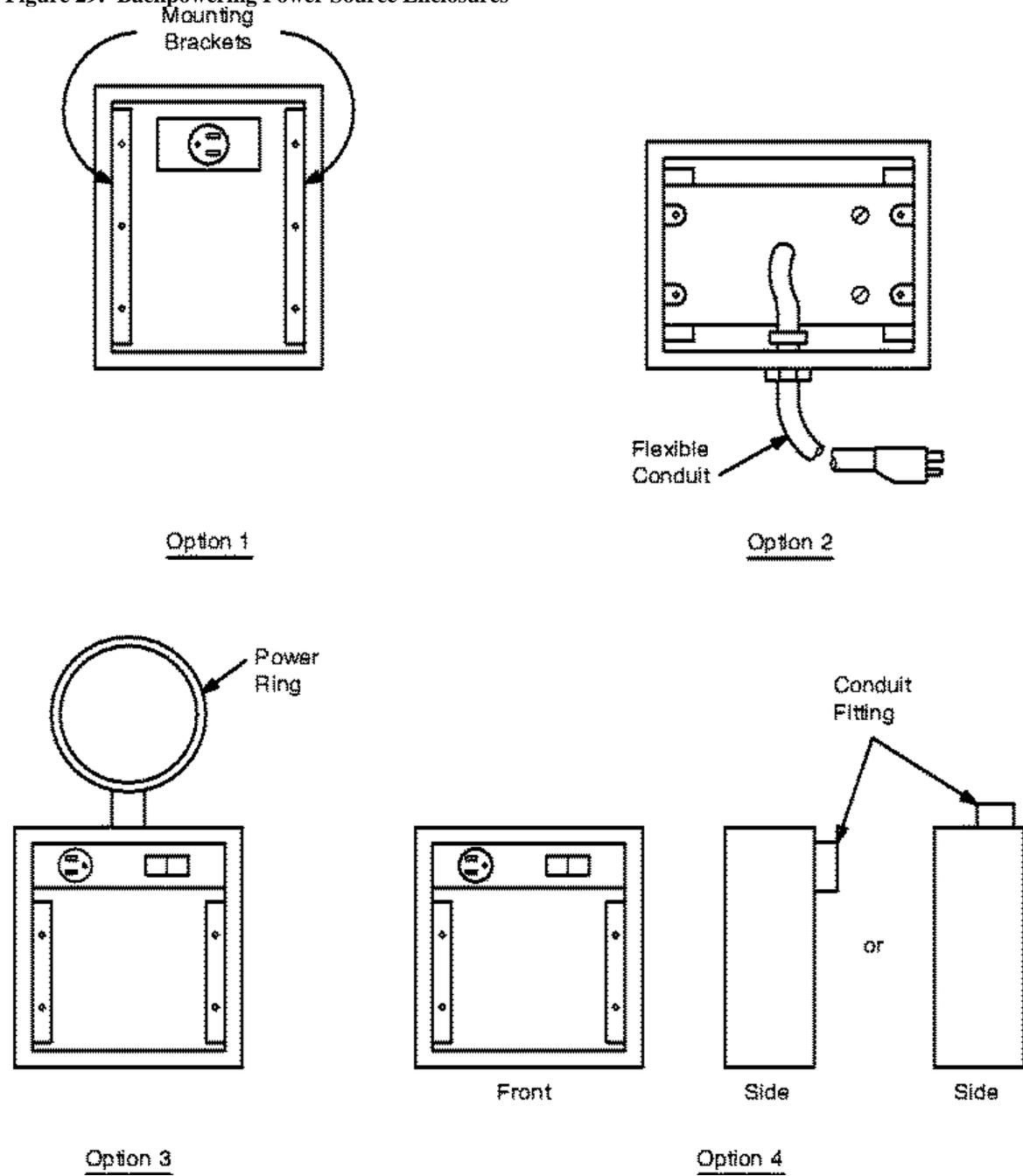


Figure 30: J99407TA-1, L1 Analyzer

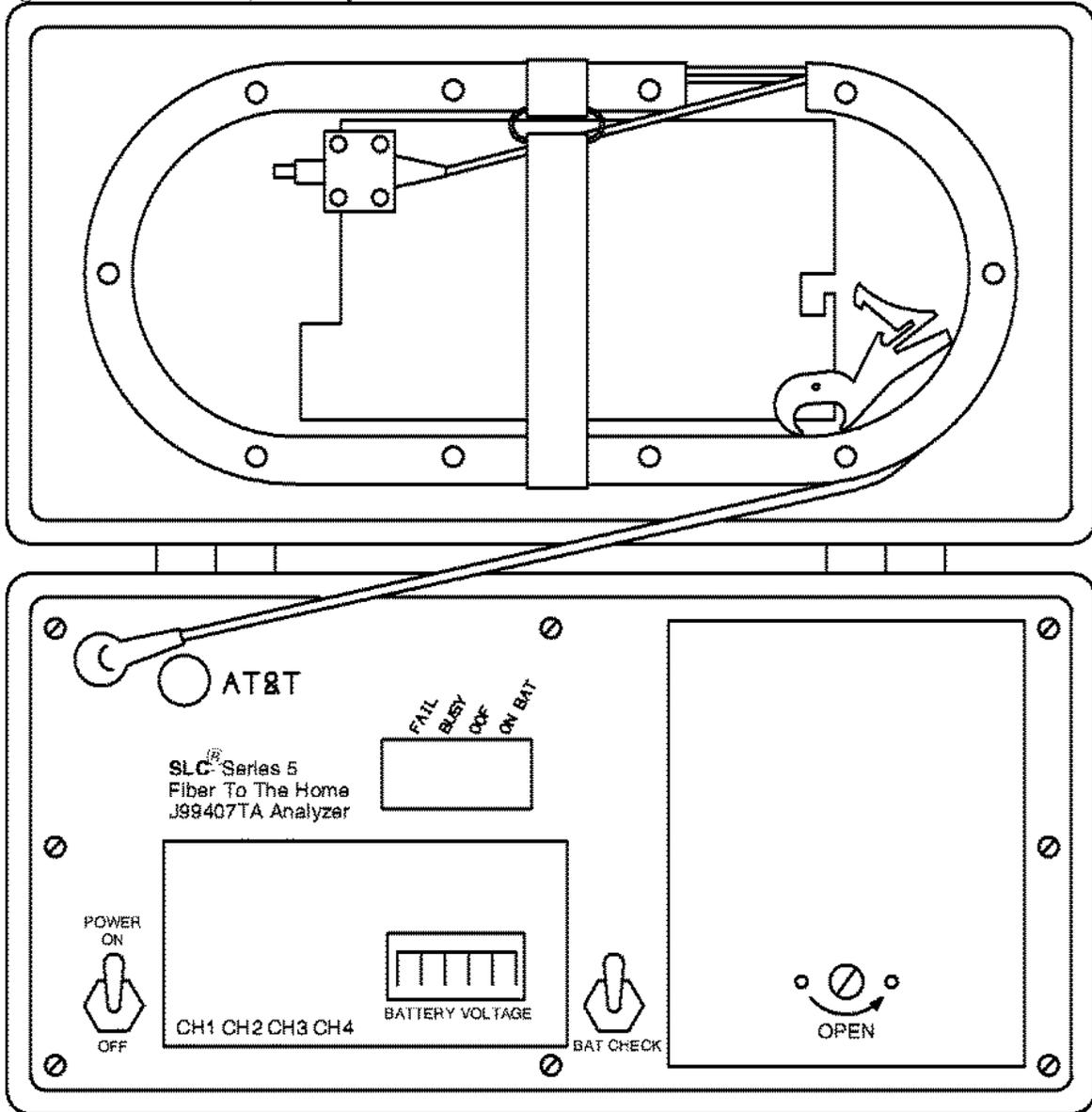


Figure 31: Cut Away View of Analyzer With KS-21906, L18 Battery Pack  
Front View  
J99407TA-1 Analyzer

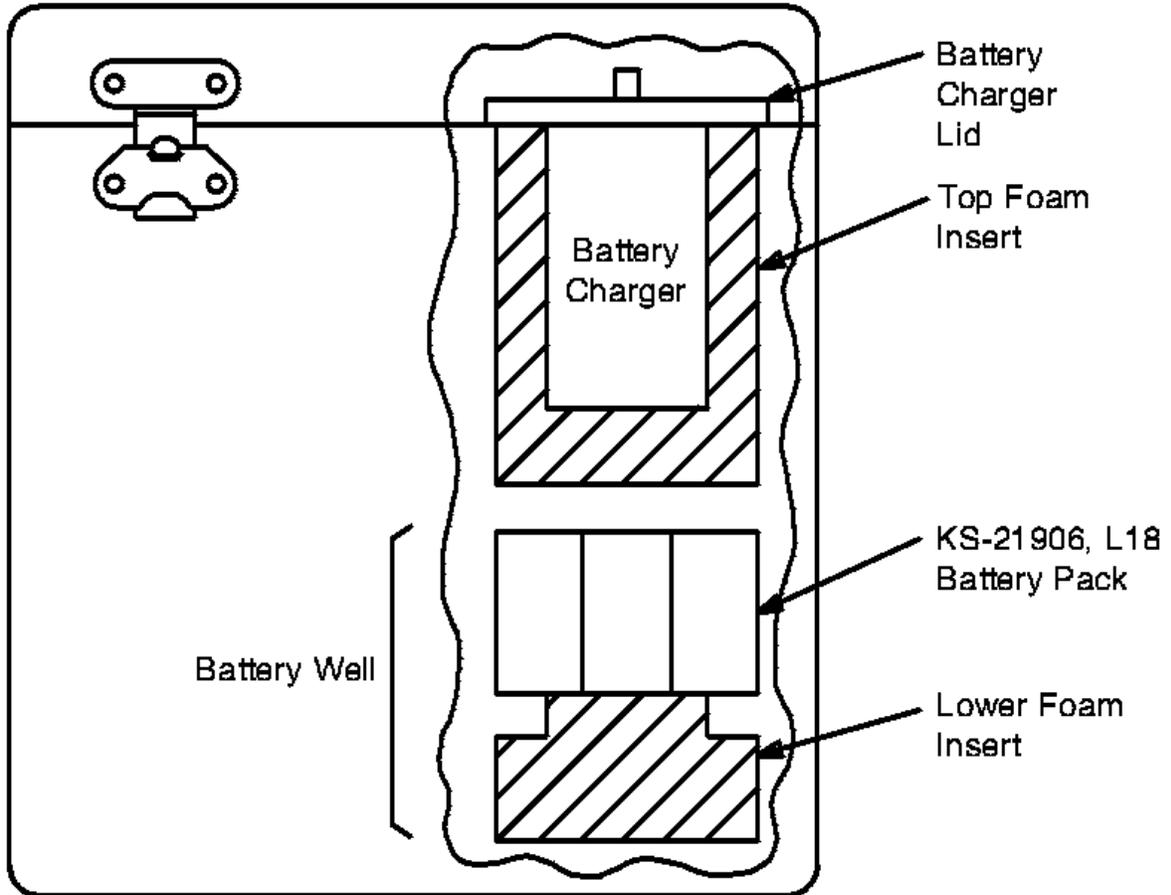


Figure 32: Cut Away View of Analyzer With KS-21906, L16 Battery Pack  
Front View  
J99407TA-1 Analyzer

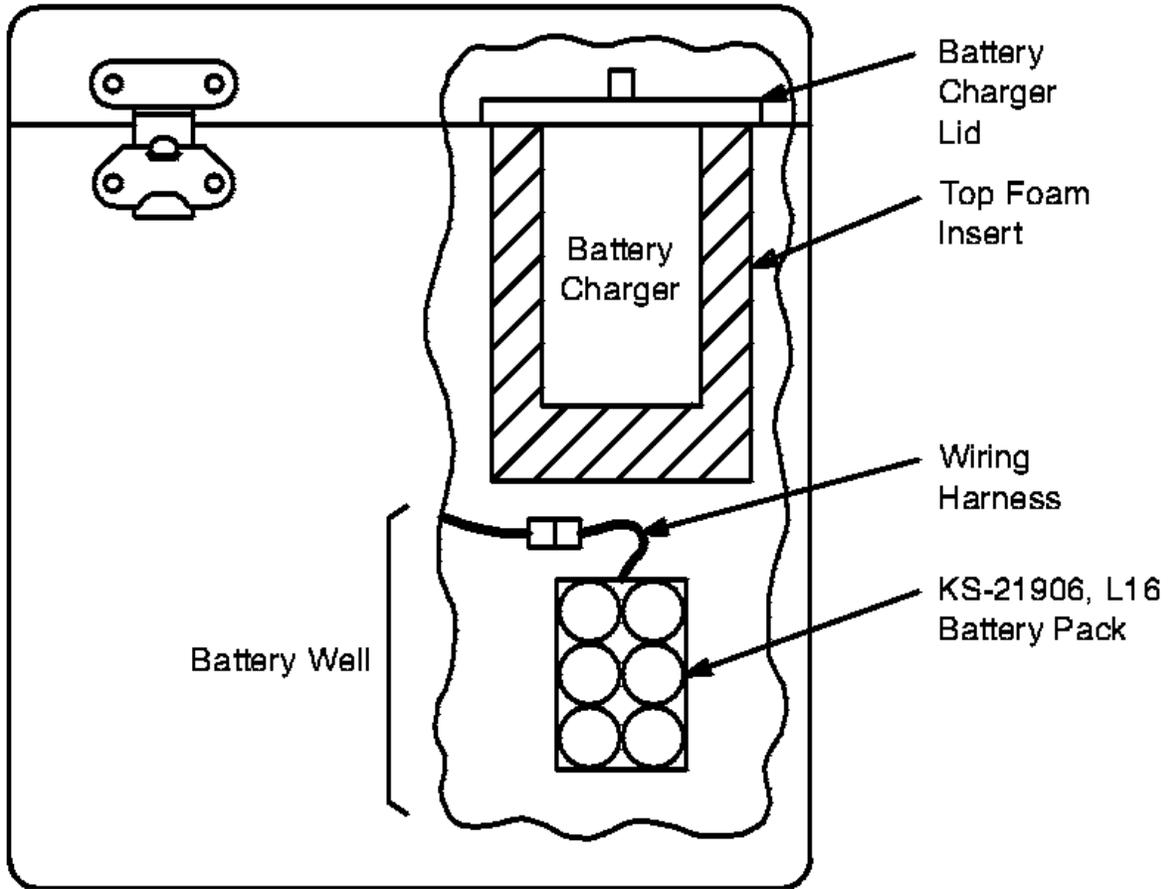


Figure 33: J99409OB-1, L1 OBMK (Cover Removed)

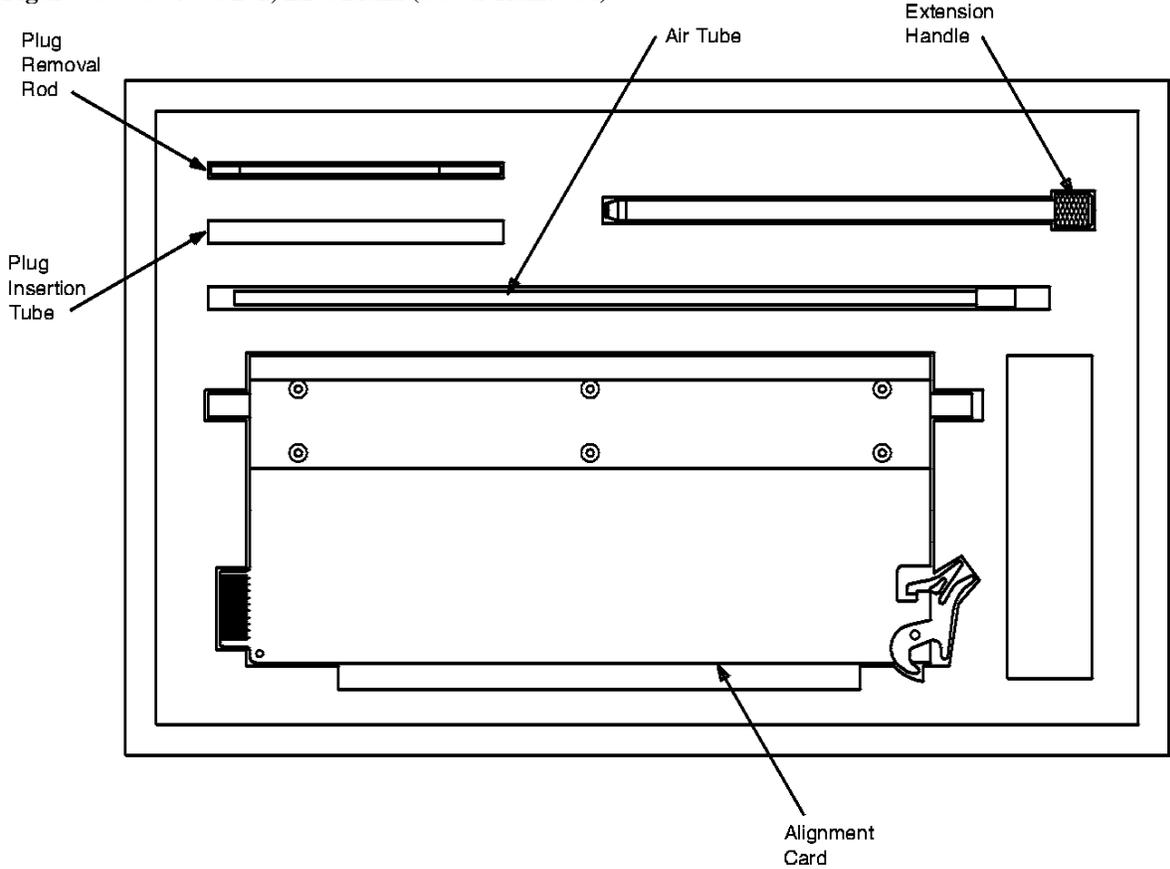


Figure 34: Video System Architecture

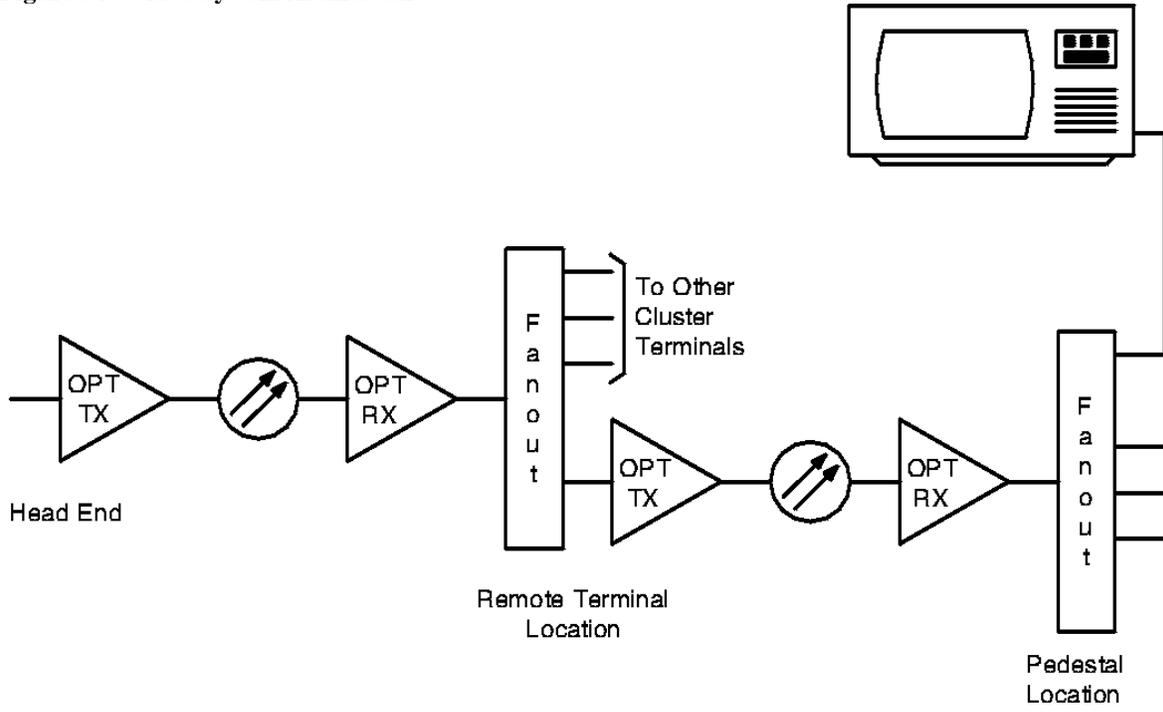


Figure 35: Gantt Chart for the FTTH System

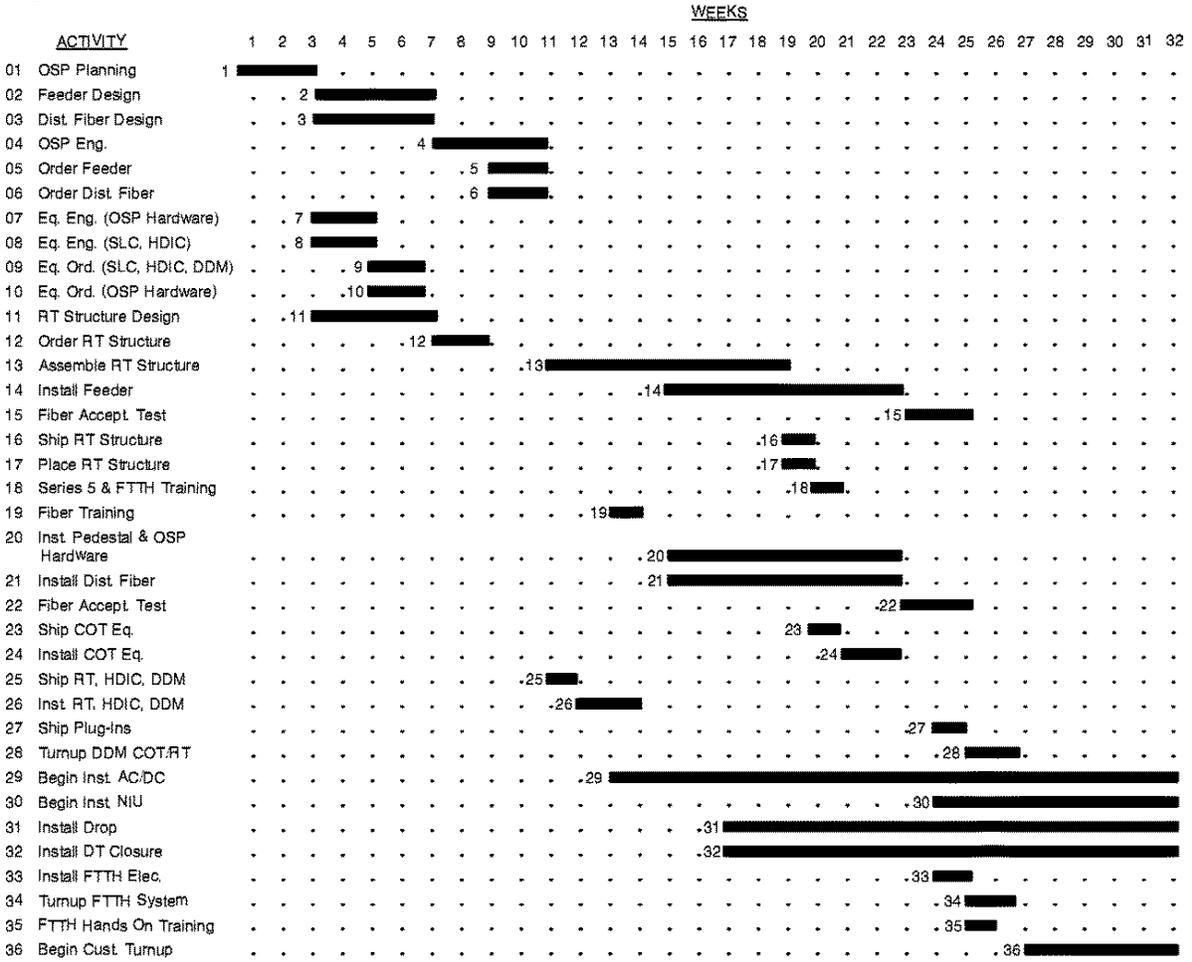
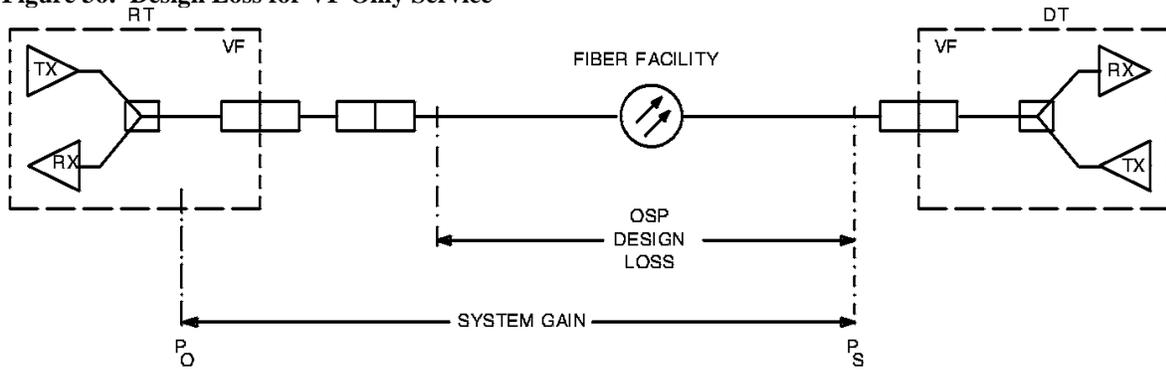


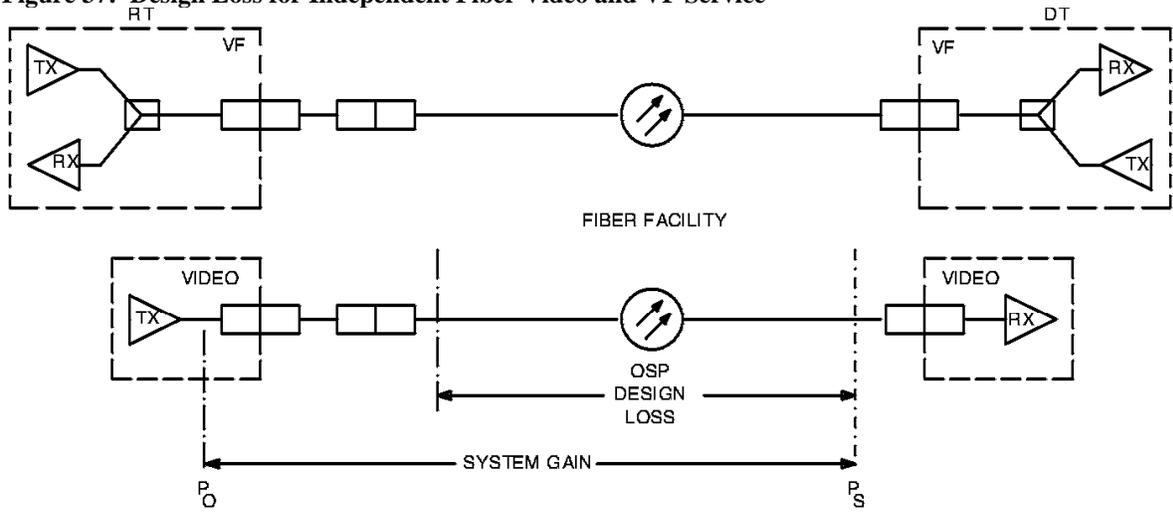
Figure 36: Design Loss for VF Only Service



LEGEND

 ST<sup>®</sup> LIGHTGUIDE CABLE CONNECTOR

Figure 37: Design Loss for Independent Fiber Video and VF Service



**LEGEND**

 ST<sup>®</sup> LIGHTGUIDE CABLE CONNECTOR

Figure 38: Provisioning Flowchart

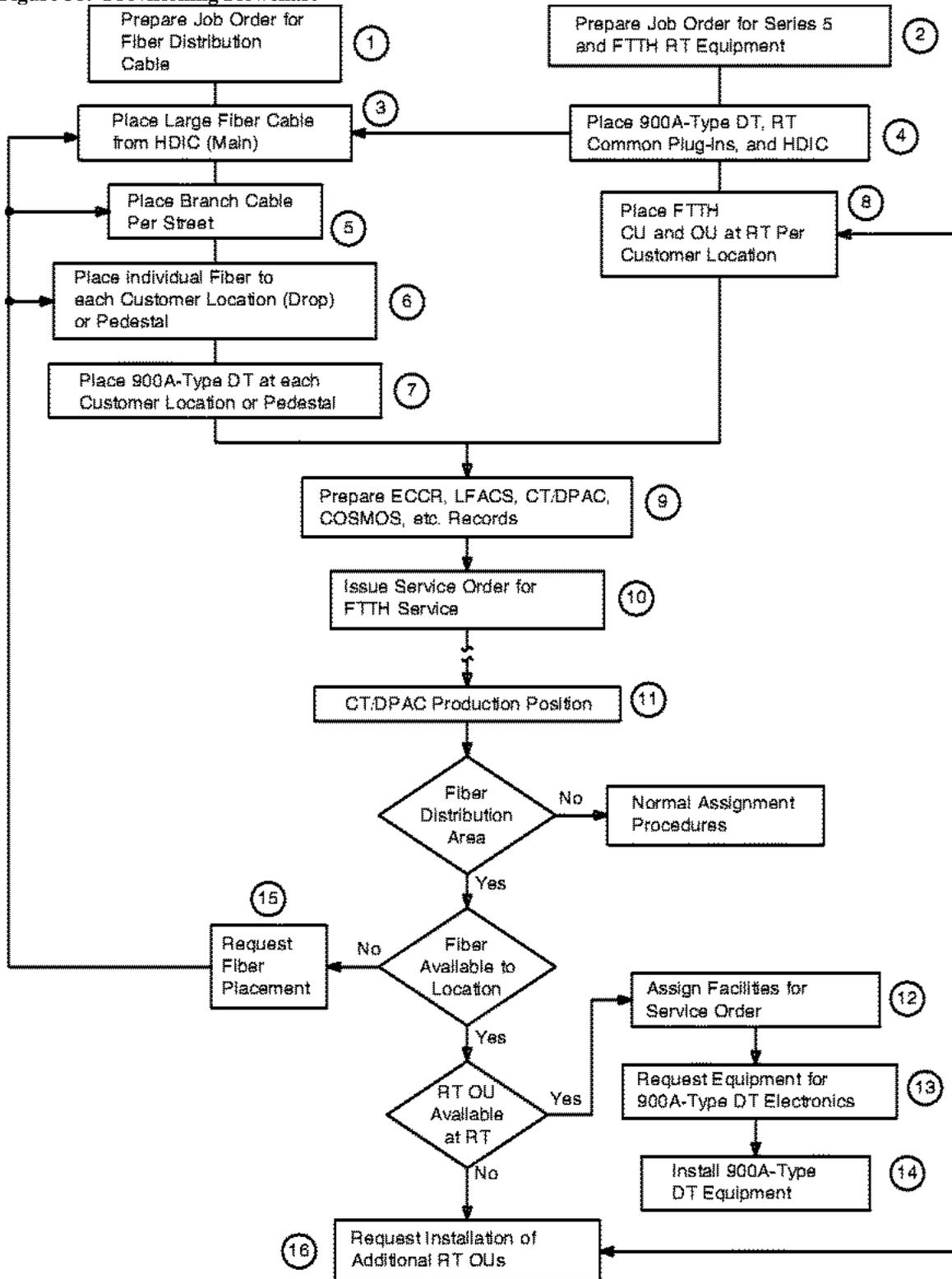


Figure 39: Derived Feeder Record

PAIRS 1 - 50 CABLE PG 5

DATE VERIFIED SERVES FIBER DIST. AREA (SLC 573 5) ESSEX-421 CA MN

CONR TO CA DEFSE COM1 1-250 TER LOC F512 LAMAR

CONR TO CA 2 COM2 1-100 FOR SUPPORT PRS. TER LOC F512 LAMAR

HELD ORDERS & REGRADES HELD ORDERS & REGRADES MIC CABLE COUNTS

ORDER NO. CAT. DATE SERV. TER. ORDER NO. CAT. DATE SERV. TER.

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120

← LT STATUS →

SEMP	TEL NO	ADDRESS	LEN	DE WY	MISC. CO. EQUIP	OF THE PR	OF THE WY	CA 14 PR	CA 14 WY	CONR TO PRS	PAIRS	LT		COT		RT		REMARKS
												12	13	14	15	16	17	
												01	W BL	1	ES	EFD	↓	
												02	W O	2	ES	↓		
												03	W C	3	ES	EFD	↓	
												04	W BR	4	ES	↓		
												05	W S	5	ES	EFD	↓	
NPT						102	SANDWICH RD.			211		06	R BL	6	ES	↓		
NPT						102	SANDWICH RD.			212		07	R O	7	ES	EFR	↓	
FT						104	SANDWICH RD.			221		08	R G	8	ES	↓		
FT						104	SANDWICH RD.			222		09	R BR	9	ES	↓		
FT						104	SANDWICH RD.			223		10	R S	10	ES	↓		
FT						104	SANDWICH RD.			224		11	BH O	11	ES	EFD	↓	
IFR	423 1323		5:18:47			101	SANDWICH RD.			191		12	BH O	12	ES	↓		
FT						101	SANDWICH RD.			192		13	BH G	13	ES	EFR	↓	
												14	BR S	14	ES	↓		
												15	BR S	15	ES	↓		
												16	Y BL	16	ES	↓		
												17	O Y O	17	ES	↓		
EP												18	O Y O	18	ES	↓		
EP												19	BR Y	19	ES	↓		
EP												20	Y S	20	ES	↓		
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Figure 40: CT/DPAC Example

STREET		FROM	TO	TYPE	PLT	ADM	SERVING AREA INTERFACE ADDRESS				DISTRIBUTION CABLE DESCRIPTION			
C O AREA		ESSEX		EXCH 421						INSIDE RT FS12 LAMAR (FIBER CA) DF 512				
HOUSE OR BLDG NO	TEL NO	SERV PTY	CO EQUIPMENT	PLT ADM	REMARKS	OTHER INFORMATION	CA	PAGE	MIN	SEC	CA	PAGE	MIN	SEC
SANDWICH RD. 100 106 FIBER														
ROUTE OF BLOCK 16C RZ LZ TAP DIST WIRE														
100											DF512	200		900A-IDT
											"	201		
											"	202		
											"	203		
											"	204		
											"	205		
											"	206		
											"	207		
											"	208		
											"	209		
102			Reserved for Future			NFT					DF512	210		900A-IDT
		IFR	SIC SYS 5			NFT	PG	5	5	5	"	211		
		IFR	"			NFT	PG	5	6	6	"	212		
			Reserved for Future			NFT					"	213		
			"			"					"	214		
			"			"					"	215		
			"			"					"	216		
			"			"					"	217		
			"			"					"	218		
			"			"					"	219		

STREET		FROM	TO	TYPE	PLT	ADM	SERVING AREA INTERFACE ADDRESS				DISTRIBUTION CABLE DESCRIPTION			
C O AREA		ESSEX		EXCH										
HOUSE OR BLDG NO	TEL NO	SERV PTY	CO EQUIPMENT	PLT ADM	REMARKS	OTHER INFORMATION	CA	PAGE	MIN	SEC	CA	PAGE	MIN	SEC
SANDWICH RD. 100 106 FIBER														
ROUTE OF BLOCK 16C RZ LZ TAP DIST WIRE														
104			Reserved for Future			NFT					DF512	220		900A-IDT
		IFR	SIC SYS 5			FT	PG	5	7	7	"	221		
		IFR	"			FT	"	8	8	8	"	222		
		IFR	"			FT	"	9	9	9	"	223		
		IFR	"			FT	"	10	10	10	"	224		
			Reserved for Future			NFT					"	225		
			"			"					"	226		
			"			"					"	227		
			"			"					"	228		
			"			"					"	229		
106			Reserved for Future			NFT					DF512	230		900A-IDT
		423 non IFR	SIC SYS 6			FT	5	111		11	"	231		
		IFR	SIC SYS 6			FT	5	112		12	"	232		
			Reserved for Future			NFT					"	233		
			"			"					"	234		
			"			"					"	235		
			"			"					"	236		
			"			"					"	237		
			"			"					"	238		
			"			"					"	239		

Figure 41: Optics Shelf (Bottom View)

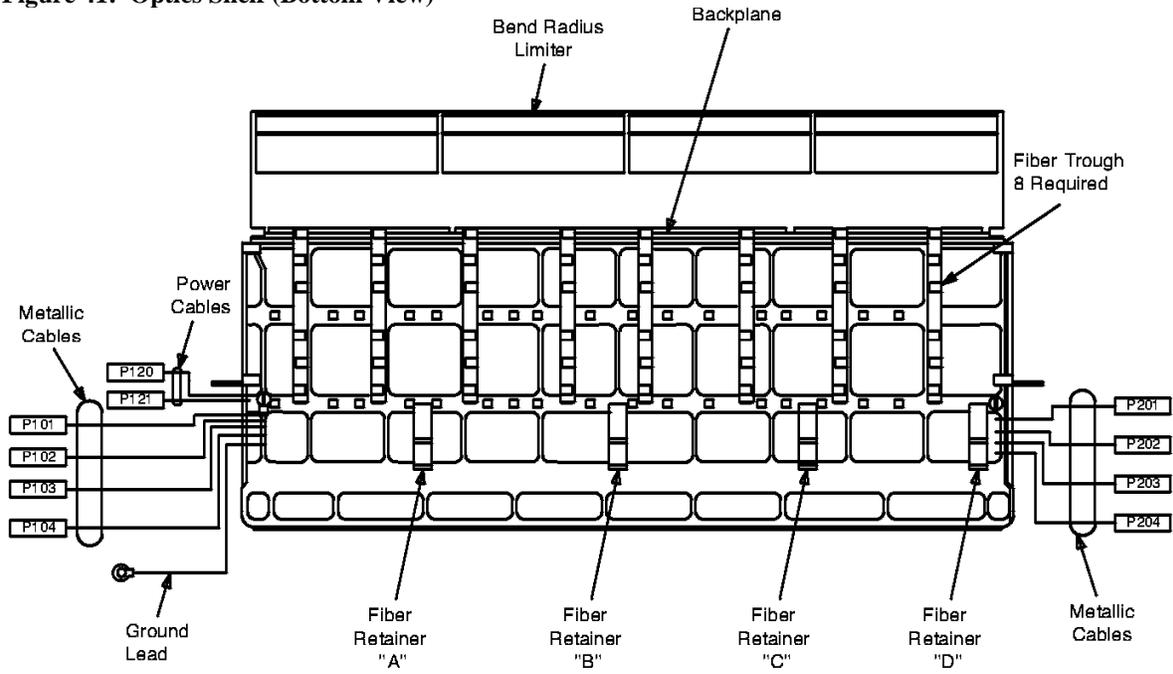


Figure 42: Optics Shelf (Side View)

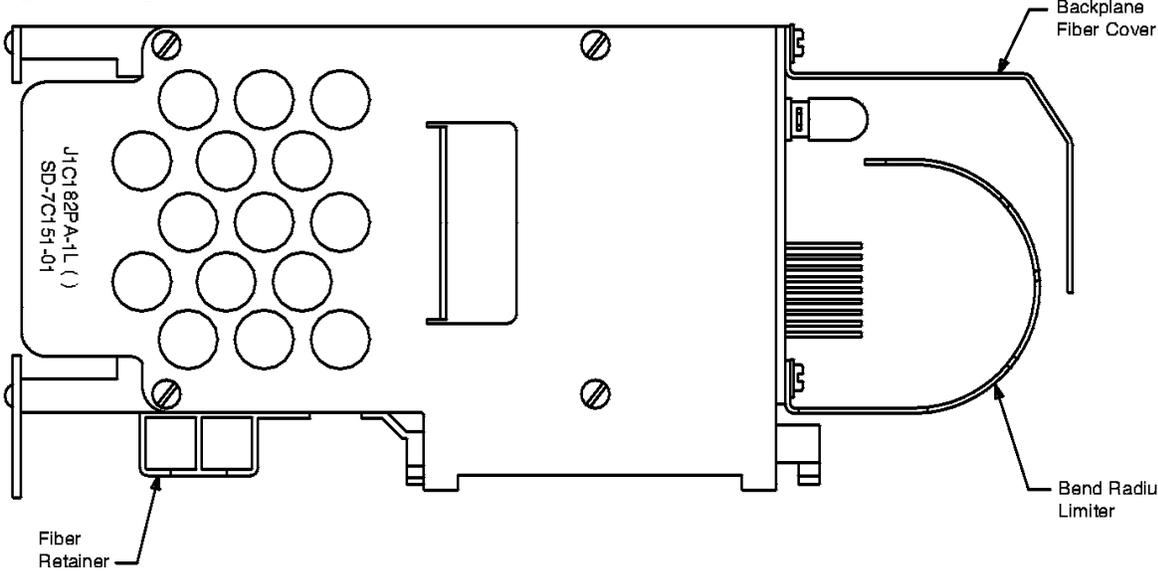


Figure 43: RT Frame Interconnections

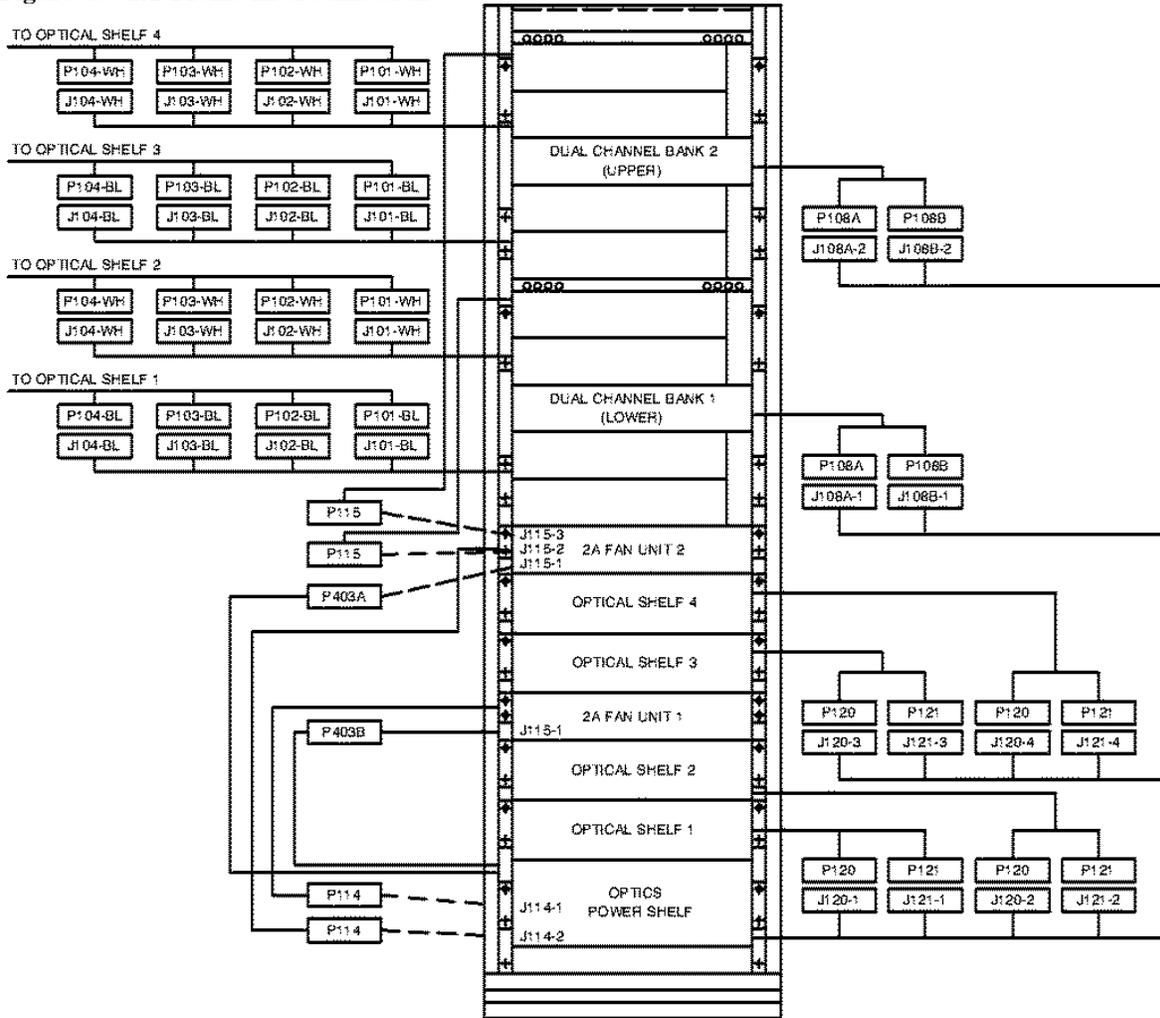


Figure 44: External RT Frame Connections

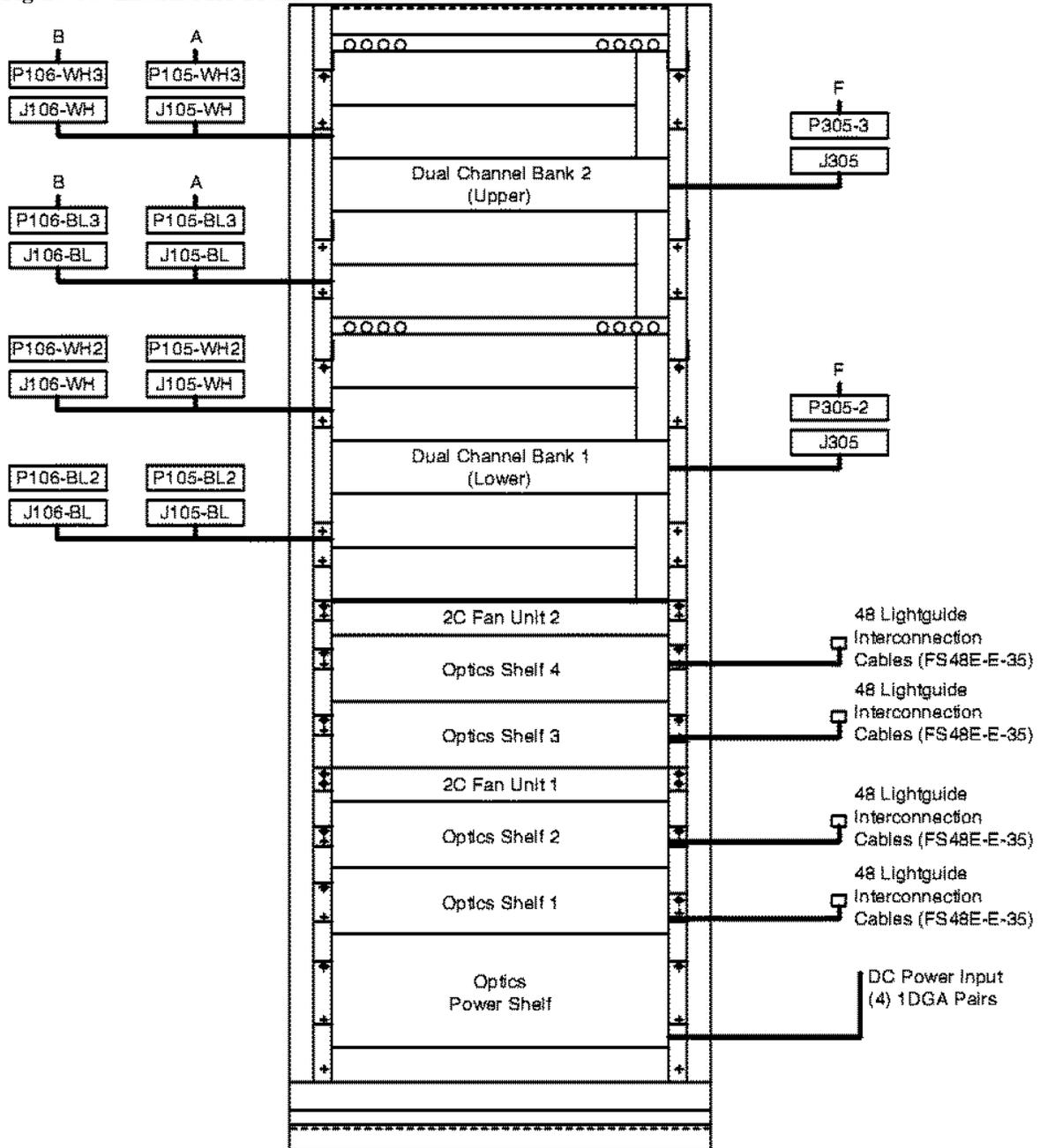


Figure 45: Fiber Connection to Optics Shelf

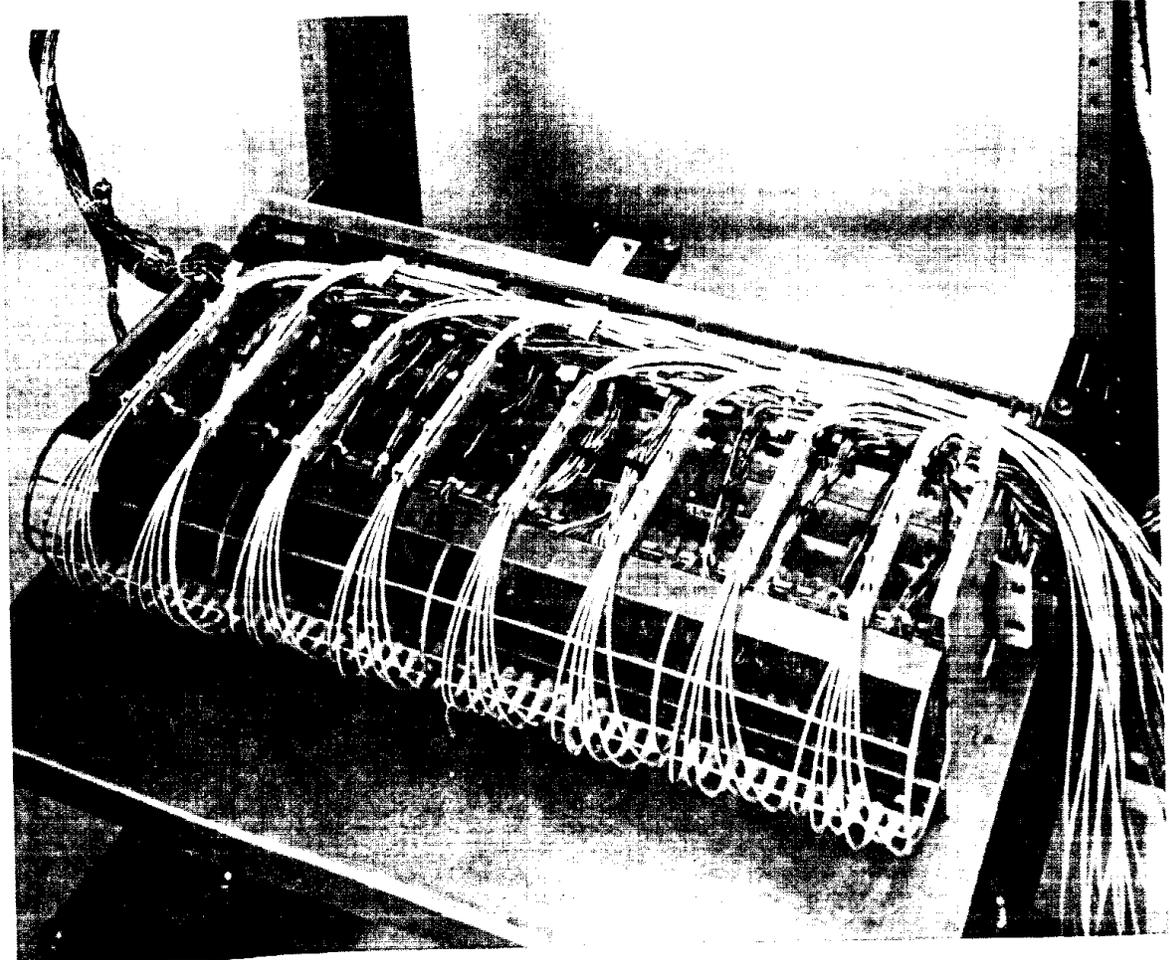


Figure 46: 900A1 DT Closure Box

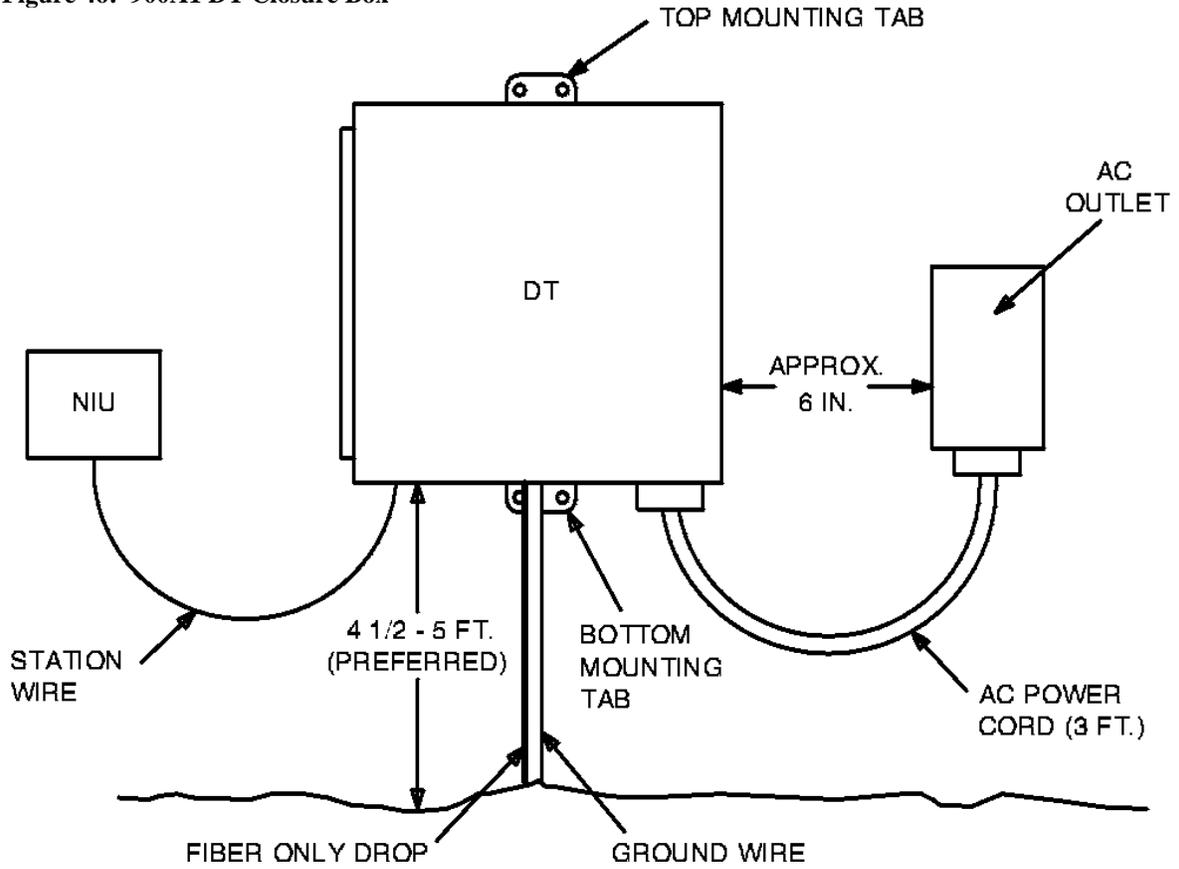


Figure 47: Distant Terminal AC Power Cord Connection

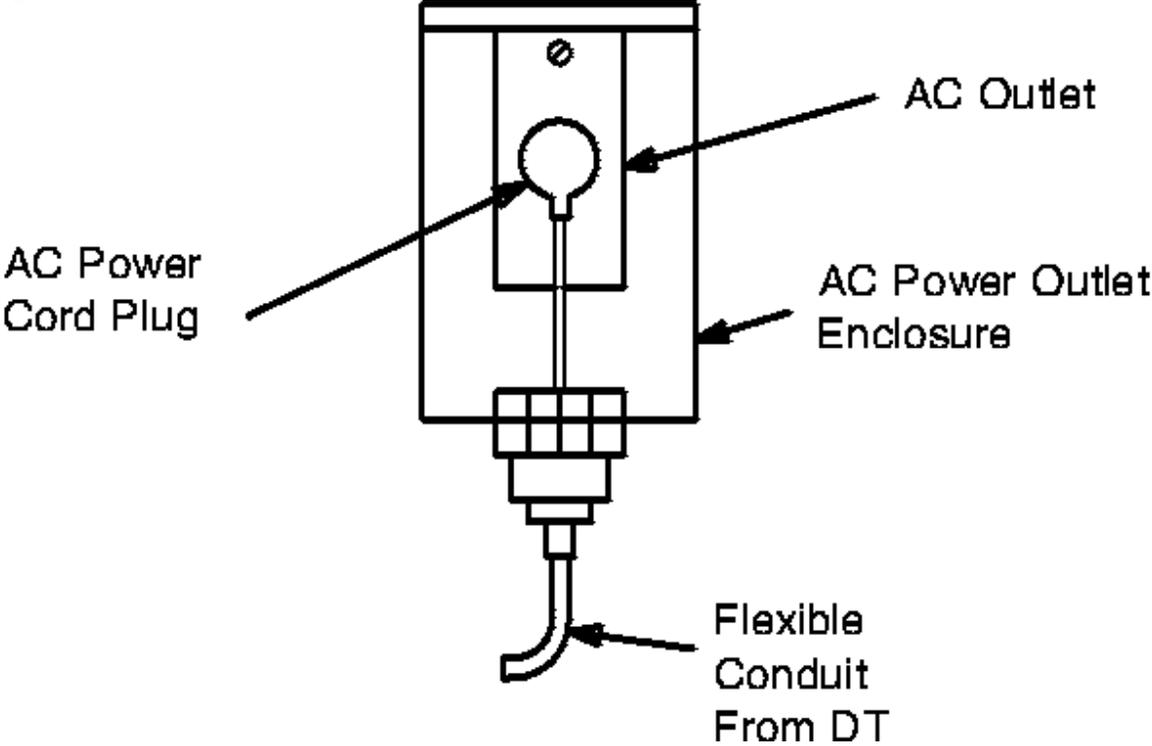
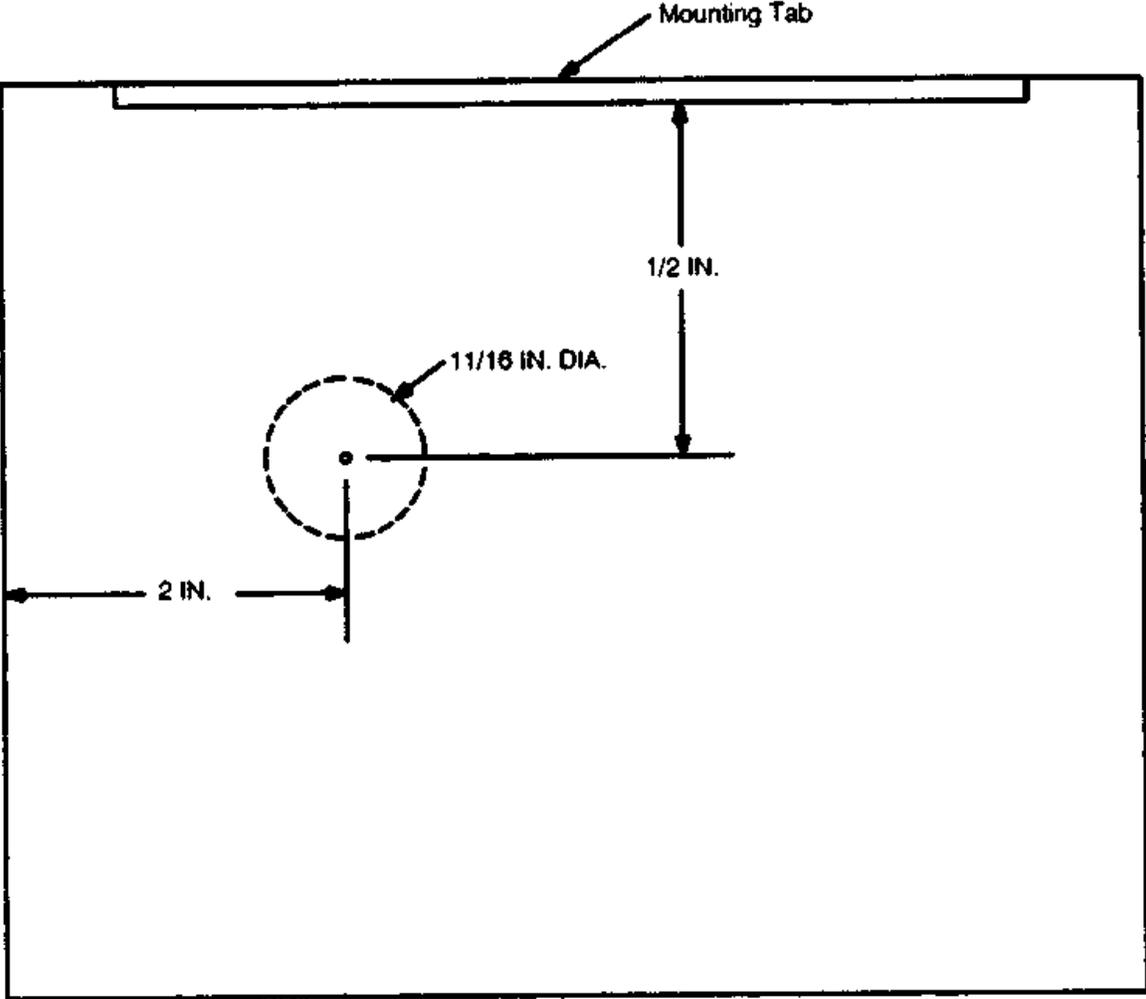


Figure 48: Location of Hole in Bottom of Enclosure



**Figure 49: Location of Hole in Rear of Enclosure**

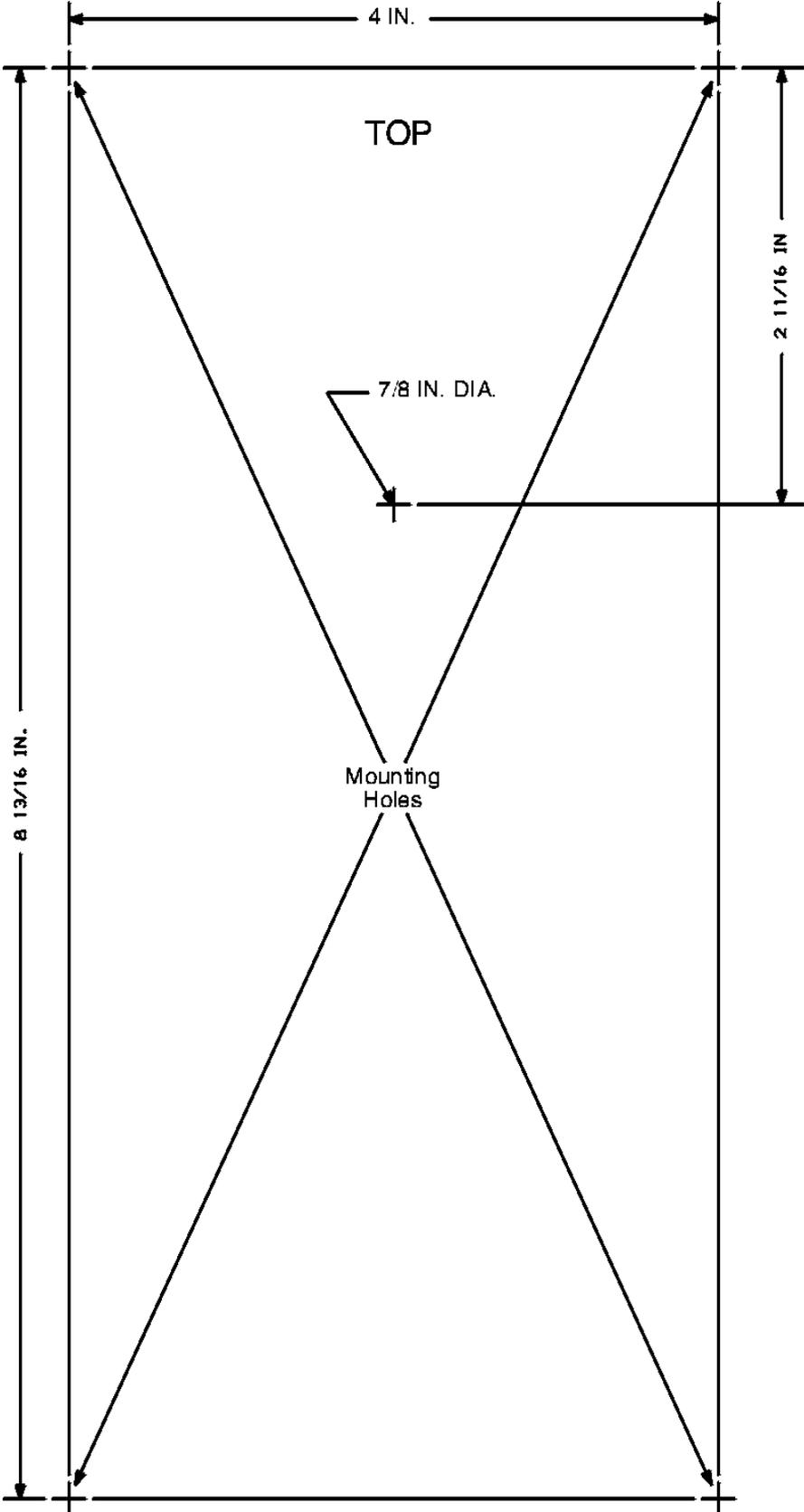
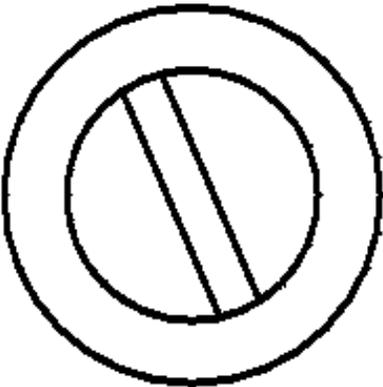
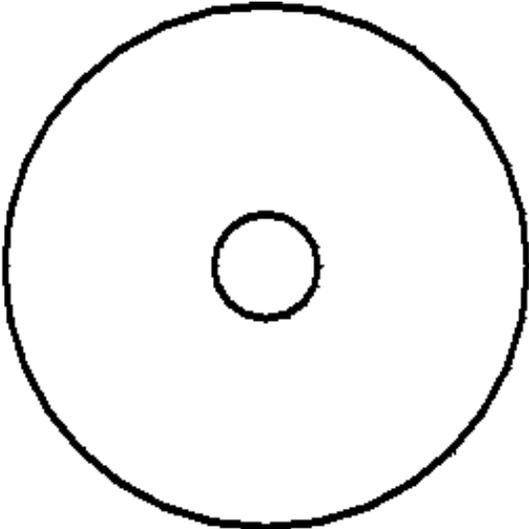




Figure 50: DT Closure Lightguide Cable Entrance Hole Grommets



Early Version



Preterminated  
Cable Version

**Figure 51: Removing Protector Tube From Preterminated Cable**  
Storage  
Protector Tube

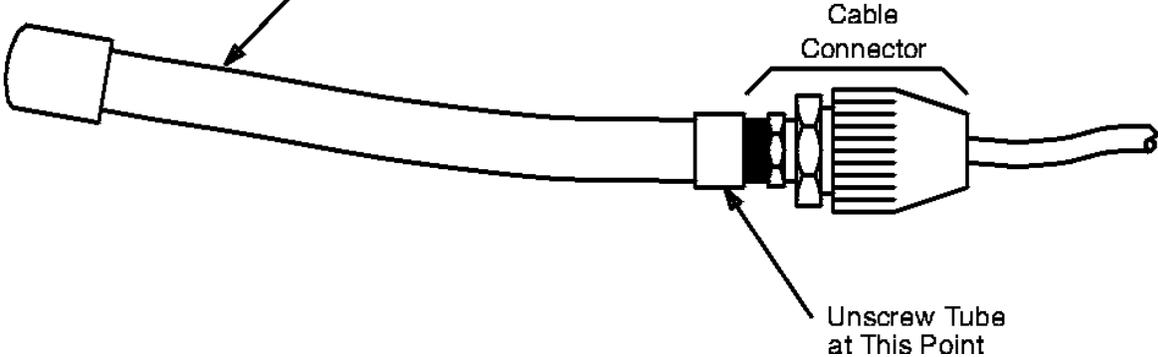


Figure 52: Attaching Connector to Closure

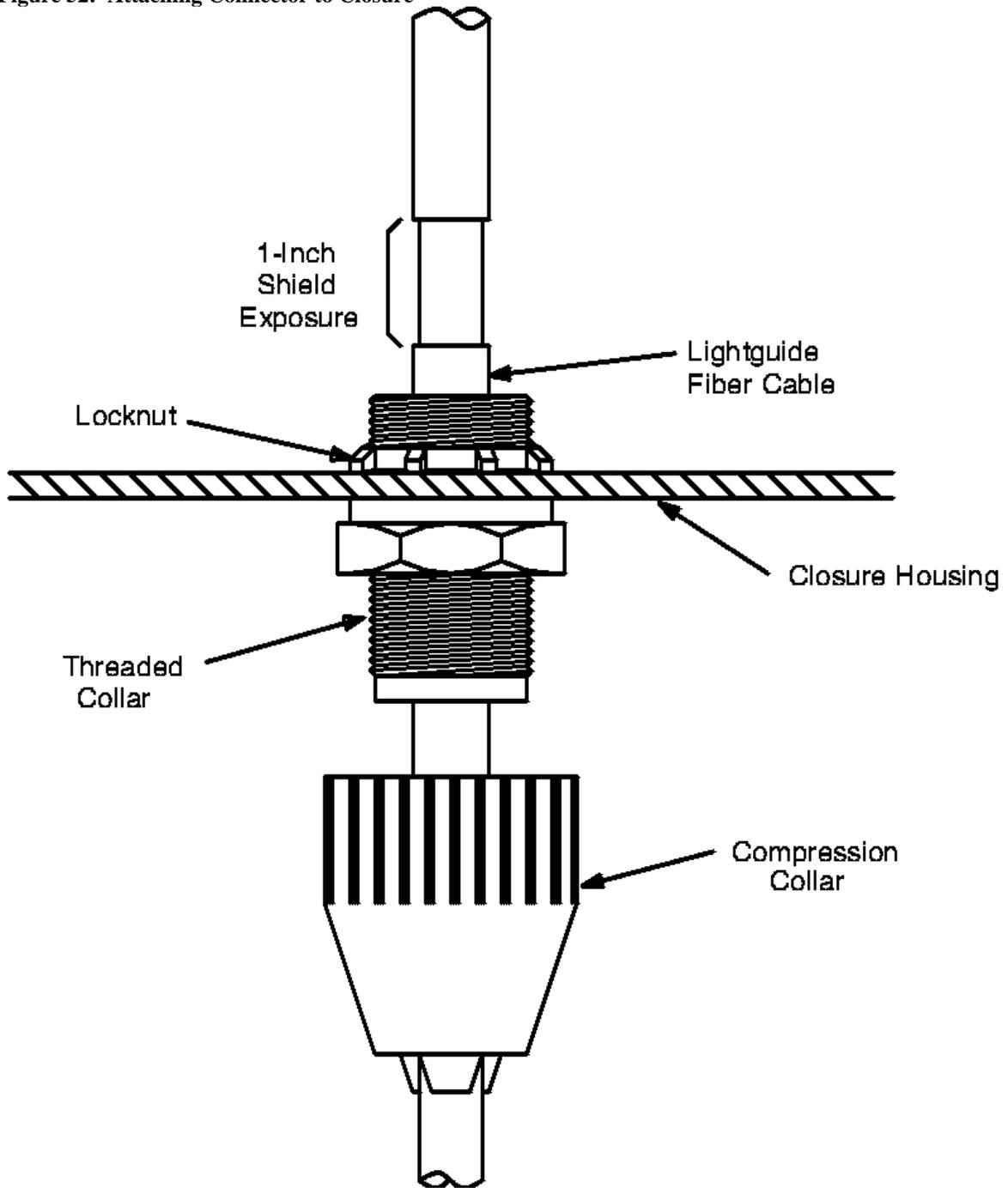


Figure 53: Analyzer Access Point

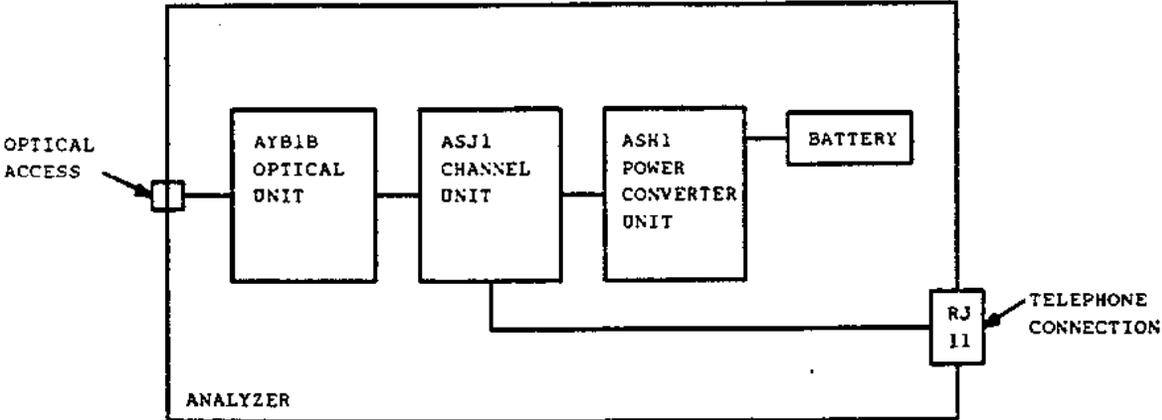


Figure 54: Analyzer Connection at HDIC

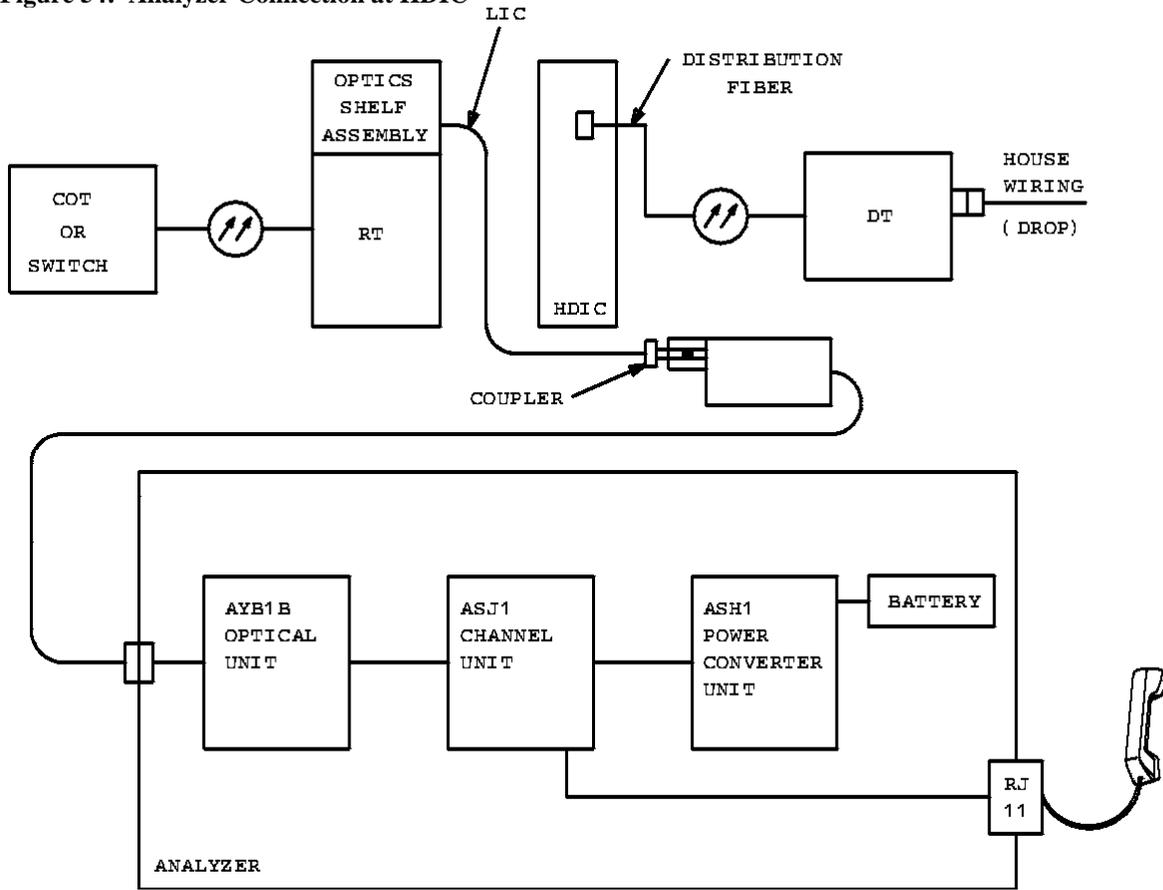


Figure 55: Analyzer Connection to Distribution Fiber at DT

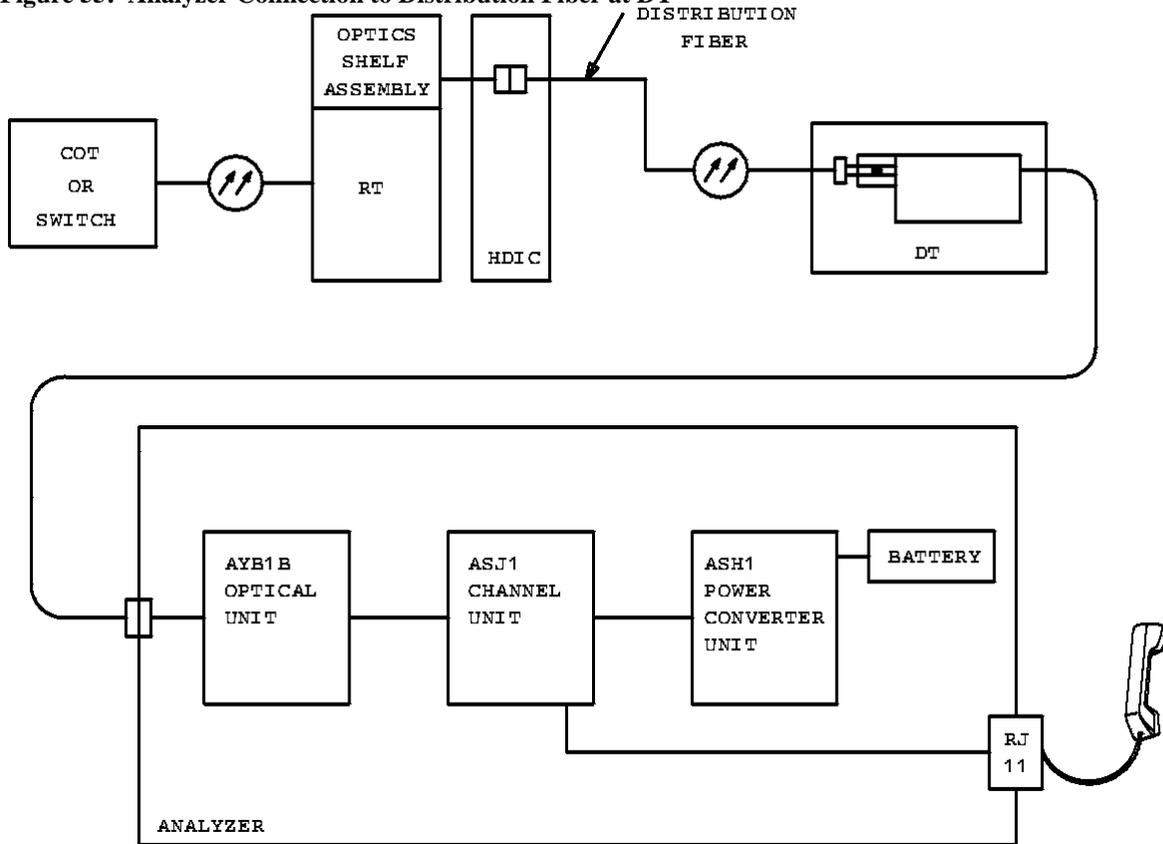


Figure 56: MLT-2/XTC Test Paths

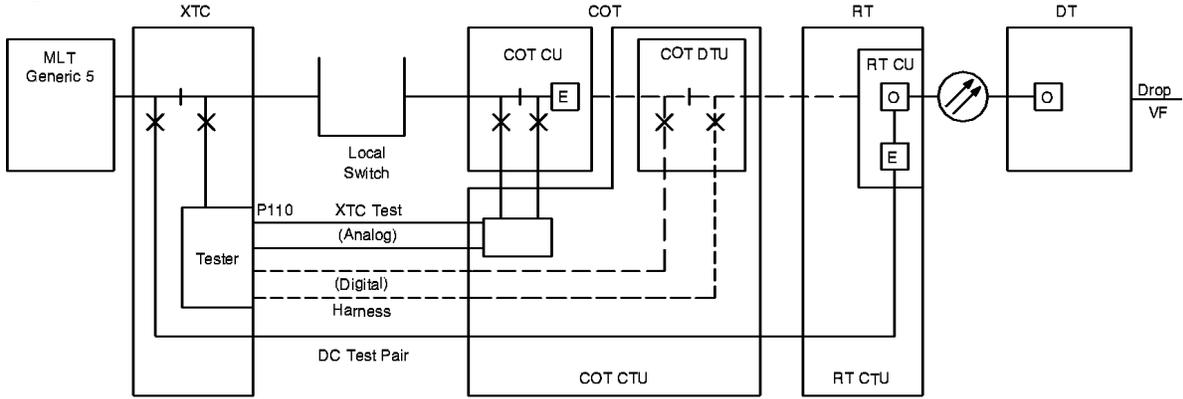


Figure 57: SAM Mask for Enhanced Test Signature #1

---

```

SAM      SYSTEM:  m2          PRTR:          BY:
REQ:    DVER -N 1          NPANNK:          EXK:
NEXT   ( Y/N ):          STATUS:
INPUT:
      VER:      MLT:      DC SIGNATURE
              KOHMS      VOLTS
              MIN      MAX      MIN      MAX
      86.00    99.00          4.0    +4.0    T-R   (   )  VER
      84.00    96.00          4.0    +4.0    T-G   (  Y )  SIGNATURE
      84.00    96.00          4.0    +4.0    R-G   (   )  VER OR SIGNATURE
                                      (   )  VER AND SIGNATURE
      -----
OUTPUT:
VER: 1X * FIBER-TO-THE-HOME LOOP INDICATED      *
      * RT-TO-DT FIBER LINK GOOD                  *
      * CHANNEL AND DROP TESTS NOT AVAIL.         *
      * ( DISPATCH TO DT)                          *
      *                                             *
      *                                             *
```

---

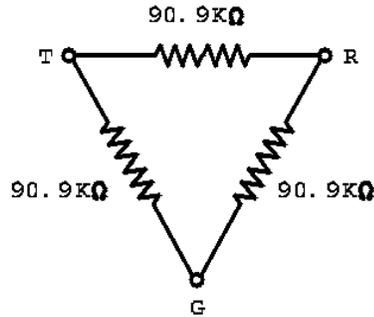


Figure 58: TV Mask for Enhanced Test Signature #1

TV EC 123 PRTR W020 REQ BY DML CB 201 386 448703-18-88 0900A

TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163			5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: IX FIBER-TO-THE-HOME LOOP INDICATED (DISPATCH TO DT)  
 RT-TO-DT FIBER LINK GOOD  
 CHANNEL AND DROP TESTS NOT AVAIL.

CRAFT: DC SIGNATURE		MLT: DC SIGNATURE		AC SIGNATURE	
KOHMS	VOLTS	KOHMS	VOLTS	KOHMS	
62	T-R	94	T-R	36	T-R
61	T-G	92.00	T-G	35	T-G
61	R-G	92.00	R-G	35	R-G

Interpretation:

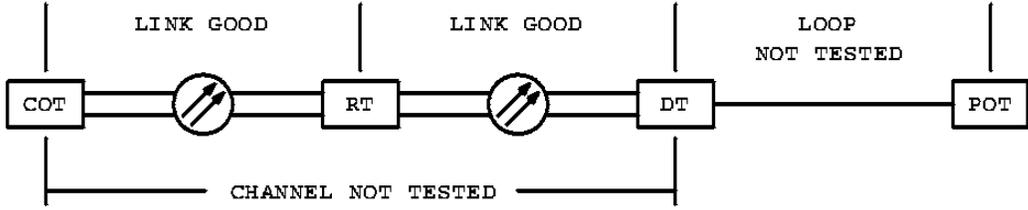


Figure 59: SAM Mask for Enhanced Test Signature #2

---

```

SAM          SYSTEM: m2          PRTR:          BY:
REQ:        DVER -N 2          NPANNX:          EXK:
NEXT      ( Y/N ):          STATUS:
INPUT:

          VER:          MLT:          DC SIGNATURE
                   KOHMS          VOLTS
                   MIN          MAX          MIN          MAX
2500.        3500.
84.00        96.00   -4.00   +4.00   T-R   ( )   VER
84.00        96.00   -4.00   +4.00   T-G   ( Y ) SIGNATURE
84.00        96.00   -4.00   +4.00   R-G   ( )   VER OR SIGNATURE
                   ( )   VER AND SIGNATURE

OUTPUT:
VER: 2X * FIBER-TO-THE-HOME LOOP INDICATED *
        * RT-TO-DT FIBER LINK BAD - OOF *
        * CHANNEL AND DROP TESTS NOT DONE *
        * ( DISPATCH TO RT) *
        * *
        * *

```

---

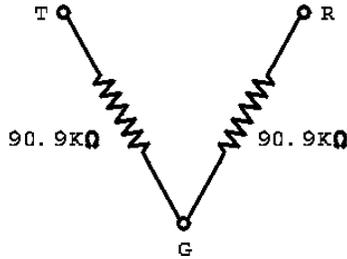


Figure 60: TV Mask for Enhanced Test Signature #2

TV EC 123 PRTR W020 REQ BY DML CB 201 386 448703-18-88 0900A

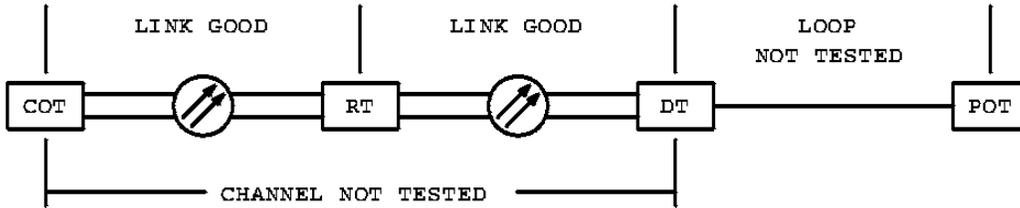
TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163				5 201 386 2805	K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: IX FIBER-TO-THE-HOME LOOP INDICATED (DISPATCH TO RT)  
 RT-TO-DT FIBER LINK BAD - OOF  
 CHANNEL AND DROP TESTS NOT DONE

CRAFT: DC SIGNATURE		MLT: DC SIGNATURE		AC SIGNATURE	
KOHMS	VOLTS	KOHMS	VOLTS	KOHMS	
184		T-R	3500	T-R	54
91	0	T-G	91.37	T-G	36
91	0	R-G	91.12	R-G	36

Interpretation:



**Figure 61: MLT-2/XTC Test Paths for Enhanced Testing Capability**

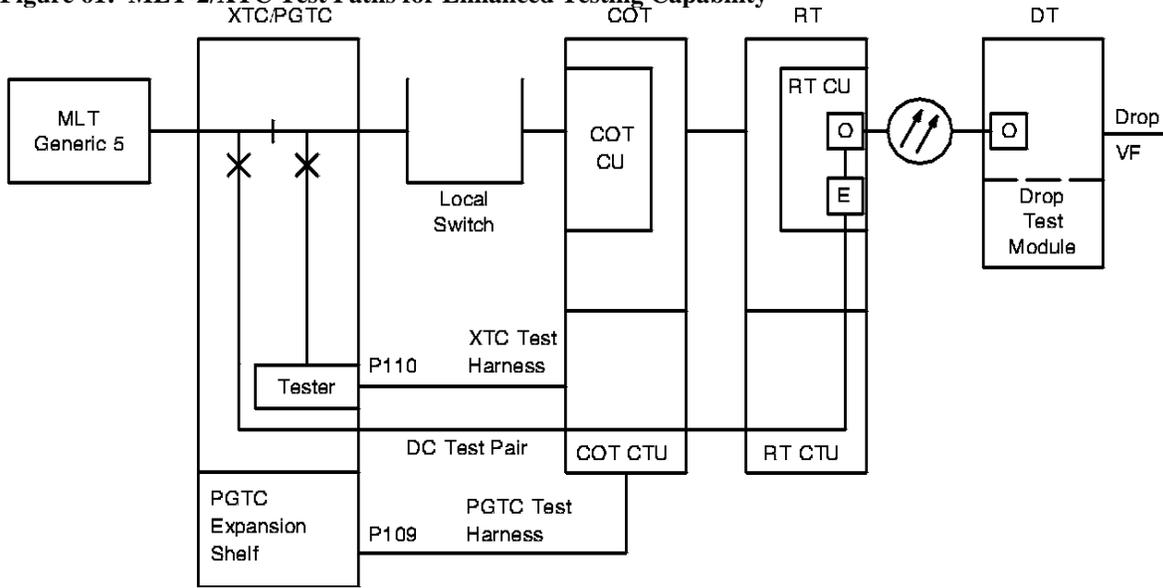


Figure 62: SAM Mask for Enhanced Test Signature #3

---

```

SAM          SYSTEM:  m2          PRTR:          BY:
REQ:  DVER  -N  3          NPANNX:          EXK:
NEXT  ( Y/N):          STATUS:
INPUT:
      VER: 95  MLT:  DC SIGNATURE
              KOHMS      VOLTS
              MIN      MAX  MIN      MAX
      24.00  34.00          T-R  (   )  VER
      84.00  96.00  -4.00  +4.00  T-G  (   )  SIGNATURE
      84.00  96.00  -4.00  +4.00  R-G  (   )  VER OR SIGNATURE
                                      ( Y )  VER AND SIGNATURE
      _____
OUTPUT:
      VER: 3X  * FIBER-TO-THE-HOME LOOP INDICATED  *
              * COT-TO-DT CHANNEL TEST OK          *
              * DT COMMON EQUIP. FAILURE            *
              * ( DISPATCH TO DT)                   *
              *                                       *
              *                                       *

```

---

Figure 63: TV Mask for Enhanced Test Signature #3

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK	TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163				5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051

REQ	L#	CMT	CA	CO: SLC SERIES 5
		TEMP (F)	PR OVER	OSP:

&FULLX TERM: SINGLE PARTY

VER: 3X FIBER-TO-THE-HOME LOOP INDICATED (DISPATCH TO DT)

COT-TO-DT CHANNEL TEST OK

DT COMMON EQUIP. FAILURE

CRAFT:	DC SIGNATURE	MLT:	DC SIGNATURE	AC SIGNATURE
	KOHMS VOLTS		KOHMS VOLTS	KOHMS
	26 T-R		30.67 T-R	21 T-R
	52 T-G		91.58 T-G	35 T-G
	52 R-G		91.54 R-G	36 R-G

Interpretation:

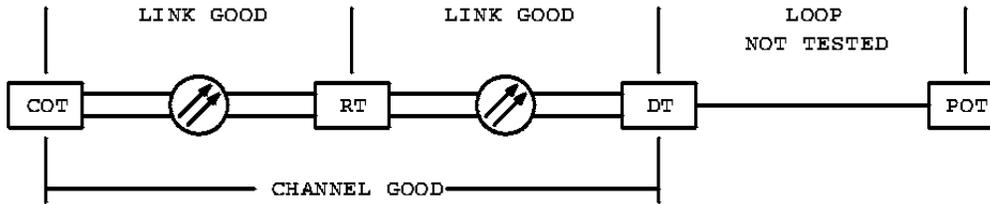


Figure 64: SAM Mask for Enhanced Test Signature #4

---

```

SAM          SYSTEM:  m2          PRTR:          BY:
REQ:  DVER -N 4          NPANNX:          EXK:
NEXT  ( Y/N ):          STATUS:
INPUT:
      VER: 95  MLT:      DC SIGNATURE
              KOHMS      VOLTS
              MIN        MAX  MIN    MAX
      34.00   44.00      -4.00  +4.00  T-R  ( ) VER
      84.00   96.00      -4.00  +4.00  T-G  ( ) SIGNATURE
      84.00   96.00      -4.00  +4.00  R-G  ( ) VER OR SIGNATURE
              ( Y ) VER AND SIGNATURE
DECISION RULE ( Y )
OUTPUT:
VER: 4X * FIBER-TO-THE-HOME LOOP INDICATED *
        * COT-TO-DT CHANNEL TEST OK      *
        * DROP TEST OK                    *
        *                                  *
        *                                  *
        *                                  *

```

---

Figure 65: TV Mask for Enhanced Test Signature #4

---

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN MDF STATUS CALLBACK TIME FRAME CABLE/PAIR COMMENT  
 1. 305 386 7163 5 201 386 2805 K1023/415 WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: 4X FIBER-TO-THE-HOME LOOP INDICATED  
 COT-TO-DT CHANNEL TEST OK  
 DROP TEST OK

CRAFT:	DC SIGNATURE		MLT:	DC SIGNATURE		AC SIGNATURE	
	KOHMS	VOLTS		KOHMS	VOLTS	KOHMS	
	34		T-R	41.42		25	T-R
	54		T-G	91.40		35	T-G
	54		R-G	91.42		35	R-G

---

Interpretation:

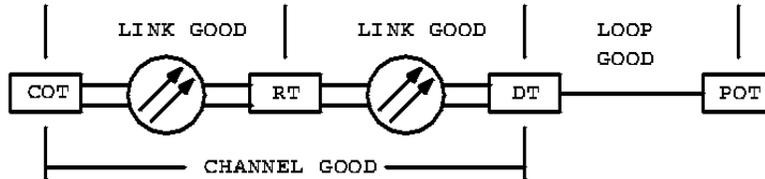


Figure 66: SAM Mask for Enhanced Test Signature #5

---

```

SAM          SYSTEM:  m2          PRTR:          BY:
REQ:  DVER -N 5          NPANNX:          EXK:
NEXT  ( Y/N):          STATUS:
INPUT:
  VER:  95  MLT:  DC SIGNATURE
          KOHMS          VOLTS
          MIN  MAX      MIN  MAX
          44.00  54.00          T-R  ( ) VER
          84.00  96.00 -4.00  +4.00 T-G  ( ) SIGNATURE
          84.00  96.00 -4.00  +4.00 R-G  ( ) VER OR SIGNATURE
          ( Y) VER AND SIGNATURE
          _____
OUTPUT:
  VER: 5X * FIBER-TO-THE-HOME LOOP INDICATED *
          * COT-TO-DT CHANNEL TEST OK          *
          * DROP TEST FAILS - OPEN              *
          *                                     *
          * ( DISPATCH TO DT)                   *
          *                                     *
  
```

---

Figure 67: TV Mask for Enhanced Test Signature #5

---

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN MDF STATUS CALLBACK TIME FRAME CABLE/PAIR COMMENT  
 1. 305 386 7163 5 201 386 2805 K1023/415 WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051

REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:

&FULLX TERM: SINGLE PARTY

VER: 5X FIBER-TO-THE-HOME LOOP INDICATED  
 COT-TO-DT CHANNEL TEST OK  
 DROP TEST FAILS - OPEN

CRAFT:	DC SIGNATURE	MLT:	DC SIGNATURE	AC SIGNATURE
	KOHMS VOLTS		KOHMS VOLTS	KOHMS
	40 T-R		51.51 T-R	28 T-R
	56 0 T-G		91.35 0 T-G	36 T-G
	56 0 R-G		91.41 0 R-G	36 R-G

---

Interpretation:

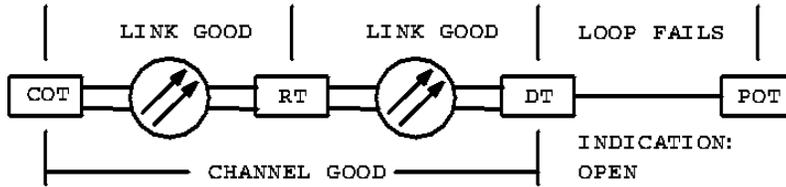




Figure 69: TV Mask for Enhanced Test Signature #6

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163			5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY  
 VER: 6X FIBER-TO-THE-HOME LOOP INDICATED WARNING!!! CHECK DROP FOR HAZARDOUS  
 COT-TO-DT CHANNEL TEST OK VOLTAGES!  
 DROP TEST FAILS - FEMF/LEAKAGE (DISPATCH TO RT)

CRAFT:	DC SIGNATURE	MLT:	DC SIGNATURE	AC SIGNATURE
	KOHMS VOLTS		KOHMS VOLTS	KOHMS
	46 T-R		61.65 T-R	30 T-R
	57 0 T-G		91.39 0 T-G	35 T-G
	57 0 R-G		91.37 0 R-G	35 R-G

Interpretation

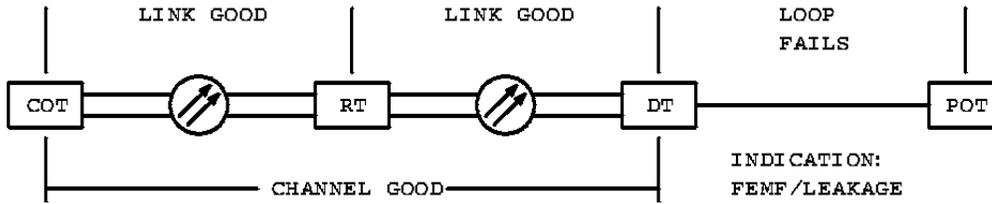




Figure 71: TV Mask for Enhanced Test Signature #7

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TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN MDF STATUS CALLBACK TIME FRAME CABLE/PAIR COMMENT  
 1. 305 386 7163 5 201 386 2805 K1023/415 WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: 7X FIBER-TO-THE-HOME LOOP INDICATED  
 COT-TO-DT CHANNEL TEST OK (DISPATCH TO DT)  
 DROP TEST FAILS - RECEIVER OFF HOOK

CRAFT:	DC SIGNATURE		MLT:	DC SIGNATURE		AC SIGNATURE	
	KOHMS	VOLTS		KOHMS	VOLTS	KOHMS	
	51	T-R		71.61	T-R	32	T-R
	59	0 T-G		91.38	0 T-G	35	T-G
	58	0 R-G		91.18	0 R-G	36	R-G

---

Interpretation:

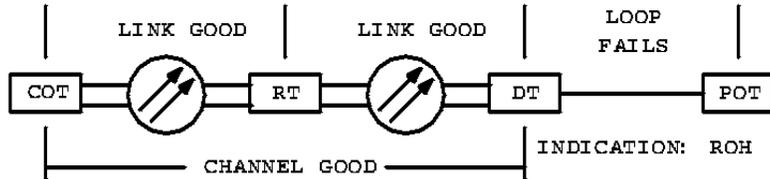


Figure 72: SAM Mask for Enhanced Test Signature #8

---

SAM      SYSTEM: m2                      PRTR:      BY:

REQ:    DVER -N 8                              NPANNX:                      EXK:

NEXT ( Y/N):                                      STATUS:

INPUT:

VER:	MLT:		DC SIGNATURE			DECISION RULE ( Y)
	KOHMS		VOLTS			
	MIN	MAX	MIN	MAX		
	15.00	24.00			T-R	( ) VER
	84.00	96.00	-4.00	+4.00	T-G	( Y) SIGNATURE
	84.00	96.00	-4.00	+4.00	R-G	( ) VER OR SIGNATURE
						( ) VER AND SIGNATURE

OUTPUT:

VER: 9X \* FIBER-TO-THE-HOME LOOP INDICATED      \*

     \* RT-TO-DT FIBER LINK GOOD                      \*

     \* BASIC FTTH DT - NO CHANNEL TEST              \*

     \* NO DROP TEST - ( DISPATCH TO DT)              \*

     \*    \*

     \*    \*

---

Figure 73: TV Mask for Enhanced Test Signature #8

```

TV   EC 123  PRTR W020  REQ BY DML                CB 201 386 4487  03-18-88 0900A

      TN      MDF  STATUS CALLBACK TIME      FRAME      CABLE/PAIR  COMMENT
1.  305 386 7163                5 201 386 2805      K1023/415  WHIPPAN

TN 305 386 7163                SW: ESS-1  OE: 233-008-051
REQ      L#      CMT      CA                CO: SLC SERIES 5
      TEMP(F)      PR      OVER      OSP:
&FULLX                TERM:
VER: 9X FIBER-TO-THE-HOME LOOP INDICATED      NO DROP TEST - (DISPATCH TO DT)
RT-TO-DT FIBER LINK GOOD
BASIC FTTH DT - NO CHANNEL TEST

CRAFT: DC SIGNATURE      MLT: DC SIGNATURE      AC SIGNATURE
      KOHMS  VOLTS                KOHMS  VOLTS                KOHMS
      18      T-R      20.45      T-R      16      T-R
      50      0 T-G      91.26      0 T-G      35      T-G
      50      0 R-G      91.30      0 R-G      36      R-G
    
```

Interpretation:

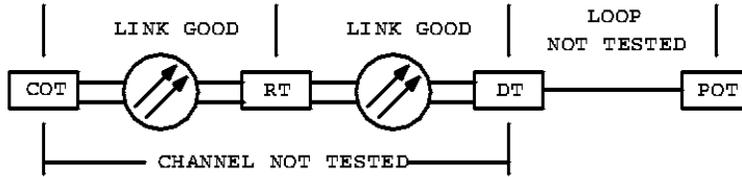




Figure 75: TV Mask for Enhanced Test Signature #10

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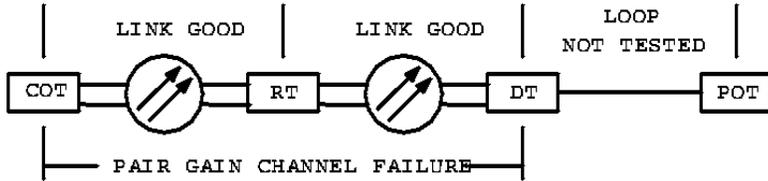
TV   EC 123  PRTR W020   REQ BY DML           CB 201 386 4487  03-18-88 0900A

      TN      MDF  STATUS CALLBACK TIME      FRAME      CABLE/PAIR  COMMENT
1.  305 386 7163                                     5 201 386 2805      K1023/415  WHIPPAN

TN 305 386 7163                                SW: ESS-1  OE: 233-008-051
REQ      L#    CMT      CA      CO: SLC SERIES 5
      TEMP(F)      PR    OVER      OSP:
&FULLX                                TERM: SINGLE PARTY
VER: 3C FIBER-TO-THE-HOME LOOP INDICATED      (DISPATCH TO DT)
      PAIR GAIN CHANNEL TEST FAILURE
      DT COMMON EQUIP. FAILURE

CRAFT: DC SIGNATURE      MLT: DC SIGNATURE      AC SIGNATURE
      KOHMS  VOLTS      KOHMS  VOLTS      KOHMS
      26      T-R      30.68      T-R      21      T-R
      52      0 T-G      91.46      0 T-G      36      T-G
      52      0 R-G      91.42      0 R-G      37      R-G
    
```

Interpretation:



tpa 785411/01



Figure 77: TV Mask for Enhanced Test Signature #11

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK	TIME	FRAME	CABLE/PAIR	COMMENT
1. 305	386	7163		5 201	386 2805	K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051

REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:

&FULLX TERM: SINGLE PARTY

VER: 4C FIBER-TO-THE-HOME LOOP INDICATED (DISPATCH TO DT)

PAIR GAIN CHANNEL TEST FAILURE

DROP TEST OK

CRAFT:	DC SIGNATURE		MLT:	DC SIGNATURE		AC SIGNATURE	
	KOHMS	VOLTS		KOHMS	VOLTS	KOHMS	
	34		T-R	41.39		T-R	25
	54	0	T-G	91.16	0	T-G	36
	54	0	R-G	91.24	0	R-G	36

Interpretation:

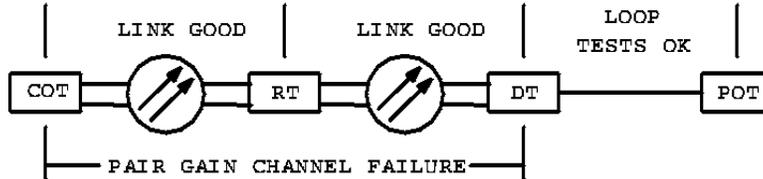




Figure 79: TV Mask for Enhanced Test Signature #12

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK	TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163				5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: 5C FIBER-TO-THE-HOME LOOP INDICATED  
 PAIR GAIN CHANNEL TEST FAILURE (DISPATCH TO DT)  
 DROP TEST FAILS - OPEN

CRAFT:	DC SIGNATURE		MLT:	DC SIGNATURE		AC SIGNATURE	
	KOHMS	VOLTS		KOHMS	VOLTS	KOHMS	
	40	T-R		51.55	T-R	28	T-R
	56	0 T-G		91.46	0 T-G	35	T-G
	56	0 R-G		91.48	0 R-G	36	R-G

Interpretation:

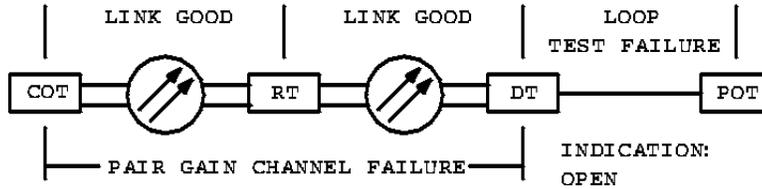


Figure 80: SAM Mask for Enhanced Test Signature #13

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```

SAM      SYSTEM:    m2          PRTR:          BY:
REQ:    DVER -N 13          NPANNX:          EXK:
NEXT   ( Y/N ):          STATUS:
INPUT:
      VER: 99   MLT:      DC SIGNATURE
              KOHMS      VOLTS
              MIN      MAX      MIN      MAX
      54.00   64.00          -4.00   +4.00   T-R   (   ) VER
      84.00   96.00   -4.00   +4.00   T-G   (   ) SIGNATURE
      84.00   96.00   -4.00   +4.00   R-G   (   ) VER OR SIGNATURE
                                      ( Y ) VER AND SIGNATURE
OUTPUT:
      VER: 6C * FIBER-TO-THE-HOME LOOP INDICATED      *
              * PAIR GAIN CHANNEL TEST FAILURE        *
              * DROP TEST FAILS - FEMF/LEAKAGE        *
              * WARNING!!! CHECK DROP FOR HAZARDOUS   *
              * VOLTAGES!                              *
              * ( DISPATCH TO DT)                      *
  
```

---

Figure 81: TV Mask for Enhanced Test Signature #13

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK	TIME	FRAME	CABLE/PAIR	COMMENT
1. 305	386	7163		5 201	386 2805	K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY  
 VER: 6C FIBER-TO-THE-HOME LOOP INDICATED WARNING!!! CHECK DROP FOR HAZARDOUS  
 PAIR GAIN CHANNEL TEST FAILURE VOLTAGES!  
 DROP TEST FAILS - FEMF/LEAKAGE (DISPATCH TO RT)

CRAFT:	DC SIGNATURE	MLT:	DC SIGNATURE	AC SIGNATURE
	KOHMS VOLTS		KOHMS VOLTS	KOHMS
	46 T-R		61.44 T-R	30 T-R
	57 0 T-G		91.57 0 T-G	35 T-G
	57 0 R-G		91.31 0 R-G	36 R-G

Interpretation:

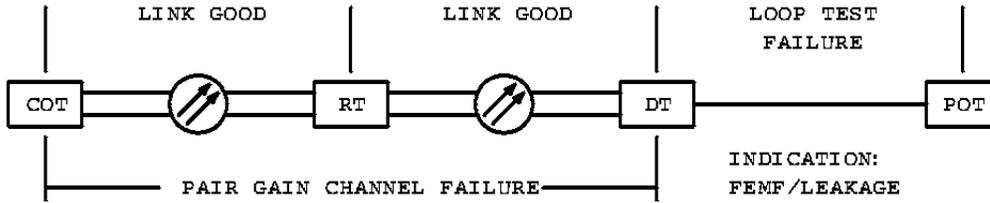


Figure 82: SAM Mask for Enhanced Test Signature #14

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```

SAM      SYSTEM:  m2      PRTR:      BY:
REQ:    DVER -N 14      NPANX:      EXK:
NEXT    ( Y/N):      STATUS:
INPUT:
      VER: 99      MLT:      DC SIGNATURE
              KOHMS      VOLTS
              MIN      MAX      MIN      MAX
      64.00      74.00      -4.00      +4.00      T-R      ( ) VER
      84.00      96.00      -4.00      +4.00      T-G      ( ) SIGNATURE
      84.00      96.00      -4.00      +4.00      R-G      ( ) VER OR SIGNATURE
              ( Y ) VER AND SIGNATURE

OUTPUT:
      VER: 7C * FIBER-TO-THE-HOME LOOP INDICATED      *
              * PAIR GAIN CHANNEL TEST FAILURE      *
              * DROP TEST FAILS - RECEIVER OFF HOOK      *
              *      *
              * ( DISPATCH TO DT)      *
              *      *

```

---

Figure 83: TV Mask for Enhanced Test Signature #14

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163			5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5  
 TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: 7C FIBER-TO-THE-HOME LOOP INDICATED  
 PAIR GAIN CHANNEL TEST FAILURE (DISPATCH TO DT)  
 DROP TEST FAILS - RECEIVER OFF HOOK

CRAFT:	DC SIGNATURE	MLT:	DC SIGNATURE	AC SIGNATURE
	KOHMS VOLTS		KOHMS VOLTS	KOHMS
	51 T-R		71.73 T-R	32 T-R
	59 0 T-G		91.30 0 T-G	35 T-G
	59 0 R-G		91.24 0 R-G	36 R-G

Interpretation

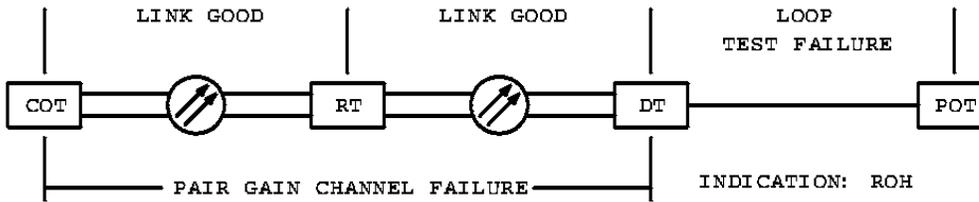


Figure 84: SAM Mask for Enhanced Test Signature #10 (Alternate)

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```

SAM      SYSTEM:  m2          PRTR:          BY:
REQ:    DVER -N 10          NPANNX:          EXK:
NEXT   ( Y/N ):          STATUS:
INPUT:
      VER: 99   MLT:      DC SIGNATURE
              KOHMS      VOLTS
              MIN      MAX      MIN      MAX
      15.00   86.00          -4.00  +4.00   T-R   (   ) VER
      84.00   96.00          -4.00  +4.00   T-G   (   ) SIGNATURE
      84.00   96.00          -4.00  +4.00   R-G   (   ) VER OR SIGNATURE
                                          ( Y ) VER AND SIGNATURE

```

DECISION RULE ( Y )

---

```

OUTPUT:
      VER: 4C   * FIBER-TO-THE-HOME LOOP INDICATED   *
              * COT-TO-DT CHANNEL TEST FAILS       *
              * RT-TO-DT FIBER LINK GOOD           *
              * DROP TEST NOT INTERPRETED          *
              * ( DISPATCH TO RT)                  *
              *                                     *

```

---

Figure 85: TV Mask for Enhanced Test Signature #10 (Alternate)

TV EC 123 PRTR W020 REQ BY DML CB 201 386 4487 03-18-88 0900A

TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1. 305 386 7163			5 201 386 2805		K1023/415	WHIPPAN

TN 305 386 7163 SW: ESS-1 OE: 233-008-051  
 REQ L# CMT CA CO: SLC SERIES 5

TEMP(F) PR OVER OSP:  
 &FULLX TERM: SINGLE PARTY

VER: 4C FIBER-TO-THE-HOME LOOP INDICATED DROP TEST NOT INTERPRETED  
 COT-TO-DT CHANNEL TEST FAILS (DISPATCH TO RT)  
 RT-TO-DT FIBER LINK GOOD

CRAFT: DC SIGNATURE		MLT: DC SIGNATURE		AC SIGNATURE	
KOHMS	VOLTS	KOHMS	VOLTS	KOHMS	
34	T-R	41.42	T-R	25	T-R
54	0 T-G	91.40	0 T-G	35	T-G
54	0 R-G	91.42	0 R-G	36	R-G

Interpretation:

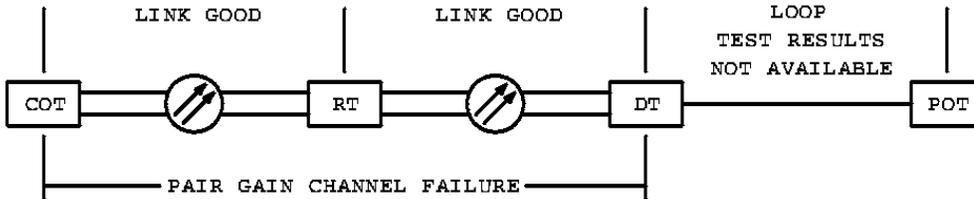


Figure 86: TV Mask for Enhanced Test Signature #1 (DMS 100(TM) Switch)

---

TV	EC 016	PRTR X441	REQ BY DSP	CB 919 821 8134	08-14-90	0948A	
	TN	MDF	STATUS	CALLBACK TIME	FRAME	CABLE/PAIR	COMMENT
1.	919 460 4290			0	469 1139	PG1GK/1	CARY
TN	919 460 4290				SW: DMS100	OE: ZR00-0-00-00	
REQ		L#	CMT	CA		CO: SLC SERIES 5	
		TEMP(F)		PR	OVER	OSP:	
	FULL					TERM: SINGLE PARTY	
	VER: 53	PAIR GAIN	SYSTEM BUSY				
		COULD NOT MAKE	METALLIC ACCESS				
		* DUE TO BUSY	ACCESS SYSTEM				

---

Figure 87: AUA400 CU Block Diagram

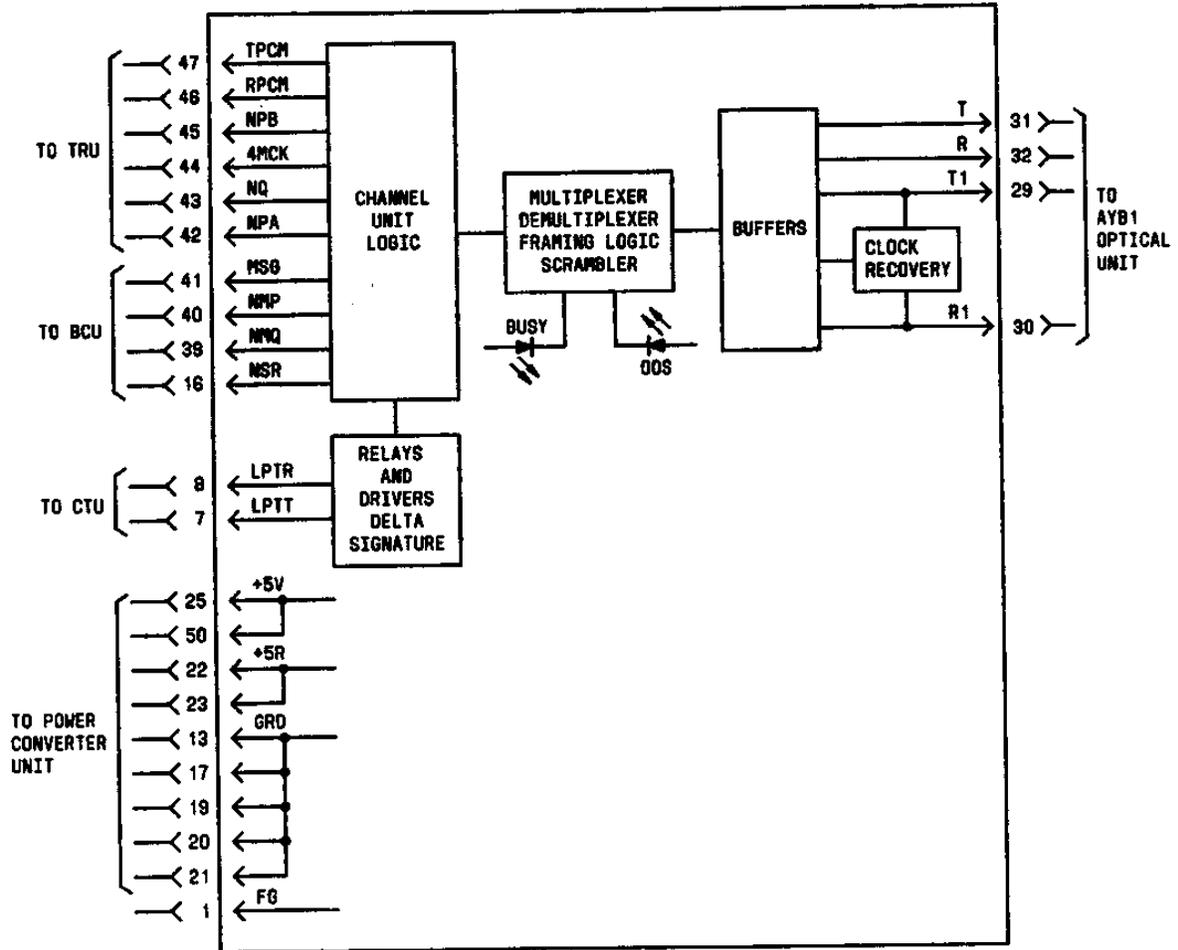


Figure 88: AUA400 CU Faceplate

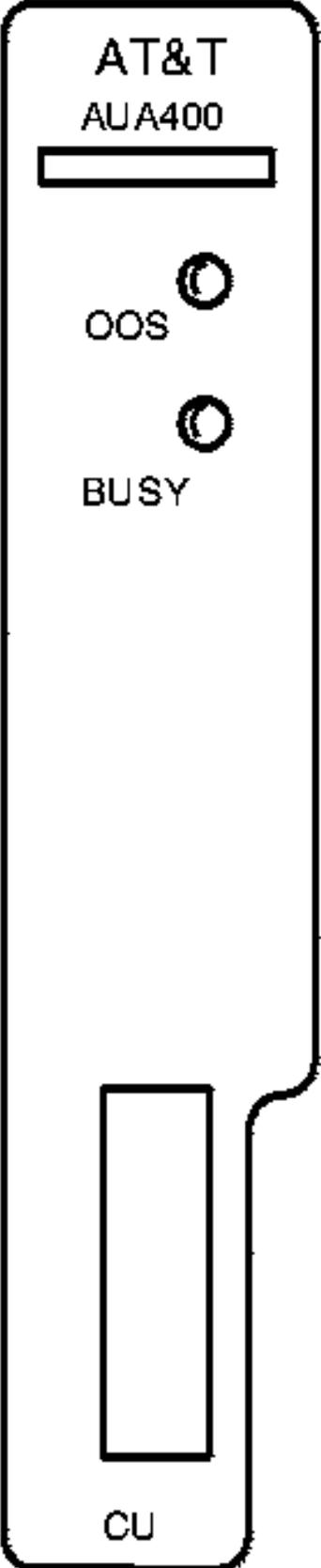
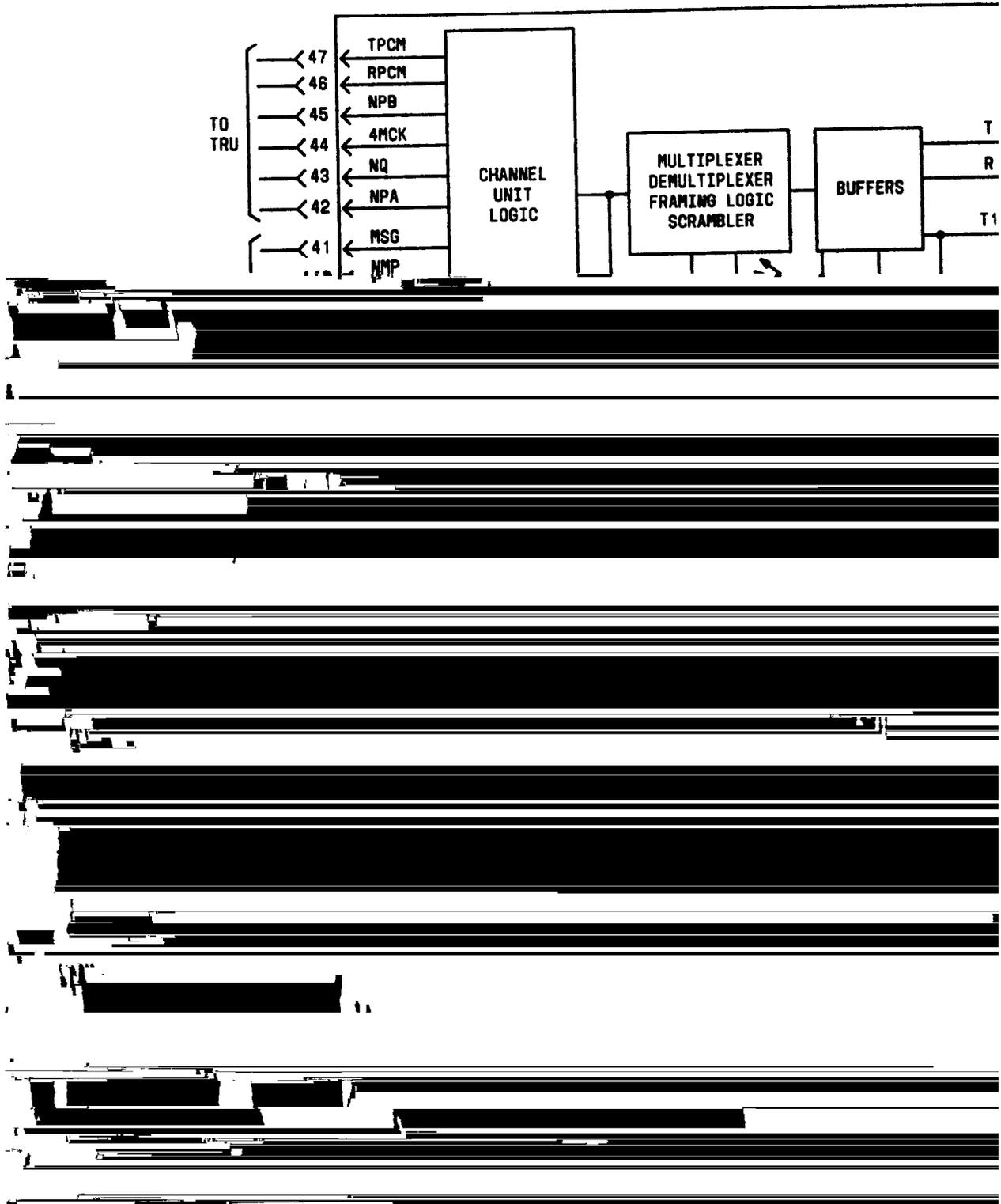




Figure 89: AUA401 CU Block Diagram



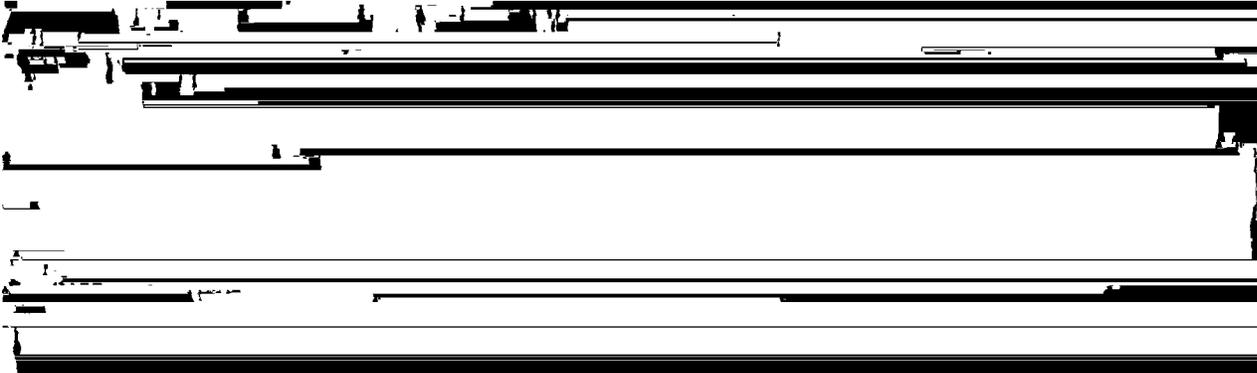


Figure 90: AUA401 CU Faceplate

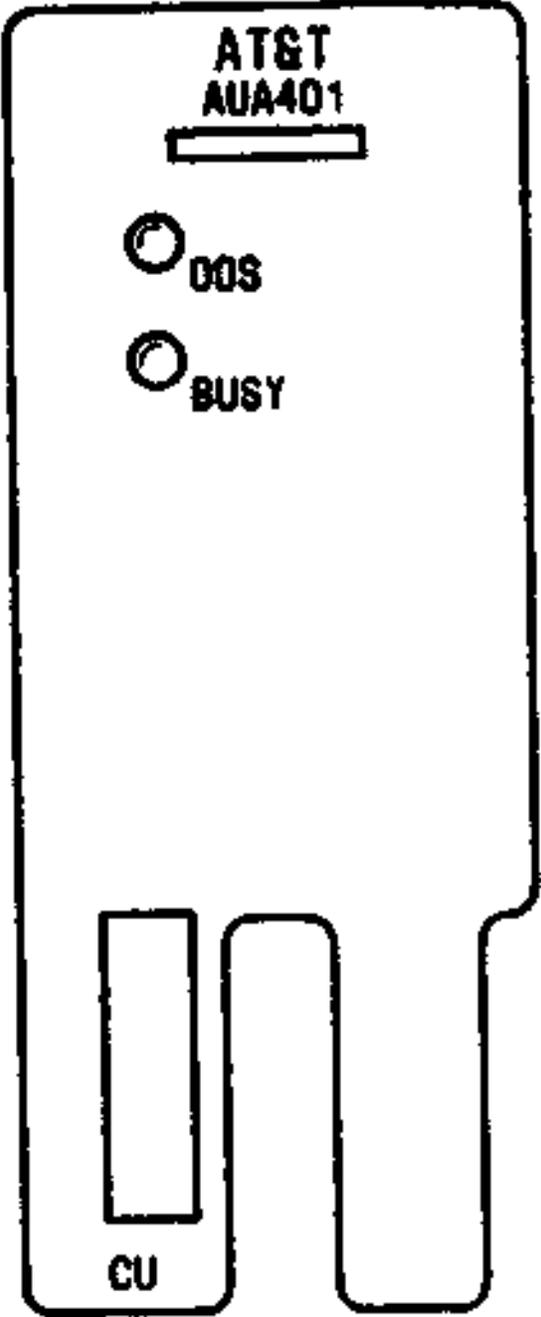


Figure 91: AYB1 OU Block Diagram

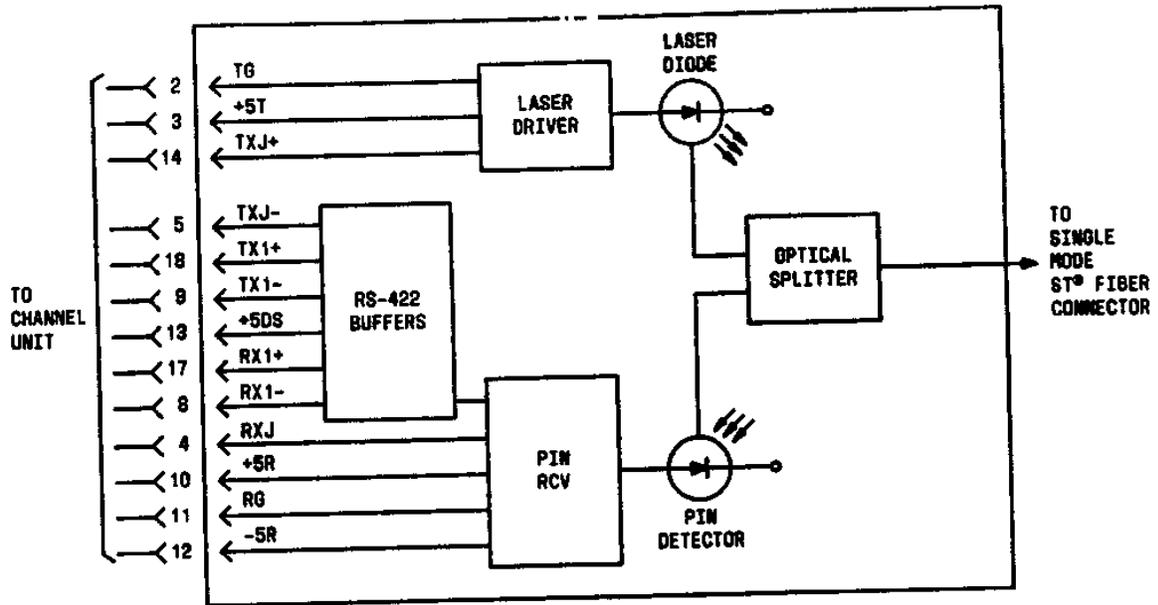


Figure 92: AYB1 OU Faceplate

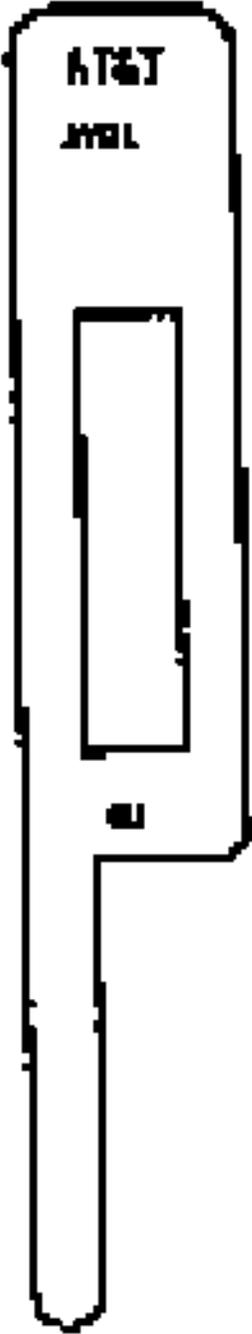


Figure 93: ASH1 PCU Block Diagram (Mother Board)

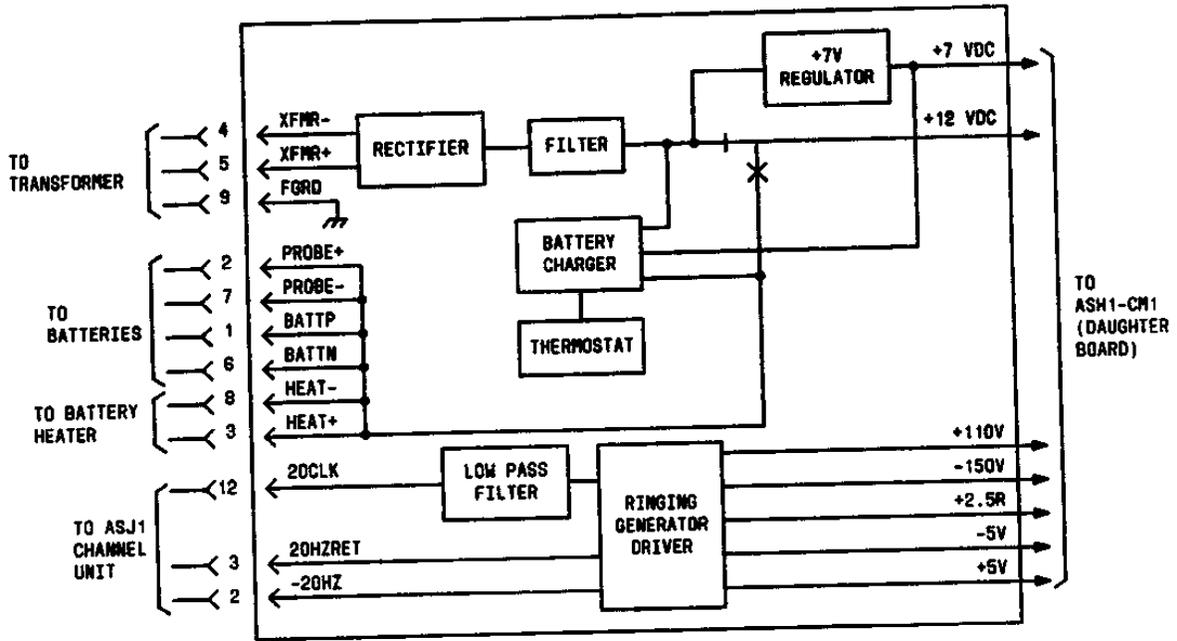


Figure 94: ASH1 PCU Block Diagram (Daughter Board)

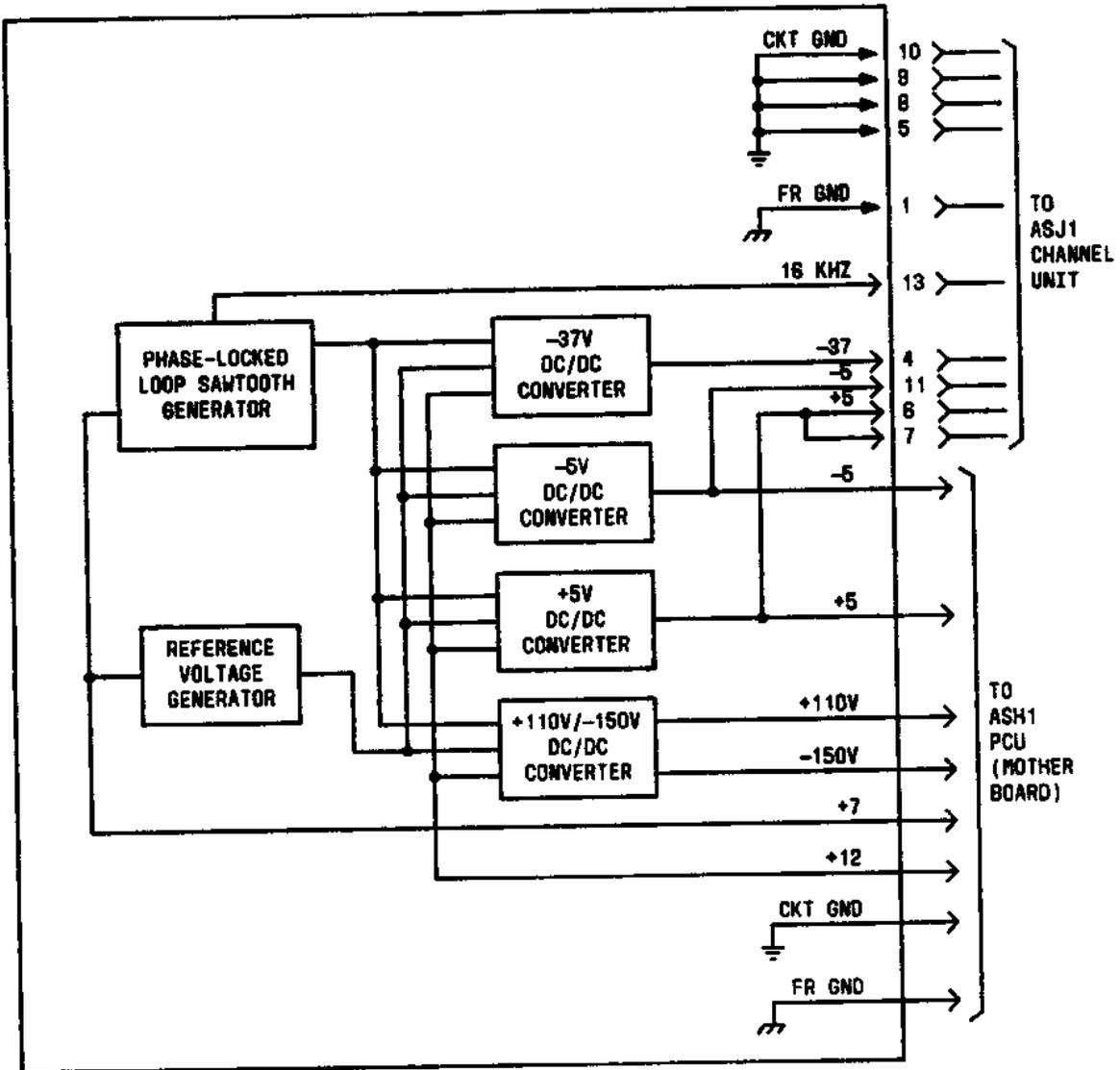


Figure 95: ASH1 PCU Faceplate

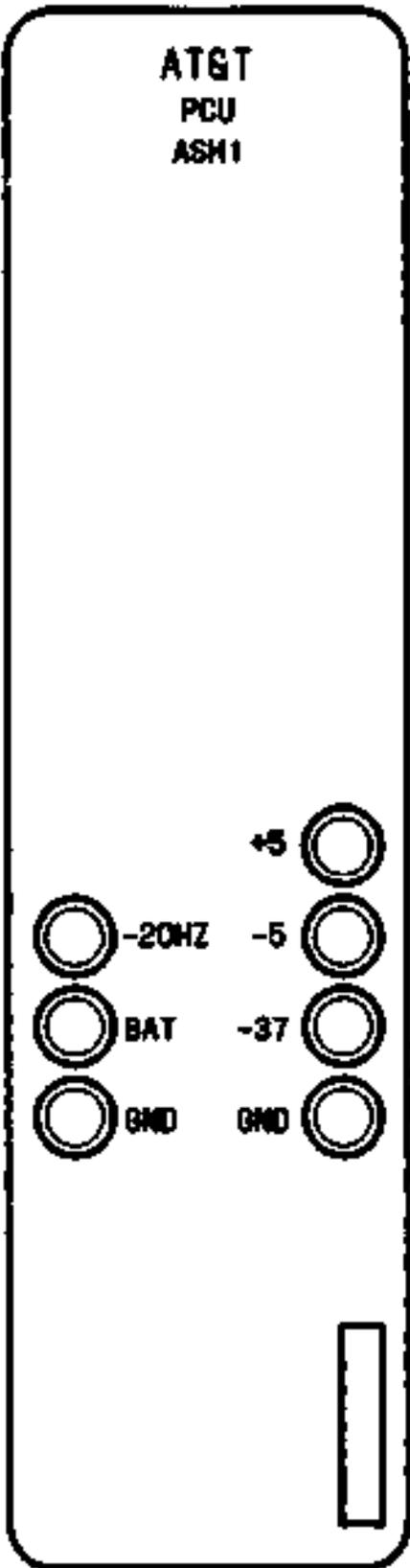




Figure 96: ASJ1 CU Block Diagram (Mother Board)

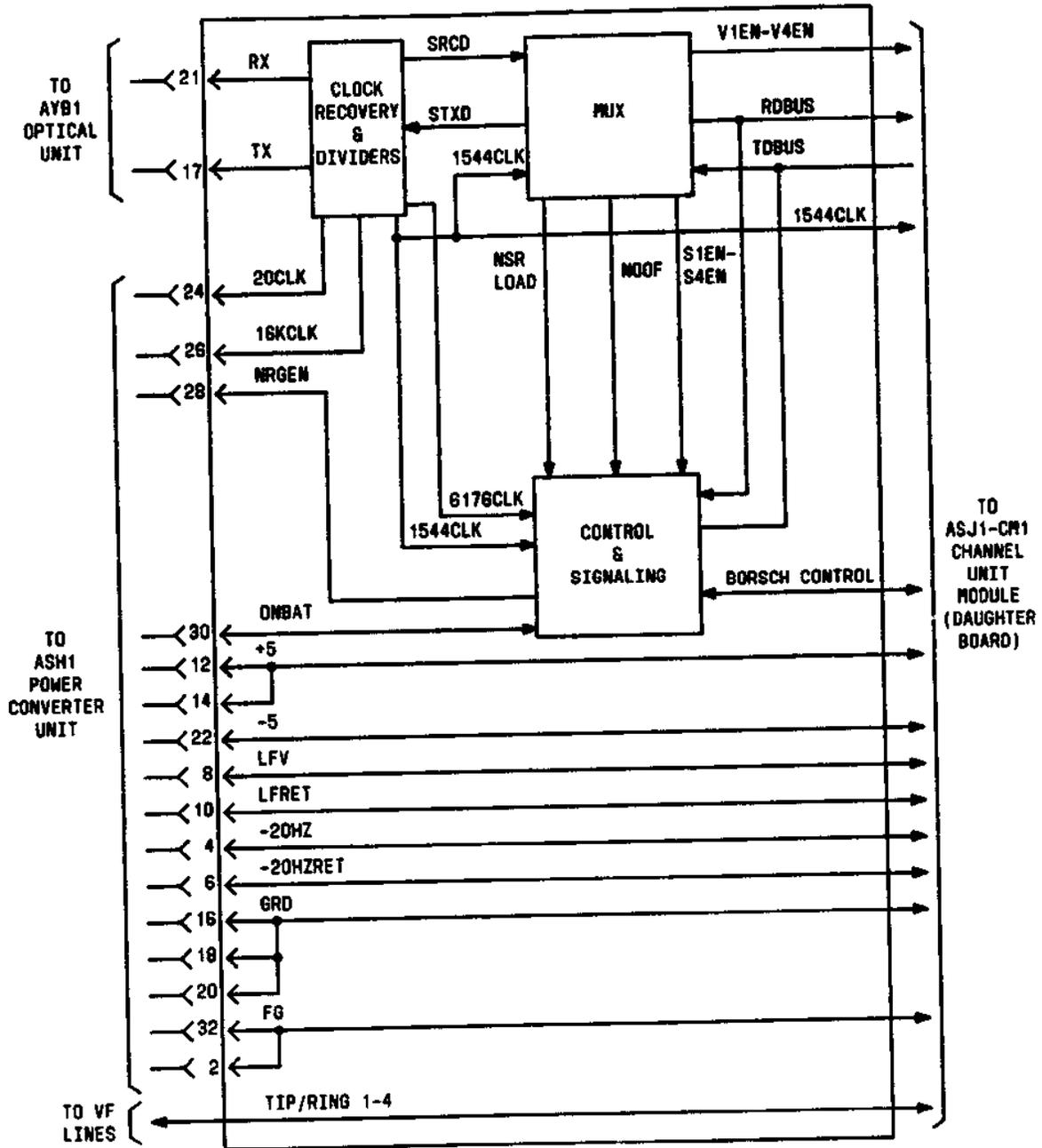


Figure 97: ASJ1 CU Block Diagram (Daughter Board)

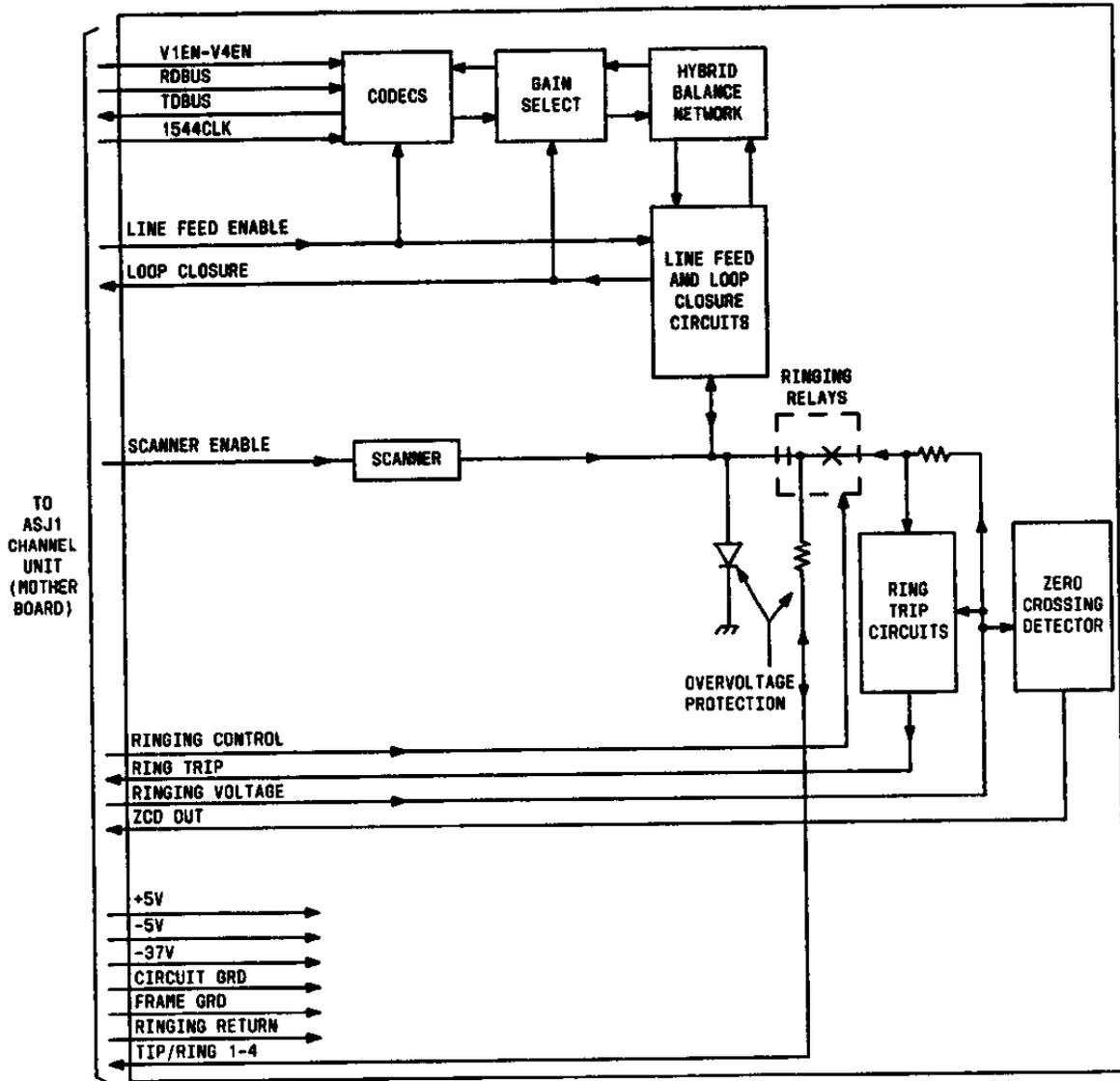


Figure 98: ASJ1 CU Faceplate

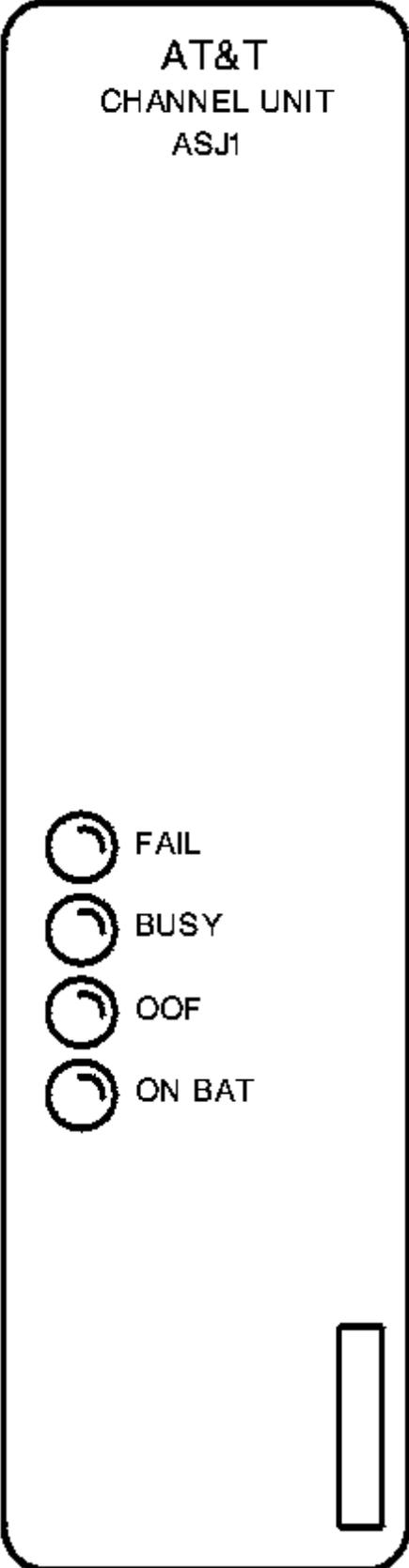
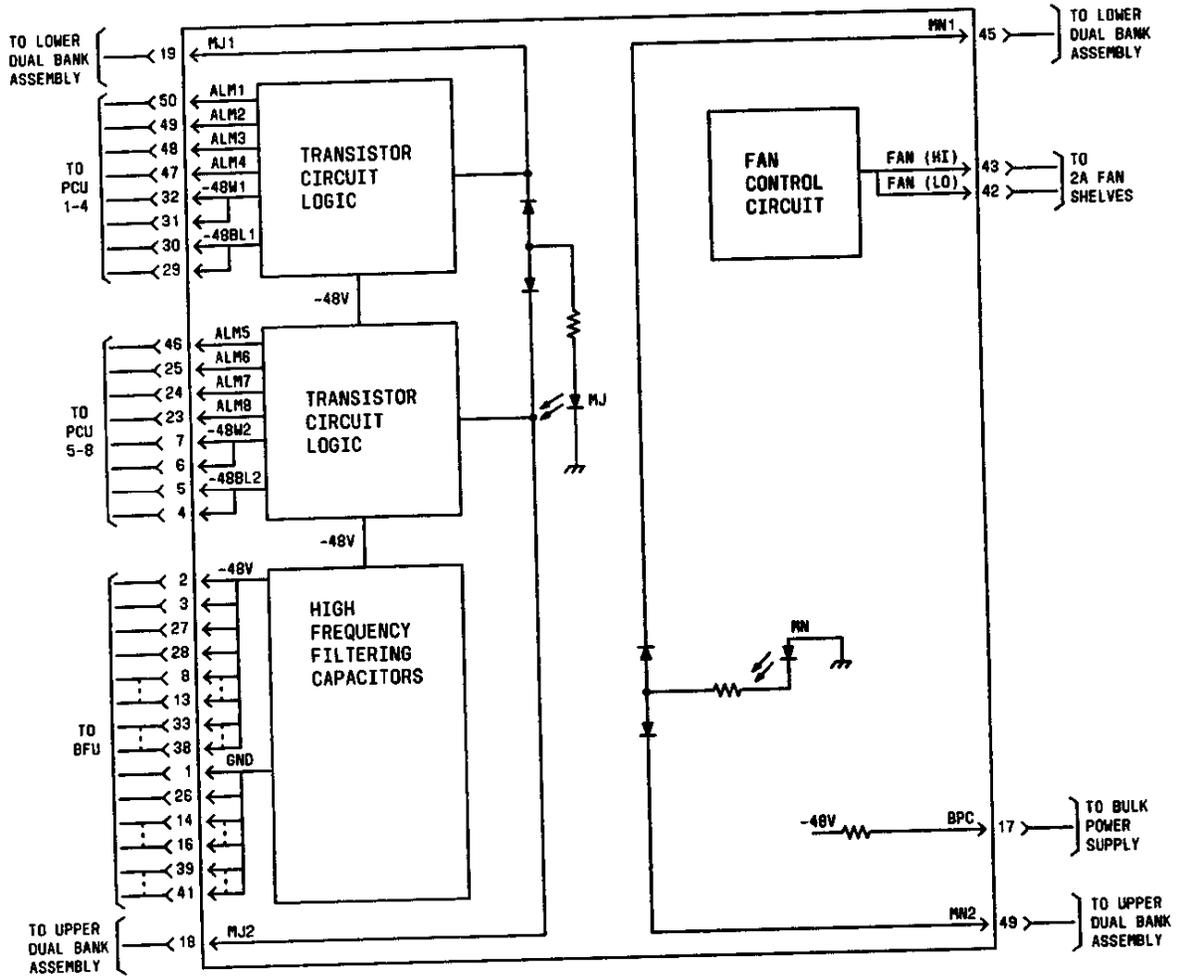




Figure 99: AUA402 A/FCU Block Diagram



**Figure 100: AUA402 A/FCU Faceplate**

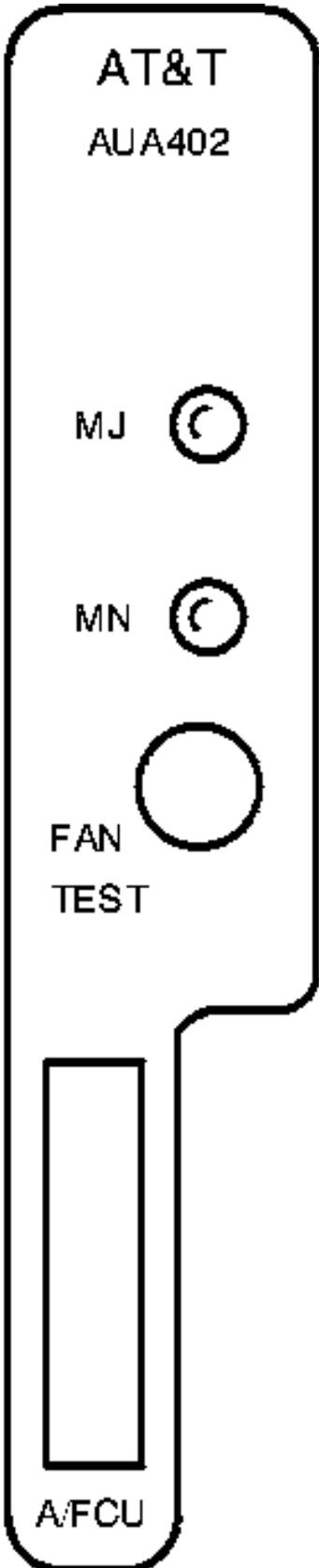




Figure 101: AUA403 RT Test CU Block Diagram

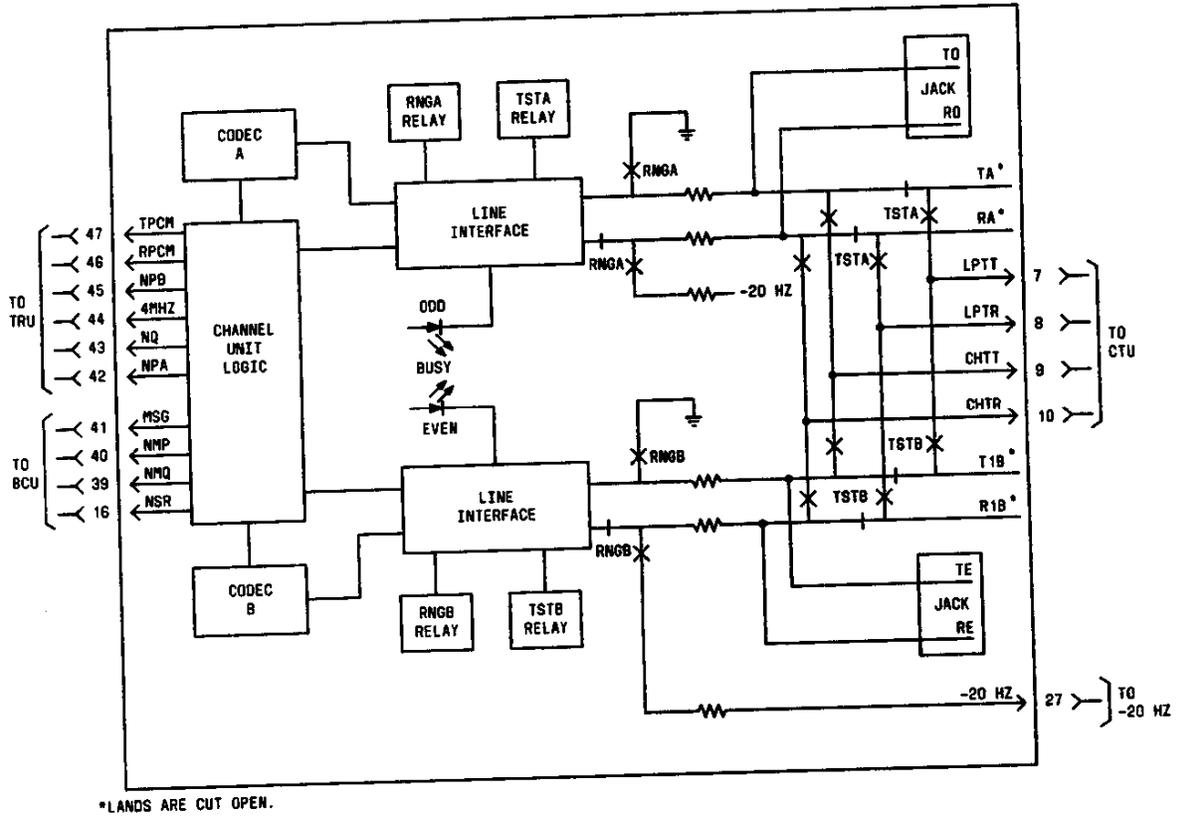


Figure 102: AUA403 RT Test CU Faceplate



Figure 103: AUA404 Block Diagram

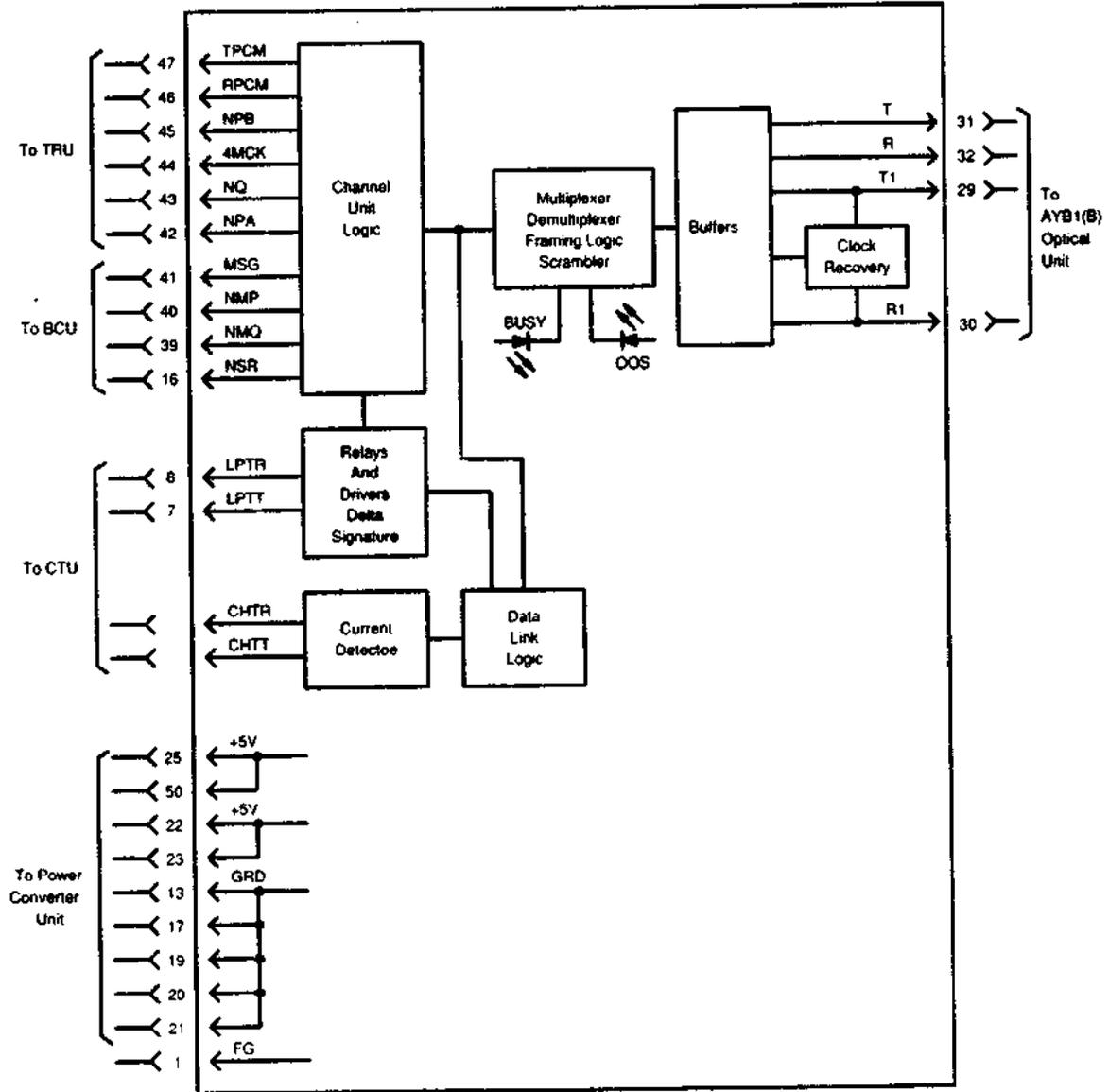


Figure 104: AUA404 Faceplate

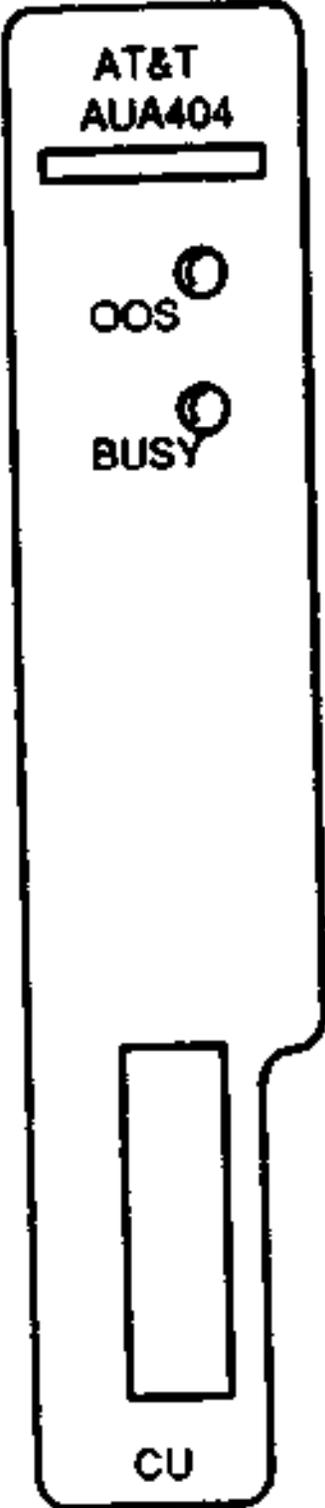


Figure 105: AUA405 Block Diagram

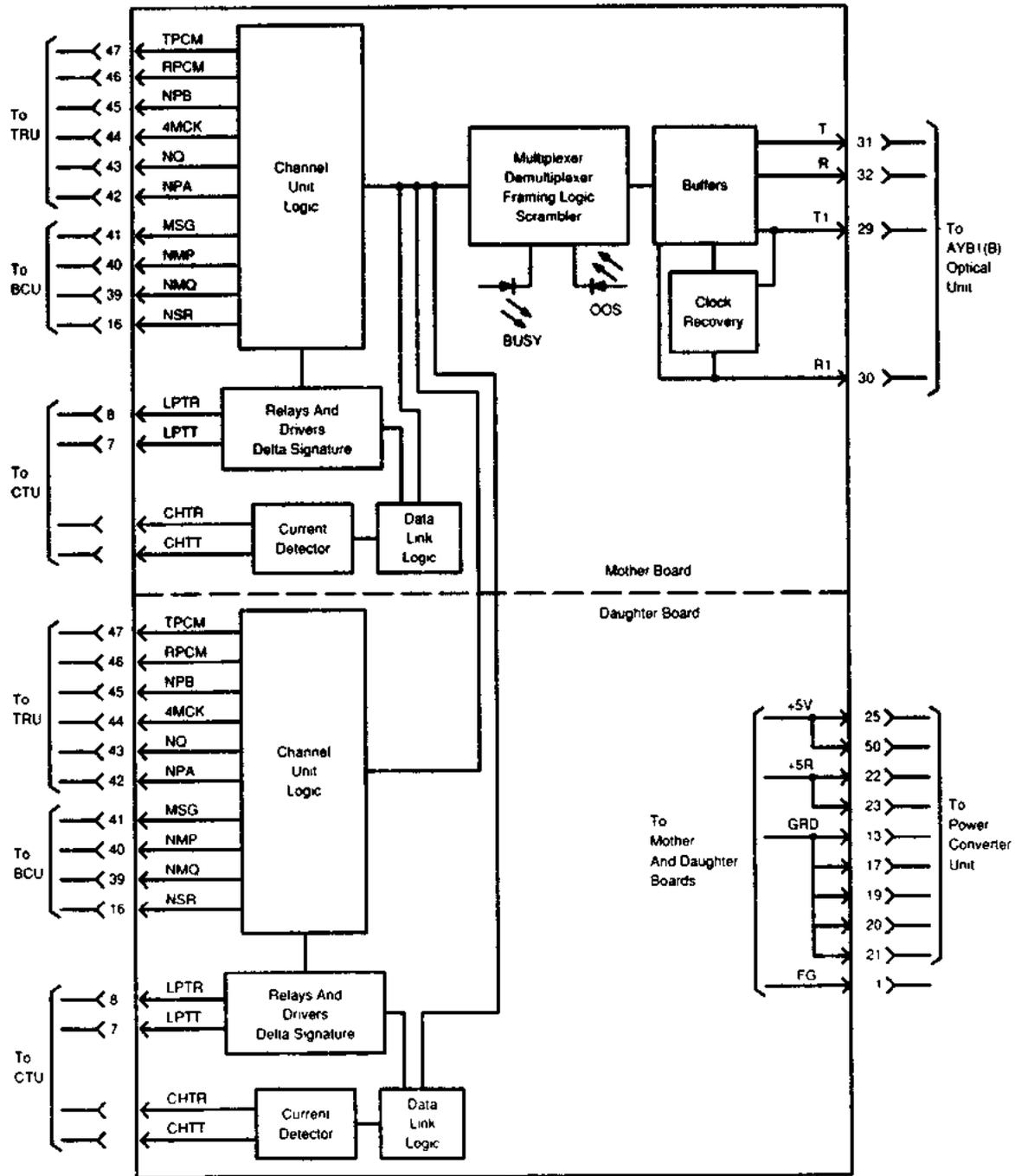


Figure 106: AUA405 Faceplate

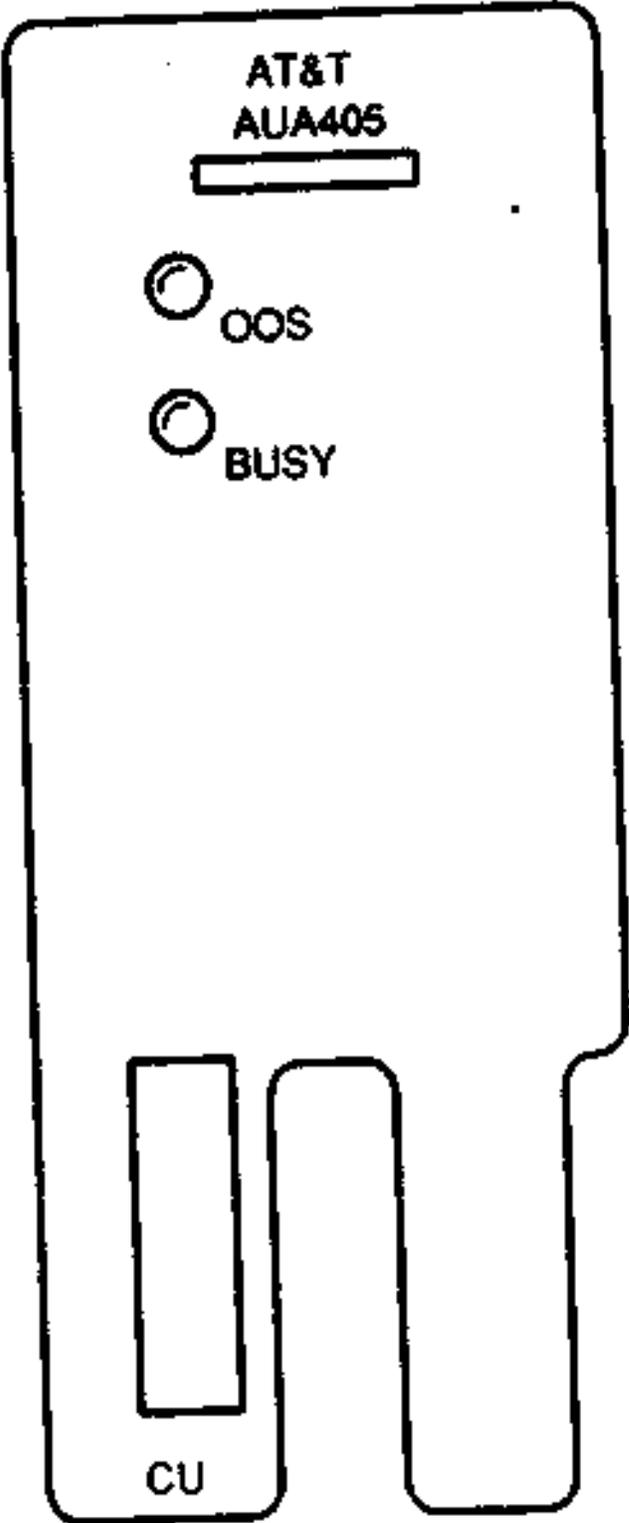


Figure 107: ASJ2 Block Diagram (Mother Board)

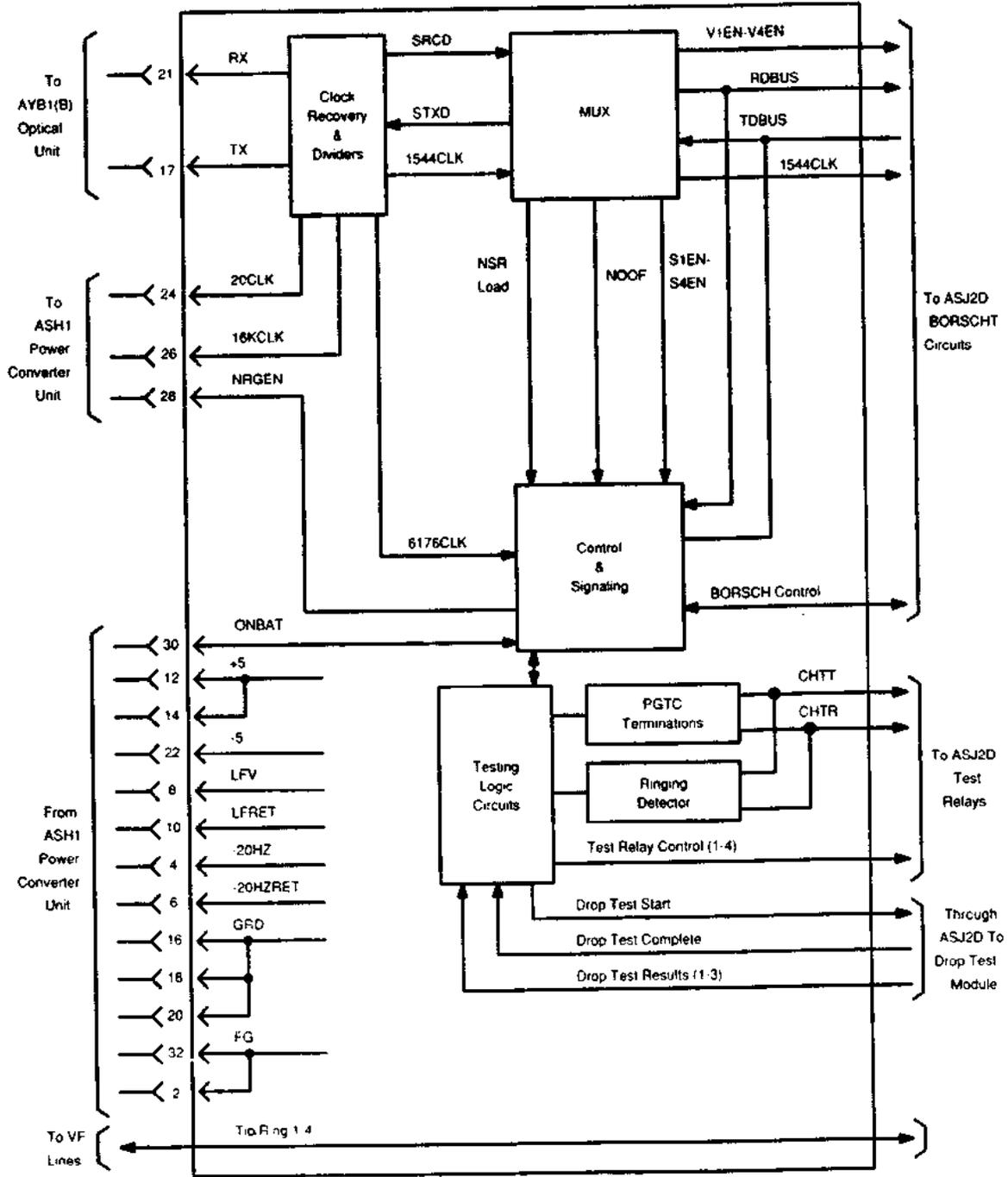


Figure 108: ASJ2 Block Diagram (Daughter Board)

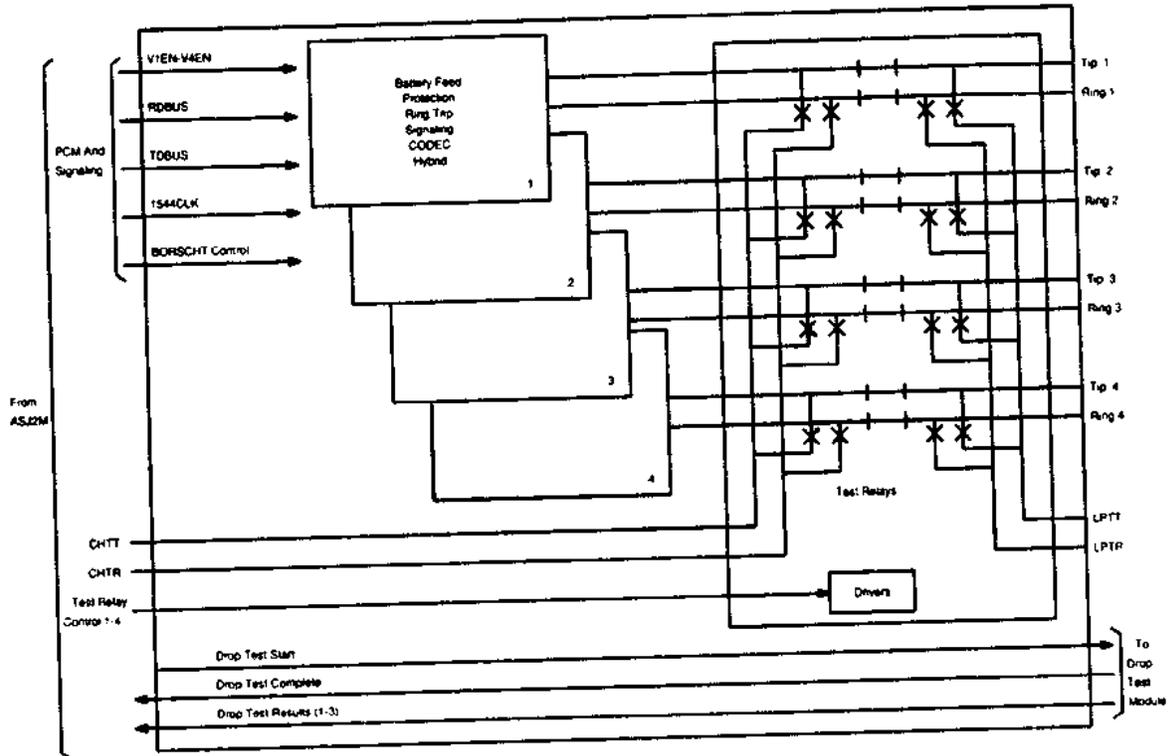


Figure 109: ASJ2 Faceplate

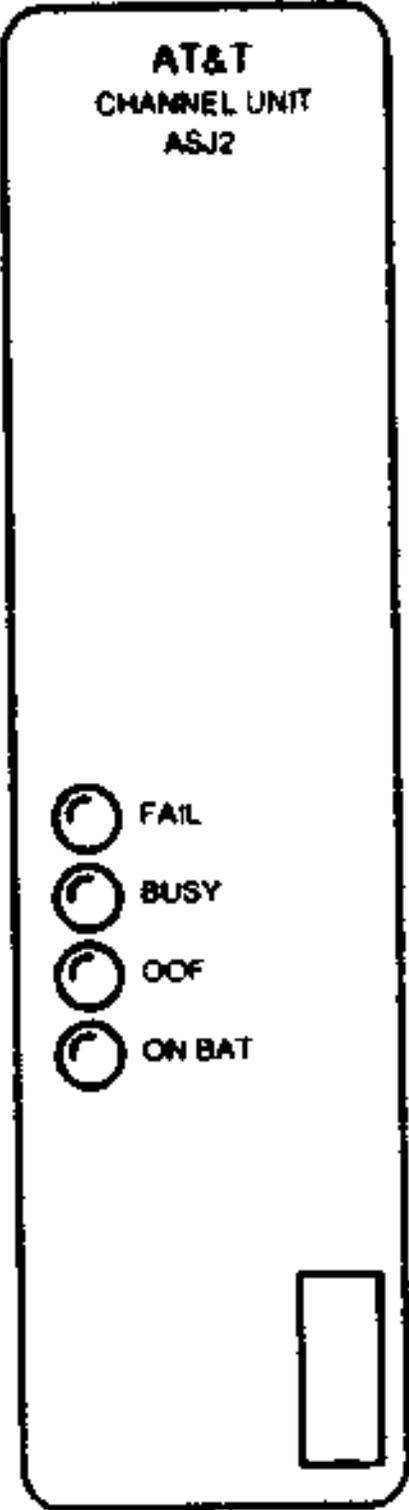


Figure 110: EAF1 DTM Front View

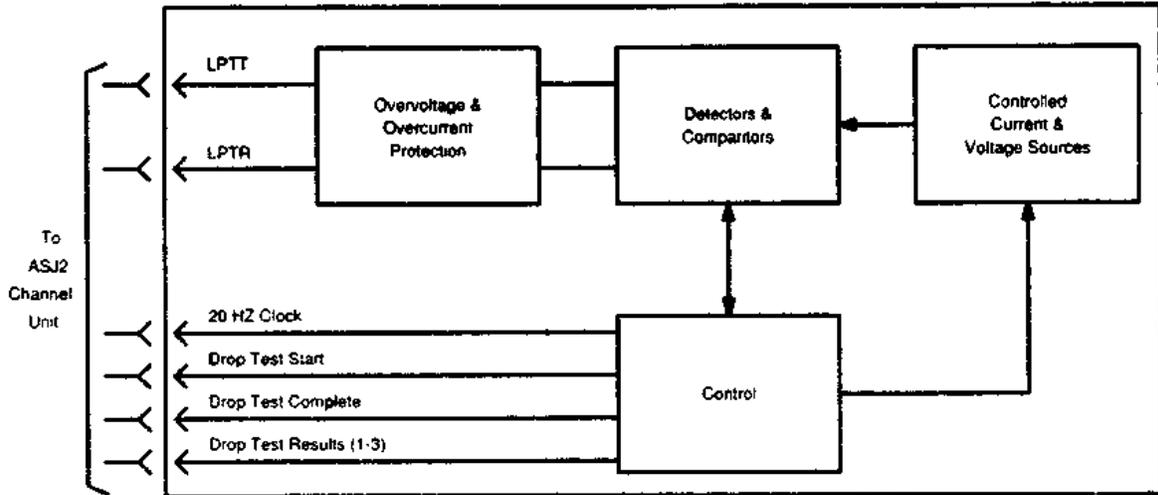


Figure 111: EAF1 DTM Block Diagram

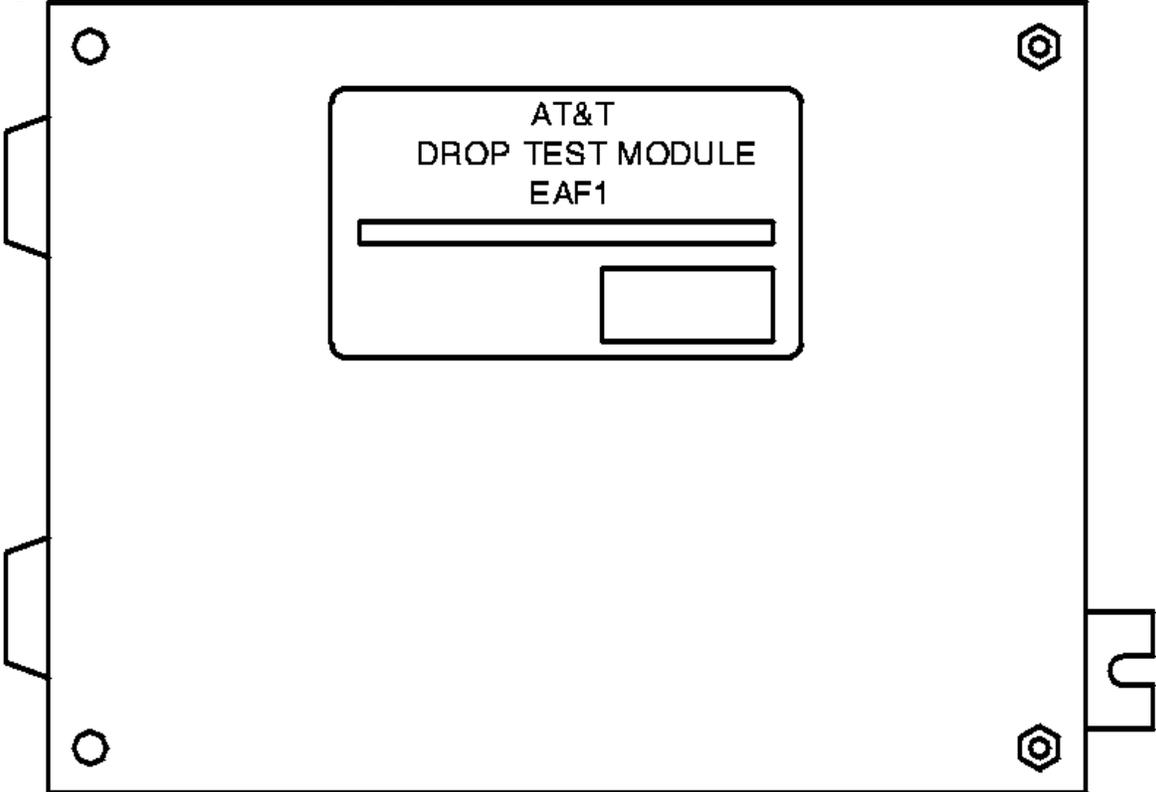


Figure 112: Floor Plan Data Sheet

ISSUE		1		FLOOR PLAN DATA				5SBCR 1					
DATE		5-10-88		EQUIPMENT IDENTIFICATION		PHYSICAL DATA		CABLING DATA		HEAT RELEASE, WATTS			
MFR'S NAME: AT&T TECH. MFR'S CODE: ED-7C680-30 RATING: LIMITED AVAIL. FLOOR PLAN DESIGNATION: 5SBCR MEGS SUFFIX: 1 CATEGORY: COMMON SYSTEMS				NEBS COMPATIBLE: YES HEIGHT: 7'-0" DEPTH: 1'-0" EFFECT. WIDTH: 2'-2" WEIGHT, LBS.: 405 FRWK TYPE: UNEQUAL FLNG MIN FRONT AISLE: 2'-6" MIN REAR AISLE: 0'-0" FRAMES,FUNCTION: 1 UNITS,FRAME: 364 (2)				SHIELD OR CLASS 1 (7) 3 4 (8)		EFFECTIVE CABLE AREA (SQ. IN.) 3.5 1.2 0.1		BUSY IDLE PLANNING VALUE 517 (3)	
<p>DIMENSIONS 1/2 INCHES AND OVER ARE IN FEET &amp; INCHES. ALL OTHER DIMENSIONS ARE IN INCHES. * DENOTES ESTIMATED VALUE. FOR GENERAL INFORMATION, SEE THE SECTIONS OF FPD 800-000-000</p>													
DC CURRENT DRAINS					<p>FIG. 1</p>								
VOLTAGE	LIST NO.	BUS	MAX AMPS	MIN AMPS									
-54	1	A	6.28	4.75									
-54	1	B	6.28	4.75									
-48	2	A	6.68	5.15									
-48	2	B	6.68	5.15									
AC CURRENT DRAINS					<p>NOTES: 1. SLC IS A REGISTERED TRADEMARK OF AT&amp;T BELL LABORATORIES. 2. UNITS REFERS TO VOICE FREQUENCY CIRCUITS. 3. THE SERIES 5, FIBER TO THE HOME FEATURE IS NOT CONSIDERED TO HAVE AN IDLE MODE; THEREFORE, IF ONE ASSUMES A FULLY LOADED FRAME (364 VF CIRCUITS) THEN THE ONLY FLUCTUATION IN CURRENT DRAIN WILL BE DUE TO THE FANS BEING ON OR OFF. THIS IS ALSO TRUE FOR HEAT DISSIPATION. THE FANS ARE CONTROLLED WITH TEMPERATURE SENSORS WITHIN THE BANKS AND POWER SHELF. THE PLANNING VALUE WAS CALCULATED AS THE AVERAGE OF THE SUM OF THREE VALUES OF 506 WATTS (FANS OFF) AND ONE VALUE OF</p>								
VOLTAGE	CATEGORY	RUNNING CURR. AMPS	INRUSH										
			CURR. AMPS	DURATION SECS									
COPYRIGHT 1988 AT&T ALL RIGHTS RESERVED				SLC SERIES 5 BAY FIBER TO THE HOME FEATURE 7' 0" FRAME TWO DUAL CHANNEL BANKS				FPD 801-450-107-1 SHEET 1 OF 2					

Figure 113: Floor Plan Data Sheet

ISSUE	1	<b>FLOOR PLAN DATA</b>	5SBCR 1
DATE	5-10-88		
<p>NOTES CONTINUED:            549 WATTS (FANS ON).</p> <p>4. BECAUSE THIS FRAME DISSIPATES MORE THAN 60 WATTS/SQ. FT OF ALLOTTED AREA, CONSULT THE PRACTICES OF THE 760-230-1XX SERIES FOR ADDITIONAL COOLING INFORMATION. THIS FRAME COMPLIES WITH THE NEBS 80 WATTS/SQ. FT LIMIT FOR FORCED AIR CONVECTION.</p> <p>5. THE ENTIRE BAY MUST BE DEDICATED TO THE "FIBER TO THE HOME FEATURE".</p> <p>6. THERE WILL BE NO RINGING GENERATORS IN A BAY OF THIS TYPE.</p> <p>7. LADDER RACK IS USED IN THE SERIES 5 FIBER TO THE HOME FEATURE, REMOTE TERMINAL. THIS IS NOT COMPARTMENTIZED. SEE ED-7C883, ISSUE 4 FOR THIS CABLING ARRANGEMENT.</p> <p>8. THE VALUE CALCULATED FOR EFFECTIVE CABLE AREA FOR SHIELD WAS ROUNDED OFF, THE VALUE TO THE NEAREST .01 IS .09 SQ. IN.</p>			
COPYRIGHT 1988 AT&T ALL RIGHTS RESERVED		SLC SERIES 5 BAY FIBER TO THE HOME FEATURE 7' 0" FRAME TWO DUAL CHANNEL BANKS	<b>FPD</b> 801-450-107-1 SHEET 2 OF 2

**Figure 114: Location of Electrical Outlet Enclosure on Residence Wall**  
Entrance Hole For Inside  
House Telephone Wiring

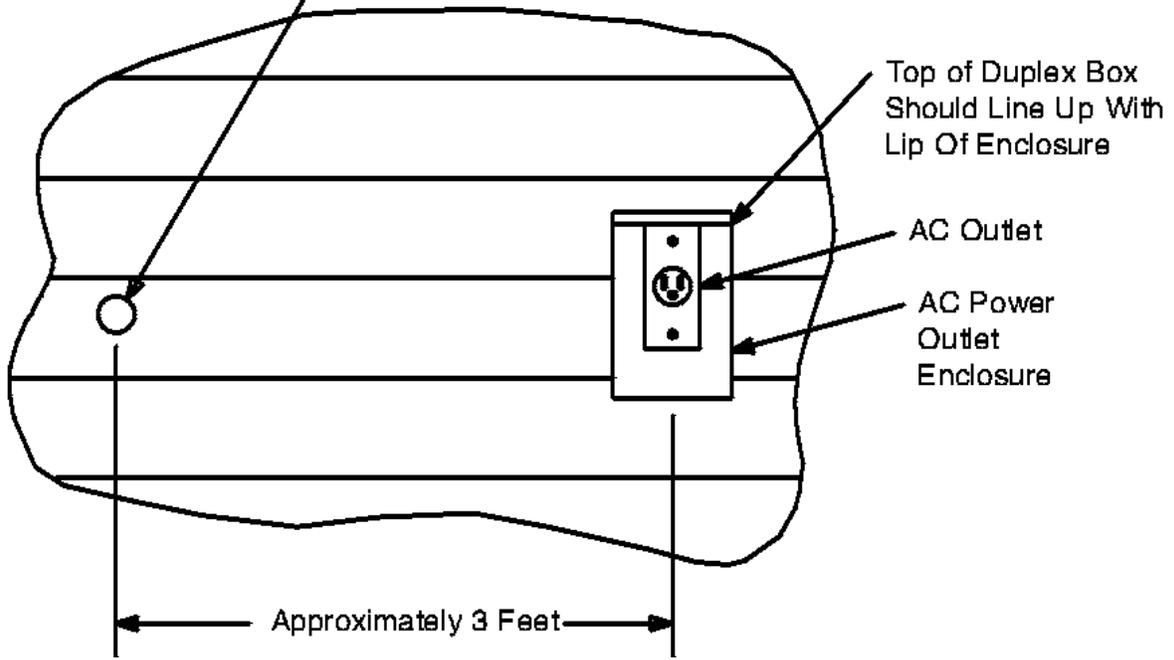


Figure 115: High Density Fiber Interconnect System Installation Instructions - 1

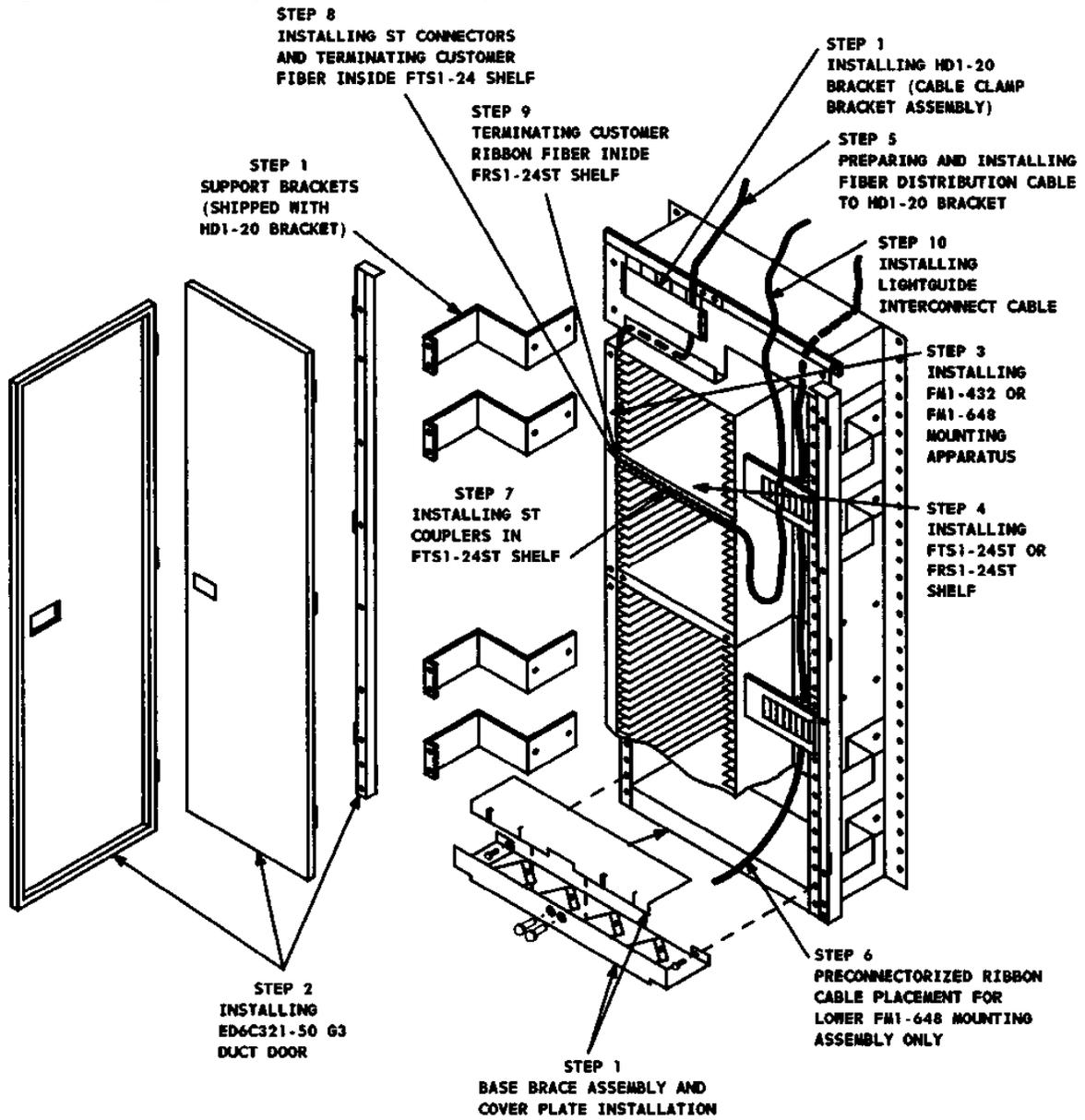
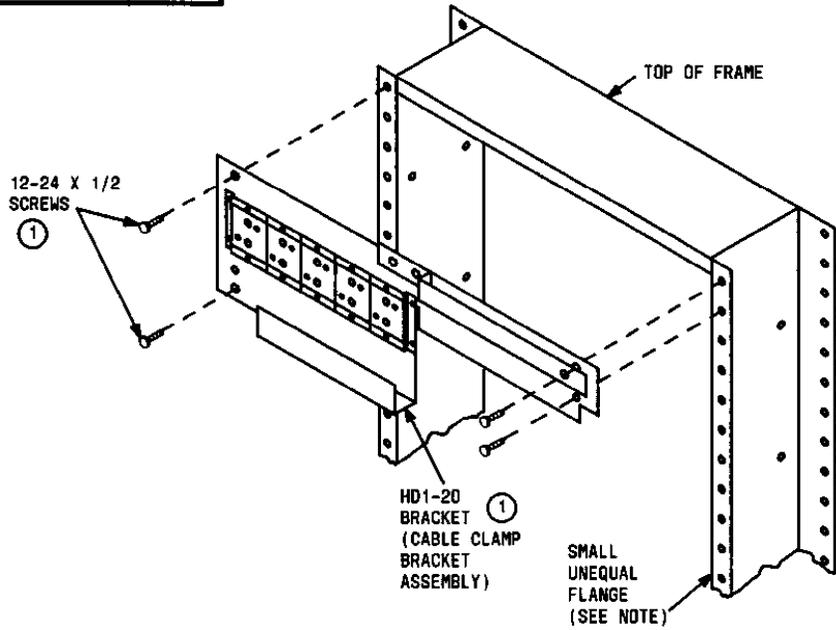


Figure 116: High Density Fiber Interconnect System Installation Instructions - 2

**STEP 1 — INSTALLING SUPPORT BRACKETS, HD1-20 BRACKET (CABLE CLAMP BRACKET ASSEMBLY), AND BASE BRACE ASSEMBLY**

PARTS	QUAN
HD1-20 Bracket	1
Support Brackets	8
Screws 12-24x1/2	24
Instruction Sheet	1
Base Brace Assembly	1
Screws 6-32x3/8	8
Labels	2

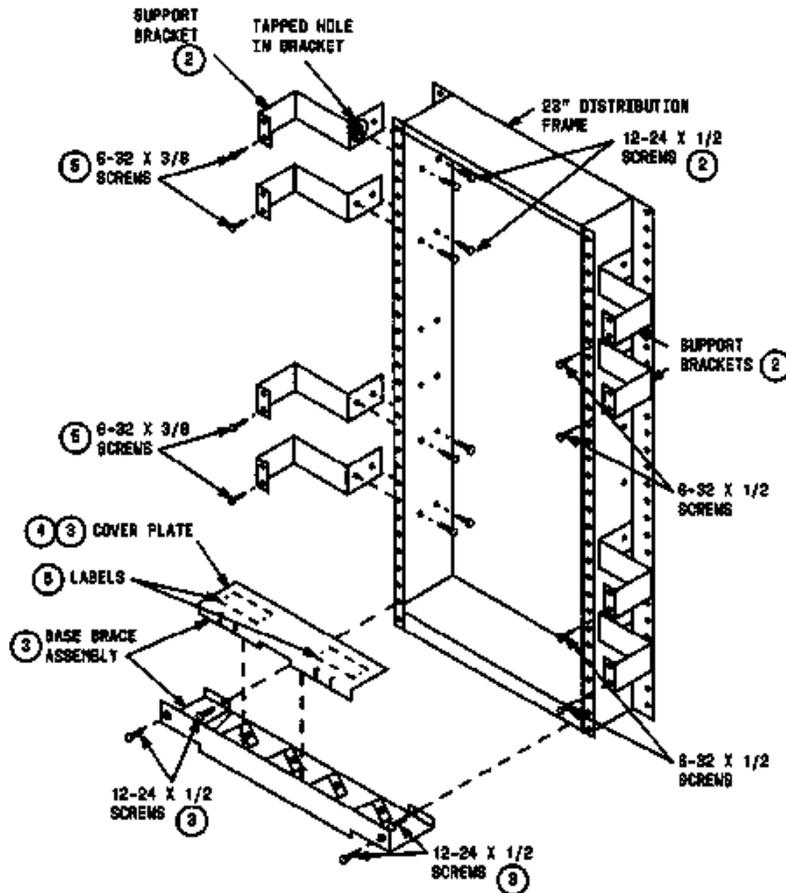


**Note 1:** Do not discard this instruction sheet after using. Place it in the FM1-Type mounting apparatus storage shelf for future use.

**Note 2:** All assemblies mount to smaller flange of 23-inch unequal flange frame.

1. Verify parts against parts list.
2. Position HD1-20 bracket assembly at top of frame, aligning top two holes in bracket with top two holes in frame flange. Secure with four 12-24 x 1/2 screws, two per side.

Figure 117: High Density Fiber Interconnect System Installation Instructions - 3

**STEP 1 — INSTALLING SUPPORT BRACKETS, HD1-20 BRACKET (CABLE CLAMP BRACKET ASSEMBLY), AND BASE BRACE ASSEMBLY (Contd)**

**Note:** Install support brackets even if duct door assembly is not part of installation. Brackets cannot be installed at a later time for door installation without removing all assemblies from frame.

1. Install support brackets (4 on each side) on outside vertical of frame between frame unequal flanges, with brackets protruding past the small frame flanges. Secure each bracket with two 12-24x1/2 screws per bracket as shown in illustration.
2. Place cover plate aside and install base brace to bottom of frame with two 12-24x1/2 screws.
3. Place cover plate over base brace engaging slots in cover onto lip of base brace.
4. If installing duct doors place the eight 6-32x3/8 screws, two 12-24x1/2 screws, and the two labels aside for use in Step 2. If doors are not to be installed screw in the eight 6-32x3/8 screws one per support bracket and two 12-24x1/2 screws in base brace as shown in illustration. Remove label backing and stick labels on cover plate.

Figure 118: High Density Fiber Interconnect System Installation Instructions - 4  
**STEP 2 — INSTALLING ED6C321-50 G3 DUCT DOOR**

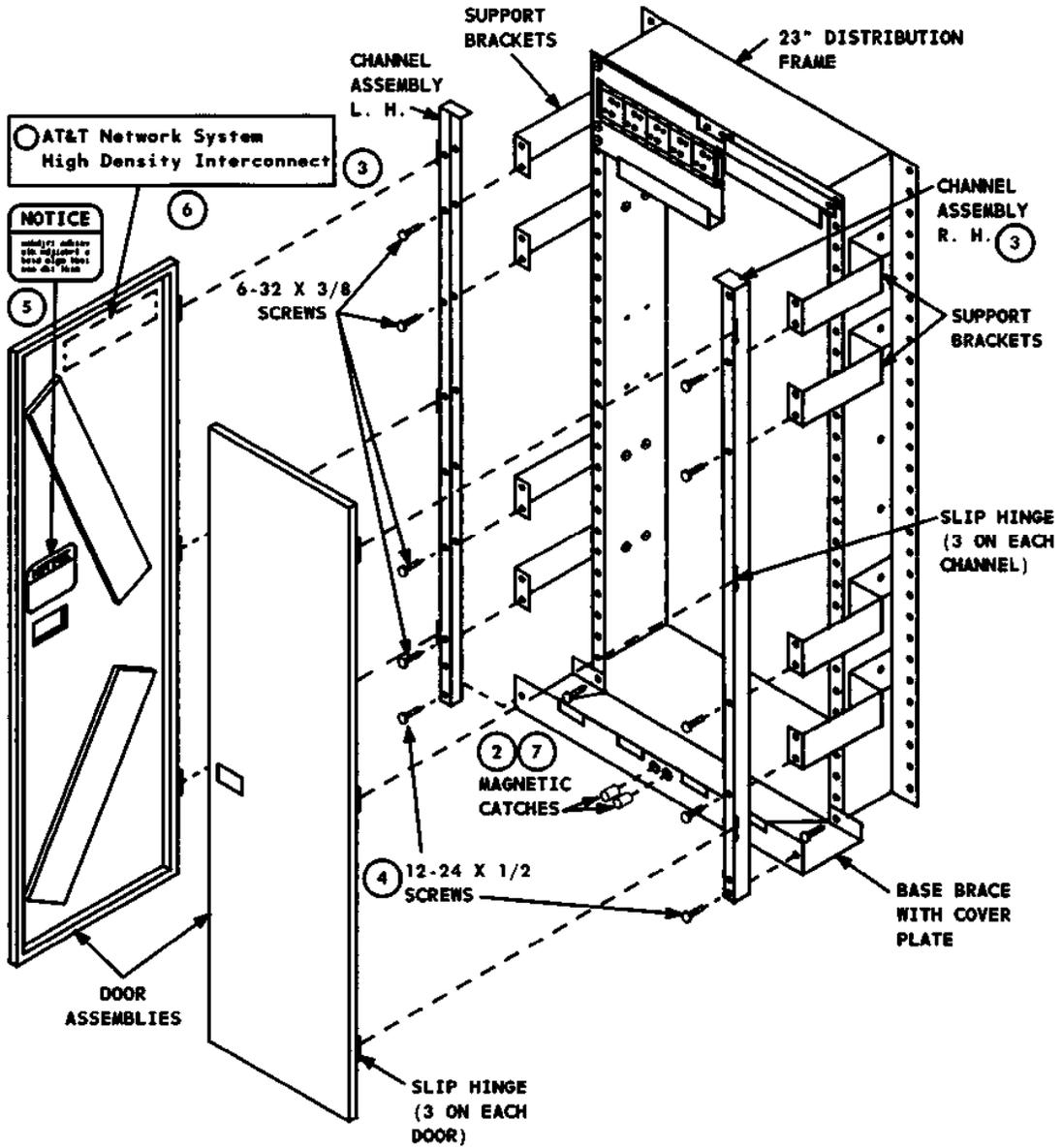


Figure 119: High Density Fiber Interconnect System Installation Instructions - 5  
**STEP 2 — INSTALLING ED6C321-50 G3 DUCT DOOR (Contd)**

ED6C321-50 G3 DUCT DOOR	
Description	Quantity
Door Assemblies	2
Channel Assembly	2
Magnetic Catches	4
Instruction Sheet	1
Assorted Screws	—

**Note:** The ED6C321-50 G3 Duct Door must be ordered separately.

1. Verify parts against parts list.
2. Open instruction sheet packet and remove two magnetic catches. Discard instruction sheet packet containing assorted screws, additional magnetic catches, and instruction sheet as they will not be used for this installation.
3. Mount L.H. and R.H. duct door channel assemblies to bottom hole of support brackets with one 6-32x3/8 screw per bracket.
4. Place one 12-24x1/2 screw in the bottom hole of each channel assembly and secure to base brace.
5. Remove the backing from the square notice label and apply to the **inside** of the door as shown in illustration.
6. Remove the backing from the rectangular AT&T Network System label and apply to the **outside** top corner of the door as shown in illustration.
7. Press two magnetic catches into the two holes in center of bottom base brace.

**Note:** To simplify installation of apparatus in frame, do not slide duct doors onto hinge pins until all assemblies have been mounted to frame.

Figure 120: High Density Fiber Interconnect System Installation Instructions - 6  
**STEP 3 — INSTALLING FM1-432 OR FM1-648 MOUNTING APPARATUS**

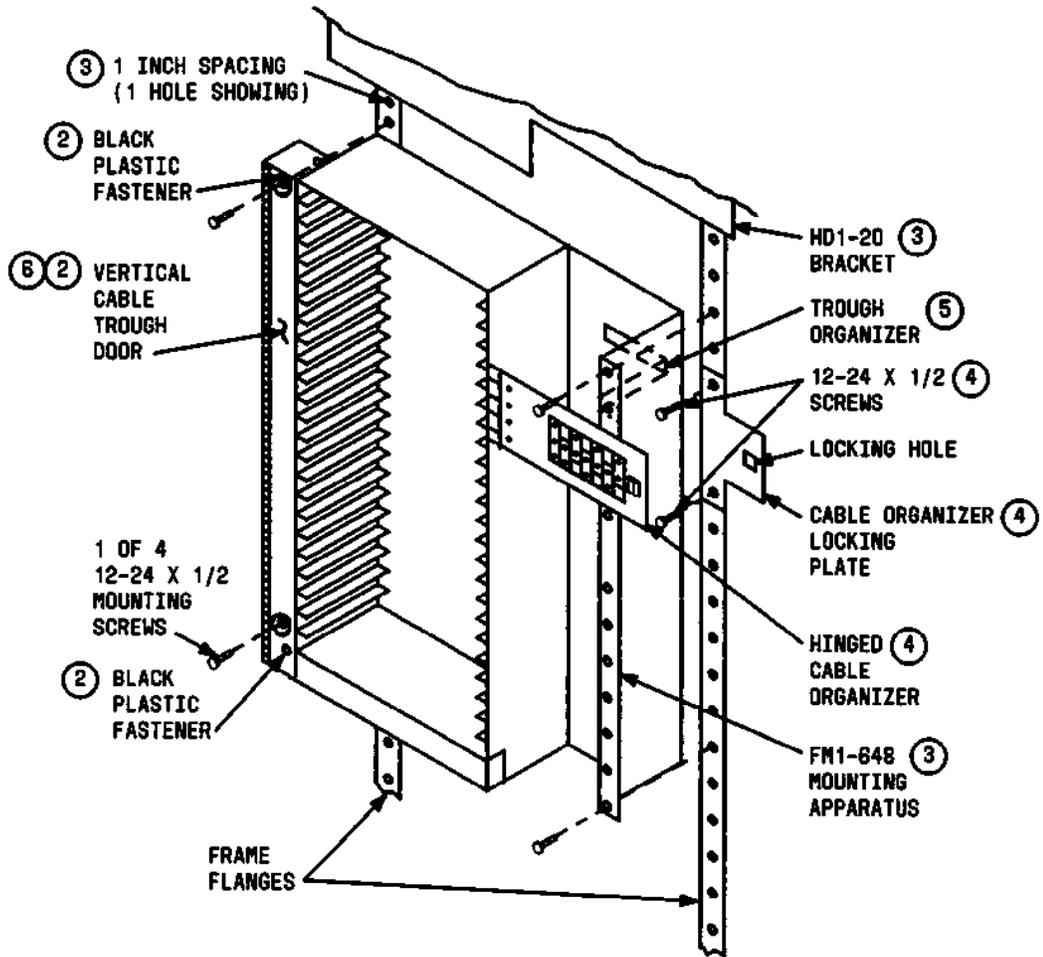


Figure 121: High Density Fiber Interconnect System Installation Instructions - 7  
**STEP 3 — INSTALLING FM1-432 OR FM1-648 MOUNTING APPARATUS (Contd)**

PARTS	QUAN
Mounting Apparatus	1
Cable Organizer Locking Plate	1
Screws 12-24x1/2	7
Decal (648 zone)	1
Instruction Sheet	1
Tough Organizer	1

**Note 1:** The FM1-432 mounting apparatus is used in an 80-type cabinet. The procedures below for frame mounting can also be used for mounting apparatus in cabinets.

**Note 2:** Always install the first 648 mounting apparatus at the top of the frame directly below HD1-20 bracket.

1. Verify parts against parts list.
2. Open mounting apparatus vertical cable trough door by pulling out the two plastic fastener plungers in door. This exposes two left-side mounting holes located in trough.
3. Mount FM1-432 or FM1-648 mounting apparatus 1 inch (one frame flange mounting hole showing) below HD1-20 bracket. Secure mounting using four 12-24 x 1/2 screws as shown in illustration.
4. Mount cable organizer locking plate to frame flange behind cable organizer. Secure with two 12-24 x 1/2 screws.
5. Mount the trough organizer directly above the cable organizer locking plate and secure with a 12-24x1/2 screw.
6. Close vertical cable trough door.

**Note 3:** Two FM1-648 mounting apparatus can be installed in each frame. The second apparatus mounting is butted against previously-installed mounting. Only one FM1-432 mount apparatus can be installed in an 80-type cabinet.

Figure 122: High Density Fiber Interconnect System Installation Instructions - 8

**STEP 4 — INSTALLING EITHER FTS1-24ST® OR FTS1-24ST-C (INDIVIDUAL FIBER) OR FRS1-24ST (CONNECTORIZED RIBBON) SHELF**

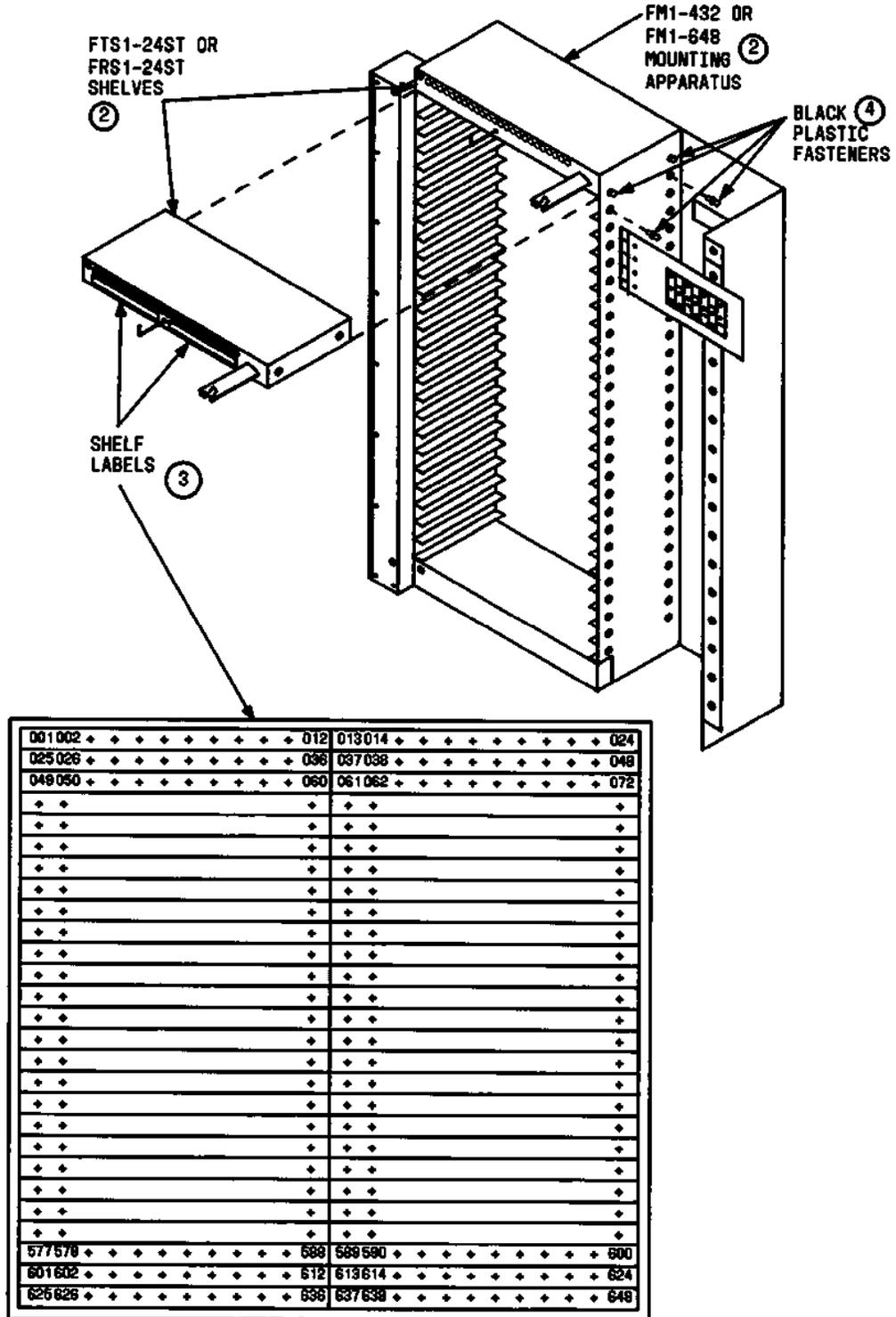


Figure 123: High Density Fiber Interconnect System Installation Instructions - 9

**STEP 4 — INSTALLING EITHER FTS1-24ST® OR FTS1-24ST-C (INDIVIDUAL FIBER) OR FRS1-24ST (CONNECTORIZED RIBBON) SHELF (Contd)**

SHELF	LOOSE PARTS	
	ITEM	QUAN
FTS1-24ST without ST couplers	BK Plastic Fasteners	2
FTS1-24ST-C with ST couplers	BK Plastic Fasteners	2
FRS1-24ST with ST couplers	BK Plastic Fasteners	2

1. Verify parts against parts list.
2. Slide FTS1-24ST or FRS-24ST shelf into top slot of FM1-432 or -648 mounting apparatus.
3. Peel off top two labels and place them on shelf as shown in figure. Labels are numerically placed on each shelf from left to right.
4. Insert two black plastic fasteners into side of mounting apparatus, pressing in fastener plungers to secure shelf.
5. Repeat 2 through 4 for each additional shelf.

Figure 124: High Density Fiber Interconnect System Installation Instructions - 10  
**STEP 5 — PREPARING AND INSTALLING OSP (OUTSIDE PLANT) FIBER DISTRIBUTION CABLE TO HD1-20 BRACKET**

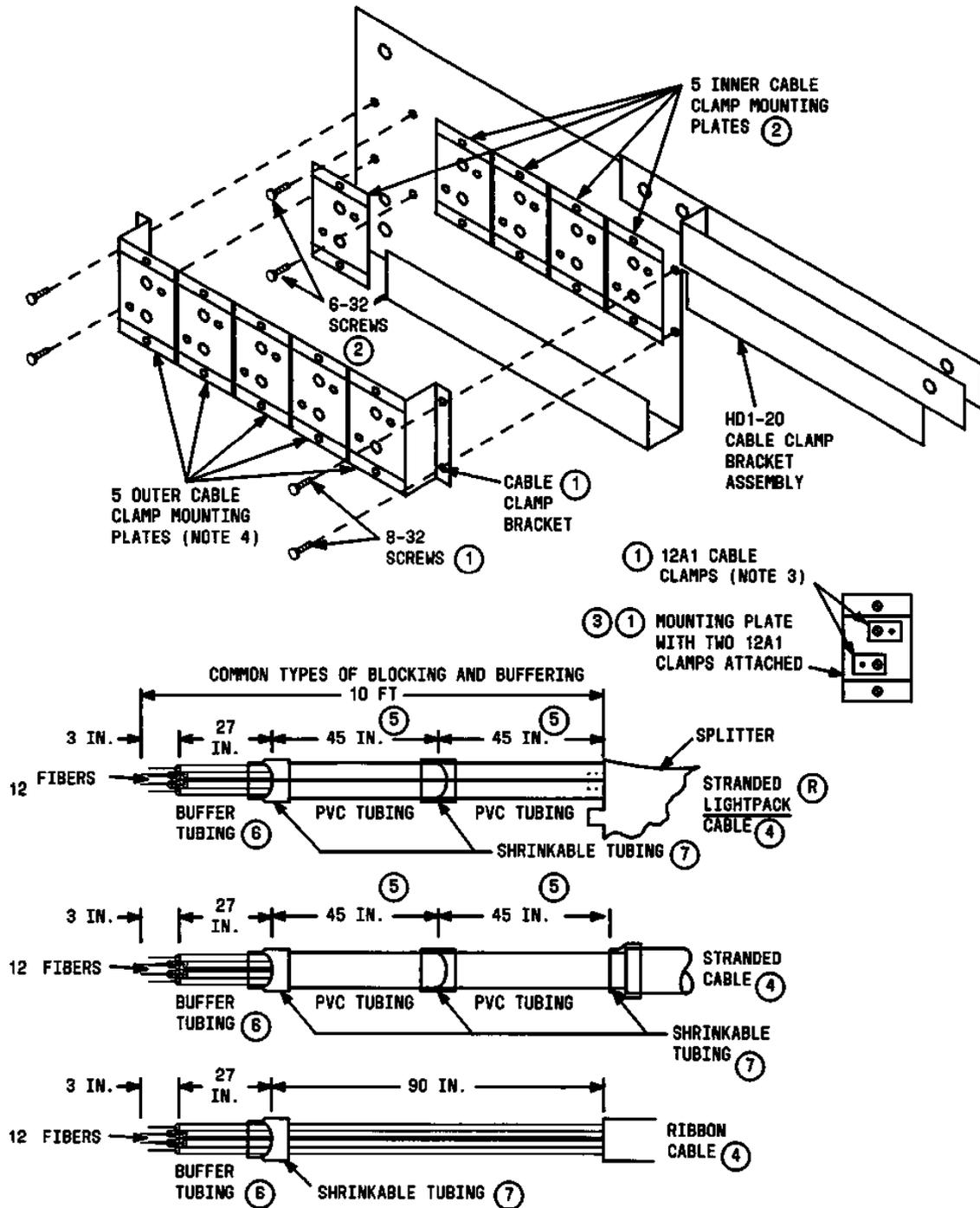


Figure 125: High Density Fiber Interconnect System Installation Instructions - 11

**STEP 5 — PREPARING AND INSTALLING OSP (OUTSIDE PLANT) FIBER DISTRIBUTION CABLE TO HD1-20 BRACKET (Contd)**

*Note 1:* A total of twenty 12A1 cable clamps can be mounted to cable clamp bracket assembly. The 12A1 cable clamps must be ordered separately.

*Note 2:* Ground all incoming cables at the 12A1 clamps to the main frame ground with a #6 ground wire. Refer to procedure 17 in Step 5 for additional information.

*Note 3:* OSP RIBBON CABLES attached to the HD1-20 bracket must terminate on the upper 648 mounting apparatus. OSP RIBBON CABLES that terminate on a bottom mounting apparatus must be routed and secured to mounting plates on the bottom base brace.

1. Remove four 8-32 screws from cable clamp bracket containing 5 outer 12A1 cable clamp mounting plates. Remove bracket to expose 5 inner 12A1 cable clamp mounting plates attached to main assembly. Two 12A1 cable clamps can be mounted on each plate. (When a mounting plate is removed, always attach two 12A1 cable clamps to plate even if only one clamp is required. This prevents possible fiber damage which could happen by adding a second clamp to plate with a cable already attached.)
2. Remove required number of inner mounting plates by unscrewing two 6-32 screws holding each plate. If more plates are required, place associated additional cables aside as instructions for using the 5 outer plates is covered later in this step. Mount two 12A1 cable clamps to each inner plate as required. (Always use all ten 12A1 cable clamps on inner five plates before using outer mounting plates and clamps.)
3. Reinstall plates with clamps attached to cable clamp assembly.
4. Install OSP cables in 12A1 cable clamps. Start with the far right clamping position and work to the left. Prepare cable, using cable preparation and grounding procedures found in AT&T Practice 636-299-110. Use procedures for raw ended cable with following exceptions:
  - a. Always remove 10 feet of cable sheath
  - b. Leave maximum of 1/2 inch of core tube showing
  - c. Prepare stranded fibers in 12 fiber bundles for insertion into PVC tubing. This step is not required for OSP ribbon cable. (The D-181755 buffer tubing kit is required for buffering fibers. A minimum of 3 kits is required per cable and is ordered separately.)
5. Install two 45-inch pieces of .025 PVC buffer tubing over each bundle of 12 fibers from first cable. Join the two pieces of PVC tubing with heat-shrinkable tubing. PVC tubing is not required for ribbon cable.
6. Separate the 12 fibers where they exit PVC tubing. For ribbon cables, separate fibers 30 inches from end of ribbon.
7. Place a 27-inch piece of fiber buffer tubing over each fiber and join all 12 buffer tubes to PVC tubing/ribbon with a piece of heat-shrinkable tubing.
8. Repeat 5, 6, and 7 for remaining fiber bundles from one cable.

Figure 126: High Density Fiber Interconnect System Installation Instructions - 12  
**STEP 5 — PREPARING AND INSTALLING OSP (OUTSIDE PLANT) FIBER DISTRIBUTION CABLE TO HD1-20 BRACKET (Contd)**

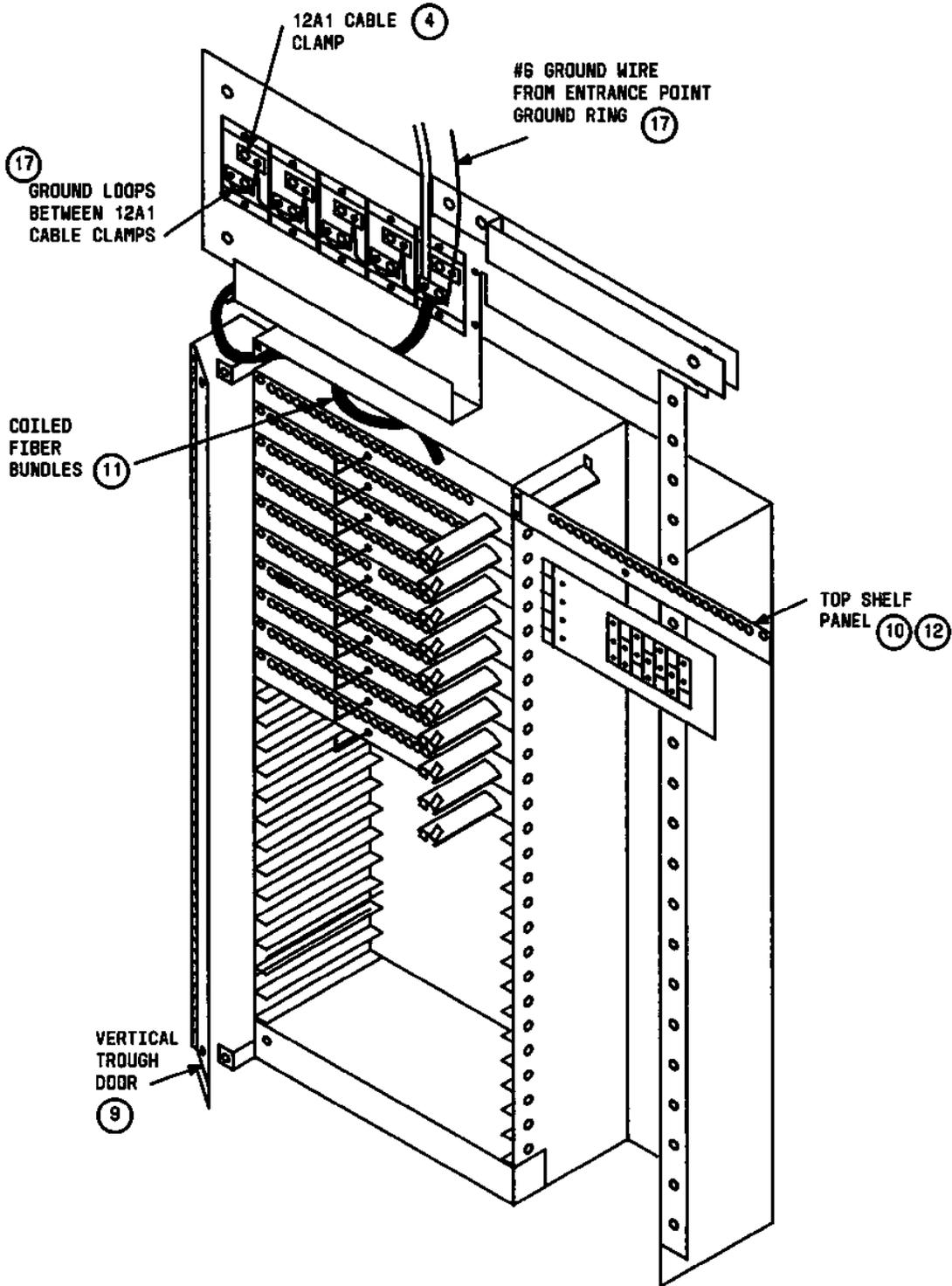


Figure 127: High Density Fiber Interconnect System Installation Instructions - 13

**STEP 5 — PREPARING AND INSTALLING OSP (OUTSIDE PLANT) FIBER DISTRIBUTION CABLE TO HD1-20 BRACKET (Contd)**

9. Open vertical trough door on FM1-432 or FM1-648 mounting apparatus by pulling out the two plastic fastener plungers in door.
10. Open panel of top FTS1-24ST or FRS1-24ST shelf by pulling out plastic fastener plunger.
11. Route and coil two (PVC tubes if FTS1-24ST shelf or two ribbons if FRS1-24ST shelf) through vertical trough and into shelf for temporary storage.
12. Resecure shelf panel by latching fastener.
13. Repeat 10, 11, and 12 for each successive shelf until all bundles have been stored.
14. Repeat 5 through 13 for each successive cable or until all 10 cable clamps have been used.
15. Reinstall and secure cable clamp bracket containing 5 outer cable clamp mounting plates, using four 8-32 screws.
16. If additional 12A1 cable clamps are required, remove required number of outer cable clamp mounting plates and install two 12A1 cable clamps to each plate. Repeat 3 through 14.
17. Install a #6 ground wire between the entrance point main ground ring and the far right 12A1 cable clamp. Use T&B ground lugs on short lengths of ground wire and loop the ground between the 12A1 cable clamps.

Figure 128: High Density Fiber Interconnect System Installation Instructions - 14  
**STEP 6 — PRECONNECTORIZED OSP RIBBON CABLE PLACEMENT FOR LOWER FM1-648 MOUNTING ASSEMBLY ONLY**

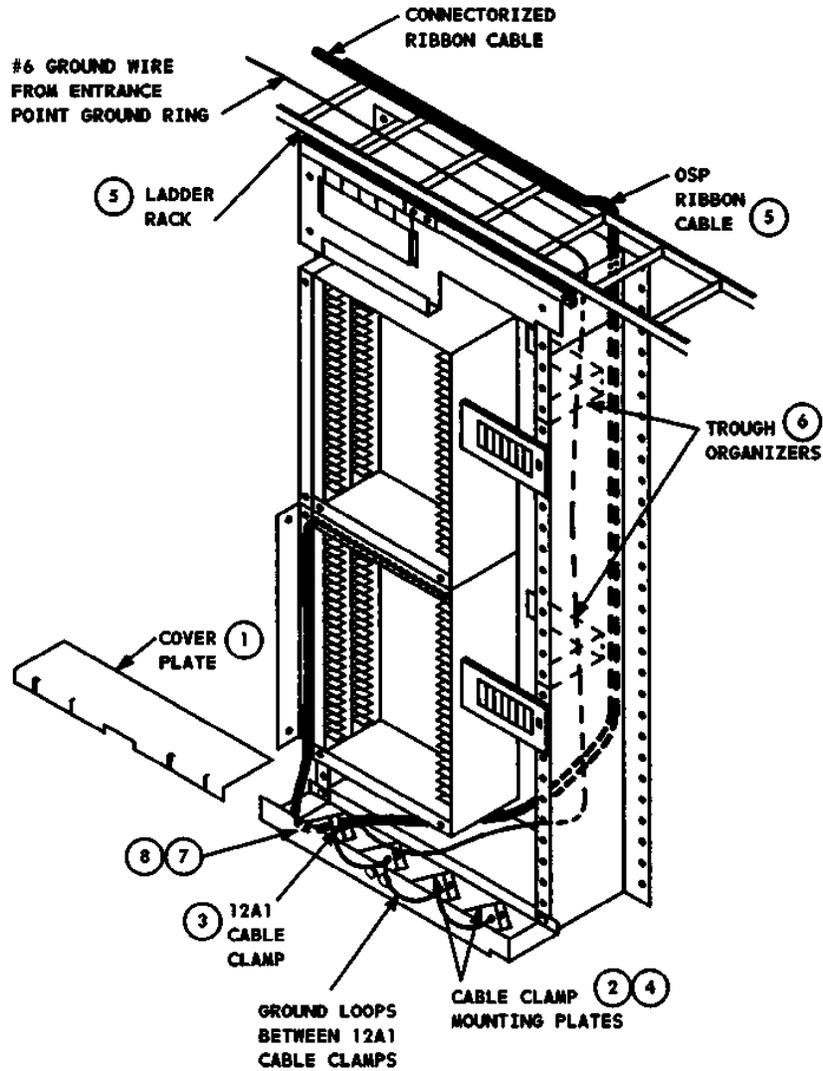


Figure 129: High Density Fiber Interconnect System Installation Instructions - 15

**STEP 8 — PRECONNECTORIZED OSP RIBBON CABLE PLACEMENT FOR LOWER FM1-648 MOUNTING ASSEMBLY ONLY (Contd)**

1. Remove cover plate from base brace.
2. Remove the required number of cable clamp mounting plates starting from the **LEFT** side of the base brace by removing two 6-32 screws per plate.
3. Mount two 12A1 cable clamps to each plate.
4. Reinstall each mounting plate with two 6-32 screws to base brace.
5. Route OSP ribbon cable with pulling eye attached over rear of ladder rack into 7-inch trough of 648 mounting apparatus as shown in illustration.
6. Slide ribbon cables behind the two trough organizers to keep cables in rear of trough.  
*Note:* OSP ribbon cables must be terminated from left to right to allow enough slack for the ribbons to reach the top shelves.
7. Carefully remove the pulling eye from the cable taking care not to damage exposed array connectors.
8. Clamp the STH (sheath termination hardware) to the 12A1 clamp per AT&T Practice 636-299-110. Connect a #6 ground wire between the far left 12A1 clamp and the entrance point main ground ring. Use T&B ground lugs on short lengths of ground wire and loop the ground between the 12A1 cable clamps.
9. Open the vertical fiber trough door by pulling out the 2 plastic fastener plungers.
10. Route ribbons from the OSP cables closest to the vertical trough through trough to the highest FRS1-24ST shelves.
11. Coil and store two ribbons in each shelf and carefully close shelf door.
12. Repeat procedures 5 to 12 for each OSP preconnectorized ribbon cable.
13. Close vertical cable trough door and secure by pushing in plungers on the two plastic fasteners.
14. Place cover plate over base brace engaging slots in cover onto lip of base brace.

Figure 130: High Density Fiber Interconnect System Installation Instructions - 16  
**STEP 7 — INSTALLING METALLIC ST COUPLERS IN FTS1-24ST SHELF**

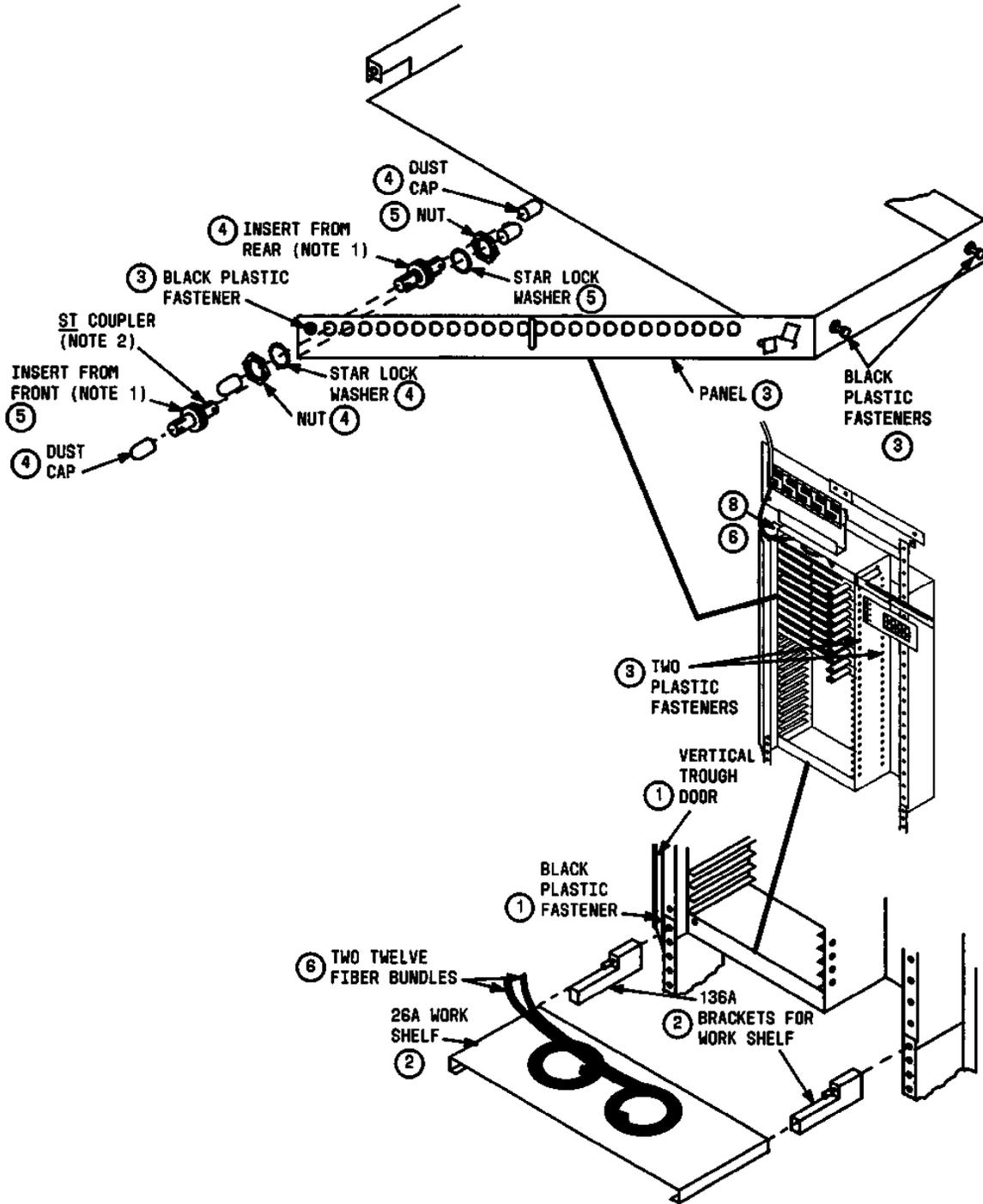


Figure 131: High Density Fiber Interconnect System Installation Instructions - 17

**STEP 7 — INSTALLING METALLIC ST COUPLERS IN FTS1-24ST SHELF (Contd)**

*Note 1:* Disregard this step for FTS1-24ST-C and FRS1-24ST shelves as they come with factory installed ST connectors.

*Note 2:* ST couplers must be installed in exact sequence shown in illustration. If first ST coupler next to plastic panel fastener is not placed from rear as shown, panel will not close properly.

*Note 3:* Metallic ST couplers must be ordered separately for this application.

1. Open vertical trough door on FM1-type mounting apparatus by pulling out two plastic fastener plungers in door.
2. Install 136A work shelf brackets to frame flanges next to lightguide jumper cable storage shelf located at bottom of apparatus mounting. Secure, using one screw in each bracket. Slide work shelf onto brackets.
3. Pull out the two black plastic fasteners from side of FTS1-24ST shelf and slide shelf out of assembly. Next, unlatch shelf panel by pulling out plunger in black plastic panel fastener and open panel. Temporarily store two 12-fiber bundles on work shelf.
4. Install threaded end of coupler from rear of panel through hole next to black plastic fastener. Install star lockwasher and nut onto coupler threads and hand-tighten. Place red dust caps onto each end of coupler.
5. Repeat 4, except place coupler through next hole from front of panel. Continue alternating placement of couplers (rear and front) until all couplers have been installed in panel.
6. Replace the two 12-fiber bundles inside shelf. Close panel and secure by pressing in plunger of black plastic panel fastener. Next, slide shelf into its original position and push black plastic fastener into side of shelf.
7. Repeat 3 through 6 for each FTS1-24ST shelf as required.

Figure 132: High Density Fiber Interconnect System Installation Instructions - 18  
**STEP 8 — INSTALLING ST CONNECTORS AND TERMINATING CUSTOMER FIBER INSIDE FTS1-24ST SHELF**

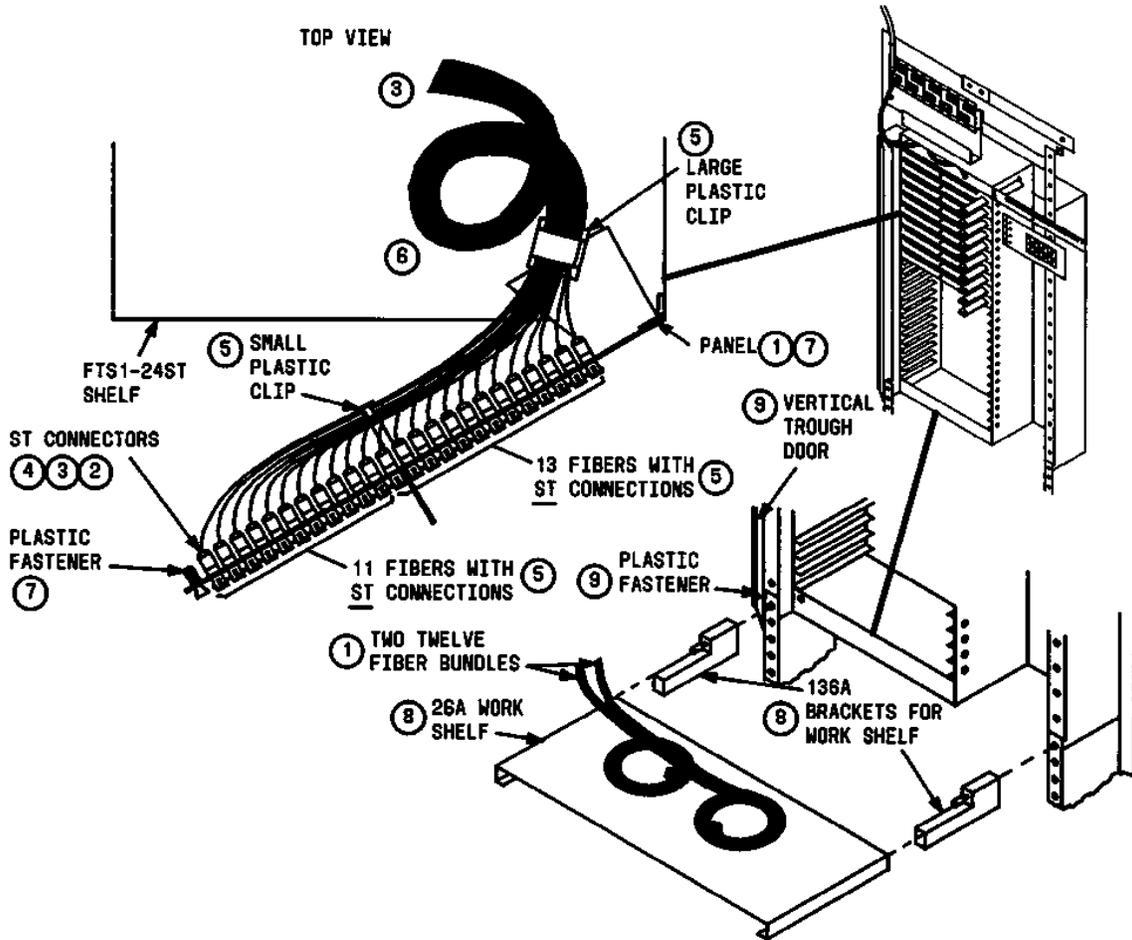


Figure 133: High Density Fiber Interconnect System Installation Instructions - 19

**STEP 8 — INSTALLING ST CONNECTORS AND TERMINATING CUSTOMER FIBER INSIDE FTS1-24ST SHELF**

*Note:* *ST* Connectors must be ordered separately.

1. Open shelf panel; remove and place the two OSP 12 fiber bundles onto work shelf.
2. Install *ST* connectors onto fibers, using 1032B kit (splice kit) and procedure in manual AT&T 640-252-044 "Assembly Instructions for *ST* Lightguide Cable Connectors — Single-Mode and Multimode Version".
3. Reroute each bundle with *ST* connectors attached back into termination shelf.
4. Use reagent grade isopropyl alcohol on swab and wipe to clean each coupler and connector. Dry couplers and connectors with can of compressed air.
5. Connect first 11 *ST* connectors to panel couplers nearest plastic panel fastener, dressing buffered fibers through both small and large plastic clips attached to panel. Connect remaining 13 *ST* connectors to panel couplers, dressing fibers through large plastic clip only.
6. Coil remaining slack and place in rear of shelf.
7. Close panel and secure by pressing in plunger of black plastic fastener.
8. Repeat 8 through 14 for each FST1-24*ST* shelf as required.

*Note:* If FRS1-24*ST* (Ribbon) shelves are also installed skip procedures 9 and 10 and go to Step 9.

9. Remove 26A work shelf and brackets.
10. Close vertical trough door and secure by pressing in two black plastic fastener plungers.

Figure 134: High Density Fiber Interconnect System Installation Instructions - 20  
**STEP 9 — TERMINATING CUSTOMER RIBBON FIBER INSIDE FRS1-24ST SHELF**

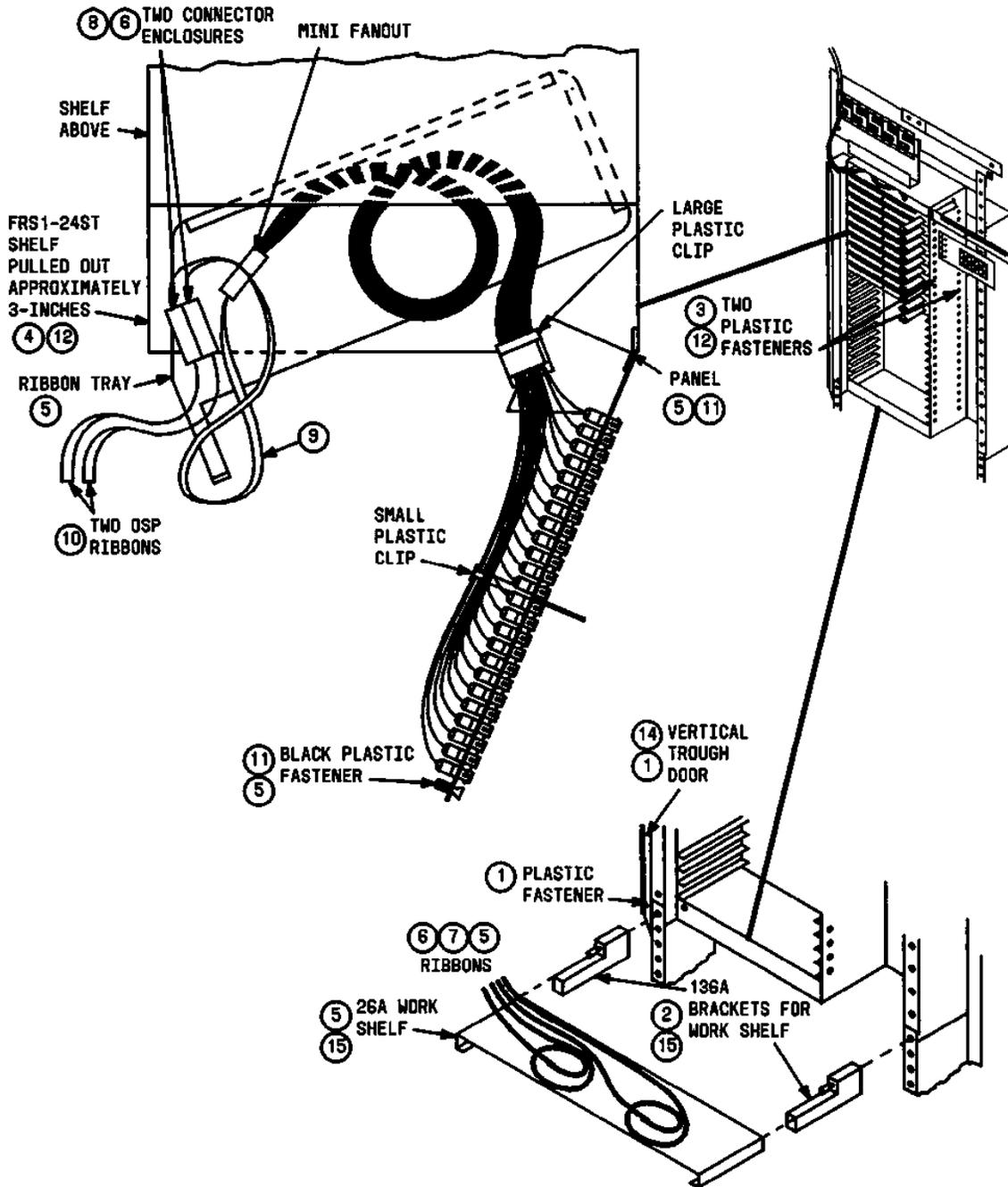


Figure 135: High Density Fiber Interconnect System Installation Instructions - 21

**STEP 9 — TERMINATING OSP CUSTOMER RIBBON FIBER INSIDE FRS1-24ST SHELF (Contd)**

*Note:* If 26A work shelf is still installed per Step 8 proceed to procedure 3; if not start at procedure 1.

1. Open vertical trough door on FM1-type mounting apparatus by pulling out two black plastic fastener plungers in door.
2. Install 136A brackets to frame flanges next to lightguide jumper cable storage shelf located at bottom of apparatus mounting. Secure, using one screw in each bracket. Slide work shelf onto brackets.
3. Pull out and remove two plastic fasteners located on side of trough holding FRS1-24ST shelf.
4. Slide the shelf out 3 inches for easy access to fibers.
5. Unlatch plastic shelf panel fastener, open panel, and remove the two OSP stored ribbons and place on 26A work shelf. Pivot out the ribbon tray until the two connector enclosures are accessible.
6. Remove the two fanout ribbon arrays and 1009C connectors from the two connector enclosures and place on work shelf.
7. Complete ribbon arrays per splicing instructions in 1030B tool kit.
8. Place the array splices inside connector enclosure(s) with OSP ribbon(s) entering front of enclosure and mini-fanout ribbon(s) exiting rear as shown in illustration.
9. Gently make a figure-8 with the mini-fanout ribbons and flip over to make circles. Carefully store ribbons in shelf.
10. OSP ribbon slack will vary depending upon shelf location. Route directly, coil or form into figure-8 as required and store in shelf.
11. **CAREFULLY** close the shelf panel while dressing the ribbons and buffer fibers under the small plastic clip bracket and ST connectors. Push plastic fastener in to secure panel.
12. Slide FRS1-24ST shelf into assembly taking care not to damage the ribbons and fibers. Replace the two plastic fasteners on the right side of the shelf to secure.
13. Repeat Steps 3 through 12 for each FRS1-24ST shelf as required.
14. Dress ribbons into vertical trough and **CAREFULLY** close and secure trough door with the two plastic fasteners.
15. Remove 26A work shelf and associated brackets.

Figure 136: High Density Fiber Interconnect System Installation Instructions - 22  
**STEP 10 — INSTALLING LIGHTGUIDE INTERCONNECT CABLES**

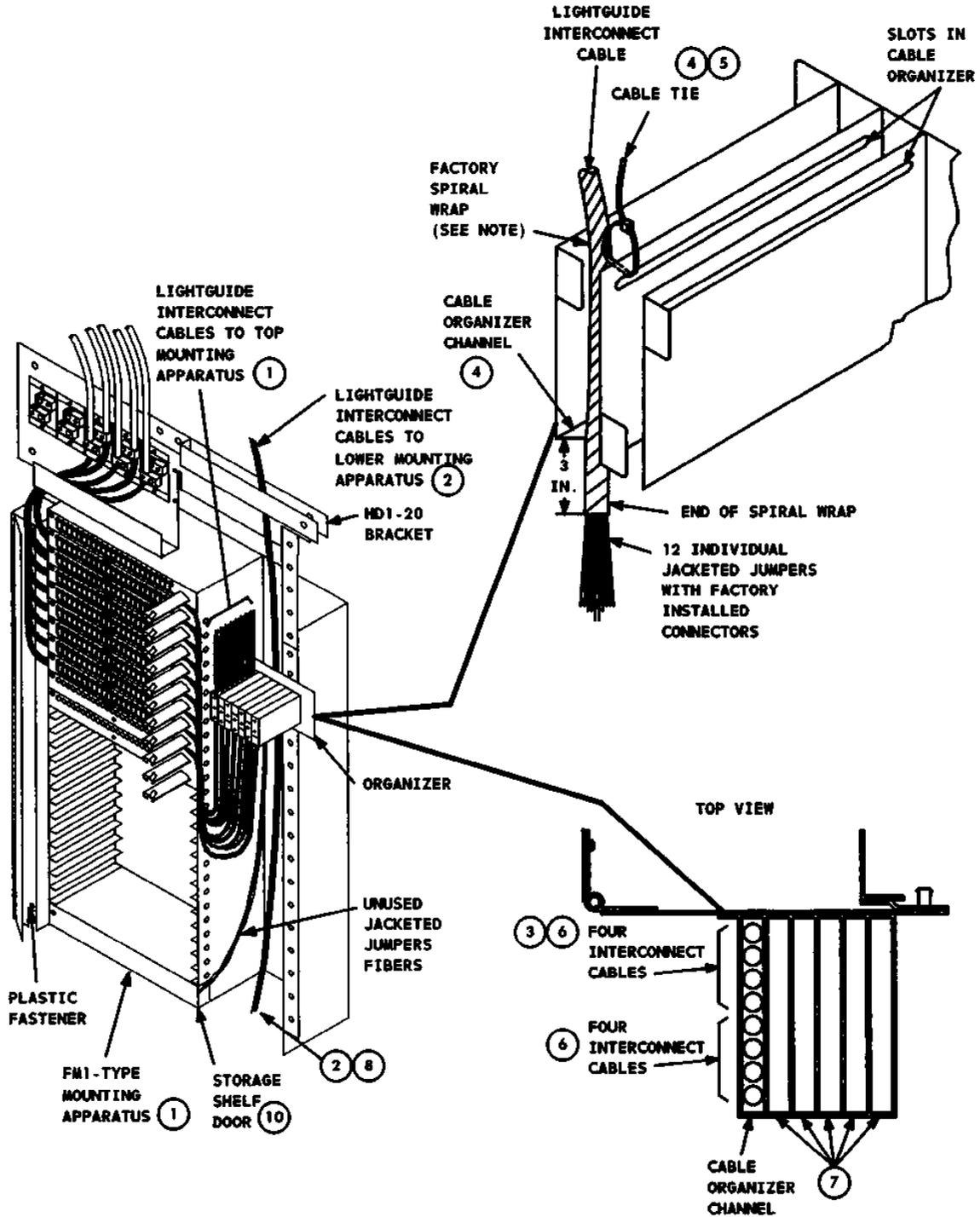


Figure 137: High Density Fiber Interconnect System Installation Instructions - 23

**STEP 10 — INSTALLING LIGHTGUIDE INTERCONNECT CABLES (Contd)**

1. Route interconnect cables associated with top FM1-type mounting apparatus in front of bracket attached to HD1-20 bracket and over front of associated interconnect cable organizer.
2. Route interconnect cables for lower mounting apparatus through cable organizer bracket and behind cable organizer to lower associated cable organizer.  
*Note:* Interconnect cables have factory-installed spiral wrap with cable tie inserted into one loop of wrap.
3. Select group of four lightguide interconnect cables to be inserted into cable organizer channel closest to shelves.
4. Insert a small cable tie through the spiral wrap 5 to 6 inches above the end of the spiral wrap.
5. Insert one of cables into cable organizer, guiding end of cable tie into slot in organizer. Secure cable tie and slide cable to rear of channel. Repeat procedure for remaining three cables.
6. Repeat 3, 4, and 5 for maximum of 8 lightguide interconnect cables per channel.
7. Repeat 3 through 6 for each successive channel.
8. Repeat 3 through 7 for each additional mounting apparatus if more than one has been installed in frame.
9. Connect jacketed jumper cable fibers to their assigned couplers on shelf panel.
10. Unlatch storage shelf door on bottom of mounting apparatus by pulling out plastic fastener plunger. Open door, and coil and store associated unused jumpers in shelf.
11. Close storage shelf door and secure by pressing in fastener plunger.
12. Repeat 9, 10, and 11 for each mounting apparatus as required.
13. Store the instruction sheet in the FM1-Type mounting apparatus storage shelf for future use.
14. Install frame duct doors on hinge pins and close doors.

*Glossary: Acronyms*

**A/FCU** — Alarm/Fan Control Unit

**ADU** — Alarm Display Unit

**AGC** — Automatic Gain Control

**Ah** — Ampere Hour

**AM** — Amplitude Modulation

**ARSB** — Automated Repair Service Bureau

**ASH1** — DT Power Converter Unit

**BER** — Bit Error Rate

**BFU** — Bank Fuse Unit

**BORSCH** — Battery feed; Overvoltage protection; Ringing; Supervision;  
CODEC; Hybrid

**BORSCHT** — Battery feed; Overvoltage protection; Ringing; Supervision;  
CODEC; Hybrid; Testing

**BPC** — Bulk Power Closure

**CATV** — Cable Television

**CET** — Corporate Education and Training

**CEV** — Controlled Environment Vault

**CFU** — Channel Fuse Unit

**CIU** — Craft Interface Unit

**COT** — Central Office Terminal

**CSA** — Carrier Serving Area

**CT/DPAC** — Connect-Through/Dedicated Plant Assignment Card

**CTT** — Completion Test Target

**CTU** — Channel Test Unit

**CU** — Channel Unit

**CU** — Channel unit

**DCLU** — Digital Carrier Line Unit

**DCTU** — Directly Connected Test Unit

**DFR** — Derived Feeder Record

## 363-205-002

**DLC** — Digital Loop Carrier  
**DS0** — Digital Signal Zero  
**DT** — Distant Terminal  
**DTC** — Distant Terminal Closure  
**DTM** — Drop Test Module  
**ECCR** — Exchange Customer Cable Record  
**EEEs** — Electronic Equipment Enclosures  
**efd** — Dual Channel Unit  
**efq** — Quad Channel Unit  
**EOL** — End Of Life  
**ERMS** — Enhanced Rotary Mechanical Splice  
**F/C** — Fibers per Clusters  
**FCU** — Fan Control Unit  
**FDI** — Feeder Distribution Interface  
**FEMF** — Foreign Electromotive Force  
**FID** — Facility Identifiers  
**FPB** — Feature Package B  
**FPC** — Feature Package C  
**FTTH** — Fiber-To-The-Home  
**FX** — Foreign Exchange  
**GFCI** — Ground Fault Circuit Interrupter  
**GND** — Ground  
**HDIC** — High-Density Fiber Interconnect  
**ISDN** — Integrated Services Digital Network  
**LAC** — Loop Assignment Center  
**LEC** — Local Exchange Carrier  
**LFU** — Line Fuse Unit  
**LIC** — Lightguide Interconnection Cable  
**LIUs** — Line Interface Units  
**LMOS** — Loop Maintenance Operations System

## 363-205-002

**LSAM** — Local Splice Alignment and Measurement

**LSU** — Line Switch Unit

**LTC** — Local Test Center

**LTD** — Local Test Desk

**LTS** — Loop Test System

**LU** — Living Unit

**LU/C** — Living Units Per Cluster

**LXE** — Lightguide Express Entry

**MA** — Maintenance Administrator

**MFB** — Multifamily Building

**MinorMLT-2** — Mechanized Loop Testing System Version 2

**MJ** — Major MN

**MLT** — Mechanized Loop Testing

**MPP** — Miscellaneous Pair Panel

**MUX** — multiplexer

**NIU** — Network Interface Unit

**NRZ** — Non-Return to Zero

**OBMK** — Optical Backplane Maintenance Kit

**OHT** — On-Hook Transmission

**OIC** — Optical Interconnect

**OOF** — Out-Of-Frame

**OOS** — Out-Of-Service

**OSP** — Outside Plant

**OSPE** — Outside Plant Engineering

**OTDR** — Optical Time Domain Reflectometer

**OU** — Optical Unit

**PCM** — Pulse Code Modulation

**PCU** — Power Converter Unit

**PGTC** — Pair Gain Test Controller

**PIN** — Positive-Intrinsic-Negative

## 363-205-002

**POTS** — Plain Old Telephone Service  
**PPV** — Pay-Per-View  
**R-G** — Ring-to-Ground  
**REN** — Ringer Equivalency Number  
**RMS** — Rotary Mechanical Splice  
**RMU** — Remote Measurement Unit  
**ROH** — Receiver Off-Hook  
**RSA** — Repair Service Administrator  
**RT** — Remote Terminal  
**SAM** — System Administration and Maintenance  
**SO** — Service Order  
**SRRS** — Single-mode Rapid Ribbon Splice  
**T-G** — Tip-to-Ground  
**TAC** — Terminal Assignment Card  
**TM** — Trademark  
**TV** — Trouble Verification  
**VF** — Voice-Frequency  
**VFI** — Voice-Frequency Interface  
**VOM** — Volt-Ohm-Milliammeter  
**VT** — Video Terminal  
**WDM** — Wavelength Division Multiplexer